

Introduction to Hospitals

Section I

SECTION OUTLINE

Chapter 1 Evolution of Hospital System in India

Chapter 2 Changing Role of Hospitals in a Globalised Society



Evolution of Hospital System in India

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“There is no theory of evolution. Evolution is a fact. The theory is of how it happened.”
—Anonymous

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- describe the global and Indian scenario of evolution of hospitals.
- define health-promoting hospital concept as new phase of evolution of hospitals.

BACKGROUND

As per the health field concept,¹ health and illness are considered to result from the interplay of four key influences: Genetic factors, environment, lifestyle and medical services. So, today, hospital is an important determinant of health. The word ‘hospital’ originates from the Latin word ‘*hospice*’. In fact, the words hospital, hostel and hotel are derived from the common Latin root ‘*hospice*’. The place or establishment where a guest is received was called *hospitium* or *hospitale*. At different times, the term ‘hospital’ has been used to refer to an institution for the aged and infirm, a place of rest, a hostel where people lived as a small community, and an institution for the care of the sick and wounded. Lodging for the pilgrim and the wayfarer was also one of the primary functions of the early hospital. Hospitals in the past were setup primarily as charity institutions for poor and weaker sections of society, giving the aura of an ‘almshouse’. The only function of such institutions was the care of the sick and the poor. The hospital was considered only a shelter for the socially unfit.

HOSPITAL EVOLUTION: GLOBAL SCENARIO

In the early Greek and Roman civilisations, the temples were used as hospitals. These hospitals were not separate entities but formed as an integral part of the temples. The Greeks and Romans considered the temples of gods and their priests responsible for providing shelter and sustenance to the sick.

With the birth and spread of Christianity, hospitals became an integral part of the Church. Gradually, these Christian hospitals replaced those of Greece and Rome. During the Crusades (Christian expeditions to recover the holy land from Mohammedans, 1100–1300 AD), over 19,000 hospitals were founded in Europe to cater for those suffering from war injuries and diseases. The order of was one such sect responsible for creating chains of hospitals. St. John’s order for creating chains of hospital has survived all centuries and still functions as St. John Ambulance Corps in England with its branches all over the world, including India.

Subsequently, certain decrees issued by the church for divesting religion from medical succor had the effect of lowering the status of the entire medical profession and stopping the monks from practicing medicine. In 1163 AD, the church formally restricted the clergy from working as physicians and this restriction heralded the beginning of the end of hospitals towards the end of the crusades (around 1300 AD). During early nineteenth century, hospitals were equated to death houses, since most of the poor and serious patients who got admitted there eventually died of infection and gangrene. Family members dumped their relatives with no hope of cure in hospitals.²

The middle of the nineteenth century saw the arrival of Florence Nightingale on the hospital scene. It fell upon Florence Nightingale to revolutionise nursing by supplementing good intentions and humane concern with scientific approach to nursing through training. The working of

hospitals underwent a sea change as a result of her efforts when she was sent to attend to the sick and wounded at the Crimean War (1853–1856). This was the turning point in the history of hospitals in the western world.²

Various developments in medical sciences gave impetus to further progress in the hospital field. Discovery of anaesthesia and the principles of antisepsis (asepsis was to follow later) were two most important influences in the development of hospitals. Discovery of steam sterilisation in 1886, X-ray in 1895 and rubber gloves in 1890 revolutionised surgical treatment and gave further fillip to hospital development. Great progress was made in cellular pathology, clinical microscopy, bacteriology and so on during the period from 1850 to 1900, and each one of these had a definite impact on hospital progress.

Besides the scientific advances during this period, rapid industrialisation during the last quarter of nineteenth century generated enormous funds in the western world. Hospital development in the twentieth century has, therefore, been explosive, especially in the United States of America (USA) and Europe. A hospital was no longer a place where people went to die. The advances in medical science brought about by antibiotics, radiation, blood transfusion, improvement in anaesthetic techniques, spectacular advances in surgical techniques and medical electronics led to tremendous growth and improvement in hospital services.

HOSPITALS EVOLUTION: INDIAN SCENARIO²

Emergence of Hospitals in Preindependence Era

Early Indian rulers considered the provision of institutional care to the sick as their spiritual and temporal responsibility. The forerunners of the present hospitals can be traced to the times of Buddha, followed by Ashoka. India could boast of a very well-organised hospital and medical care system, even in the ancient times. The writings of Sushruta (6th century BC) and Charaka (200 AD), the famous surgeon and physician, respectively, were considered standard works for many centuries with instructions (in Charaka Samhita) for creation of hospitals, for provisions of lying-in and children rooms, maintenance and sterilisation of bed linen with steam and fumigation, and use of syringes and other medical appliances. The most notable of the early hospitals were those built by King Ashoka (273–232 BC). There were rituals laid down for the attendants and physicians who were enjoined to wear white clothes and promised to keep the confidence of the patients.

However, the age of Indian medicine started its decline from the Mohammedan invasions in the tenth century. The Mohammedans brought with them their hakims following the Greek system of medicine, which came to be known as 'Yunani'. This system and its physicians started to prosper at the expense of Ayurveda (which continued to survive in the south).

The modern system of medicine in India was introduced in the seventeenth century, with the arrival of European Christian missionaries in South India. In the seventeenth century, the East India Company, the forerunner of the British Empire in India, established its first hospital in 1664 at Chennai for its soldiers and in 1668 for civilian population. European doctors started getting popular and during the later part of eighteenth and early nineteenth century, there was a steady growth of modern system of medical practice and hospitals, pushing the indigenous system to the background. Organised medical training was started with the first medical college opening in Calcutta in 1835, followed by Mumbai in 1845 and Chennai in 1850.

As the British spread their political control over the country, many hospitals and dispensaries that originally started to treat the army personnel were handed over to the civil administrative authorities for treating civil population. Local government and local self-government bodies (municipalities, etc.) were encouraged to start dispensaries at *tehsil* and district level. In 1885, there were 1250 hospitals and dispensaries in British India but the medical care scarcely reached 10% of the population.

Emergence of Hospitals in Independent India: The Early Phase

The health scenario during the time when the country became independent in 1947 was highly unsatisfactory. The bed to population ratio was 1:4000, doctor to population ratio 1:6300 and nurse to population ratio 1:40,000. Although the population was distributed in urban and rural areas in the proportion of 20:80, a great disparity existed in the facilities available in urban and rural areas. On the eve of independence in 1947, there were 7400 hospitals and dispensaries in the country with 11,000 beds, giving a bed to population ratio of 0.25/1000. There were 47,000 doctors, 7000 nurses, 19 medical schools and 19 medical colleges in the country.³

Emergence of Hospitals in Independent India: The Late Phase

Lately, a hospital can be variously described as a factory, an office building, a hotel, an eating establishment, a medical care agency, a social service institution and a business institution. In fact, it is all of these in one and more. Sometimes it is run by business means, but not necessarily for business ends. This complex character of the hospital has fascinated social scientists as well as lay people.

From its gradual evolution through the eighteenth and nineteenth centuries, the hospital—both in the eastern and the western world—has come of age only recently during the past 50 years or so—the concept of today's hospital contrasting fundamentally from the old idea of a hospital as no more than a place for the treatment of the sick. With the wide

coverage of every aspect of human welfare as part of health-care, viz. physical, mental and social well-being, a reach-out to the community, etc. the healthcare services have undergone a steady metamorphosis and the role of hospital has changed, with the emphasis shifting from:

- Acute to chronic illness.
- Curative to preventive medicine.
- Restorative to comprehensive medicine.
- Inpatient care to outpatient and home care.
- Individual orientation to community orientation.
- Isolated function to area-wise or regional function.
- Tertiary and secondary to primary healthcare.
- Episodic care to total quality care.

Along with the tremendous advances in clinical care witnessed during the last part of twentieth century, there was a shift in image of hospitals also. Traditional role of hospitals, focused mainly on curative services (Figure 1.1).⁴

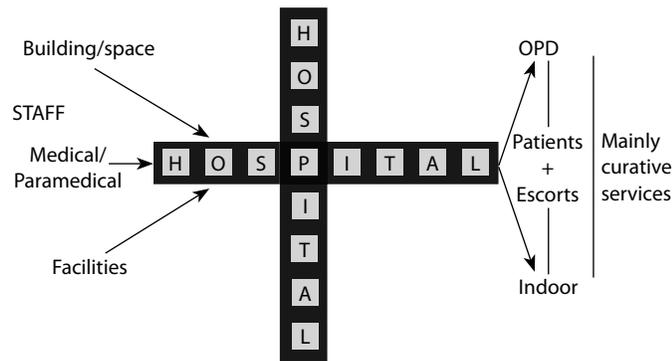


Figure 1.1 Hospitals in India – Traditional Model.

HEALTH-PROMOTING HOSPITAL CONCEPT: NEW ERA OF HOSPITAL SYSTEM

Currently, the hospitals are not just seen as curative centres, but also as a place that actually promote healthful living. This was defined as health-promotion concept. Health-promotion concept is now being sought to be applied in all spheres of our lives and in all settings (settings approach). The settings approach implies that health-promotion principle can be applied in all organisations and at all levels, viz. home, school and even hospital. This approach seeks to substantially change the image of hospitals. This model is based on the concept of health-promoting hospitals, which emerged in 1980s. To be health promoting in any meaningful sense, a hospital has to be committed to instituting a process of organisational development and change. It must extend its activities in the healthcare system beyond merely providing clinical and curative services.^{1,5}

Health-promotion concept can be gainfully applied in hospitals. It has been documented in context of Ottawa Charter that though health-promotion concept is costly (as it involves infrastructure development related nonrecurring expenditure), it can be converted into an earning venture.

The general public would prefer to visit hospital that offers many facilities rather than going to a hospital that only caters to the patient care.

With this concept, the image of the hospitals gradually changed for the better and they are being reoriented from just being the centres for medical care and treatment to a facility providing comprehensive promotive, preventive, curative and rehabilitation services.

Today's patients are better informed about healthcare and its ramifications. They demand and expect modern and best means of medical and healthcare to be made available to them not only within the four walls of the hospital but also at their door steps. At no time in history have people known so much about healthcare as they do today. For this reason, they shop for the best hospital regardless of cost. That is why the traditional hospitals of yesteryears have now become distinctly passé, while the advanced high-tech hospitals that are mushrooming across the country are becoming the preferred destinations—the Mecca for healthcare. The hospitals, nowadays, focuses on the needs of the patient. These hospitals create a cohesive network of multitude of services, where treatment is taken to the patient rather than the other way around.

The planners and implementers face great challenges with unprecedented changes taking place in the healthcare field. In addition, they are faced with challenges pertaining to medico-technological developments as both the examination and treatment equipment become outdated before the building is even completed. The newer advancements like electronic records also place greater demands on technical installations. Accreditation (quality control mechanism that follows certain standards) will also present a challenge for hospitals in the future—placing both patient safety and patient procedures under the scanner.

All of these advancements in medical field pose demands on hospital administrators' ability to adhere to a very tight budget. Therefore, hospital owners will begin to focus more on operations than on newer constructions—and they will be open to alternative types of partnerships and financing. In twenty-first century, modern hospital, as depicted in Figure 1.2, pertains to multitude of services besides curative services. Community participation and involvement of various other groups besides medical and paramedical staff in running the hospital services is the backbone of this model.⁵⁻⁷ The changed image of modern hospital in contemporary twenty-first century society implies that hospitals are now expected to provide multitude of services besides curative services.

Health must appear on the agenda of policy makers in all sectors and at all levels of the hospital, and work carried out in a hospital must be organised so as to create a healthy hospital environment. Today, hospitals and health systems are modifying their strategies everyday in the face of mounting challenges, like exhalations in costs, human resource unavailability, resource wastage and inefficiency, growing

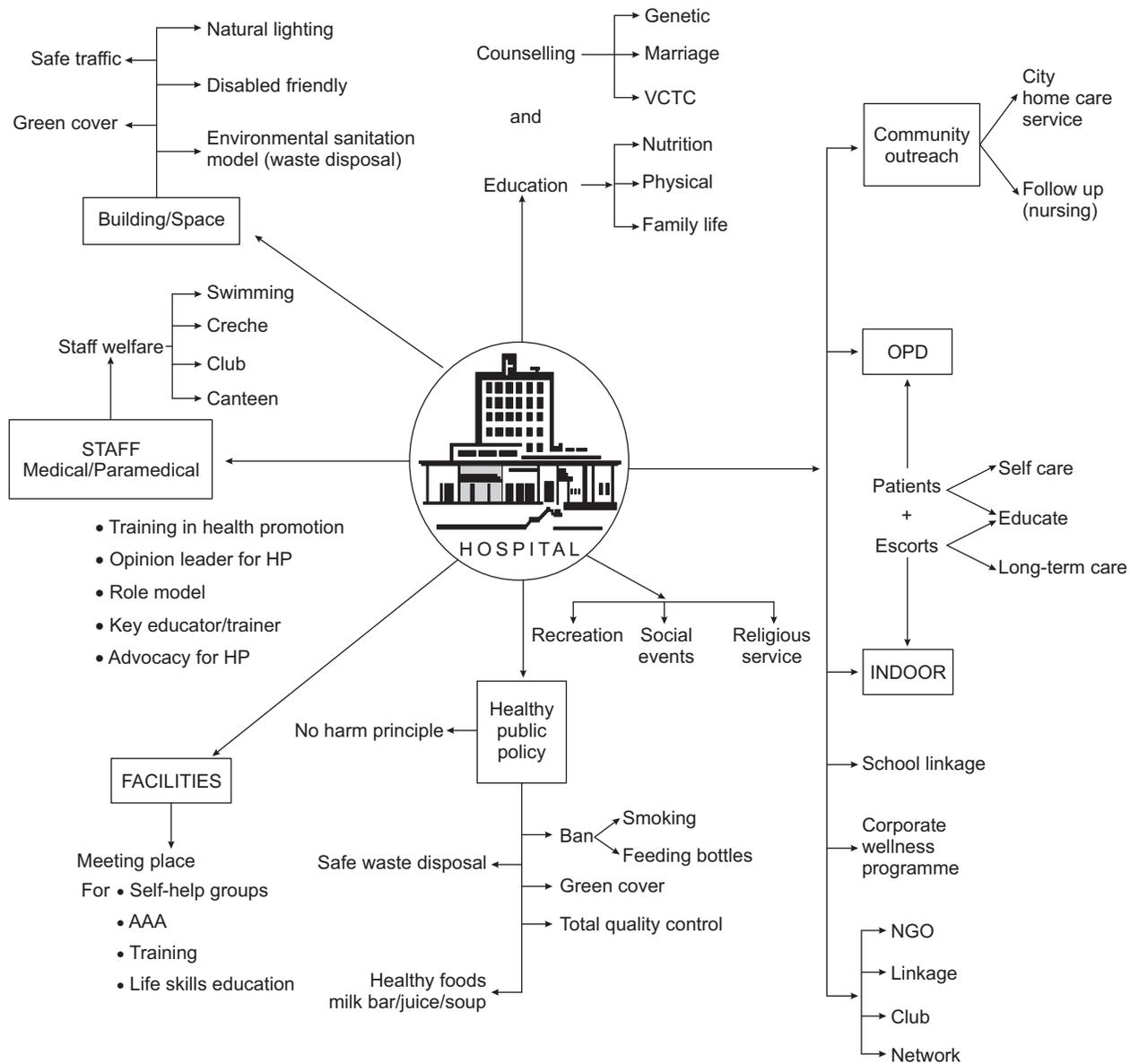


Figure 1.2 Health-promoting hospital model.

demands of vulnerable populations, overcrowded emergency departments and so on.

Despite these challenges, there are glimmerings of a brighter future for hospitals and our system as a whole. With healthcare consumerism, chronic-care management tools and the widespread adoption of healthcare IT, this brighter future will look like universal insurance coverage, empowered consumers, readily available information about price and quality, focus on early detection and prevention, and outcome-driven payments to health providers. This transformation requires basic changes from all stakeholders in healthcare. Hospitals and health systems in current scenario have an unique opportunity and motivation to embrace such change so that they can be a centerpiece of a twenty-first century model healthcare institutions. This level of change requires hospitals and health systems to embrace new values, goals and long visions.

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Changing Role of Hospitals in a Globalised Society

2

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“One day there will be no borders, no boundaries, no flags and no countries, and the only passport will be the heart.”

—Carlos Santana

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- describe the process of globalisation and its theoretical concepts.
- understand the direct and indirect impact of globalisation on health.
- comprehend the positive and negative effects of globalisation with reference to India.

INTRODUCTION

In twenty-first century society, globalisation has become the watchword in every sector. It is happening even in healthcare sector. Globalisation has a potential to affect different facets of our lives as well as the whole world. The process of globalisation has a tendency to transform local or regional issues into global ones and vice versa. There is speeding up of movement of people, money, technology, ideas, cultural items and goods across the globe. The term ‘globalisation’ has been used initially by social scientists in the 1960s. However, discussions about globalisation have been accelerated since 1990s.¹⁻⁷

With time, the pace of globalisation is rapidly accelerating. Business organisation and practices are evolving fast to keep up with the opening up of the booming economy. There are downsides also, of this hurricane economy, as seen in the unprecedented IT/banking/shares-related market failure in 2009 even in giants like the United States (where scores of Indian IT professionals lost their jobs overnight).

Globalisation is fuelled by increased international travel, information flow, telephony and internet use. Main feature of globalisation has been said to be relaxation of government control on international exchanges in various spheres of our lives. Many people identify globalisation with the rise of multinational corporations (MNCs) and the increase in multiculturalism. The ultrarapid transfer of information, made possible through these technological advances, has been one of the strong facilitating factors for globalisation.¹⁻⁷

Along with the social changes globalisation also affects the health sector, as described below.⁸⁻¹³

DIRECT IMPACT OF GLOBALISATION ON HEALTHCARE SECTOR

- *Spread of infections:* Through increased travel and contacts, globalisation facilitates the spread of infectious diseases. Many disease outbreaks, viz. severe acute respiratory syndrome (SARS), swine flu, foodborne diseases, etc.
- *Change in role of the state in public health:* Although the different countries have their own healthcare systems, the issue of pandemics and international spread of infections requires action by international health organisations. These need to be reoriented to deal with this with five core functions:
 - Surveillance and control of diseases.
 - Promote research on problems of global importance.
 - International certification.
 - Protection of international refugees.
 - Advocacy for vulnerable people.
- New infections and the resurgence of old ones have been on the rise lately. Plague has reappeared in India. Cases of tuberculosis have shown a rising trend. Bovine spongiform encephalopathy and foot-and-mouth disease have also been said to be a fall out of globalisation.

- *Lifestyle diseases:* Globalisation has brought with it widespread adoption of unhealthy 'western' lifestyle by larger number of people resulting in a rising trend of noncommunicable diseases. With colossal mechanisation of our life, added with computers and TV occupying much of our daily routine, we have become rather grossly inactive physically. Simultaneously, a 'reverse globalisation' is happening. Yoga shows on-and-off TV have become very popular nowadays. Millions of people have been reported to have changed their health/exercise-related behaviour after watching these sessions. Sale of herbal drugs has also increased.
- *Access to healthcare:* Globalisation is also leading to rise in the cost of medical care. Healthcare is becoming increasingly costlier. Investigations are also very costly now. Post-1990 privatisation movement, even in countries like India, saw healthcare being increasingly projected as a private good. Healthcare industry has been opened to the market. As a result, universal access to even the most basic medical services is being practically denied to general public. Globalisation process is also accelerating shifting of nurses/doctors from developing to developed regions. Thus, rich and poor gap is increasing.
- *Environmental degradation:* There are increasing instances of environment pollution and the resultant health problems in the wake of globalisation. The burden is mainly faced by the poor countries. In nineteenth and twentieth centuries, the richer countries first took raw material from poor countries and manufactured goods in their factories to sell the finished products again in the markets of poor countries. Now, in twenty-first century, the richer countries have shifted production from their lands to poor countries.
- *Ethical dilemma in health:* Genetically modified (GM) food is one example of the effect of globalisation that has also been a topic of regular discussion among the health experts regarding the ethical aspects of the related health effect.
- *Health impact of illicit trade/trafficking:* Trade in illegal drugs and small arms have its own health impact affecting mainly the poor section of society. One of the dominant demographic imperative of globalisation has been trafficking of women and children, and illegal migration across international borders.
- *Dietary excesses:* With globalisation, a trend of overconsumption and overindulgence in food has been seen universally. We are consuming more of processed and packed foods now. Fresh food intake has declined. Packaging industry is thriving. All this is possibly contributing to the rise of diseases like diabetes, metabolic syndrome, etc.
- *Private car ownership:* With betterment of standard of living of people, private car ownership has exponentially increased. A parallel increase has been seen in urban obesity and related problems.
- *Psychosocial health problems:* There has been a fall out of globalisation in the form of urban underclass alienation. More mental health problems/depression cases are seen in urbanites, in general. Social fragmentation is also seen more nowadays, particularly in big cities. Lawlessness and normlessness (anomie) is also being witnessed as a result of rising individualism.
- *Arm-twisting by globalising forces:* Powerful countries/structures have been shown to disregard the health safety requirements of the increasing trade. World Trade Organisation's (WTOs) ruling against European Union's (EUs) ban on hormone-treated beef has been cited as an evidence by experts that WTO is keen to sacrifice food safety issues to favour free trade (of US exports!).
- *Impact on national health policies:* These are also affected by globalisation, e.g. WHO and the World Bank. Privatisation also increases due to these changes.

INDIRECT EFFECTS OF GLOBALISATION

Above-mentioned direct health effects of globalisation are often accompanied by indirect effects. For example, globalisation is also responsible for the economic crisis in Asia (devaluation of local currency in Indonesia). Shift to dollar economy in such countries along with relinquishing of local control of the government on the country's economic affairs has been responsible for such crisis. This had far-reaching health impact, e.g. rise in suicides, malnutrition, abandoned children, low birth weight and a rise in deaths from preventable diseases such as acute respiratory infections, diphtheria and measles. Lack of access to the health services further accentuated the problem. There was also rise in poverty and unemployment, rise in crimes, prostitution, migration and drug trafficking.¹⁴⁻¹⁷

Globalisation also affects child health through an increase in proportion of working women. Health of the migrants (their low level of health and role in spread of communicable diseases) has become a serious issue for health administrators in twenty-first century.

Another effect of globalisation is drastic rise in cross-border migration. Civil strife and conflicts also affect the health of the people in the affected area. Routine healthcare delivery system is also disturbed/disrupted. There are also discussions about link between globalisation and religious fundamentalism, worldwide tensions and intolerance.¹⁶

POSITIVE HEALTH EFFECTS OF GLOBALISATION

From a public health perspective, globalisation appears to be a mixed blessing. Positive effects have also been seen, e.g. life expectancy in many countries has increased. Globalisation facilitated improved economy also ensures better healthcare.

Globalisation potentially increases the speed of response of authorities to medical/health emergencies. We now witness that news/communication about the outbreaks are

transmitted to the requisite destinations instantaneously, e.g. SARS/swine flu. Global alerts, travel advisories, quarantine, monitoring/surveillance, etc. are the useful tools in this regard.

India and Globalisation

Impact of globalisation through economic liberalisation has helped India has to become one of the economic giants—one of the fastest growing economies in the world. Exports have also improved significantly. India has to exploit its peculiar situation in the global scenario, building on its strength (strong culture, democracy, stable society, knowledge of English, younger population, massive skilled and unskilled manpower, IT industry), overcoming its weaknesses (declining quality of civic amenities; sensitive political scenario), utilising the opportunities (opened-up international markets, etc.) and warding off the threats (China as a competitor, regional politics, hegemony of US). These things apply to health field also. India now needs to harp back to its heritage of ayurveda and yoga. This has a great future in ensuring health promotion. India has to take a lead role in rejecting the model of fighting a losing battle of laboratory investigation-based approach of controlling the demon of noncommunicable diseases. Simultaneously, India needs to export its superspeciality-trained nurses' and doctors' skills and services. One of the opportunities India has in the era of globalisation is exploitation of full potential of its medical manpower. Quality of medical care provided by Indian doctors and nurses has received worldwide appreciation. Medical sector is one of the fastest growing revenue-generating segments in Indian economy. Availability of low-cost advanced healthcare services, e.g. general surgery/medicine, cardiovascular interventions, organ transplant, eye surgery, state-of-the-art laboratory services, infertility treatment, etc. along with a diversity of tourist destinations make India suitable for medical tourism. Ayurveda and yoga are also receiving plenty of attention abroad. Spas, stress relief, art of living schools and rejuvenation centres of India are growing in demand.^{18,19}

Globalisation has changed the very nature of our society. It has ushered in new opportunities as well as risks in every sphere of our life, including health. Globalisation is not likely to slow down or be stopped. There is too much power behind the forces pushing it. The forces opposing globalisation are far too weak. In any case, for most nations of the world, there is very little choice. Efforts to opt out would push the concerned nation into the backwaters of the global

system. A most likely option for most such nations is that they become active exporters of the global products in the global system, rather than being passive recipients of what is created and produced elsewhere, especially the US.

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Introduction to Health-promoting Hospitals

Section II

SECTION OUTLINE

- Chapter 3** Building Health-promoting Hospitals: A New Concept in Hospital Administration
- Chapter 4** Healthy Hospital Environment: A Key to Safe Health
- Chapter 5** Informed Patients: The Changed Scenario of Doctor–Patient Relationship in 21st Century



Building Health-promoting Hospitals: A New Concept in Hospital Administration

3

Dr Mahesh Devnani, Prof Anil Kumar Gupta, Dr Sonu Goel and Dr Amarjeet Singh

“To keep the body in good health is a duty, otherwise we shall not be able to keep our mind strong and clear.”

—Lord Buddha

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the concept of health-promoting hospitals.
- enlist the role of hospitals in health promotion.
- explain the fundamental principles upon which the concept of health promoting hospitals is based.
- describe the structural and functional system of a health-promoting hospital.

BACKGROUND

According to World Health Organization (WHO) Ottawa Charter (WHO 1986), health promotion is the process of enabling people to increase control over health and thereby improving their health, i.e. disease reducing or positive health developing qualities or health outcomes, attributable to medication, treatment, rehabilitation and training.¹ WHO's 2005 Bangkok Charter for health promotion in a globalised world has defined the health promotion as 'the process of enabling people to increase control over their health and its determinants, and thereby improve their health.'²

A health-promoting hospital/health service aims to incorporate the concepts, values, strategies, and standards of health promotion into the organizational structure and culture of the hospital. The goal is to improve the quality of healthcare, the relationship between the hospital and the community, and the conditions for and satisfaction of patients, staff and relatives. The idea is to apply the principles of the 1986 Ottawa Charter for health promotion and to develop the hospital in the way expressed in Vienna recommendations (1997) on health-promoting hospitals.³

The first conceptual development on health-promoting hospitals and health services (HPH) started in 1988.¹ A first model project "Health and Hospital" was initiated in 1989 at the Rudolf stiftung Hospital in Vienna, Austria, and

successfully finished in 1996.⁴ In 1990, the WHO international network of health-promoting hospitals was founded as a multicity action plan of the WHO healthy cities network. In 1991, the HPH network, which was in the beginning an alliance of experts, launched its first policy document. This document introduces the HPH concept and target groups— patients, staff and community—as well as related HPH strategies and action areas.⁵

The network of health-promoting hospitals and health services (HPH) was started in 1993 with the aim to integrate the health promotion and education, disease prevention and rehabilitation services in traditional curative care services of hospitals. Starting 1995, national and regional networks of HPH are being implemented and developed in order to disseminate HPH concept to as many hospitals and healthcare institutions as possible. This called for a new policy document. The Vienna recommendations on health-promoting hospitals were launched in 1997.⁵ Now HPH has become a global movement with national and regional networks, individual member hospitals and health-promotion initiatives in all continents.

ROLE OF HEALTH-PROMOTION APPROACH IN HOSPITALS

The word hospital brings to one's mind a rather dismal picture of rows of beds occupied by agonised human beings

eagerly waiting the healing of their sufferings. Yet, hospitals are the felt need of highest order of every community. It is not often remembered that establishment and maintenance of hospitals with modern technologies in a developing country takes away a disproportionate share of health budget, which is invariably meager. Today, hospital beds are extremely scarce even for acute and emergency; such is the load on hospitals.

Hospitals are characterised by a range of risk factors: Physical, chemical, biological and psychosocial. Paradoxically these risk factors in hospitals are poorly acknowledged or often neglected despite strong evidence on the relationships between staff health, productivity and quality of patient care.⁶ The hospitals can play a major role in influencing the behaviour of patients and relatives specially as the prevalence of chronic diseases is increasing throughout the world and compliance is low with treatment, hence making therapeutic education an important intervention. In absence of permanent cure of many illnesses, long-term treatment and rehabilitative services aimed at improving the quality of life of patients require that patients and relatives be educated and more intensively prepared for discharge. The responsibility of the hospital for patient care does not end with the discharge of patients. To reduce the hospital readmissions and related cost and suffering, it is very important that patients are better prepared for after discharge and subsequent providers of medical and social care are kept involved

Hospitals utilise a wide range of goods and produce high amounts of toxic and infectious waste and hazardous substances. Introducing health-promotion strategies would help to reduce the pollution of the environment and support the purchasing of locally produced, healthy products and produce. From the management perspective – who strive to maintain a healthy and productive workforce – health promotion for hospital staff and their health is an important focus.⁶ The goal of a health-promoting hospital is to develop high employee morale, by providing employees' with a working environment that is conducive to good health and to improve their control over the determinants of health, leading to reduced absenteeism due to morbidity and improved physical, mental and social health. Health promotion for staff means opportunities to improve their health status through their health assessment and by adopting healthy lifestyles and to enhance the staff to manage their health to improve productivity, their quality of life and to enable them to continue to work to achieve optimal health in terms of physical, mental and social health.

To achieve this it is very important that staff members should take control of their health. Hospital staff usually suffers from stress, burnout, anxiety and irritability. Workplace is an appropriate setting where mental health of the workers can be effectively protected and promoted transforming the hospital into a healthy organisation.⁶ It is also pertinent to mention here that hospitals can realise

numerous benefits by providing comprehensive health-promotion packages. It can add to the profitability of a hospital by generating new revenues by charging some fees for health- promotion-related activities or by marketing health-promotion packages of the hospital. Lastly, the role of the health-promoting hospitals in their communities has been dedicated an important task of the health-promoting hospital philosophy: The link with the community and its primary healthcare services.⁶

FUNDAMENTAL PRINCIPLES OF HPH APPROACH

Based on Health For All (HFA) Strategy, the Ottawa Charter for Health Promotion, the Ljubljana Charter for Reforming Healthcare and the Budapest Declaration on Health-Promoting Hospitals, a health-promoting hospital should:

- promote human dignity, equity and solidarity, and professional ethics, acknowledging differences in the needs, values and cultures of different population groups.
- be oriented towards quality improvement, the well-being of patients, relatives and staff, protection of the environment and realisation of the potential to become learning organisations.
- focus on health with a holistic approach and not only on curative services.
- be centred on people providing health services in the best way possible to patients and their relatives, to facilitate the healing process and contribute to the empowerment of patients.
- use resources efficiently and cost-effectively, and allocate resources on the basis of contribution to health improvement.
- maintain close links as possible with other levels of the healthcare system and the community.

HEALTH-PROMOTING HOSPITAL SYSTEM

The WHO HPH movement focuses primarily on four areas: Promoting the health of patients, promoting the health of staff, changing the organisation to a health-promoting setting, and promoting the health of the community in the catchment area of the hospital. Adoption of health-promotion strategies in healthcare settings can have a major public health impact by improving the quality of care, reducing the dependence of patients and their families on doctors/nurses, reducing the risk to the community from diseases related to hospital waste, improving the health of staff, reducing absenteeism and improving their productivity. It also encourages healthy behaviour, prevents readmission and maintains quality of life of patients.

Health professionals in hospitals can also have a lasting impact on influencing the behaviour of patients and relatives, who are more responsive to health advice in hospitals. Furthermore, as research and teaching hospitals produce, accumulate and disseminate a lot of knowledge and they can

have an impact on the local health structures and influence professional practice elsewhere.

Health-promoting hospital system is an approach where hospital may focus on several possible functions of the hospital as a system.

Hospital as a Physical and Social Setting

Patients, visitors, staff and the community in the hospital environment are affected by the character of the hospital setting in multiple ways:

- Ecological effects of the hospital operations (e.g. management of dangerous waste and resource utilisation).
- *Health-promoting hospital architecture*: both functionality and aesthetic design can affect the health of patients, staff and visitors.
- The hospitals should be smoke free.
- Individual competency development for health-promoting action and health potentials (by means of education, training).
- Providing opportunities for participation of staff as well as patients by improved information, communication and decision taking.⁷

HPH as a Healthy Workplace

In order to further develop the hospital setting towards a healthy workplace, hospitals should consider at least the following aspects of staff health promotion:

- As hospital staff is one of the most endangered working populations, the health of hospital staff should be given high priority on the agenda of the hospital organisation.
- The reorientation of work processes by reducing health risks and promoting the health potentials of staff; the systematic consideration of effects of service provision on the health of staff when designing physical and psychosocial work environments (e.g. by conducting health circles), the elimination/avoidance of unnecessary health risks (e.g. anaesthetic gas, ergonomic problems), where necessary, compensatory offers for specific health problems (e.g. back problems).
- In order to enable staff to have a healthier working life and to perform better health promotion for patients, the improvement of staff training and education may be necessary.
- In order to create healthy and health-promoting work places, an HPH should systematically promote an active and participatory role of its staff (staff empowerment).⁷

Hospital as a Provider of HPH Services

The hospital as a setting for training/education and research can systematically integrate principles of health promotion into its routine service provision, teaching and research functions.

- Existing services may be reoriented towards more health gain orientation and new services for health promotion and disease prevention may be implemented in addition to the routine hospital service provision.
- Developing an HPH includes also the quality assurance and improvement of medical, nursing, psychosocial services, the reduction of risks and a focus of treatment and care.
- HPH services should be provided according to principles of holistic, continuous and integrated treatment and care.
- HPH should also offer more opportunities for participation of hospital patients and relatives for successful prevention.⁷

Training, Education and Research in HPH

The reorientation of the training, education and research function of the hospital may include:

- The consideration of health-promotion issues in the education and training of clinicians, nursing and other hospital personnel (health-promotion theory as well as health-promoting services provision).
- The inclusion of questions of health development, health indicators, etc. in hospital-based research.⁷
- In addition, there is a need to do operational research for understanding advantages of HPH approach.

Hospital as an Advocate and Change Agent for Health Promotion

Hospitals can further promote health in their environment/community (in cooperation with other players in the form of Healthy Alliances by:

- Contributing to health reporting
- Organising specific action programmes (e.g. information, counselling, training) in cooperation with schools, enterprises, other healthcare providers, local health policy.
- Cooperating with supermarkets in the provision of healthy nutrition and nutrition counselling.
- Systematically cooperating with the neighbouring community/environment in planning services.

Taking together the possibilities for health-promotion interventions in and by hospitals, the health-promoting hospital concept can be understood as an 'umbrella' or integration concept, that comprises a number of methods that contribute to reaching its goals, and focuses these methods on the health and empowerment of hospital patients, hospital staff and the population in the local hospital environment.⁷ Two factors mainly affect the outcome of health-promoting hospital's initiative; the degree of organisational commitment made by hospital and type of health-promotion activities undertaken. The main thing in health-promoting hospital's approach is developing effective and collaborative working relationship with patients and their families, other service providers and broader community to achieve the best outcomes.

This way, hospital clients can make informed choices and change their behaviours in order to achieve an optimal level of physical and mental health and improve their overall quality of life.

HPH can therefore be linked and combined with other strategies of hospital development (e.g. health education, patients' rights, health at work, hospital hygiene, quality management).⁷ However, the concept of 'health-promoting hospital' is still relatively new for Indians and Indian hospitals. Health in India is considered more or less synonymous with absence of disease and some physical condition alone.

Sustained efforts in improving awareness of 'health-promoting hospital' concept would go a long way in improving the outcome performance of Indian Hospitals.⁸ Tertiary care hospitals should take a lead in this regard to implement HPH approach.

Hospitals are in strong position with in the healthcare system to be the advocates for health promotion. They represent the main concentration of health service resources, professional skills and medical technology.

The fact that hospitals command extensive resources means that even a small shift of focus toward health promotion has potential to stimulate public opinion favourably toward health-promotion and in time, brings health benefits to community at large. In European countries, hospitals are increasingly positioning themselves as the leading providers of health promotion services within the community. In India this movement is yet to take off.

Case Study 1: Health-promoting hospitals – need of the hour

Project: A project 'Development of Nehru Hospital, PGIMER, Chandigarh as a health-promoting hospital' was started with the help of World Health Organisation in April 2011, a leading tertiary care hospital of North India. The project aimed at spreading the concept and knowledge of 'Health-promoting hospital (HPH)' among hospital employees. The specific objectives were to undertake risk profiling of employees, sensitisation and empowerment of employees for HPH concept and improvement of biomedical waste management (BMWM) practices. The mission statement of the project was 'Development of Nehru Hospital, PGIMER, Chandigarh as a centre of excellence in health promotion by empowering its stakeholders to improve the physical, social and mental health determinants through their active participation and providing them opportunities of inclusive and sustainable health-promotion activities in order to improve the stakeholders' overall quality of life to achieve their optimal health.'

The major activities performed under the project were:

- Constitution of a health-promotion committee and a health promotion cell comprising of senior functionaries
- Survey of employees
- Training programmes on HPH
- Workshops on BMWMs
- Seminar on Information, Education and Communication (IEC) on HPH and subsequent display of material



Outcomes: This project was able to fulfill its stated objectives in terms of improving knowledge and awareness about health-promoting hospitals and promotion of sound biomedical waste management practices. The pre-post test scores taken during training programmes showed significant improvement. In the employee survey, majority participants were females working as staff nurses in Nehru Hospital and most of them were diploma holders. Sixty per cent participants were within normal range of basal metabolic index. The participants got their medical, dental and eye checkup regularly. Around 35% participants were not vaccinated for hepatitis B. Musculoskeletal problems were more prevalent amongst the hospital staff than any other ailment. Most participants (96%) were satisfied with their jobs. Around 23% participants had suffered from needle-stick injuries in past and about 35% participants were not aware of facilities available at PGIMER for management of such cases. Almost all of the nursing staff suggested that there was a need for in-service training programme, from time to time, to generate awareness on HPH activities.

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Healthy Hospital Environment: A Key to Safe Health

4

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“Patients of course give the highest priority to obtaining the very best available treatment; but they are also individual who merit respect, who may be frightened and need reassurance, and who are people with eye, ear and other senses, who need and deserve to receive pleasure from their environment.”

—Wickings

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- enlist the components of healthy hospital environment.
- get an overview of planning and designing a hospital keeping in mind the components of healthy hospital environment.

BACKGROUND

The hospitals must have humanising environment that can contribute positively to the health of patients as well as staff. It needs to heal and promote health. The objective should be to create a patient-focused and patient-centred environment by offering an atmosphere of safety, security, cleanliness and physical comfort.¹ A clean hospital environment plays an important role in ensuring that best results are obtained for all kinds of medical care offered by it. Many factors, like the design of patient care areas, housekeeping services, air quality, water supply and laundry, etc. plays a significant role in this regard.²

In this context, sound environmental practices are important for improving hospital environment along with increasing efficiency, satisfying statutory requirements and reducing costs. But, it is really unfortunate that the hospital administrators readily make cost-cutting compromises when called upon to meet environmental compliance standards. So, besides providing the curative services, and research and training facilities of high quality, hospitals also have to ensure that they practice ‘No Harm’ policy, i.e. human health should not be adversely affected due to impact of hospitals on local environment.

Health-promoting hospital (HPH) concept recognises that structure and function of hospitals are affected by the overall environment and hospitals themselves affect the environment.³ In order to minimise these environmental

problems, action should be taken to deal with pollution at source, for instance, waste should be segregated and concentrated within healthcare institutions, and whenever possible it should be disposed-off safely. Also, due consideration must be given to the impact of hospitals on environment, especially to risk of pollution of water, air and soil, besides aesthetics.

For a healthy hospital environment, the hospital should ensure certain requirements like evidence-based design of hospital, floor space for beds, interbed space, safe water supply, proper sanitation and housekeeping, effective biomedical waste (BMW) management, adequate hand-washing facilities, isolation facilities, ventilation, etc. In addition regulation of traffic flow to minimise exposure of high-risk patients and facilitate patient transport, precautions to control rodents, pests and other vectors, good dietary services, utilisation of renewable energy sources, effective use of natural light, adequate waiting facility for patients and their relatives, disabled-friendly facilities inside the hospital, social and religious environment, and recreational and patient welfare activities, etc. are also important.

COMPONENTS OF HEALTHY HOSPITAL ENVIRONMENT

Aesthetics

Aesthetics is now considered as an essential ingredient of healthy hospital environment. The hospital design should

balance between function and aesthetics. Designing of a hospital should be done utilising knowledge of the latest and appropriate styles of architecture and furniture. This should be planned for the following dimensions:

- Physical aesthetics implies evidence based and well planned.
- Psychological aesthetics, which includes happiness, joy and pleasure.
- Spiritual aesthetics, which suggests hope, contentment and peace.
- Intellectual aesthetics inspires interest and contemplative delight.

There is adequate access to natural light and fresh air at all levels inside buildings of Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh. For example, see-through windows from top to bottom in advanced eye centre provide eye-catching view in addition to providing natural light and fresh air.

Air and Ventilation

The ventilation systems of hospital should be designed and maintained to minimise microbial contamination. Certain high-risk areas such as operating rooms, critical care units and transplant units have special ventilation requirements. High-efficiency particulate air (HEPA) filters prevent recirculation of microorganisms. Unidirectional positive pressure laminar airflow systems are required in operating rooms.

The air-conditioning system of PGIMER Chandigarh is a centrally air-conditioned system with water-cooled reciprocating type of chillers, as per the international norms. It runs 24 × 7 for 365 days a year, for more than 12 years, maintaining all the requisite parameters. It maintains a temperature of 23–27°C, relative humidity of 60% and 7–8 air changes in the ward areas, and a temperature of 20–22°C, relative humidity of 50–60%, and 15–24 air changes in operation theatre areas. Microvee Filters (fine filters that filter up to 0.03 μ of particles) are present throughout the system. Frequent maintenance/validation of efficacy of filters, ducts, diffusers and grills are done in accordance with manufacturer's requirements.

Safe Water

The healthcare facility should provide safe water to patients, their relatives as well as to the staff. Sufficient number of water outlets depending on the requirement should be provided. If present, water storage tanks should be cleaned regularly and the quality of water should be sampled periodically to check for microorganism contamination. As water is now a scarce resource, there should be emphasis on water conservation. Health-promoting hospitals should have facilities for rainwater harvesting.

All the overhead tanks of PGIMER Chandigarh are regularly cleaned by sanitation and engineering wing of the hospital. The water samples of various tanks of PGIMER

Chandigarh are sent for testing and culture, and appropriate action, if required, is taken accordingly. Water coolers are provided at strategic sites throughout the hospital campus.

Sanitation and Housekeeping

Routine cleaning is important to ensure a clean and dust-free hospital environment which is important for quality patient care. Patient-care areas should be cleaned by wet mopping, dry booming is not recommended. The use of a neutral detergent solution improves the quality of cleaning. Hot water (80°C) is a useful and effective environmental cleaner. Any areas visibly contaminated with blood or body fluids should be decontaminated and cleaned immediately with detergent and water. All horizontal surfaces and toilet areas should be cleaned daily. The housekeeping service is responsible for the regular and routine cleaning of all surfaces and maintaining a high level of hygiene in the facility. The sanitation and housekeeping department is generally responsible for classifying the different hospital areas by varying need for cleaning and develop policies for appropriate cleaning techniques, adopting procedure (frequency, agents used, number of staff in area, etc.) for each type of area-from highly contaminated to the most clean-developing policies for collection, transport and disposal of different types of waste, informing the maintenance service of any building problems requiring repair (cracks, defects in the sanitary or electrical equipment, etc.) providing appropriate training for pest control practices, establishing methods for the cleaning and disinfection of bedding (e.g. mattresses, pillows), etc.

The floors at all the areas in PGIMER hospital are wet-mopped two or three times per day (more in intensive areas and emergency). The emergency operation theatres are fumigated monthly. The sanitation and housekeeping staff is given regular training on different subjects like infection control, BMW management, etc. These programme stresses on personal hygiene, the importance of frequent and careful washing of hands and cleaning methods (e.g. sequence of rooms, correct use of equipments, dilution of cleaning agents, etc.).

Hospital Waste Management

Hospital waste (especially biological waste) potentially contains pathogenic microorganisms, and requires appropriate and safe handling. There should be designated persons responsible for the management of waste collection, handling, storage and disposal. Waste management should be conducted in coordination with the infection-control team and waste management practices must meet legal and other statutory requirements.

At PGIMER Chandigarh biomedical waste (BMW) is handled and managed as per the provisions of BMW rules, 1998. The BMW is generated at various places in the institute, viz. outpatient department (OPD), operation theatre

(OT), inpatient department, intensive care unit (ICU), laboratories, etc. The BMW generation rate in PGIMER is approximately 1.5–2.5 kg/day/bed. The segregation and treatment of waste with 1% sodium hypochlorite solution for minimum 30 min is done at the source of generation. As 70–75% of waste generated in the hospital is nonhazardous or general waste, segregation reduces the quantum of waste that needs special treatment to only 25–30% of the total waste. The BMW is collected regularly 3–5 times/day from all the areas of generation and transported to a common refuse point in covered containers. The team for collection is earmarked and wears a special uniform with all protective gears. From refuse point, the noninfectious general waste in bags with proper tags/labels is transported to dumping area earmarked by Chandigarh administration for land filling. The incinerable waste is sent to the incinerator. The pretreated plastic is shredded in the shredder and again treated with 1% sodium hypochlorite solution for minimum 30 min. All the waste generated is finally disposed-off within 24 hours of generation.

Central Sterilisation Service Department

Central sterile supply department (CSSD) of a hospital plays a major role in infection control. The responsibilities of the central sterilisation service are to clean, decontaminate, prepare for use, sterilise and store aseptically all sterile hospital supply. Its policies are developed in collaboration with the infection control committee and other hospital programmes.

The CSSD in charge of a hospital is responsible to oversee the use of different methods (physical, chemical and bacteriological) to monitor the sterilisation process, supply sterile material (gauge, dressing material, procedure sets, gloves, vials) timely to the units/departments, ensure quality assurance of sterilisation by autoclave tape (on a daily basis) and by biological indicators and Bowie–Dick test pack (on weekly basis), reports any defect (supply, repair and maintenance, raw material, manpower and infection control) to Deputy Medical Superintendent, maintain complete records of each autoclave and steriliser run, communicate with various stakeholders (infection control committee, the nursing service, the operating suite, maintenance, and other appropriate services on the matters of sterilisation in CSSD).

Dietary Services Department

The dietary department of a hospital plays a direct role in promotion of health. The dieticians of a hospital provide consultations to patients on specific dietary requirements, define the criteria for the purchase of foodstuffs and other material, and maintain a high level of quality. In addition they issue written policies and instructions for hand-washing/clothing/staff responsibilities and daily disinfection duties, ensure the methods used for storing, preparing and distributing food that is devoid of contamination by

microorganisms, issue instructions for the cleaning of dishes after use, ensure appropriate handling and disposal of waste, and regular training of staff in food preparation, cleanliness and food safety.

Laundry Service Department

The laundry department of a hospital plays indirect role in health promotion. The laundry manager of a hospital is responsible for participation in selection of fabrics for use in different hospital areas, developing policies for working clothes in each area and group of staff, maintaining regular supplies/distribution of working clothes, ensuring separation of 'clean' and 'dirty' areas, develop policies for the collection and transport of soiled linen, defining the method for disinfecting linen, recommending washing conditions (e.g. temperature, duration), ensuring safety of laundry staff through prevention of exposure to sharps or laundry contaminated with potential pathogens, and periodic training of staff.

All the above-mentioned health-promoting activities are performed by laundry manager of PGIMER Chandigarh.

Social and Religious Environment

Hospital is an indispensable community institution. Life patterns, value systems and ethics of the community served by the hospital should merit due consideration. The local architectural norms and traditions should be incorporated.

At PGIMER Chandigarh, many recreational and religious facilities are available for patients and staff in the institute. There are eye-catching fountains inside and outside OPD, besides flower beds and flower pots in and around campus. Religious sentiments of patients are also taken care of. There are temples, gurudwara and church inside campus. Celebrations are also held on various occasions like Diwali, Christmas, New Year, Fresher's day, Saraswati puja, etc. Various self-help groups like *Sewa Bharti* are operating in PGI to help needy patients. There is a provision of meeting place for voluntary groups like alcohol anonymous, breath-free group within the hospital. Besides this, there is a blood bank society and a Thalassaemia Society to create awareness among patients.

Biological Environment

It is a well-established fact that living plants (especially green) have a positive psychological effect on humans. Studies have shown that patients in healthcare settings experience have expressed improved satisfaction and speedy recovery when plants are present. Studies by National Aeronautics and Space Administration (NASA) and other scientists have also produced documented evidence that interior plants and their root-associated microbes can remove harmful chemicals from sealed chambers. Studies also show that interior plants may be beneficial in reducing the levels of microbes in the ambient air. Many hospitals in Japan have plants inside

hospital to take advantage of their air-cleaning properties. Takenaka Garden Afforestation, Inc., Tokyo is adding 'ecology garden' in hospitals.⁴

During the last few years, many new centres and buildings have come up in PGIMER campus. Despite this, PGIMER is adequately covered by trees throughout its campus. The area under green cover is 36% of the total area of the hospital campus. The department of horticulture in PGIMER has been a regular winner at city-level rose festival every year. The green lawns in the premises provide a comfortable place for patient's relatives. The cattles and dogs are not allowed in the campus.

Noise

A hospital must ensure a quiet, calm environment for patients by providing a physical setting conducive to recovery. This requires an organisational culture that supports patients and families by not multiplying, through a noisy atmosphere, the stresses already being faced by the patients and their relatives due to illness, hospitalisation, medical visits, healing and bereavement.⁵ To accomplish this, hospital administrator must identify internal and external noise factors, whether it is due to people themselves, the equipment or the building. They must also discern the noise sources that are controllable. The hospital must also measure and reduce the noise in patient rooms within the prescribed limits. Hospitals are meant to ensure a quiet and calm environment for patient's early recovery. The noise levels limits during daytime at a hospital should not exceed 50 dB, as laid down by the noise pollution (regulation and control) rules 2000.⁶

Surprisingly, the noise level was found to exceed the laid down standards at the various locations in PGIMER. Since the unwanted sound produced in the hospital has an adverse impact on patients and their attendants, it is very necessary to curb the cause and adopt measures to reduce its impact. Noise causes sleep deprivation and leads to increased anxiety and stress on the patients and their relatives who are already in a stressful state. Noise also has an impact on the hospital employees. It leads to depression, irritability, reduced efficiency, decrease in productivity, and increased medical and nursing errors besides leading to hearing loss and adversely affecting cardiovascular health.⁵⁻⁷

A higher noise level in an institute could be attributed to unnecessary movement of people (patients/employees) in the hospital area, too many attendants and relatives of patients, mishandling of equipment, viz. trolleys and wheelchairs also produce rattling sound during the transfer of patients for various tests and checkups, reflection of sound from hard hospital walls/floors and ceiling, buzzers/beepers/monitors in ICU, telephone/mobile in patient-care areas, careless rattling of utensils and casual attitude of kitchen staff during distribution of food in the wards, unnecessary and avoidable enquiries of patients due to lack

of information boards, excessive student-to-patient ratio during clinical teaching and any renovation/construction activities in the campus.

Following steps would help to reduce the noise level in the hospital. All the equipment, viz. trolleys, wheelchairs, beds, etc. should be subjected to regular maintenance and oiling or be replaced, proper rubber padding should be present in the wheels of chair and beds to ensure smooth operations, the ceiling tiles can be changed from sound-reflecting to sound-absorbing tiles, an auditory impact query should be conducted for every equipment purchase/construction activity, light music can be played in wards to avoid noxious sounds, regular orientation of staff on the importance of maintaining appropriate noise levels, and proper signage and displays should be present for patients and their attendants to reduce their enquiries, reduced waiting lines in OPDs (online appointments, etc.). The signs/slogans such as 'Silent Zone', 'Silent Zone Helps Healing Body', 'Silent Hospital Helps Healing', etc. should be placed throughout the hospital, regular oiling of the doors of wards, renovation/repair activity should be done in a phased manner, reduction in the number of attendants accompanying the patients, recording of ambient noise levels in various areas throughout the day by sound meters (for informing policy makers/directors).

Traffic Safety

A good traffic design in a hospital would ensure road safety of the patients and their relatives, besides providing pollution-free atmosphere. In PGIMER Chandigarh, multilevel parking facility near new OPD has been constructed to tackle heavy vehicular rush during peak hours. Speed level limit below 20 km is displayed at number of places inside campus for traffic safety. There is one-way traffic outside the hospital. Also signage boards are displayed at various locations in the complex.

Disabled-Friendly Nature

A hospital should be a barrier-free structure that enables people with disabilities to move around safely and use the facilities within its premises.

Seating Facility

In hospitals, patients are accompanied by their relatives. They have to wait for their turn for hours. Therefore, adequate seating facility should be provided for patients inside hospital and OPD.

Recreational and Health Educational Activities

Recreational and health educational activities boost up the image of the hospitals. Therefore, posters and panels should be displayed inside hospital and OPDs for awareness of

patients and their relatives. In PGIMER, there are eye-catching fountains inside and outside OPD that provide soothing effect to ailing patients. Besides this, flourishing flowerbeds and flowerpots in and around campus provide a relaxing atmosphere for everyone.

Workplace Health Promotion

In order to ensure minimum distraction of the employees from their household and other concerns, steps should be taken in their favour so that they devote their attention thoroughly to the institute. Besides providing various facilities, strategies to reduce health risk to staff should also be in place. There should be a working women's hostel, employee's welfare canteens, community centre, a crèche for children of staff in the hospital premises. Besides this, to support employees financially in their hour of need, there is a provision of employees welfare fund scheme, income-generating programme for families of staff (stitching of hospital linen and gowns by wives of hospital staff, vocational training for families for staff.

There is six-lane swimming pool inside PGIMER campus for staff and their families. Free yoga camps are also organised for staff from time to time. There are two schools inside PGI campus for the children of staff. Besides this, there are many staff canteens providing nutritious food according to menu suggested by residents. There are milk booths near the hospital, which are quite popular among patients as well as hospital staff. A 1-week-long spring festival is celebrated every year inside PGIMER campus. February is celebrated as sports month every year. Various inter- and intradepartmental as well as intercollege championships are organised.

The prime reason of a hospital is to provide patient care. Hence, the policies of hospitals have been primarily oriented towards the health and well-being of the patient. But lately hospitals have focused on environmental issues as well. It is essential that hospitals focus on environmental issues along with core patient care to provide clean, safe and quality patient care.⁸

Case Study: PGIMER – A health-promoting hospital

PGIMER Chandigarh was evaluated for its 'health-promoting hospital' status based on World Health Organisation (WHO) self-assessment tools for health promotion in hospital. Interviews of healthcare providers, patients and their relatives were conducted. Observations for HPH indicators were also considered. The tool sought information on five standards (Table 4.1).

Table 4.1 HPH score of PGIMER Chandigarh

Standards of HPH	Maximum possible score	Observed score
Management policy	18	5
Patient assessment	14	5
Patient information and intervention	12	8
Promoting healthy work place	20	6
Continuity and cooperation	16	11
Total score	80	35

Each standard was classified into substandards comprising 13 in all. Each substandard was further supplemented by indicators quantifying substandards comprising 18 indicators in all. The results are shown in Table 4.1. The strengths were good intra- and intersectoral collaboration of PGIMER with health and social care providers, patients being given follow-up instructions/rehabilitation plan on discharge, programmes like smoking cessation are successfully enforced, staff complies with health and safety requirements at work place, working condition of employees comply with directives. However, hospital aims and mission as a health-promoting hospital was not formally declared, no specific existing HPH policy document was available, no clearly labelled sets of health-promotion activities were in force, information on formal assessment for patient satisfaction was not available and there was no evidence that staff is involved in HPH policy making, audit and review. However, under WHO project for making PGIMER as a health-promoting hospital, all these activities were carried out in 2011–2012.

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Informed Patients: The Changed Scenario of Doctor–Patient Relationship in 21st Century

5

Dr Sonika Raj and Dr Amarjeet Singh

“A doctor who cannot take a good history and a patient who cannot give one are in danger of giving and receiving bad treatment.”

—Anonymous

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the importance of a good doctor–patient relationship.
- differentiate between various types of doctor–patient relationships.
- realize the importance of informed decision making by doctors as well as the patients.
- discern the role of information technology in changing doctor–patient relationship.

BACKGROUND

In medical practice, provision of correct treatment by doctors depends upon correct diagnosis. This requires proper disclosure of symptoms by the patients. This implies that the doctors should be well adept in eliciting proper history of illness from the patients. Hence, good doctor–patient communication is needed for satisfactory outcome of all clinic visits. Good communication skills of doctor are critical for effective delivery of medical care.¹ For this, a well-trained doctor will be required to foster a relation with his/her patients.

The quality of interactions at clinics has a potential to affect both doctors as well as the patients. In the prevailing scenario, the medical profession inspires awe and faith in patients. They disclose their health problems (even intimate) in an alien setting of hospital, even to stranger doctors because of their faith and trust on them. The compliance of the patients with the instructions given by doctors/nurses affects the treatment outcome. This again, naturally, will depend upon their communication skills.

While personal traits of doctors come into picture, as far as their communication skills are concerned, they are required to maintain a professional outlook when treating a patient.

GOOD COMMUNICATION: AN ESSENCE FOR DOCTOR–PATIENT RELATIONSHIP

Thus, favourable outcome for patients in terms of recovery necessitates that the patient and physician develop a ‘partnership’ or ‘relationship’. Available data suggest that patients who actively ask questions during the medical encounter and who participate in their care have higher satisfaction.² Their quality of life improves more as compared to those who play a passive role. Stewart et al. reported that patients were more at ease when their interaction with treating physician was more congenial.³ Ideally, all patients should be fully educated about the nature of their condition. Doctors should tell them about different treatment options available. Active involvement of the patients in treatment is becoming a norm these days. Good communication between doctors and patients will facilitate this. Lack of trust between doctors and patients will lead to incomplete disclosure of disease-related information. Similarly, stressed may not understand the instructions given to him by doctor. All this has a major influence on treatment outcome. Accordingly, it has a definite impact on practitioner and patient satisfaction. It also helps in prevention of practitioner burnout. This is also a major determinant of compliance of patient with doctor’s

instructions.⁴ Thus, successful medical practice depends on good communication.

Parsons examined the 'sick role'. This described the relationship between patients, doctors, family and society.⁵ As per his views, society has defined roles for doctors and patients. His theory depicted the four roles of patients.

- Because of sickness people could forgo their routine responsibilities.
- Patients required care by others to get well.
- They are obliged to seek care of a doctor/healer.
- They should exhibit a desire to get well.

This theory described the sick role as a deviant behaviour, which is transient and needs to be medically certified. Here, a doctor, in reciprocation of cooperation by the patient is expected to help him/her to get well through application of his medical knowledge.

A good doctor should make the patients feel at ease. He should encourage patients to share their apprehensions, tensions, worries and concerns to their doctors. Patients also need to be encouraged to talk freely.^{6,7}

TYPES OF DOCTOR–PATIENT RELATIONSHIPS

This has been categorised into many types on the basis of power equation between doctors and patients.⁸

Paternalistic

It involves more control by doctors over the clinic interaction. Patients have less control over the situation.

Here, the physician plays a dominant role. Keeping the interest of the patients in mind, he takes all treatment-related decisions as a father figure. This was the orthodox traditional view of power equation between doctors and patients. In such a relationship, conventionally, as happened in olden times, patients feel at ease, since they feel comfortable in relinquishing all worries about treatment-related decision making to the doctors.

Here doctor undertakes all tasks related to diagnosis (clinical and laboratory) and treatment to ensure a favourable outcome for the patients.

Paternalistic relationship was more prevalent in earlier times. It was mostly seen in developing countries like India, especially in illiterate, poor and rural people because of low health literacy. This is also known as 'doctor-knows-best' model.

Here, health literacy is defined as 'the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions'.⁹

Relationship of Mutuality

Here, patients participate actively in their treatment. Due consideration is given to patients' apprehensions, beliefs and preferences by the doctor while deciding about treatment plan and modalities. Doctors make an effort to listen to understand the patient's perspective. This type of relationship is more seen nowadays in developed world and literate, rich and urban section of developing society.

Consumerist Relationship

Here the locus of control is internal, i.e., here, doctors accede to most demands or requests of the patients. Here, the patients know what is expected from doctors. In this self-determined model the patients rely on their own resources to make treatment decisions. This type is seen more in scenario where the physicians are labelled as 'panel doctors' or 'certificate doctors'. For example, many private doctors join on the panel of private companies, schools, etc. Their practice is often affected and guided by patients' demand. Patients even dictate prescription of particular medicines. For example, in cities like Delhi, it is common scene in clinics to see patients telling doctors '*yeh wali dawai likh do*' (prescribe this medicine). Similarly, to make money, many doctors make medical fitness certificates 'on demand' for students/employees. Nowadays, medical certificates are needed according to visa's or job's requirements. Moreover, bariatric surgery or cosmetic surgeries nowadays are being done on a large scale on demand by the clients. This trend has increased with opening up of insurance sector—where before buying a policy the client is required to undergo many laboratory tests. Many doctors join the panel of such insurance companies. They spend bulk of their time in doing checkups of people for insurance companies. Thus, here, the patients play a dominant role.

Relationship of Default

In this situation, the patients do not take charge of the situation while negotiating the treatment regimes, even when the doctors are willing to relinquish charge of the situation. This happens in the situation where the society has modernised and the medical practice scenario has become relatively permissive, but the patient who has come for consultation is poor, illiterate or not willing to dominate the treatment proceedings.

In other words, the new egalitarianism does not work in clinics. Above-mentioned doctor–patient relationship styles can be further explained by a following case study.

Case Study: A young girl harbouring hepatitis B virus, unknowingly

Mrs Sharma, a 47-year-old woman was recently told that she has a breast mass. Chest X-ray, bone scan and liver function tests revealed 3 cm ductal carcinoma without lymph node involvement and any evidence of metastasis. Now, in planning for the treatment, the role of physician in the different types of doctor–patient models will be as following:

- *In paternalistic model:* The physician will directly advice for lumpectomy followed by radiotherapy, as he thinks it is the best possible treatment for her without taking in account the considerations of the patient. He would not discuss the options with the patient. This is likely to happen if patient is from lower socioeconomic strata and is illiterate.
- *In mutual model:* The doctor will guide the patient about her illness. He will explain to her and her caregivers about both lumpectomy and mastectomy procedures. The pros and cons of both the therapies will be told. He can provide them with the latest literature available about ductal carcinoma. He can also suggest various websites and related information the latest literature revealed that mastectomy or lumpectomy with radiations results in 10 year survival in 80% of the total cases. So, the physician will engage the patient or caregivers in discussion to elucidate their preferences. Moreover, to prevent recurrence, the doctor will explain about both radiotherapy and chemotherapy options. Patient and her family would be able to decide for best-available treatment option along with physician's advice (counselling mode). However, no relationship may fit all the situations encountered in the clinics.

For example, in emergency situations where delays in treatment might irreversibly harm the patient, there is a need of a dominant role of the doctor.

He should clearly and strictly decide about appropriate course of action.

CONSULTATION STYLE

Nature and extent of doctor–patient interactions may also be affected by the style of the practice adopted by a doctor. There are two main styles:¹⁰

1. Doctor-centred Consultation

Here the doctor plays the traditional orthodox 'father figure' role. He adopts the 'God-like' stance. Patients feel that whatever the doctor thinks is best for them. Accordingly, they comply with his instructions. The doctor takes history, examines the patients, orders investigations and prescribes treatment without so much of discussing it with the patients.

2. Patient-Centred Consultation

Here, the doctors exercise lesser control over some aspects of treatment negotiations. Due consideration is given to the concerns, feelings, apprehensions and preferences of the patients. The degree of listening by doctors is more. Patients are given more opportunities for expressing their perspectives about the disease, symptoms, treatment, etc.¹¹ By and large, many patients derive a lot of relief in their symptoms just by such participative interaction with doctors.

Such variations in the styles of doctor–patient relationships reflect the prevailing culture of medical practice. Doctor-centred consultation represents the typical professional approach. It focusses on objective analysis of the patients' condition, emphasis on medical theories and standard procedures. There is less of flexibility in deciding about treatment options.

A more patient-centred approach aims to understand patients' own illness framework in consonance with their belief system. Here the doctors also give due importance to the patients' frame of mind, personality, daily life, family situation. Choices, limitations and idiosyncrasies of patients are also listened to and given suitable consideration by the doctors.¹² Here, the emphasis is on suitably educating patients about the disease and its treatment so that they can understand and give their opinion about the line of treatment to be followed.

Here, patient and his caregivers participate in decision making regarding the health of their family and also to promote self-care. However, all such interaction needs to be in a language comprehensible to all categories of patients. This is expected to give them the power to say 'NO' to medical care when not needed. Thus, it helps in preventing unnecessary surgeries and over testing. This is informed decision making.

This approach is also likely to empower the patients. Compliance is also likely to be better. Burden on hospital and doctors will also reduce since this approach will enhance the self-efficacy of patients.¹³

INFORMED DECISION MAKING—A KEY TO EFFECTIVE MEDICAL CARE

This approach focuses on provision of all possible information about various aspects of the disease, its symptoms, tests, diagnosis, treatment and prognosis. It seeks to invite patients' opinions on the appropriate treatment choices.⁸ Informed patients are a hallmark of a more patient-centred approach. Here the rights of the patients are given more importance. As indicated earlier, the patients also give voice to their views while their treatment is being discussed.

Benefits of such an approach include improvements in outcome of clinic visits by patients. Satisfaction level of both doctors as well as the patients is better. Patients' health literacy level improves. Referral system also becomes efficient.

Simultaneously, this approach will also help the health-care providers like general physicians in improving the efficiency and quality of services they provide. This way they will be able to prioritise more of their time for those who need face-to-face care. It also has an added advantage of reducing instances of unfair medical practices. Research has also pinpointed the role of problematic doctor and patient-centred relationship in medical malpractice. Patients tend to complain against the doctors when they considered them less caring.¹⁴

Whenever, particularly in modern society, it is aimed to protect the rights of the patients, there is a need to make available all kinds of patient education materials. This may be in the form of a handout, a booklet, a video or a CD.

Such material should contain all possible information about various aspects of the disease, its symptoms, tests, diagnosis, differential diagnosis, treatment options available, risks, side effects with related costs and prognosis. Focus should be on evidence-based decisions.

Randomised controlled trials (RCTs) have consistently shown the benefits of adopting such a patient-centred approach. This has shown to reduce unnecessary surgeries.¹⁵ Enormous savings—to the individual, to the family, to society as well as the state—are likely to accrue by using such a strategy. This is due to the demedication effect of this approach. The cost and time savings are immense.¹⁶

INFORMATION TECHNOLOGY AND INFORMED PATIENTS

The decision to adopt a patient-centred approach expects doctors to be good communicators. A doctor needs to spend quality time with patients to effectively educate them on various aspects of disease. At the same time, a physician has to refrain from forcing their decisions on patients. However, this is a particular challenge in hospital settings, where pressure of efficient performance in terms of better treatment outcomes is always there. In this context, the information technology (IT) revolution has changed the doctor–patient equation. Recent advances in mass media channels (televisions, newspapers, magazines), penetration of mobile phones, computers, internet, etc. have revolutionized the access potential of people to health information.¹⁷

Information accessed via the internet is often free, bulky yet dubious. It provides opportunities to people to get answers to their questions related to medical/health issues in plain language. It seeks to empower the patients. It facilitates a patient-centred approach.¹⁸

Relevant information from the support groups for individual diseases is also available on the internet. Patients and their families may access such information and get benefited. In contemporary society, the locus of power in healthcare is shifting. People, especially educated, read health-related information on modern media channels and get informed. These informed patients gain information related to their symptoms and come prepared to their physicians. And this

is not the mistrust on the physician that the patients turn to internet for information. Rather, internet users are curious information seekers who wish to be prepared in advance before visiting a clinic.^{19,20}

This approach needs to be encouraged especially in hospital situations, where, because of patients overload, doctor is unable to spend quality time with every patient. This approach may help the healthcare administrators to overcome the constraints of time and resources. Thus, internet can help to meet demands of providing complex information to public at large in simple language. This empowers the patient to exercise a particular treatment choice. For instance, if a doctor wants to tell a patient about some exercises, he can provide him with details of reputed internet resources. From there he can learn to do them in a correct way. This may also save him from injuries. This will help in saving the doctor's time. Often, it is seen that many patients forget the exercises taught to them on returning back to their homes. Thus they may end up doing wrong exercises. The patient can do exercise correctly while watching a video.

Thus, the patients coming to a doctor will be already primed in basic knowledge about the disease and its treatment regimes, including the exercises as per the need. He can thus offer refinement in the technique and manner of exercises, as done by the patients before him.

This area has tremendous potential for further trials and refinements. A study has shown that patients often report the OPDs to be usually overcrowded and that if they go there well prepared, they could discuss with doctor in a better way about their treatment in whatever limited time they get to spend with the doctor. Information technology has a potential to produce educated patients as well as and informed doctors. Internet can be effectively used by the doctors for getting educated about recent advances in therapeutics. These days it will prove very useful since most doctors do not have time to keep pace with ever-expanding frontiers of medical knowledge. Modern technology thus focuses on physician motivation also. Information technology has not only created informed patients but also the 'informed doctors.' Now with a single click, physicians can access any amount of latest medical information. Through electronic health records (EHRs) and communication tools doctors can access patients' record anywhere, anytime. Moreover, IT use can help in customizing the patient services. Access to latest healthcare knowledge will help the physicians in improving the efficiency and quality of services they provide. However, all said and done, technology cannot be a substitute for face-to-face interaction.²¹ Yet, it can enhance the quality of doctor–patient relationship.

Information technology can provide more flexibility and power to doctors. For instance, telemedicine enables them to access patients' records as per their convenience and permits them to practice telemedicine. It also facilitates their mastery over the art and science of medicine. Through EHRs, physicians can easily interact with other medical experts.²²

Moreover, informed doctor can make his patients health literate by providing them information therapy. Since medical information turnover is so fast due to rapid advances in science, doctors may also often feel inadequately equipped to 'know all'. A time has come now that doctors will include in their prescription for medicine, advice for patients to also consult relevant website/literature. He can provide patients with a list of websites that are peer reviewed and have evidence-based health information.²³

ONLINE MEDICAL INFORMATION—IMPLICATIONS ON DOCTOR–PATIENT RELATIONSHIP

It needs to be kept in mind, however, that the quality of the available information on the internet, information overload, complicated jargon, biased sources and conflicting recommendations are the reasons that still limit the benefits of its usage. Much of the internet-based information may be unreliable. It may be based on feedbacks given by patients themselves. Powerful search engines can only work on the search items typed. These cannot discern between authentic or spurious information. Sometimes, the information is presented in a promotional advertisement. Much time is wasted on sifting through these. Moreover, sometimes the search poses more questions than it answers.

Moreover, online medical information may also provide a false sense of security when patients feel that they have learnt enough through internet. Sometimes they may not even seek opinion of a doctor and may indulge in wrong self-medication themselves. This is particularly dangerous in countries like India where over-the-counter medicines are freely available. Patients who come to the physician after searching internet may often criticise doctors when they find them 'ill informed'. They are more likely to have an unrewarding OPD encounter.

It is highly true that technology has drastically impacted on the ways people live. But at the same time, it is also widening the gap between poor and rich people. For instance, only the rich and educated class can avail the benefits associated with the internet. Underprivileged sections of society with poor resources may not be able to avail the advantages of IT. Poor people will continue to be guided by advertisement about quacks on wall hoardings near bus stand/railway station. However, positive aspects of technology, if used properly, could improve the poor people's quality of life. Like for instance, in our country, mobile phone penetration has made tremendous inroads even in remote areas. Mobile phone tariffs in India are among the lowest in the world. Since poor also have wide access to these, from a mere communication device, the mobile phones can be converted to an instrument of empowerment. They can be used to enhance the outreach of healthcare even at inaccessible locations. In this context, health ministry has also Mother and Child Tracking System (MCTS) in 2010 to facilitate maternal and child health (MCH) care delivery.²⁴

Through this system the government has also started use of mobile phones for disseminating health education messages to masses. Health workers are also being contacted on mobiles to transmit instructions. This strategy is aimed at enhancing the status of MCH care at periphery.

A striking example of the effective usage of this technology has been seen in Karnataka, where a health worker used the camera facility of mobile phone to capture the clinical condition of patient to contact an apex eye hospital to get relevant advice. As a result, child is now able to see, who, otherwise would have gone blind.²⁴ So, this way, the technology can be used to reduce the health gap created due to difference in literacy levels of the Indian population. In this 'technological age', physicians and patients have so many resources, which they both can utilise to improve their quality of life, relationship and possibly the health outcomes. If doctors use IT in their medical practice, the doctor–patient dynamics can be converted into a fruitful alliance. Hence, research and development in this field is required so that the physicians could be provided with access to wide variety of inexpensive, easy-to-use tools so that they can easily and effectively use these resources in improving their health knowledge as well as of their patients.

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Planning and Designing Hospitals

Section III

SECTION OUTLINE

- Chapter 6** Building a Teaching Hospital
- Chapter 7** Challenges in Setting Up a Tertiary-care Hospital—AIIMS, Bhubaneswar Experience
- Chapter 8** Hospital Administration—A Contemporary Overview
- Chapter 9** Role of Planning and Designing in Hospital Management
- Chapter 10** Creating Specialist Manpower for Hospital Administration in India
- Chapter 11** Designing Disabled-friendly Hospitals—Need of the Hour
- Chapter 12** Energy Conservation—A New Facet in Hospital Administration



6

Building a Teaching Hospital

Dr BNS Walia

“Careful planning of projects, lobbying of support for these and their dogged pursuit is essential for success.”

—BNS Walia

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- get an idea about the process involved in the inception of a teaching hospital.
- describe the ideal location for construction of a tertiary-care hospital.
- enlist the various steps in recruitment and training of hospital staff.
- mention the important points to remember while construction of the institute.
- describe the budgeting of funds allotted to a teaching hospital.
- learn how to maintain discipline within a medical institute functioning at tertiary level.
- cite the methods by which administrative set-up of a hospital can be strengthened.
- elaborate the role of the CEO in setting up of a teaching hospital.

INTRODUCTION

Every institution can be compared to a child. It must be wanted, planned, delivered and nurtured for its proper growth. Its early years are like the toddler years of childhood, when the foundations are laid of its character, work culture, growth and future role in society.

The birth of a new institution must start with a plan. The plan must be comprehensive enough to accommodate all the needs of the present times and must have enough flexibility to include the expected requirements that may arise in the next 25 years. In essence, therefore, the plan must have a short-term objective and a long-term vision. Total land mass for the institution should provide enough space for future expansion; it is bound to be required for new departments, new laboratories, and office accommodation for additional administrative and faculty staff.

The exact size, functions, administrative structure, budget, etc. must be given due thought, right at the beginning. One must think big, as a stunted plan ultimately leads to sacrifice of several essential facilities, and, consequently, to sacrifice of important objectives. One must realise that if the plan is accepted budget to implement is bound to follow. Supplementary budgets can always be asked for, to meet the

requirements of escalating prices or for inclusion of some important services that have been left out in the initial plan.¹

LOCATION

As far as possible, the institution should be located near a city, with large population at a place that is easily accessible to a large majority of patients, who will come from far and wide. In an attempt to improve care in rural areas, large institutions are sometimes located far from urban conglomerations. Medical needs of small populations can be easily met by small polyclinics with a few beds attached to them. Location of large institutions at a distance from a well-developed city puts a great strain not only on accessibility to patients, but also on the supply line of hospital and facilities of shopping and schooling of children of employees. Ideally, large institutions with 500 beds or more should be located on the outskirts of a large town.

The land area earmarked must have a ‘site plan’, where different services and facilities shall ultimately be located. Thus, space for faculty housing, nursing and resident hostels, laundry, animal house, workshops and public utilities like banks, shopping centre, post office, security services, and engineering services should be allocated right at the onset.

Adequate space must be left vacant close to the clinical services for future expansion of wards and other diagnostic services.

The size of the institution shall be determined by several factors like the demography of the area to be served and the number of services to be provided. These, in turn, shall determine what departments to have and how many beds to be provided to each speciality/superspeciality. In general, one must take care to see that trauma care, emergency services and facilities for isolation of infected patients are adequate. A good number of operation theaters and labour rooms must be provided; otherwise, surgeons' time cannot be optimally utilised, while patients wait for days or weeks. Provision must be made for a faculty guest house, shopping centre, and a community centre for staff and an inn for patients' attendants.

A large area of space must be reserved for research laboratories for all basic departments and sophisticated instrument centre, which must form an important facility in every medical college.

RECRUITMENT AND TRAINING OF STAFF

Although most of the medical staff at the junior level and paramedical staff has to be recruited when the construction of building is complete, persons who are going to head different departments should be identified and, if possible, sent for training to some advanced centres in India or abroad; as ultimately, it is the men who make the institution and not its walls. A building is only a shell without a soul, if the leadership of different heads of departments is not of the highest calibre.

Every care should be taken to recruit faculty of the right calibre. Vested interests must be ruthlessly ignored. Any assistant professor recruited today may occupy the post of Director of the institute just two decades later. Besides, good academic record and confidential information should be obtained by telephone, regarding 'emotional quotient' of the applicants, from institutions where the applicant has trained or worked earlier. Care should be taken that selection committee for faculty posts comprises only of academics. This would reduce chances of political nominees to be selected.

It is best to train staff as a team. For example, the intensivist and the sister-in-charge of intensive care unit should be sent for training—at the same time and to the same institution. This would ensure a harmony of thought and clinical understanding of situations. Both of them should be expected to train the residents and nurses working under them on return to the institution so that good clinical services can be made available.

Any team is as weak as its weakest link. In our country, it is often said that though the doctors are of international standard, the nursing and technical teams often leave something to be desired. This situation can be only remedied if a

job description is available for every post that is created. The recruited person is not only informed about his duties, but is also trained and supervised to carry out those duties by his seniors, during the induction period of a few weeks.

In order to develop an aptitude of clinical research, all departments must have their own research laboratories. Faculty member must be provided enough free time to work in such laboratories. The number of hours for clinical work and research work need to be earmarked for this purpose. Secondly, faculty member should be encouraged to focus on a few subjects and try to master all aspects of their subjects of study.

Case Study 1: Role of skill laboratory in honing skills of clinician

The author of the article visited skill laboratory of a nursing institution in Holland where he witnessed an instructor demonstrating students how to administer an intravenous injection on a mannequin. A student was then told to administer intravenous injection in the same mannequin while the instructor watched on and scored the procedure on predetermined steps by a checklist. The procedure was asked to be repeated till the student obtained a desired level of competency. Only after passing this test in skill laboratory, the students were permitted to administer intravenous injections to patients. Similar exercises were conducted for cardiopulmonary resuscitation and many other surgical procedures. In some institutions, the author had witnessed that the students of Masters of Surgery had to perform surgery on organs of animals obtained from slaughter house, before undertaking the same operation on patients. The concept of honing skills in skill laboratories should be introduced in every medical institution.

CONSTRUCTING AND EQUIPPING AN INSTITUTION

Architectural plans must be made in consultation with departmental heads, as they know best what they need for their speciality. After the tenders have been allotted following proper procedures, the progress of construction of buildings as well as for purchase of equipment must be monitored at regular intervals. The quality of construction must be frequently monitored by designated people, who can be held responsible for any lapses. If a third party with a good reputation is engaged for this purpose, the contractors are not likely to cheat as much as they would otherwise do. A punitive clause must be built into the tender so that contractor does not cause undue delays in the project, which ultimately leads to cost overruns.

It is best, if chief executive officer (CEO) of the institution has total autonomy for the expenditure of the budget. Of course, committees can be formed to sanction and monitor the expenses. Besides internal audit, external audit must also be built into the system. A visit to some of the recently constructed similar institutions can be very useful. Discussions with users of such institutions should be held regarding adequacy of accommodation and location of different services so that defects observed may be avoided.

It is often forgotten that a hospital needs residential accommodation for its doctors, nurses, technicians and residents, nearby, so that their services may be available promptly for an emergency. The construction of these facilities must be started along with the construction of the hospital building so that these are ready for occupancy when hospital starts working. Considering the high rentals in all important towns these days, it would become impossible to recruit faculty and nurses unless accommodation is provided. In recent years, the enhancement of training seats by 25% for residents and nurses belonging to 'other backward classes', without providing for residential accommodation for them, has caused considerable difficulties. It is important to bear in mind that adequate and appropriate infrastructure with respect to accommodation, laboratory and technical facilities are provided and are in working condition before the first patient is admitted or the first student is registered. Reputation of institutions takes years to build; but an indifferent start because of lack of essential facilities is liable to lead to a poor first impression and causes disappointment.

Case Study 2: Design of hospital

During trainings and workshops across the world, the author visited several children hospitals and made a note of architectural designs, so as to make delivery of services more convenient and easily accessible to patients. In University Children's Hospital, Bern, Switzerland, he observed that clinical and research areas were located in separate wings of hospital, however, well-connected through corridors and bridges. Thus a faculty member can spend his research time uninterrupted by patients or administrative staff. A similar principle was adopted in planning the advance paediatrics centre of a hospital in North India. He later applied similar concept when he was associated in designing the All India Institute of Medical Sciences (AIIMS), Rishikesh, Uttarakhand, India. Care was taken to keep certain areas in proximity to each other, such as emergency complex with other wards, location of cardiac ICU between ward and cardiac laboratory, etc. Adequate bed space was provided for isolation of infectious patients in view of high prevalence of infectious diseases in India. He emphasised on functionality of the hospital over physical appeal.

BUDGET

While planning the budget for the institution, a liberal view should be taken. Besides the money required for the construction of buildings and provision of essential equipment, it must provide a decent salary structure for all the categories of staff. Keeping in view the fact that corporate hospitals are paying much larger salaries, unless a decent remuneration is paid to the institute staff, there will be a continuous flux of staff from the institute to the poachers from corporate hospitals.

The plan budget should be used in such a way that 30–40% of sanctioned amount is spent on well-considered priorities and the remaining amount on needs of different departments. Priority should be given to services that serve many departments like radiology, pathology and biochemistry, and such departments and facilities that add prestige to the institutes like magnetic resonance imaging (MRI), computed tomography (CT) scan, etc. Equipments like auto-analysers and cell counters for haematology would help to provide quick service with few staff members. A part of the budget must be earmarked to sponsor faculty for advanced training in India or abroad. Budget specifically sanctioned for a particular department, must not be directed to another department unless the former is unable to utilise its grant; otherwise, it leads to avoidable resentment.

DISCIPLINE

The CEO must see to it that a good working environment is created and foundations of a desirable work culture are built in. Shirkers and indifferent workers must be taken care of under the existing rules. The Indian service rules have enough bite to keep workers on the straight path. The fault lies mainly with their nonimplementation. Though the CEO should be available to listen to the employees' grievances and satisfy their reasonable demands, the employees must know that they have been hired to work in a dedicated manner. If they neglect their duty, censure punishment must follow. At no time should employees' union be allowed to hijack the institution. Enforcement of such discipline is essential from day one; otherwise, the unions will rule the roost to the detriment of the services and efficient functioning of the institution.

STRENGTHENING ADMINISTRATIVE INFRASTRUCTURE

Most of the departmental heads are just specialist in their subject, often new to administrative procedures. It is helpful if they are exposed to man and material management. This is bound to improve efficient functioning of the institution. It is also desirable to send the most senior, three or four, members of the faculty for training to the administrative staff college of India. In due course of time, it is they who are expected to occupy the positions of Dean, Sub-Dean and

Director, and, thus, contribute to administer the institution. Every attempt at politicising issues by local politicians should be thwarted. Any institution that becomes hunting ground for politicians is ultimately ruined. In order to be able to do this, the CEO should refrain from asking any favours from politicians for him; otherwise, they are likely to ask for their pound of flesh, which may turn out to be damaging to the institution. This does not mean that the CEO should not discuss/lobby for the requirement of the institution with politicians who are part of the governing council of the institution.

ROLE OF CEO

The CEO must regard his position as a public trust, which has been handed over to him for a finite time. The position occupied should not germinate arrogance; and he must realize his responsibilities of taking care of the employees and creating and maintaining standards of service. The CEO

must, at all times, work in a transparent and fair fashion within the established rules and always in public interest. With such conduct alone, the foundations of an institute of excellence can be laid. Persons at the helm of affairs have the important responsibility of creating an environment that is stress free and open to debate and discussion. The CEO must, personally, set an example of rectitude and dedication and become the role model for others to follow. It is important that a work culture of care, honesty and harmony is created right at the beginning of a new institution. These constitute the real foundations of an institute of excellence. It has been truly stated that unless the first layer of bricks is carefully laid in correct alignment, the whole edifice cannot be expected to rise without bends and bumps.

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Acknowledgement

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Challenges in Setting Up a Tertiary-care Hospital: AIIMS, Bhubaneswar Experience

7

Prof Vikas Bhatia, Dr Sujit Kumar Tripathy and Prof Ashok Kumar Mahapatra

“Rome was not built in a day.”

—A French Proverb

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- get an overview about establishment of a tertiary healthcare hospital.
- conceptualise the challenges faced in building a tertiary healthcare hospital.

INTRODUCTION

The health system of India has improved spectacularly in last few years. The infant mortality rate (IMR) has fallen drastically and life expectancy has doubled compared to the year 1947. Despite these health status improvements, are we comparable to world standards? Malnutrition, maternal mortality rate and IMR are still high compared to many other developed and developing countries. Compared to world's average, the health expenditure, physician density and hospital bed density of India is very low. There are only 0.9 beds/1000 population compared to world's average of 3.96 beds/1000 population, and physician density is 0.599/1000 population compared to the world's average of 1.4/1000 population. Thus, India faces huge need gap in terms of availability of healthcare facilities. In India, one million people die every year due to lack of adequate healthcare facility. Unfortunately, the healthcare accessible to the people is only at basic level and there is no access to specialist care. Almost 700 million people are lacking specialist care facilities in India. Surprisingly, 80% of specialists are working exclusively in urban areas.¹

Inequalities of Healthcare

In India, only 22% of the healthcare expenditures are from public fund. Of remaining 78% of expenditure, most are paid by the individuals. The share by the richest 20% of the population in total public sector funding is 31% which is almost three times the share by the poorest 20% of the population. This indicates that there is a gross

inequality in healthcare provision between urban and rural sectors and, also, between rich and poor group population. The difference in healthcare service and its quality between different groups of population is getting more noticeable with the introduction of private sector into the Indian healthcare industry. As the Indian government has allowed participation of private health sectors in Indian healthcare industry, there is an enormous improvement in infrastructure and quality of care. The Indian healthcare industry is growing at a rapid pace. Current annual growth rate is around 13% and there is high demand of quality healthcare by the middle class families. It is expected that the annual growth rate will increase further because of expansion of private hospitals and increased public spending on health. Other than this, there is growing aging population, growing urbanisation and there is higher awareness among people. Also, more skilled professionals are available and facilities of telemedicine, bank funding, health insurance and low cost treatment are available to most of the individuals. Because of availability of low cost quality healthcare facilities, Health tourism is increasing and it is now one of the major reasons for the growth of healthcare industry.¹ With the huge demand of quality healthcare, is it possible to deliver the service through our current three-tier public health system?

Need of a Change in Healthcare Service

The report by a working group on tertiary-care centre for 12th year plan (2012–2017) clearly mentioned that the

primary and secondary healthcare system in India is not up to the mark and it is also difficult to upgrade or modify these centres in the near future. Although, the private or corporate sectors are planning or in fact have come up with hospitals in most metros and towns, the affordability to this tertiary service by the middle- and poor-class people is a big concern.¹ For example, hip replacement surgeries, which may cost 2 lakhs in a corporate set-up can be easily performed in half of its cost in public sector. Similarly, essential services such as angioplasty or bypass surgeries in a corporate set-up may cost double or even triple the amount needed in a government set-up. Because of financial problem and also to get best service, people are increasingly being dependent on apex public healthcare centres that provide tertiary-level care. All India Institute of Medical Sciences (AIIMS), New Delhi; Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh; Sanjay Gandhi Postgraduate Institute (SGPI), Lucknow and few other institutes are already known for their quality care, and these institutes have proven themselves as 'centre of excellence'. However, with the increasing demands of tertiary-level quality care, these institutes are getting overburdened, and doctors are not getting enough time to spend in research, teaching and learning new technology. Again, poor people coming from far distance are waiting for the services of these centres for years. It seems, if the current public health system is not changed, a day will come when the quality of healthcare will be only in the hands of rich and affordable people. The current scenario demands few modifications in the existing public healthcare services that should ensure three 'Es—Expand—Equity—Excellence'.

EXPANSION OF TERTIARY HEALTHCARE

Access to adequate healthcare would need expansion of tertiary-care facilities. Along with the primary care, secondary care and referral services, tertiary health centres provide specialty and superspecialty services. Thus, the tertiary hospital institutes should have advanced facilities, including laboratory and image services provided by a group of skilled personnel.¹⁻³ However, the tertiary care should be equitably distributed to different segments of population. These new hospitals will have to address imbalances at three levels—regional, specialties and ratio of medical doctors to nurses and other healthcare professionals. The working group proposing for tertiary healthcare system for next 5-year plan (2012–2017) had unanimous opinion about the systematic expansion of the hospitals whose contours must be based on infusing quality in the future medical education and care.¹ Effective healthcare delivery would depend largely on the nature of education, training and appropriate orientation of all categories of medical and paramedical staffs. Therefore, it is equally urgent to assess appropriate manpower mix in terms of the required numbers and assigned functions of human resources (HR) for health in tertiary healthcare.

Government of India launched Pradhan Mantri Swasthya Suraksha Yojana in March 2006. The primary objective of this project was to correct the imbalances of affordable and reliable tertiary healthcare among Indians of different socio-economic status, religions and regions. The project also aimed at providing quality medical education in the under-served regions of the country. In view of that, six new AIIMS-like institutions (ALIs) were proposed in under-served and un-served regions of India.¹ Establishment of these ALIs is a big task that needs huge budget and a well-planned strategy. The executive committee may have to face many challenges in establishing these healthcare setups.

STRATEGIES FOR ESTABLISHMENT OF A HEALTHCARE AT TERTIARY LEVEL

Establishment of a tertiary healthcare setup needs a huge budget and a rigorous planning. A coordinated activity of the following sectors is essential to have a smooth and balanced function of the system.

- Architectural planning and building construction
- Manpower
- Finance
- Healthcare equipment and furniture

Phases of Hospital Construction

Setting up the hospital, recruitment of manpower, and procurement of equipment and other allied materials can be executed in different phases. At the first phase, building constructions of the hospital, medical college and residential complex should be completed. In second phase, medical, paramedical and other healthcare assistant staff should be recruited. In third phase, procurement of medical equipment, beds and furniture may be executed. Every effort should be made to achieve the best quality in a minimal budget. Loss or inadequate financial support at any stage may be a major obstacle in further progress.

Land Acquisition

Identifying the land is a major issue; but it is largely the responsibility of the state and central government in public healthcare setup. Many factors need to be analysed before land acquisition, such as cost, closeness to an urban area, vertical (height rise) and prospects of future expansion. The land area should be at one place and enough free space should be available for need of future expansion. Developing additional department or specialty hospital at a distance may incur many difficulties. To establish a medical and surgical setup at a distance from the hospital needs extra money and manpower. It may need additional library, residential complexes and supportive services such as kitchen, store room, sports complex, etc.^{2,3} A frequent movement of doctors and paramedical staff to this centre may create many

problems like late and inadequate service and compromise in teaching activity. Thus, it is very essential to develop the hospital in a large area of land with provision of future expansion. It is essential to select the 'leader' or 'director of the healthcare system' at the stage of land acquisition to monitor and guide the hospital construction process.

Architectural Planning and Building Construction

Architect engineers should prepare a design that should consider the need of the region and goals of the institute, and study the excellent facilities available in different tertiary hospitals of the country. For example, an architect engineer planning to propose a design for a paediatric set-up may study the architectural design of Advanced Pediatric Centre, Postgraduate Institute of Medical Education and Research, Chandigarh. Similarly, ophthalmic setup of Dr Rajendra Prasad Centre, AIIMS, New Delhi may provide a good idea in building an eye hospital. Picking an architect for a hospital construction is like making a selection at an ice cream shop—there are vast arrays of options and choosing only one flavour (or architect) that suits your taste is pretty darn hard. The architect engineer and his executive committee must work out on the design concepts, the desired efficiencies and the hospital requirements. The architectural planning is not only the first need of a healthcare system but is also the most essential part.²⁻⁴ The plan should focus on arrangement of spaces satisfying certain functional needs identified by the users and so designed that it can be expanded in future depending on demand. All major hospital facilities should be located on the ground floor. The building should be constructed in such a way that it can provide service to all major specialties including OPDs, wards, ortho, neuro and cardiac surgery, rehabilitation centre, dentistry, ENT, ophthalmology, neurology, cardiology and other superspecialties besides support facilities, e.g. laundry, kitchen, hospital pharmacy, cafeteria, record room, solid and liquid waste management, administrations, store, sports complex, etc. An imaginative grouping of the spaces taking into considerations of location, material, manpower and above all cost and construction time is a desirable objective. The disease prevalence of the society and referral services must be considered for allocation of bed strength, in particular, in medical or surgical field.^{2,3} Now, there is an epidemic of noncommunicable diseases in our society. Diabetes mellitus, hypertension, cardiovascular disease, stroke, psychiatric illnesses and arthritis problems are on rise. Besides that road traffic accidents are also increasing. Thus, the need of these services will be increased; accordingly, more beds should be allocated to these disciplines. Separate outpatient and inpatient buildings with easy connectivity are of paramount importance. Trauma and emergency building should have a connection to the inpatient building. Medical college and residential complex can be established inside the premises of the hospital, but at a distance. Once building construction is completed, water,

electricity and sewer system should be developed; but planning for that must be completed in advance.

Manpower

Recruitment of manpower should be started once hospital building construction starts. Proper selection of faculty, paramedical staff and nursing staff is crucial, as the success of the hospital mainly relies on the staff. Mix of experienced and fresh talents can be a recipe for success along with a will for succeeding for self and hospital that every consultant must emulate. The consultant's first and foremost behaviour towards his patients in terms of patiently listening to the patient, educating him about his disease, and the approximate time of care along with proper medication prescribed and explained to patient will make a difference in patient's outcome of treatment and choice of hospital. Thus, a consultant's behaviour and attitude towards the patient, apart from his clinical knowledge, has a lot to do with success for any hospital he is affiliated to. In private sectors, consultants as well have to participate for all efforts hospital makes to promote them. Most consultants attached to corporate hospital setups feel that their job is to see patients; marketing or marketing activity planning is not their area or is left solely to the marketing teams. Thus, through hospital management business aspiration targets should be made clear to consultants with respect to new patients expected every day, so that they start thinking in that direction and support initiatives to develop the business.²⁻⁴ Technical and nontechnical staff (paramedical staff, security staff, IT professionals, etc.) at all levels again can be a breed of experienced and freshers. Skilled jobs should be filled with right matching profiles and compromise should not be made on such fronts. Then hospital must have an endeavour to see that whichever areas they are operating recruited manpower is familiar with rules and regulations. Constant training, supervision and on-job mentoring is required. Hospitals should mandatorily have a training manager to ensure that the technical and nontechnical trainings are constantly done including soft skills; as this is a service industry, the best of treatment given to patients from entry in hospital to exit will make his experience worthwhile to come back again for his healthcare needs. Timely appraisal and rewarding the performers will be a motivation once a year. Instead, best performers in the month certified by their HOD should be rewarded or acknowledged in front of all so that others to feel the need for the same. Timely promotions and increments should be based on merits as performance targeted and met.^{2,3} Inefficient staff once proved over a time should not be tolerated, as it will impact hospital success.

Procurement of Healthcare Equipment and Furniture

The tenders for procurement of healthcare equipment and furniture should be called for, once the hospital construction

process is nearing to its end and manpower has been recruited. Cost, quality, durability, demand and recent advances must be considered while procuring the instruments and equipment. The suggestions of concerned specialists must be respected. Quantity of the materials may be decided based on inpatient bed strength, number of operation theatre, ICU beds, and trauma and emergency beds.

Marketing and Publicity of the Hospital

All new hospitals should aggressively promote their available facilities for initial few years, before they get established. In private sectors, marketing will always remain important; as competition is brewing up with time, hospital, even old in system, have started realizing this fact. Big corporate hospitals need to choose people very selectively, largely from pharma domain; and already experienced healthcare professionals will make a difference. It is also needed to train marketing team on various aspects of hospital in term of infrastructure, consultants and services offered. The marketing team should be always clear on competitive edge hospital has and competitive advantage, if any, in industry; a detail competitive intelligence data should be either available or worked out. This aspect, along with constant training, will give confidence for marketing to make in roads and see success fast. Branding a part of marketing again has to have clear insight from self-experience and management direction in aspects of hospital that need to be focused with time. Complete branding calendar with branding budgets has to be worked strategically and ensured with 360° approach and see the perspective that 'knowledge is information rightfully given to the customers internal and external at right time'. The hospital has to target patient referrals through doctors, corporates, direct-to-customer activities, international patients, staff referrals, government subsidy schemes, health/privilege membership card schemes, insurance/TPA tie-ups.^{2,3} The teams have to be selected on the basis of target patient referrals and are trained accordingly. In private sectors, it is essential to set the marketing objectives for a year and evaluated at intervals to access the effectiveness. However, in public sectors, government should focus on constant improvement of healthcare facilities and the skills of medical professionals working there.

CHALLENGES IN BUILDING THE HOSPITAL

Although building a new hospital is rewarding, there may be many challenges that may appear at any phase of the hospital construction process.

Construction Defect

The defects or deficiencies in the building's structure, function and operations are commonly labelled as construction defect. It may be either a patent defect or a latent defect.

Patent defects are recognized during hospital inspection construction or defect liability period (DLP). But latent defects are recognized over a period of time when hospital construction is complete, the DLP is over and building is completely occupied. Both patent and latent defects are serious issues because repair of these defects need another planning, manpower and a huge expenditure. Most of the defects are because of weaknesses in project implementation process. Poor specification of the materials, workmanship and supervision are the common defect noted. Poor building design may cause patent or latent defects. A well planned design by a designer is essential. The most important point is that the project planning, implementation and evaluation should be conducted taking the client's requirement into account and it should be transmitted to all the team members.^{5,6}

Financial Barriers

Every hospital management team must overcome this barrier before it moves forward with its own construction project. There may be multiple of reasons for financial problem such as insufficient funds for financing of healthcare, inefficient collection of contributions, gradual introduction of numerous new health technologies and equipment without prior analyses of their clinical and financial impacts, nonrational network of health institutions, inefficient organisation and provision of healthcare.²⁻⁴ Financial problem is the major obstacle in hospital construction and can be easily overcome with a proper planning.

Human Resources

The apex team and executive team should remain constant till hospital construction phase is over. Any loss of member significantly affects the work progress. Similarly, there should not be manpower deficit involved in hospital construction. Otherwise, the project may be delayed, which may incur extra financial burden. If there is a delay in hospital construction process, the service of the consultants and paramedical staffs also get delayed. There is a high possibility that the consultants who have joined earlier may lose interest and may resign from the hospital, if the hospital construction gets delayed. However, this period of the consultants may be effectively used in some other suitable ways, like planning and execution of statutory services, preparing treatment protocol of the individual discipline, getting involved in research, writing scientific articles, books, improving surgical and technical skills by attending workshops, training programme. It is difficult to select well-motivated and skilled medical and paramedical persons who are indeed interested in teaching, research and patient care. But this is an essential part and should not be compromised upon.

OVERCOMING THE BARRIERS IN A LOGICAL WAY

Executive and Review Committees

Building new hospitals are big projects and expensive ventures. Executive and review committee must be established before starting the hospital, which will work till the work being completed. For example, the pattern of governance and management of ALIs was approved by the Union Cabinet in August 2010. As per the decision of the Union Cabinet, the ALIs will be registered under a society and these societies will be functional till the ALIs are brought under Act of Parliament. Recently, a high-powered committee has reviewed the Governance and HR practices of AIIMS and this committee has reported that the existing ALIs also need similar review for better functioning.¹

Project Evaluation and Review Technique

The hospital building project should be monitored by project evaluation and review technique (PERT) charting and necessary steps to overcome the obstacle should be taken at right moments. PERT charting involves evaluation of the project in three phases and ten steps.

Phase I: Project Formulation

- Step 1: Project decomposition
- Step 2: Specification of the precedence relationship
- Step 3: Estimation of activity duration
- Step 4: Construction of project network

Phase II: Planning and Scheduling

- Step 5: Computation of each activity's earliest start time and earliest finish time
- Step 6: Computation of each activity's latest start time and earliest finish time
- Step 7: Computation of each activity's total slack and critical path
- Step 8: Scheduling activities

Phase III: Monitoring and Replanning

- Step 9: Monitoring the activities
- Step 10: Replanning of the remaining portion of the project

All phases of the hospital construction must be divided into several small projects governed by a team. The project progression and review will continue in the sequence of PERT chart. Along with a central governing and executive committee, the hospital resource management need to be strengthened for proper implementation of the project. Unlike other streams, medical profession demands higher commitment, dedication, knowledge, skill and expertise. To attract competent and skilled health professionals, the HR system need to plan and design better policies. The implementation of different small projects and recommendations in healthcare delivery should be evaluated by experts from

post-graduate institutes, IITs and IIMs. Every effort should be made for knowledge and skill improvement of medical staff and professionals. Providing facilities of tele-networking, training, conferences, workshops and CME are some of the examples of faculty development programme. A faculty development unit (FDU) should be constructed for promoting and implementing different faculty development programs in the institute/hospital. Ministry of health and family welfare should work in collaboration with the ministry of Defence, Railway and Labour (Employee's State Insurance) for development of hospitals under their cater. These hospitals can be transferred to a tertiary care centre and can also be upgraded to medical colleges.¹

Overcoming Financial Constraints

Financial problem can largely be avoided with the following measures.²⁻⁴

- *Accessing affordable capital:* Before starting the project of a new hospital, executives must know the capital and financing options that are available to them.
- *Selecting an approach and facility design that optimises costs:* Hospitals have to weigh the overall design of the building against the outlined budget. The financial crisis can be easily overcome by limiting the increase in healthcare costs, promoting quality and efficiency of service provision, and utilising resources in a more efficient and rational way.
- *Forecasting future needs.*
- *Engaging and gaining support* from medical staff, civic leaders and the public early on, who can help out in solving the financial crisis in an effective way.

Public-Private Partnership (PPP)

Public-private partnership (PPP) is a new model to improve and reform the health conditions of people. It works on three principles. First, equality among the partners in the project; second, mutual commitment among partners for common agreed objectives and third, there should be mutual benefits of the partners. PPP can be used for better healthcare delivery, operation and management. It enables better utilisation of resources so that the healthcare service can be equitable, affordable and of high quality to all individuals. With the help of PPP, new technology can also be introduced into the healthcare system in a cost-effective manner. Taking all the advantages of PPP into consideration, it seems PPP can assure a high quality healthcare delivery to the people. However, to execute PPP in an effective way in healthcare sector, government should take few aggressive initial steps. Government need to develop competencies, infrastructure and a proper environment before implementation of the PPP in the 12th five-year plan. To set the standard, initial bottom-up approach of costing should be undertaken. Once a standard of healthcare is achieved, top-down monitoring can be

done using relative value units, hospital stay, bed occupancy, etc. to allocate total costs for a healthcare system to individual services. Smooth payment system, placement of appropriate and adequate human resources and good communication system are essential for developing positive behaviour among actors of PPP. The project should be evaluated properly by the expert institutes such as Indian Institute of Management (IIM). With the involvement of PPP, Information and Communication Technology (ICT) can be effectively utilized in different areas of healthcare such as education, research, referral and data management. It seems PPP is the best way by which the Government can improve the healthcare system in the country.¹

Tertiary healthcare needs a sound policy and dedicated experienced executive team for setup. Project planning must be methodical and should be executed with the existing financial and human resources. It is necessary to further monitor, review and set new and more demanding goals, taking into account the newly emerging needs of the population. It is also necessary to constantly accelerate the process of quality improvement, rationalisation, optimisation, resource management, transparency of funding and functional interface between public and private healthcare for the sake of a better-functioning quality healthcare system and financial sustainability of healthcare. The main goal of healthcare policy is preservation and improvement of population health, along with sustainability of healthcare system. Development is needed by means of a constant process of problem identification and analysis of causes,

setting priorities and timelines for relevant activities, and evaluation for the sake of redefining the goals.

Building a tertiary care hospital of national importance is a not an easy task. It needs proper planning, execution and huge resources. The challenges that we have faced in building AIIMS, Bhubaneswar are worth sharing as it will be helpful for the administrators, architects and medical professionals for planning such hospitals.

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Hospital Administration: A Contemporary Overview

8

Mr Vijay Chandan

“A hospital bed is a parked taxi with the meter running.”

—Groucho Marx

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- give a contemporary perspective to the practitioners.
- provide a preliminary material on concepts, amongst others on action research, tools of operation research for evolving a new thinking in the field of hospital administration.

INTRODUCTION

Hospital administration as a subject of study has increasingly attracted the attention of the medical fraternity, administrators and planners. Traditionally, healthcare institutions were established by the initiative of the state or charitable organisations and at a decentralised level around community dwellings by individuals. In the present times, the notion of a hospital as a social institution providing healthcare services has undergone a change in terms of scale and design. Exponential increase in population and spread of literacy has resulted into increased awareness in the patients about health issues. The location and access to the service providers has resulted into large number of patients seeking the services. While the number of patients have grown in geometrical progression yet the healthcare institutions and their capacity to provide services has merely expanded in arithmetical progression. Resultantly, there is a huge gap that must be addressed.

Given the present load, the public healthcare institutions are inadequate in terms of their numbers and capacity to deliver the services. A number of private or corporate health service institutions have come up with state of art facilities, yet they do not serve to fill the huge deficit as they are being operated with profit maximisation objective. High cost of providing service acts as a barrier to the number of service seekers in such institutions despite the fact that their service inbuilt capacity is high and commensurate to the number of patients who can afford to avail services at higher costs. To

the contrary, public healthcare institutions that are meant to serve the society are conveniently located and render the services at a very low cost. Resultantly, huge numbers of patients rush to these hospitals thereby placing the incremental load on already strained capacity. Though these health institutions have adequate infrastructure, but given the high number of patients, the existing capacity appears to be inadequate to meet the challenge. The scenario is no different in other community and charitable hospitals, which anyway have a limited capacity and resources. In this backdrop the urgent interventions are warranted, which could be done by way of strengthening the existing infrastructure, revisiting the aspects related to organisation of activities related to delivery of services, redefining the job content of the actors and bringing about the structural changes. In the changed context, the very idea of the organisational change seeks to bring about organisational improvement. A planned change is likely to be more effective to meet the challenges. If viewed from the organisational perspective, the increase in specialisation and growth of subspecialties is the cause of fragmentation; therefore the functional specialisation must give way to interfunctional integration so as to create and maintain organic harmony. For incremental increase in the complexity of the medical care and the acceptance of the hospital as a service, the supportive services must be realigned to supplement the core medical and nursing care. Amongst others, the interventions in support services like registration, patient facilities and conveniences in service areas, transport,

maintenance, linen and laundry, nutrition, housekeeping, medical record technology, medical laboratory technology, hospital accounting and physiotherapy are required to be made. The modern hospitals have to perform more complex functions by way of employing highly skilled manpower for ultimate deliverance. The organisation of the activities and functions has become complex and their operations more costly. Ecosystem interactions and interplay have affected the organisations, which, in turn, have led to new challenges. This makes a perfect premise for need of systematic study in the domain of hospital administration. A noticeable trend of organisations and social institutions attempting to change from the hierarchical organisation to the functional model, it is in this backdrop that there exists the premise and a rationale that the organisational aspects of the medical services delivery need a new way of thinking.

STUDY OF STRUCTURE AND SYSTEM

Hospital administration entails different sets of challenges depending upon its structure and objectives. Speciality hospitals, nursing homes or corporate hospitals differ in their objectives, design and delivery. Another dimension is that hospital services are different than any other service organisations in terms of its design and delivery. The service delivery is a net result of collaborative and corroborative efforts of highly skilled human resources at each stage of the process of delivery. A few healthcare institutions in India classified in terms of their objective are illustrated below:

- *AIIMS, New Delhi and PGI, Chandigarh*: Medical Education and Research Institutions serving as public healthcare Institutions at tertiary level controlled by the government.
- *Tata Memorial Hospital*: A specialist cancer treatment and research centre, closely associated with the Advanced Centre for Treatment, Research and Education in Cancer (ACTREC), created as a research and charitable institution.
- *Christian Missionary Hospital*: Charitable societies and trusts providing multispecialty healthcare services funded on grants and institutional receipts.
- *Apollo hospitals*: The hospitals on this model spread across the country, with state of the art facilities serving as institutions on self-sustaining profit enterprise model.
- *Fortis, Max and Wockhardt hospitals*: Super speciality hospitals functioning as a corporate enterprise.
- *Nursing homes*: Holy Family New Delhi (category), enterprise offering specialist services in selected areas run on revenue generation model.
- *Private specialist/general practitioners*: Operating as an individual enterprise.

The challenges of the hospital administrator depend upon the category of the hospital and the model upon which it has been created. The inflow of patients, the services areas, the quality and cost largely depends on the model and the

objectives. Broadly, hospital administration as a field of study sets out to achieve the institutional effectiveness. The quality is required in each process of delivery and not merely in medical intervention. The aspects related to quality are so important that the processes and mechanism have to be redesigned considering the ultimate outcomes. The healthcare delivery, unlike other services rendered by service organisations, is unique as it deals with human life with no place for postproduction control. Quality control in the delivery of medical services therefore has to be all-pervasive and at each stage of the process of delivery. Human resource management and human resource development (HRD) function therefore are very critical to the hospital administration, as dealing with highly skilled manpower is in itself a challenging task. Besides, traditional functions of the manager or administrator-like planning, organising, directing, communicating, coordinating and reporting in a crisis situation the system always falls back on human resource manager. Crisis and conflict management therefore is an important and integral aspect of hospital administration and therefore orientation in the human aspect of the organisation is very critical to the challenge.

Conventional Approach

The healthcare services represent the combination of physical facilities, use of advanced technologies, and coordinated effort of highly skilled and specialised human resources. Traditionally, the health service institutions were organised on the basis of functional specialisation and the management of the entire effort was managed by medical/paramedical specialists as per their standard operating procedures. The principal source of hospital finance had been government or social and charitable contributions. Advent of medical technology has expanded the capacity of services; its access and a spectrum of institutions have come into existence. The structural organisation of services, as it exists today, has subsumed the distinction between inpatient and outpatient services. The trend is exhibited by emergence of specialty/multispecialty hospitals serving amongst others in specific areas of healthcare to serve cardiac patients or orthopaedic, nephrology patients, etc. The management of delivery is becoming far more complex and the conventional style of management by the consultants, specialists, etc. may not be appropriate for the optimum results. Given the load and the quantum of effort, the task can only be managed by experts trained in the field of hospital administration.

Contemporary Approach to Hospital Administration

The traditional models of healthcare institutions were designed to match the community needs, which over the period of time have outlived the purpose in view of the changes in the ecosystem. With the advancement of

technology and its impact on all social institutions, there is a noticeable change in the level of expectations and aspirations of the people. It is in this changed context that the existing model of each healthcare system deserves to be reexamined. With the changed aspirations of the clients, the model of institution has to be designed with the needed structural changes. This entails redesigning the system and structure to match the aspirations and to reorient the design and delivery of medical services in the everchanging context. To bring about the structural changes, the felt constraints are of structural aspect of the service area in which changes cannot be affected smoothly in a given time frame and involve huge financial implications. The way forward is the re-engineering of the medical service delivery, altering the mechanism, process, design and delivery commensurate to the expectations and aspirations. The entire process of change comprises of delivery and evolving collective visions for desired future outcomes. The keen practitioner of hospital administration must design the areas of enquiry and intervention, and discover the best ways of problem solving. Evaluation of alternative designs and the short listing of appropriate design for adoption are the key areas that need to be firmed up by use of analytical tools, understanding of total system and the roadmap as to how the systemic and reinforcing intervention is to be made on continuous basis.

Contingency Theory

Contingency approach deals with intervening as and when the problem arises. It postulates that while making a decision, a comprehensive view of all aspects of the current situation must be taken and the aspects that are critical to the situation must be identified for appropriate action. Rate at which emerging and unforeseen problems arise in the process of healthcare delivery is very high. Increasingly the hospital administrators and managers are adopting the situational style of leadership for solving the emerging problems, as the degree of complexity of each problem varies and the intervention has to be commensurate to the problem at hand. In hospital administration, since the outcomes are a result of corroborative efforts of many skilled personnel, a more participative and facilitative leadership style is probably best suited.

Systems Theory

Systems theory deals with study of parts or subsystems and has been an important tool in the hands of management scientists in understanding the organisations. A system is a collection of parts that are integrated or unified to accomplish an overall goal and objective. An intervention in one part of the system brings about some changes in the nature of the system. A system can be studied in terms of inputs, its processes, outputs and outcomes. Systems provides for a mechanism of information sharing and feedback to others.

Hospitals are open systems and interact with environment and therefore the system approach is an important conceptual tool for understanding the hospital as an organisation and its dynamics. The resources of the organisation, i.e. raw materials, finance, technologies and human resources are the inputs that undergo through a process of planning, organising, motivating and controlling, and are so deployed to meet the organisation's objectives, i.e. products or health-care services. The information amongst others from human resources carrying out the processes, the patients using the services, ecosystem, society, regulatory bodies and the government influences the effort and impacts the system, subsystems and the departments in the organisation. The system theory has recently been in focus, and its interpretation and application has brought about a significant change (or paradigm shift) in the way the studies of the management approaches of the organisations should be carried. The premise of system approach is important as it is a huge corroborative effort of highly skilled human resources leading to the ultimate delivery.

Another reason in support of the systems approach is that it enables the interventionists to look at the organisation from a broader perspective. Systems approach has brought a new perspective to interpret the patterns and events at the workplace. The study of system involves examination of the various parts of the organisation, interrelations of the parts and the coordination of administration with its programs. The system thinking is all about seeing the aspects of the subsystem, and realigning and coordinating for bringing organisational efficiency.

DEVELOPING THE NEW IDEAS AND PERSPECTIVE

The major task of hospital administration comprises of evolving the improvement strategies based upon the gained insights from the dynamics and the practice at work place. In order to bring about change, the change has to be planned, continuous and across the system. Given the complexity of the hospital as an organisation, the planned change must focus on the structure, mechanisms, processes and culture of the organisation. Organisation development as a field of study in management deals with the shared vision of the structure, mechanisms, processes, individuals, teams and developing insight by taking a holistic view and intervening to bring about a planned change. Important techniques employed by the managers that are relevant to the administration of hospital shall be briefly discussed for the purposes of building the perspective.

Action Research

The action research model in the context of hospital administration gives a basic understanding of the work place, its operation and how to affect intervention to bring about the change and yet enable the interventionist to gain further

insight and knowledge while doing so. The interventions are planned and they seek to improve the system and its processes including the social processes and ensures congruency of structure, processes and actors. The hospital administrator can act as a consultant or a facilitator, participating collaboratively, while bringing the objectivity and expertise in the intervention. A hospital administrator in action research works with the leader and the group to diagnose the strength and weaknesses to develop his action plan so as to suggest processes and procedures for addressing the problem, and to bring about the incremental change. Briefly the stages postulated by Kurt Lewin are:

- Force field analysis and equilibrium of current situation.
- Unfreezing.
- Changing through cognitive restructuring and develop new ways of looking at the problems and equilibrium.
- Refreezing and integrating new point of views.

The practitioners develop the need of change, diagnose, develop alternatives goals and options, transform intentions into actual change, stabilise and generalise the change. The action research and organisation development (OD) interventions are data-based approach to problem solving by way of using the method of scientific inquiry. The process involves following steps:

Diagnosis phase and identification of problem

- Data collection, study of system and processes and culture.
- Study of subsystems processes.
- Methods deployed are mainly observations, third party observations, survey, questionnaire, survey of panels, examination of policies, records, rules, regulations, interviews, etc. Regular meetings are held at various levels and the focus group gives important information.
- The action research generates valuable data, facilitates informed choice, and enables fixing of problems, realignments and evolution of new vision.

Conceptual aspects of problem analysis

- Analyse the current performance against expected level.
- Determine the extent of deviations from performance standards.
- Precise description of the identified problem.
- Identification of cause of the problems during analysis.
- Determination of the most likely cause that exactly explains all the facts. Group process approach is useful for hospital administrators for the programme development. Reference groups must be associated at the various stages of the programme development as under:
 - *Exploratory phase:* First-line staff users, in-problem exploration.
 - *Knowledge exploration:* External resource persons, in-house specialists.

- Priority development, adaptation key administrators and resource controllers.
- Building proposal involves organisational staff.
- Evaluation of design and final approval.

Data collection for analysis

Identification of problem and its analysis requires data. While secondary data is available, yet it is the primary data that supplies the critical inputs for the problem at hand. The primary data needs to be collected. Brief overview of concept and methodology is as under:

- Statistical method.
- Action research statistical method.

Survey design needs a carefully planned and systematic method of study. Reliability of result depends upon the method applied. Scientific method comprises of systematic observations, classification, analysis and interpretation of data. It carries certain amount of formality, verifiability and general validity. The survey work comprised of four major components: data collection, tabulation of data, analysis and interpretation. Two methods are employed in the survey:

- Census.
- Sampling
 - Method of selecting sample units: Nonprobability or probability.
 - Random sampling, purposive sampling, stratified sampling, quota sampling, multistage sampling or convenience sampling.

HUMAN ENGINEERING IN HOSPITAL ADMINISTRATION

In the context of hospital administration, the delivery of service is the result of corroborative effort of many skilled personnel. It is, therefore, imperative that there should be a study related to people at work, method, equipment and machinery used, layout and design, hours of work and environment to assist the interventionists in man machine environment system. The aforesaid has special relevance as the human resources, machinery and equipment has to be located so as to facilitate access and to ensure minimum movement and effort of medical interventionists and technicians. The effort to eliminate inefficient motion, revisit, layout and to facilitate the service delivery. It also must take into account that adequacy of safety measures, removal of the duplication effort, and to create ambience and general condition for a good working environment. Most critical aspect in the interventions is the human resources, job design, job content and job assignment, which must be revisited.

Work Design and Job Analysis

The process involves the analysis, measurement, control, and design and redesign of different jobs. The effort is made

to undertake each job specification, the study of system of work and the determination of the manpower required for its performance—both in quantitative and qualitative terms. It also entails study of the nature and characteristics of the people who are to be assigned the jobs, the skill, knowledge, ability and attitude required for successful performance. The study provides a very good exposition to hospital administrator to study the processes, procedures, mechanisms to undertake the job redesigning and determine the standards of each job to promote the effectiveness (Flowchart 8.1).

Work Study

As a preliminary step, a hospital administrator needs to undertake work study to develop insight into how the work is organised and performed so as to determine as to whether the available resources are being deployed efficiently. A critical evaluation of operating procedures, mechanisms and time taken for performance needs quantification—the aim of the study being the determination of equipment and manpower required to accomplish the jobs in a given time frame. Work study comprises of selecting, recording, process charts, flow diagrams, time and motion studies. Critical information is collected as to:

- *Purpose:* What is done?
- *Person:* Who does it?
- *Place:* Where it is done?
- *Method:* How it is done?
- *Sequence:* When is it done?

After a critical examination, best options are recorded and the most practical, feasible, safe, effective and economical option is developed, adopted and installed.

Application of Models of Operation Research

Application of scientific techniques and tools for study and solving the problems related to operation of the system alone can provide inputs for optimum solution. An exposition in the techniques of operation research provides important and

significant tools for analysis and decision that are based upon conceptual frameworks or scientific models utilising mathematical tools to express the variables. Some of the tools that can help the task of hospital administration are listed as under:¹

- Network analysis: PERT–CPM.
- Assignment and transportation models.
- Queuing and wait line theory.
- Linear programming and simplex model.

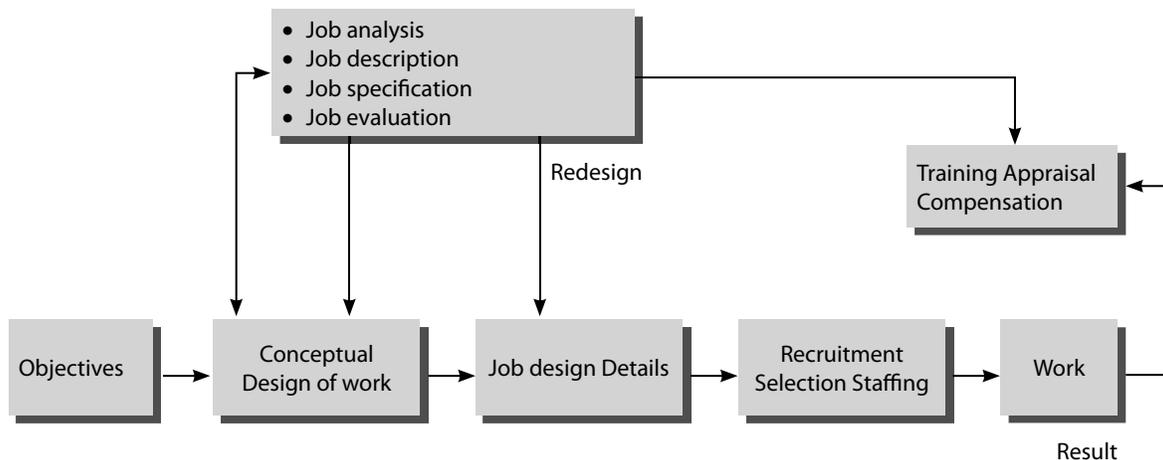
ORGANISATIONAL DEVELOPMENT AND CHANGE MANAGEMENT^{2,3}

Preliminary phase comprises of studying the state of the system for its strengths and weakness. Techniques of strategic management have influenced the management thought; and these techniques are employed to determine the state of the system and are relevant to hospital administration. Hospital as an organisation has to change fast to cope and evolve new ways of thinking. This is the precise premise and area of intervention in hospital administration.

Two techniques generally employed are:

- SWOT analysis (strengths, weaknesses, opportunities and Threats).
- ETOP analysis (Environmental Threat and Opportunity Profile).

Strengths create competencies and core competencies. Core competencies are strategic in nature. Weaknesses reveal the area of intervention and carve out the domain to the hospital administrator for precise area of intervention. Hospitals are organisations that are alive and continuously interact with environment and social systems. In ETOP analysis, environmental threats and opportunities are also identified. Amongst others, environment comprises of the legal and regulator framework-like statutes and laws related to healthcare, quality and deficiency of service thereof, norms and ethics, and sociopolitical system affecting the



Flowchart 8.1 Human resource recruitment and selection framework.

functioning. SWOT and ETOP analysis enables the hospital administrator to evolve an action plan:

- To take corrective measures in problem areas.
- To maintain strengths.
- To seize opportunities.
- To undertake fact finding about the results of actions.
- To redefine problem area.

Generation of valid information about the status quo enables him to plan intervention in the organisational processes, decision-making processes, communication patterns, relationship of the actors and groups, existence of conflicts, etc. These interventions transform the hospital administrator from the role of problem solver to the role of stage manager. Organisation development interventions have a dual aspect related to his actions and learning during the process of action. He has to be continuously motivating the change, developing support for the change, managing the transition and sustain the effort to bring about a meaningful transformation.

Project Evaluation and Review to Technique (PERT) and Critical Path Method (CPM)⁴

In network analysis the project activities are subdivided in small activities that can be analysed. PERT and CPM are the techniques used in project management for planning, scheduling and executing project in a defined time frame. Some of the terms and concepts are as under:

Event: An event represents the instant of time at which an activity of project is started or finished and is represented by a node (Figure 8.1).

Activity: A distinct operation or work that has to be performed represented by arrow.

Predecessor: It is the activity that must be accomplished prior to the start of another activity.

Successor activity: It is the activity that cannot be started until one or more activities are completed.

Concurrent activity: These are the activities that can be accomplished simultaneously.

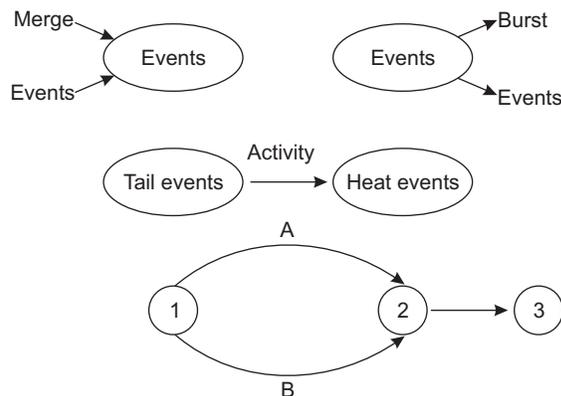


Figure 8.1 Representation of node event and activity.

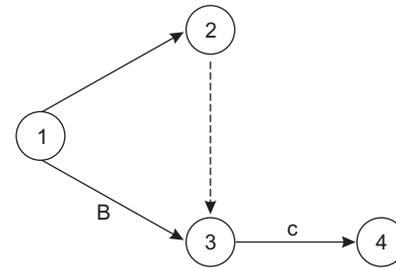


Figure 8.2 Dummy activity.

Dummy activity: The activity requiring no resource or time is called dummy activity.

Logic dummy: A dummy activity is used to preserve the essential logic of network (Figure 8.2).

Table 8.1 and Figure 8.3 present the sequence of activities and events.

Notation concept: $X < Y$ means that activity X must finish before Y can be taken up.

A hospital activity or a procedure has following constraints:

$B < E, FC < G, LE, G < HL, H < IL < MH, M < NH < JI, J < PP < Q$ (Figure 8.4).

Activities or steps of any procedure or task can be conceptualised on the basis of working insight in terms of notations as above. Network diagram can be drawn and at each step resources including human/skilled manpower required to accomplish can be assigned. Along the path, time taken for each activity can be optimally assigned and minimum time and resources required for accomplishing the task can be worked out precisely. Any slacks can be consciously removed. Task can also be organised in such a way that the activities performed simultaneously to obtain the best outcomes. In hospital administration PERT and CPM can be an important tool to gain insight and realign or correct processes for optimum results.

Table 8.1 Sequence of activities and events

Activity	Immediate predecessors
A	-
B	-
C	A
D	C, D
E	C, D
F	E
G	E
H	F

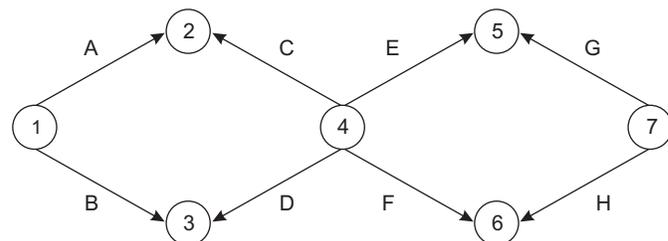


Figure 8.3 The sequence of activities and events.

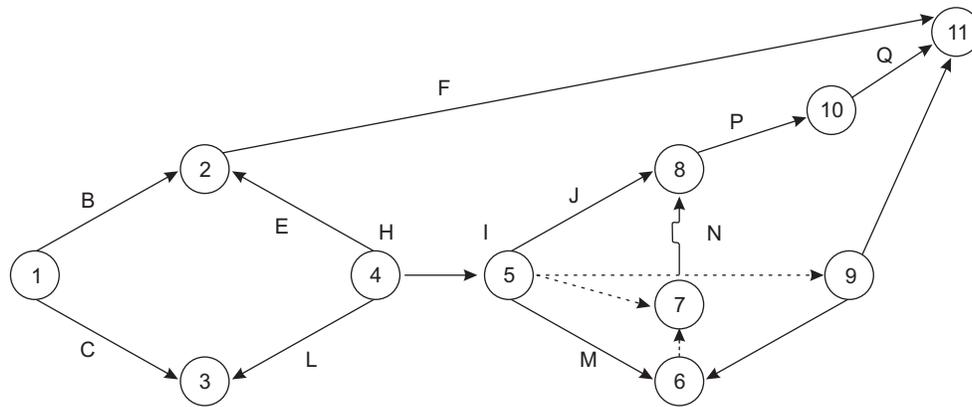
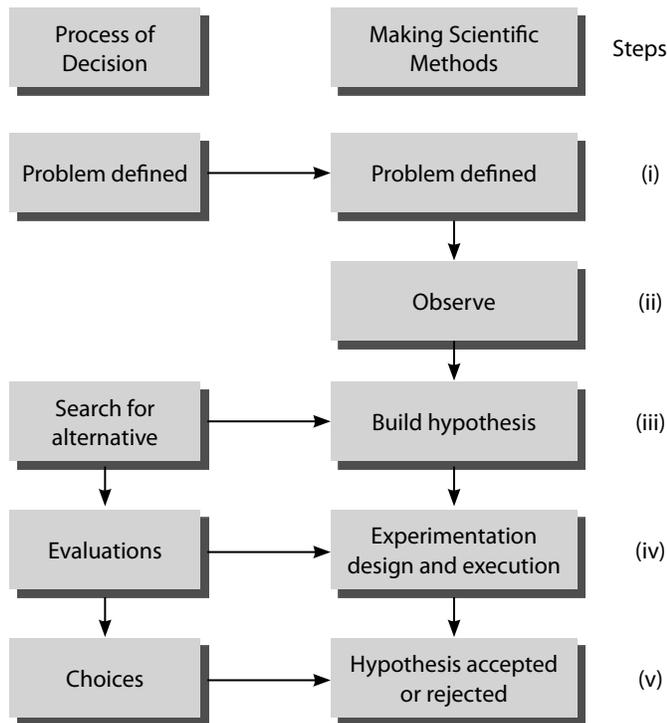


Figure 8.4 Network analysis.

Decision Making

The process of decision making is illustrated in Flowchart 8.2.



Flowchart 8.2 The process of decision making.

Queuing theory

A group of items (patients) waiting to receive service is a typical situation in hospitals. Queues are formed when inflow is greater than the rate at which service can be rendered. If there is no wait line, the system could be idle. Traffic intensity or utilisation rate is the rate at which service facility is used:

$$\text{Utilisation rate } (p) = \text{Mean arrival rate} / \text{mean service rate}$$

The waiting lines develop because the service to the seekers may not be rendered immediately as the patient reaches the service facility. Thus, lack of adequate service facility

would cause waiting lines of customers to be formed. The only way that the service demands can be met with ease is to increase the service capacity (and raising the efficiency of the existing capacity, if possible) to a higher level. The capacity might be built to such high level as can always meet the peak demand with no queues. But adding to the capacity may be a costly affair and uneconomic. Beyond a stage, it shall remain idle to varying degrees when there are no or few arrivals. A hospital administrator has to decide the appropriate level of service, which is neither too low nor too high. Inefficient or poor service would cause excessive waiting, which has a cost in terms of customer frustration, loss of goodwill in the long run, direct cost of idle employees (where, e.g. the employees have to wait near the store to obtain the supplies of material, parts or tools needed for their work), or loss associated with poor employee morale resulting from being idle. On the other hand, too high a service level would result in very high setup cost and idle time for the service station(s). Thus, the goal of queuing modelling is the achievement of an economic balance between the cost of providing service and the cost associated with the wait required for that service. Some of the queuing examples are provided in Table 8.2.

Table 8.2 Queuing examples

Situation	Arrival	Service facility
Arrival of patient	Patients	Registration counters
Flow of automobile	Patients and attendants	Parking
Registration and fee counters	Patients and attendants	Registration/cash receipt
Outpatient department	Patients and attendants	Waiting hall
First-line doctor consultation	Patients and attendants	OPD chamber
Medical labs: Biochemistry/microbiology	Patients and attendants	Laboratories: pathology/radio-diagnosis, etc.
Emergency/trauma unit	Patients and attendants	Service area of emergency

General structure of queuing system

The general structure of a queuing system is depicted in Figure 8.5.

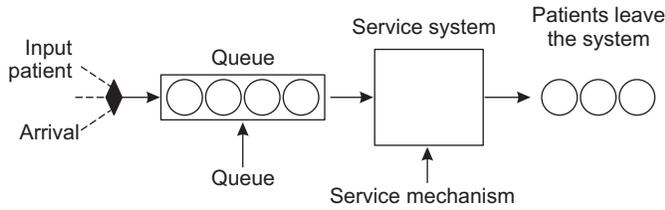


Figure 8.5 OPD system.

• Queuing system

The elements of a system are:

- **Arrival process:** The arrivals from the input population may be classified on different basis as follows:
 - According to source: The source of patients for a queuing system can be infinite or finite. The number of people arriving in public healthcare hospital is generally very large, say infinite. On the other hand, there are many situations in multispecialty corporate hospitals where we may not consider the population to be infinite—it is finite.
 - According to number: The arrival for service may be individual or in groups.
 - According to time: Patients may arrive in the system at known (regular or otherwise) times, or they might arrive in a random way. The queuing models wherein arrival times are known with certainty are categorised as deterministic models. On the other hand, a substantial majority of the queuing models are based on the premise that arrive in the system stochastically, at random points in time, as in the case of emergency/trauma unit.

With random arrivals, the number of patients reaching the system per unit time might be described by a probability distribution. The frequently employed assumption, which adequately supports many real world situations, is that the arrivals are Poisson distribution.

- **Service system:** There are two aspects of service system.
 - (i) Structure of the service system and (ii) the speed of service.
 - Structure of the service system (Figure 8.5):
 - A single-service facility: A library counter is an example of this. It involves a single-service facility (Figure 8.6).

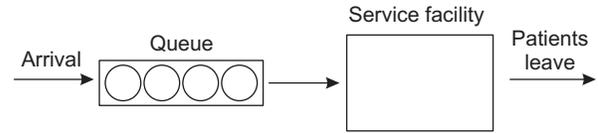


Figure 8.6 Single server, single queue model.

- Multiple parallel facilities with single queue: That is, there is more than one server. The term parallel implies that each server provides the same type of facility. Booking at a service station that has several mechanics, each handling one vehicle, illustrates this type of model. It is shown in Figure 8.7.

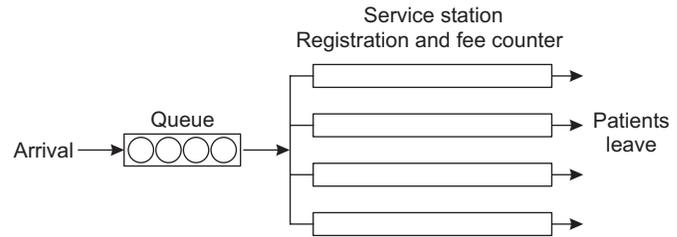


Figure 8.7 Multiple parallel servers, single queue model.

- Multiple parallel facilities with multiple queue: Each of the servers has a different queue. Different cash counters where the patients can register or make payments is an example of this type of model. Figure 8.8 below portrays such a model.

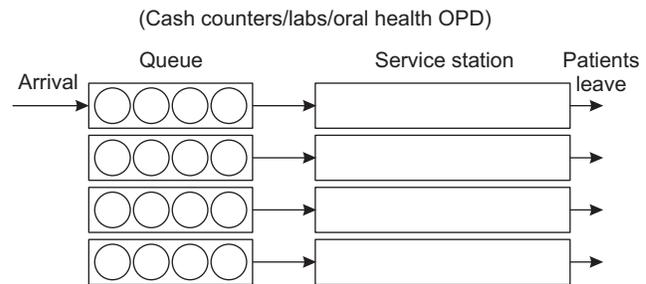


Figure 8.8 Multiple parallel servers, multiple queue model.

- Service facilities in a series: In this, a patient enters the first station and gets a portion of service; and then moves on to the next station, gets some service; and then again moves on to the next station and so on; and finally leaves the system. Figure 8.9 shows such a situation.

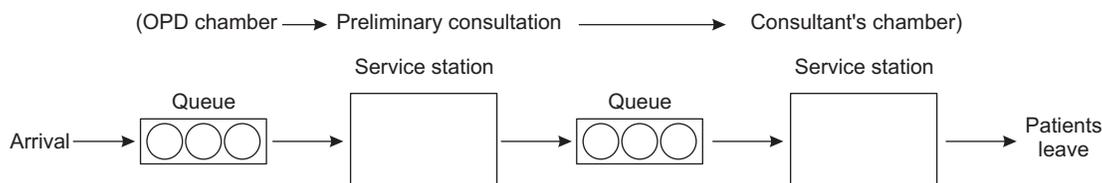


Figure 8.9 Multiple servers in series.

- **Speed of service:** In a queuing system, the speed with which service is provided is expressed as service rate or as service time. The service rate is the number of customers serviced during a particular time period. It indicates the amount of time needed to service a customer. Service rates and times are reciprocals of each other and either of them is sufficient to indicate the capacity of the facility. Thus, if a cashier can attend, on an average 10 customers in an hour, the service rate would be expressed as 10 customers/hour and service time would be equal to 6 min/customer. Generally, however, we consider the service time only.

Operating characteristics of queuing system

An analysis of a given queuing system involves a study of its different operating characteristics. This is done using queuing models. Some of the more commonly considered characteristics are discussed below:

- **Queue length:** The average number of customers in the queue waiting to get service.
- **System length:** The average number of patients in the system, those waiting to be and those being serviced.
- **Waiting time in the queue:** The average time that a patient has to wait in the queue to get service.
- **Total time in the system:** The average time that a patient spends in the system, from entry in the queue to completion of service. Large values indicate the need to make adjustment in the capacity.
- **Server idle time:** The relative frequency with which the service system is idle. Idle time is directly related to cost. However, reducing idle time may have adverse effects on the other characteristics mentioned above.

An exposition to the concepts, tools and techniques of operation research equip the hospital administrator with analytical skills in planning of the activities, job content, time frame required to accomplish, gain knowledge about capacity of the system and its optimum utilisation. These techniques are useful in determining the capacity, especially, and its optimum utilisation in emergency unit, trauma unit, operation theatres, diagnostic labs, OPDs and nearly in every aspect of hospital administration.

OUTSOURCING OF SERVICES

Outsourcing of services has been an emerging area wherein apart from outsourcing a number of activities and jobs formerly held by the regular employees to the service provider also brings the operational efficiency at much lesser costs, thereby enabling the organisation to pay focused attention on the key areas. The complexity of tasks in the hospital administration is such that the administrators have to continuously involve in 'pulse taking'. Given the complex problems at hand and the required timely interventions,

some of the functions that do not fall in the core competencies must be identified to be assigned to service providers. Housekeeping, sanitation, catering and security are a few such areas that could be identified to be assigned.

Organisations—both in the government and corporate sector in their quest for achieving operational efficiency in the changing context—are now increasingly placing reliance on the decisions based on strategic thinking. The competition for resources, especially financials being the compelling reason for restructuring, readjustments, realignment, redefining, correcting the human and social processes, and rightsizing the organisation. Rightsizing is being done horizontally as well as vertically to reduce the levels, which entail redefining the tasks and functions in terms of their strategic importance to the organisation. Outsourcing is the delegation of tasks or jobs from internal to an external entity involving elimination of employees and assigning the tasks to the service providers. It is in a way out-tasking, transferring a part of management functions and control to the service provider while the organisation concentrates on key areas of its operations. This has helped the organisations to focus on strategic areas of core competencies and a distinct competitive advantage for achieving overall operational efficiency. Development of a model and devising performance parameters is the key task for hospital administrator.

Outsourcing of hospital services is expected to conform to the norms requiring inputs, thereby ensuring quality standards with cost effectiveness. There are service providers available who not only offer the basic services but are also offering hybrid services to match the specific requirements. This brings about the needed expertise in the field that has been incidental and hitherto taxing the administrators of the institute. Increasingly the line of demarcation between public and private activities is getting less distinct due to liberalisation, privatisation and deregulation of the government functions. With globalisation, most organisations are turning to either out-tasking or outsourcing or even offshoring. This enables the practitioners of hospital administration to focus and optimally utilise the time in a specifically planned intervention.

The object of the contents of this reading has been to give a contemporary perspective to the practitioners and to provide a preliminary material on tools of OR, the management perspective in a highly complex and specialised area of work that shall enable them to evolve their perspective, enabling them to build upon and evolve new ideas and interventions so as to generate new thinking in hospital administration.

The contents provide a preliminary material on changing contexts and challenges. Use of knowledge base, organisation development exercises, quantitative techniques in developing new perspectives to serve as a premise for evolving new ideas and interventions.

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Role of Planning and Designing in Hospital Management

9

Dr S Satpathy and Dr Anki RJ Reddy

“Let our advance worrying become advance thinking and planning.”

—Winston Churchill

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- get an overview about planning and designing a hospital.
- ingrain general principles of hospital designing along with some planning and designing issues.
- learn best practices in hospital architecture.

INTRODUCTION

Hospitals are probably one of the most complex types of building known to mankind. This, in part, is attributable to increasing complexity of medical sciences, development of newer technology at a rapid pace, increased levels of expectations of the patients and demands of healthcare providers. Needless to say, amendments to the technological requirements including adherence to building codes also complicates the issue. Other factors include the socioeconomic capacity of the patients in the vicinity; other already existing healthcare facilities, the disease profile of that area, use of traditional architectural patterns, financial sponsors for the project, climatic zone of the concerned area and local/regional building bye-laws. In order to assimilate and coordinate all these myriad factors, it is imperative that the planning and designing of hospitals be carried out in a scientific, logical and holistic manner.

For the purpose of this chapter, it is clarified that there are certain basic assumptions with regard to the planning and designing. It is assumed that this is a ‘greenfield’ project for setting up a multispecialty general hospital with a definite catchment area. This chapter is not only intended to be a definitive comprehensive guide book, but also provides an overview of the entire process with some details on important facets. Readers are advised to consult other comprehensive textbooks for detailed planning and designing aspects of various services. Bibliography at the end of the chapter provides relevant details.

CONSTITUTION OF HOSPITAL PLANNING TEAM

Most authors believe that the first step is constituting a planning team with the following members: Hospital architect (with experience of earlier successful projects), hospital administrator (exclusively dedicated for this project), engineers (structural, electrical, heating, ventilation and air-conditioning (HVAC) systems at the least), financial experts, promoters/owners of the project, few key clinicians, health statistician/epidemiologist (if available), other consultants (project, fire safety, environmental), etc.

It may be kept in mind that the team may have to start with two to four members to start with and gradually expanded. As stated earlier, planning for hospitals is a highly specialised matter and ‘experience’ of each member of planning team will be crucial for the success of the project. A short induction programme for the envisaged project outlining the “goals” could go a long way in developing cohesiveness in the team.

Similarly, it is of vital interest to identify members of the planning team who will ultimately run the health facility, as this inculcates a sense of belongingness for the project. It is imperative that all the members of the planning team are able to devote adequate time for the project. Too often, it has been seen that absence of a dedicated planning team, or lack of ownership of hospital leads to inevitable project delays and cost overruns. In our hypothetical greenfield project, key functionaries like Head of Clinical Departments and Hospital Administrator should ideally be appointed full time. Other members can be on part-time/as per requirement basis.

STEPS IN THE PLANNING OF HOSPITAL

For the successful execution of any hospital project, it requires a lot of attention to detail and a logical sequence of activities. However, there seems to be lack of consensus on in the order in which a project is executed, with the public sector hospitals in India favouring the UK pattern, whereas most private sector hospitals go in for the US model.¹ The basic difference between both is the amount of 'micro-level planning and detailing' at the planning stage, with the U.S. model applying liberal doses of microplanning at the very beginning. Their model combines 'strategic facility planning' with 'programmatic space planning' in which exact square footage for very closed/open room or space, departmental internal circulation areas; floor-wise horizontal circulation space, building-wise vertical circulation space, and common service areas are computed in detail. Finally, after obtaining detailed inputs from users, the final space programme, design brief and initial construction budget are finalised. This entire exercise may see 10–15 revisions, several rounds of discussions with all those concerned, and may take up to 10–12 months.

On the other hand, the UK model which is generally followed for projects in the public sector in India [e.g. 6 AIIMS-like institutions, expansion of medical colleges under Pradhan Mantri Swasthya Suraksha Yojana (PMSSY), etc.] is given below.²

Needs Assessment

Although most textbooks on hospital planning and designing state that this is the first step and should be carried out diligently, there is a wide chasm between theory and practice. Invariably, in our country, most decisions to have hospitals are political decisions with hardly any need assessment. The logic generally given is that because of inadequacy of public sector healthcare organisations, the occupancy levels in any new hospital will be high. Hence, in practice, a 'need assessment' is cooked up after the decisions has been taken to establish the hospital.

Feasibility Report

After the decision has been taken to establish the hospital, a feasibility report is prepared either by the concerned organisation/ministry. This may be done by them or outsourced to another consultant/organisation who prepares the document in consultation with experts and users. It provides an overview of the health scenario at the national and regional level, alongwith vital statistics, morbidity profile of the area, need assessment, site and location of the project, level of hospital (secondary or tertiary), approximate costs, source of funding and a SWOT (strengths, weaknesses, opportunities and threats) analysis.

Architect's Brief

Some authors consider this as the second stage in planning for the hospital, when the planning team is joined by the architect, whose responsibility will be to prepare the general design of the hospital.³ Essentially, this is a written document which has the following parts: Introduction of the project including philosophy and site information in terms of landmarks, bearing, topography, weather conditions and connectivity with nearest city/town. It should also contain the functional contents of the various departments (number of OTs, ICUs), number of beds in each ward, major equipments, work and traffic flows; number of staff along with schedule of accommodation, phasing of project (if required) and financial aspects.

Request for Proposal (RFP)

This is an administrative document, which is required for providing relevant project information to the shortlisted project consultants, generally through expression of interest (EOI) mode. In addition to the architect's brief, it also contains the methodology and expected time frame for project completion, constraints and limitations, and the terms and conditions of the contract including scope of work and local regulations.

Appointment of Project Consultant

This can be done either on 'nomination basis' or through EOI mode followed by finalisation or by an open advertisement and competition. More often than not, the first method is used by Ministry of Health and Family Welfare, and central government PSU's like HSCC and HLL become the project consultants. Sometimes, the EOI mode is followed, and rarely, if ever, the open advertisement with competition method is used. Quite often, this process leads to discontentment with the client (user department) and because of poorly framed scope of work and contractual obligations which ultimately leads to delays and cost escalation, besides litigations.

Case Study 1: Improper planning during expansion of a functional cancer centre causes huge time and cost overrun

A functional 35-bedded, two-storied cancer centre in the public sector was due for expansion. The concerned sponsoring ministry in consultation with the cancer centre approved the expansion project in February 1993 at a total cost of 20 crores, with a project completion time of 43 months from date of approval of Expenditure Finance

Committee. Funds were to be provided from the National Cancer Control Programme during the VIIIth 5-year plan period.

The initial plan was to expand it to a seven-storeyed structure (basement + ground + 7 floors) with 150 beds, with paying wards, bone marrow transplant rooms, ICU, three operation theatres. Project consultancy work was awarded to M/s HSCC, a Central Government Public Sector Undertaking by the Ministry on nomination basis, and agreement signed by AIIMS and M/s HSCC. Its role was to inter alia identify the space/room requirements, calculate total area of constructions, plan for all relevant facilities, assign costs to each facility at the time of EFC.

After the expansion project was completed in March 2004, at a revised cost estimate of 98.41 crores, it was observed that the cost overrun was to the tune of 392% and time overrun was 209%. This project was taken up for in-depth analysis of causes of delay and cost escalation by Project Management Division of Ministry of Statistics and Programme Implementation, which submitted its report in July 2006.⁴

The report stated that the main causes of delay could be attributed to (i) delay in grant of approvals from statutory agencies, which required lot of coordination and regular follow-up, (ii) lack of proper planning at the initial stages during project conception by the project consultant M/s HSCC, by not including manifold services, electrical substation, fire escape ramp, underground water tank in the first EFC, (iii) not being able to foresee the actual requirement of hospital building, allied services like air conditioning, lifts, accounts, maintenance departments, etc., which increased ground coverage, (iv) detailed project report (DPR), submitted to EFC should have been more realistic, and vetted by Expert Committee of Specialised Professionals/Consultants.

- *Notice inviting tender (NIT)*: Based on the BOQ prepared by the project consultant in the detailed project report, the NIT is done. In India, there is a dearth of project consultants who also undertake actual construction activities, hence it becomes necessary to identify builders/contractors who can carry out this activity. Usually certain prequalification criteria like annual turnover, previous experience of constructing hospitals, etc. are kept to identify suitable agencies.
- *Award of work*: The construction of the hospital is awarded to the firm (builder/contractor) selected after evaluation of the techno-commercial bids. If the tendering process has been carried out by the project consultant (as a part of scope of work) then final decision is taken in a joint meeting with the client (user/owner of hospital). This is required as the builder will translate the buildings (plan) on paper to the actual hospital, which will be used for treating patients. If the tender has been called by the owner of the hospital,

even then a joint meeting is desirable for proper coordination. Sometimes, another 'entity' called project implementation consultant or project management consultant is also hired to keep track of the progress of work and also for coordinating with user department/owner. Even in defence establishments, a need has been felt to engage a full time Project Officer, especially for large hospital projects from start to finish.⁵

- *Construction of hospital and services building, equipment selection and procurement, and manpower recruitment*: Some authors describe this as the fourth and final stage of the planning of hospital. A lot of coordination is required between the various agencies, mainly builder/contractor, architect and the actual end users. If the project has been properly planned, there is less likelihood of any major amendments. Minor changes, based on local requirements of various departments can be accommodated at this stage. Periodic review of the construction process should be carried out to ensure that progress is on schedule. In the public sector (hospital) projects in India, the Ministry of Statistics and Programme Implementation has formulated guidelines for mandatory approval from competent authorities at several stages for proper monitoring. However, in quite a large number of such projects, the final building after construction does not match with the conceptualised hospital and the users have to compromise with the built structure. Typically this period of construction takes about 18–36 months depending upon the size of hospital, expertise of builder and the level of coordination with all concerned.

After about a year into the construction phase, the hospital planners should focus on the procurement of machinery and equipment and recruitment of remaining manpower. Both these activities are highly specialised activities which can be carried out by either the original hospital planning team (with the inclusion of concerned user departments) or can be outsourced to other agencies that specialise in purchase of such items. Whichever be the modality, a lot of coordination is required between all stakeholders in order to improve the final outcome. Almost simultaneously, the process for recruitment of the remaining manpower must be started. It is generally observed that there is significant difference between sectors (public and private) when it comes to recruitment. Whereas the job specification is quite well-defined in the public sector, the job description is either not available or unclear, resulting in a long gestation period for selection process. In the private sector it takes relatively less time, and hence can be started a little later.

- *Stage of commissioning*: This period refers to the last few months (2–3) before the hospital is opened for the patients. In the experience of the author, here also there is a sectoral difference with the private sector hospitals

usually preferring to go for a “soft launch” when the out-patient department (OPD) is started; and a formal launch/inauguration some months later when the in-patient department is operationalised. On the other hand, the public sector hospitals are generally “inaugurated” formally on some historical (auspicious) day like Republic Day, birth anniversary of national leaders, etc., when the new hospital is “dedicated” to the nation. Invariably, some amount of public relations activity is carried out prior to the launch, and this opportunity must also be utilized to give due credit to the hospital planning team and other members associated with the project.

- *Shake-down period:* Most authors agree that the first 6–9 months after the commissioning of the new hospital is very critical with regard to the acceptance by the local population. As with any other project, this period may witness minor operational/maintenance problems, as the users settle down to their operations. Legally, this period generally coincides with the defect liability period, within which the builder/contractor is responsible for rectifying any defect. Usually, after this period, the operations of the hospital become smooth and get seamlessly integrated for providing patient care.

Detailed Project Report (DPR)

This is the document which is prepared by the project consultant on the basis of the RFP document to which has been added inputs from the hospital architect, engineers specialising in civil, electrical and HVAC, specialist consultants, financial experts. It includes a brief background note on the project, constraints and limitations, financial (cash flow) statement, deployment of labour, detailed estimate of the entire project including bill of quantity (BOQ), the expected timeframe for execution of the project in the form of a PERT [programme (or project) evaluation and review technique] chart. The vital section of the DPR is the detailed architectural drawings, working drawings, structural drawings, plumbing and drainage drawings, fire detection and firefighting, HVAC, electrical and mechanical drawings, plan for manifold system, signages, waste management, bulk services and interior designing. On the financial front it provides information regarding running, maintenance and operational costs with detailed budgetary projections.

Some authors make specific mention of this stage as the Design Brief Stage wherein the hospital architect(s) translates the requirements of the users (from the architect’s brief) and gives it a proper shape. The amount of work carried out is considerable and it requires regular inputs from engineers. Similarly, the user departments (clinicians, nurses, etc.) also have to regularly meet the team of architects to clarify regarding the space required, machinery and equipments required, etc. The design passes through a series of steps, viz. preliminary drawings, with modifications sent

for approval of relevant authorities working drawings with BOQ DPR. Lack of proper coordination between team members and/or speeding up the process without taking due care can create ill-planned buildings, with cost and time over run.

GENERAL PRINCIPLES OF HOSPITAL PLANNING AND DESIGNING

For the benefit of readers, it would be worthwhile to first lay down the fundamental principles on which hospital planning and designing is based.

Design Must Follow the Function

Essentially this means that the design of the building(s) must be suited to the activities (functions) carried out in that building. There have been instances when buildings designed for certain support services, hostels, etc. have been converted into clinical areas/departments of hospitals, which cause problems in functioning. It has been observed in a number of secondary hospitals, wherein the emergency room or labour room has been ‘created’ out of corridors or waiting halls, which later develop problems when functional.

Devote Adequate Time for Planning

Go into all details without hurrying up the process. Many a times it is seen for quick results, there is a tendency to take short-cuts, which ultimately create more problems. Needless to say, both macro and microplanning are equally important in hospitals. It is important to remember that buildings planned and designed will certainly outlive, as they are much more permanent than people who work in them. Hence, it is better to go through a consultative process rather than rely on one or two departmental heads, who may not ultimately be able to use the building.

Hospital Planning Starts with the ‘Circulation Area’

Very aptly summed up by Emerson Goble who said ‘separate all departments, yet keep them together, separate types of traffic, yet save steps for everybody; that is all there is to hospital planning’. It is important to integrate various departments, keep traffic routes short and separate, but maintain privacy of patient-care activities. The ingenuity and skill of architect in handling circulation of the hospital will determine its efficiency.⁶ Broadly, the public and pedestrian traffic should be segregated from staff and service traffic.

Maintain Proper Balance Between Privacy of Patients and Attention of Nursing Staff

The nursing stations should be strategically located to be able to observe critical patients, exercise control over patient

corridors, and visitor's entry and exit. The concept of progressive patient care can be applied to design of wards, where most sick patients are nearer to the nursing station.

Separation of Dissimilar Activities/areas in any Department/building

This principle must be especially kept in mind when the issue is control of infection in critical areas of hospital, e.g. operation theatres (OTs), intensive care units (ICUs), high dependency units (HDUs), central sterile supply department (CSSD), etc. where clear demarcation of 'clean' and 'dirty' areas is sacrosanct. Similarly clean and dirty operations, noisy and quiet activities, and crowded and sparse areas should also be separated for ease of operations and efficiency of services.

ACCEPTED BEST PRACTICES IN HOSPITAL ARCHITECTURE

Most authors seem to agree on the following best practices:

Patient-focused Architecture

All activities in a hospital are because of patients, hence at the time of planning, it is imperative that patient's interest is kept in mind. Modern patients have become quality conscious and price sensitive, hence all the more is the felt need to make patients feel safe, secure and comfortable in the hospital. Proper maintenance of facilities adds to level of satisfaction.

Optimal Space Utilisation

Hospitals are categorised as category 'C', i.e. Institutional buildings in the National Building Code of India, 2005, with medium to high occupancy levels.⁷ In a number of public sector hospitals, one gets a sense of overcrowding due to over optimisation of space. It is always beneficial to base microplanning for areas/rooms on anthropometric inputs, and provide for optimal space – neither too much nor too less for all functional and behavioural requirements. Certain basic parameters regarding minimum space requirements such as roof height (8–10 feet), corridor width (6–10 ft) and zoning should always be adhered to for greater efficiency.

Synergy with Local Climate and Vernacular Architecture

Although, India is a tropical country, the extremes of weather make this a very important factor. Due to harsh and long summers and humid monsoons, most hospitals have to be air-conditioned to provide proper comfort. As this is costly, some hospitals, especially those in the public sector opt for partial air-conditioning of only critical areas. In such hospitals, to keep interiors cool, it is prudent to have high ceilings, thicker walls and smaller windows, and plan

buildings in such a manner to have (almost) continuous wind movement at lower heights. It is imperative to orient the buildings in such a manner that the longer walls face north and south, and shorter ends face east and west. This does not allow the early rising and setting sun rays at lower angles to enter the building.³ Strategic location of staircases at shorter ends also allows for less heat in 'direct' patient-care areas. Similarly use of local materials, skills and natural resources help in developing synergy in the social profile of the hospital and better acceptance in the community.

Conformance with Statutory/regulatory Issues

India is rated as having one of the most overregulated environments and hence the need for statutory/regulatory compliance. In addition to the local building bye-laws of the place where the hospital is being planned, relevant State/Central Acts, rules and regulations, along with provisions of the National Building Code 2005, shall also be applicable. In practice, a large number of existing hospitals, especially in the public sector, have several deficiencies with respect to regulatory issues. It would be worth mentioning here about several newer initiatives which have been launched in recent past like environmental impact assessment, GRIHA ratings/scale, rain water harvesting provisions, solar heating facility, barrier-free building design should also be adhered to. Some authors refer to these initiatives as 'going green' or being ecologically friendly.

SPECIFIC PLANNING AND DESIGNING ISSUES

In addition to the general 'principles' enumerated before, there are some specific issues, which ought to be kept in mind while planning for hospitals.

Zoning of Departments and Services

Most architects seem to prefer keeping those parts of the hospital that are mostly linked with the community (e.g. OPD, ER) nearer to the main access (entrance) to the facility. Those sites which have multiple entrances should site these near the main entrance and utilise the (other) side entrance for building services (stores, equipment, manifold systems, dietetics, etc.). Close to the outpatient department (OPD) and emergency room (ER) should be the ancillary departments which cater to both OPD and inpatient department (IPD) patients. These include radioimaging and laboratory facilities. Some authors also include procedures like endoscopies and daycare (surgeries and medicine) as part of this area/zone. Beyond this zone, should be the core inpatient area which should include all the wards, HDUs, ICUs and OTs. Apart from these, space has to be identified for other supportive services like laundry, CSSD, kitchen, manifold, etc. and also for sanitation and housekeeping, engineering services, HVAC, diesel generator (DG) set and electrical services, etc.

Whenever multistoried buildings are envisaged, it makes sense to house the public services (crowded) in the ground (and occasionally first) floor, with the inpatient areas being sited on the upper floors. Most architects prefer to house the OTs on the top floor, as it has the least traffic. Other critical areas like ICUs, should also be on the upper floors, which are less crowded. However, this is not sacrosanct, and some architects may not conform to these, especially if security systems are impeccable.

Visual Impact of the Hospital

Primarily the architectural inputs to the design will affect the visual impact of the hospital. Most tertiary-care superspecialty/multispecialty hospitals in urban areas tend to be imposing multistoried structures and the difference between this and residential units is stark. However, secondary and primary level hospitals, which are functionally nearer to the serving population, tend to be smaller and have more horizontal spread. While the architect is at liberty to give expression to his/her creativity in designing the hospital and nursing units, most architects believe in having same/similar design and layout plans for nursing units and stack them one over the other for uniformity. It is important for the architect to amalgamate both the 'science' and 'art' components of architecture, so as to meet the functional requirements in an aesthetic manner.

Future Expandability of the Hospital

It is common knowledge that the gestation period of large public sector hospital projects is so long that within a few years of commissioning, they start becoming crowded. Hence, in every project, at the stage of preparing the 'master plan', it must be ensured that there is adequate space left for future expansion. Here the challenge is to have compactness in such a manner that departments have space to expand. It is also important to know the more rapidly expanding/accelerating departments from the relatively slower ones. Davies and Macaulay state that the velocity of growth is maximum in diagnostic laboratories followed by medical services, staff facilities, administration.³ Between IPD and OPD, growth is more in OPD than IPD, hence space must be kept aside to cater for this.

Daylight Factor in Hospitals

The importance of natural light in a hospital cannot be over-emphasised. It is critical for proper orientation of the patient and is also required for staff, attendants and visitors. It is generally observed that earlier hospitals had less artificial lighting and relied more on natural lighting, example the long corridors with rooms on one side commonly seen in community hospitals/centres. The concept of daylight factor (DF) was introduced in the early twentieth century in UK and is determined by dividing the horizontal work plane

illumination 'indoors' by the same on the roof of the building under 'overcast' conditions and multiplying by 100. (e.g. if we have 400 lux indoors and 20,000 lux outdoors on roof, then DF would be $400/20,000$ multiplied by 100, i.e. $DF = 2$). This is very helpful in comparing relative daylight penetration under overcast conditions and British standards BS 8206-2 requires DF of 2–5 depending on electric lighting to support human well-being.^{8,9} In recent times, our reliance on natural lighting has become less and that on artificial lights has increased. Some studies have shown that too much of visibility of sky (and consequently light) can be discomforting to patient, especially those who are lying down. In tropical countries it would be prudent to have only a small part of sky visible through vertical/horizontal blinds.³ Diffuse light in circulation areas would be better than direct harsh light. Complementary colour schemes will make the hospital appear more attractive. Maximum use of natural light should be done in all those areas where 'direct' patient-care activities are not being carried out, e.g. stores, administration, finance, accounts and billing and support services.

Right Building Materials for Right Surface

It is indeed quite an arduous task to find the appropriate surface at reasonable cost. What must always be remembered is that the floor should be sturdy and durable, water impervious, generally nonslippery when wet and, lastly, easy to maintain. Some authors seem to favour vinyl flooring with thermosealed joints, as they make the floor resilient, hence, they are easy on the legs of staff besides being easy to clean. However, critics point out that they tend to allow water to seep in from the sides/corners, resulting in 'bubbling', and have to be stripped off sooner than later. Most authors agree on the suitability of 'self-levelling epoxy' for most critical and semi-critical areas, for better infection control. Public and semi-public areas can have marble/kota stone or vitrified tiles. Commonly the latter is used in areas in close vicinity of sewer lines/drains and in these areas which have seepage/leakage.

The walls should be smooth with either *dadoing* or tiles fixed up to 5 or 6 ft to protect from soiling and better cleaning properties. Guard rails at the height of trolleys and wheelchairs should be provided as protection, along with 5–6 inch skirting at the floor level, especially in corridors. Light colours provide cheerful ambience and are advised. Newer trends include application of acrylic emulsions (water resistant) or antibacterial coating of paints in most areas of the hospital. Modular operation theatres have also been introduced recently, which have modular steel plates welded together to provide antibacterial surface.

IMPACT OF INFRASTRUCTURE ON THE FUNCTIONING OF HOSPITAL

This is best summed up by Sir Winston Churchill who said that 'first we shape our buildings, thereafter they shape up'.

We have seen earlier how the efficiency of the hospital depends upon the masterly planning of circulation space by the architect. The following points highlight some of this impact.

Never Lose Sight of Maintenance Issues While Planning

In general, it is seen that most builders (contractors and project consultants) focus all their energies on the immediate present and near future, conveniently forgetting that the life of the building is around 80–100 years. To some extent this is also compounded by the authority's propensity for commissioning even half-baked projects. The following case study highlights how improper designing and lack of foresight created a maintenance nightmare in a tertiary-care hospital.

Case Study 2: Design fault with respect to sewerage shafts in a hospital

All buildings have some enclosed space wherein fresh water pipes, rain water pipes from the roof top, drain water, soiled water pipes run from top to ground/basement level, ultimately opening into the sewers. These enclosed spaces are called shafts and they form a vital part of the building. There are two prevailing schools of thought, when it comes to the 'siting' of these shafts in buildings. The older method was to have the shafts completely outside the buildings, sometimes in an enclosed area surrounded by a cluster of buildings. As this becomes unsightly after few years of usage, the recent school of thought is to house them 'within' the building; so that the exterior of the building looks aesthetic. The trade-off during such a practice is that sometimes access to the shafts becomes a problem, resulting in improper maintenance.

In a large tertiary-level hospitals, which underwent an expansion few years back, the project consultant mentioned in the report that vertical shafts would be modified to restrict their height, so that they do not become carriers of insects and rodents. Accordingly, the vertical shaft was sited within the building at two different locations; one segment from seventh to fourth floor and the other segment from third floor to ground floor. These two locations were joined together by a short horizontal section of pipes on the floor of fourth floor.

One day there was choking of the sewer line due to indiscriminate disposal of wastes, which resulted in foul smell in patient-care areas, followed by leakage from the drains running on the roof of third floor. Water dripped continuously resulting in paying ward room being rendered unusable. The reason could not be found for a couple of days as there was no access to the shaft. It was

also observed that the vertical shafts had no 'access points' for maintenance and the concrete walls had to be demolished for access to the shaft. Finally the civil engineering department had to make access to the shaft by demolishing a portion of the wall of the bathroom, and rectified the blockage. Subsequently that opening was kept as the access point of shaft for that floor.

Be Wary of 'Buzz words' and Fancy Trends before Incorporating them in the Project

It has been observed that in the last few years there has been a trend among architects and builders to liberally use glass façade in buildings (Figure 9.1). This is generally done to increase the 'aesthetics' of the building and are also be seen as trendy, in tune with the times. Not only private sector hospitals, but also many buildings in the public sector have embraced this. During the expansion project of the regional cancer centre in New Delhi, the architects decided to provide glass façade on the sixth and seventh floor at the top of the seven-storied building. The consequential implications of such a monumental blunder have been described in the following case study.



Figure 9.1 Glass facades of hospital building.

Case Study 3: Use of glass façade in modern public sector hospitals—pros and cons

Nowadays, modern hospitals are commonly using glass façade in the buildings to showcase architectural ingenuity and bolster aesthetics. During the expansion project of an apex tertiary-care hospital in northern India, the project consultants advocated for having glass façade on the sixth and seventh floors (top two floors), with the justification that this would help break the monotony and heaviness of existing surrounding blocks.

After the hospital was functional, the advent of monsoon brought in its wake is a peculiar problem—incessant seepage of rain water from the junctions between the glass panes and the wooden structure on which it was fixed. Despite couple of coats of sealant sprays, leakage/seepage of water into the bone marrow transplant (BMT) rooms and OTs (on sixth and seventh floor), respectively, led to rooms remaining vacant and OT schedules being disrupted. The problem was finally resolved with a third and final coating of water-repellant spray at the junctions with a 'high-pressure water jet gun', after which mercifully leakage stopped.

The next year in February, surgeons started complaining of increased temperatures inside the OT's, when the entire building was being provided plenum ventilation, due to cool ambient temperature in the comfort range. Measurement of temperature inside OTs showed 24–25° plus C during afternoon period, which was attributable to the 'trapping of heat' by the glass façade in the dirty corridor. Finally, it was decided to have a separate central A/C pipeline for these floors for this specific period – a very high cost in lieu of aesthetics.

Surprisingly, even older books on hospital planning generally have a word of caution regarding increased use of glass as it increases air conditioning costs.¹⁰ Some recent authors also seem to indicate this point of view.^{11,12}

Attention to Infection Control in Hospitals

It is very important that at the planning and design stage due attention is given to the methods of infection control in the hospital. Most of the primary and secondary level hospitals in our country rely predominantly on natural ventilation, thereby reducing chances of cross-infection. As they are horizontally spread out with ample space between beds and hospital-associated infections (HAI) due to design faults are virtually nonexistent. Hospitals are vulnerable to HAI due to continuous generation of biomedical wastes, improper/poor segregation of wastes, poor adherence to good hand hygiene practices and sometimes due to bad designs. It is extremely important to decide about the disposal routes of all wastes at the design stage, especially from all the critical and semi-critical areas of hospital. All the infected materials should be removed from the patient-care areas without crossing the 'clean' areas. Proper ventilation and pressure gradient for air movement across zones in operation theatres are imperative. Use of 'chutes' for disposal of hospital wastes should be avoided as they cannot be cleaned and disinfected. Dumb waiter-type lifts are better for vertical transportation of wastes in hospital.

It is also important to decide about the location of Central Sterile Supply Department (CSSD) and also if there



Figure 9.2 Blood bank corridor of hospital—open false ceiling.

should be separate stand-alone theatre sterile supply units (TSSUs). Although the former have economy of operation and standardisation of process in their favour, some hospitals opt for a mixed system. Similarly the ventilation of both positive-pressure and negative-pressure isolation rooms, including their number and location should be thought of at the planning stage. The ventilation requirements in the OT have been scientifically studied, and it is important to meet ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) parameters for proper infection control.

Most modern, large tertiary-care hospitals have central air-conditioning units with a chilled water distribution system, with peripherally located air handling units in each wing/block. These air-conditioning ducts are generally hidden from view by a partition, which is called the 'false ceiling'. From an architectural perspective, this is carried out by dividing the entire vertical space (from floor to actual ceiling) into two broad areas, viz. (i) interstitial service zone at the top and (ii) functional zone at the bottom, as depicted in Figure 9.2. Although this provides a good aesthetic result, sometimes it can create problems, especially when the workers from other departments have to enter this potential space for laying new cables, maintenance activities, etc. The case study goes into the detail of the problem and raises questions regarding whether false ceilings should be provided at all places in hospital.

Case Study 4: False ceilings in hospitals—boon or bane?

Most modern hospitals prefer to have 'false ceilings' with the emphasis on aesthetics. All the cables and conduits for various services (power, telephones, intercom, internet, manifold gases) including air-conditioning ducts are

hidden from view, resulting in a spruced-up look. This has almost become an industry norm, especially with the increased number of centrally air-conditioned hospitals. Rising to the occasion, a variety of materials are available commercially for this purpose.

However, most of the architects, designers and hospital planners are not aware of the flipside of these false ceilings. Few such incidents which that occurred in a large tertiary-care public hospital are described:

- *Collapse of false ceiling during installation of ceiling-mounted OT lights:* The OT had a false ceiling made up of gypsum board with dimension of 2 sq ft, which was suspended from the actual ceiling. It was also fastened to the air-conditioning ducts fixed to the ceiling. The suppliers of the new OT light had removed one slab of the false ceiling and had mounted the ceiling with OT light. The slab of false ceiling was refixed and OT was closed for the night. On the next day, it was observed that three slabs of the false ceiling along with the new OT light had crashed during the night. Enquiry revealed that the support of false ceiling in that portion had given away being of poor quality.
- *Entry of bats/animals in the potential space above false ceiling:* Due to lack of coordination between various agencies which install cables for different services, more often than not, the slabs of false ceilings (especially in remotely accessible areas) remain unfixed. This results in a potential gap, through which stray animals (cats, rats and monkeys) or bats can enter. Once inside, they constitute a hospital hazard and can also cause the false ceiling to collapse. In one incident death of a rodent in this space caused storm of ICU for two days, before remedial measures could be taken.

Adequate Space and Appropriate Facilities in Each Nursing Unit

It has been now established that each nursing unit in the hospital is the 'core' from where all patient-care activities are generated. While planning for any ward, it is imperative to keep in mind the requirements of nursing staff as they spend the maximum time with the patients. It would also be prudent to keep in mind requirements of some patients, physicians, housekeeping staff and attendants of sick patients.⁹ Generally, it is seen that after the hospital becomes functional, there occurs scarcity of space for storage of various items, closet and room for janitors/housekeeping staff, and a separate room for the nursing supervisor. It is prudent to have one or two unassigned cubicles/spaces, which later come in handy for investigations, medical social service, pantry, etc.

BASIC PLANNING GRID AND BED SPACE

We have seen earlier that whether the hospital expands horizontally (in rural areas) or vertically (in urban area) the planning of the structure is done in grids. It is from this planning grid that the structural grid evolves and the location of the weight-bearing columns are derived. When the building structure on all floors is arranged in a 'stack diagram', location of columns gets juxtaposed. Generally, the site of the grid is taken as 20" × 20" (length and breadth). In such a scenario it really does not matter whether if the footprint of the ground and/or first floor is more.

Similarly, the space available per bed is also an important parameter. The actual area required by a hospital bed (Fowler's) is 2 m². However, some more space is usually required on all sides of the patient bed to carry out patient-care activities.

Hence, about 70–80 sq. ft of space is required per bed in a bay having containing 4–6 beds, and about 120–130 sq. ft. of space is required for a private room. If the entire hospital is considered, the total floor area comes to about 70 m²/bed. In the HDU's and ICU's, because of more equipments, the floor space should be 20–25 m²/bed. Some other common parameters related to hospital-bed space is the minimum distance between two centres that is 2.5 m in order to reduce cross-infections. The thumb rules for space requirements of other supportive service areas are: (i) CSSD @ 0.7–1.0 sq. m²/bed, (ii) laundry 1.0–1.5 sq. m²/bed, (iii) dietetics 1.5–2.0 sq./bed, (iv) blood bank – as per statutory guidelines (minimum 1.0 sq. m²/bed.).²

The entire exercise of planning and designing a hospital draws a lot from good teamwork among members of the planning team, proper coordination of the entire process in a scientific manner, and the collective experience of all members. It is but natural that members have trust amongst each other, and they learn from past mistakes, as they negotiate the learning curve. This chapter does not claim to provide detailed information on all aspects of planning and designing, but aims to provide an overview of the entire process. It provides information about potential pitfalls which should be avoided through illustrative case studies about which the author has first-hand experience.

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Creating Specialist Manpower for Hospital Administration in India

10

Dr JC Mehta, Dr Parampreet Kaur Ahuja, Dr. Amarjeet Singh and Dr Sonu Goel

“A good scientist is a person with original ideas. A good engineer is a person who makes a design that works with as few original ideas as possible.”

—Freeman Dyson

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- describe the role of hospital engineering in efficient healthcare.
- understand the importance of integration of technical and healthcare (Heal-Tech) concept.
- outline the scope and practices of hospital engineering courses.

BACKGROUND

Since 2005, National Rural Health Mission (NRHM) has been the flagship of healthcare strategies in our country.¹ However, despite the rhetoric related to Indian Public Health Standards (IPHS),² nothing tangible has progressed for India towards making the hospitals responsive to the needs of patients, nurses or even doctors. The very service sector, which caters to our health needs, the Indian (public) hospitals remain sick. This is because the people who may be responsible for building or maintaining hospital facilities are themselves either deficient or incapable of taking appropriate policy decisions.

There is a systemic lack of vision regarding keeping the public hospitals up-to-date as far as new concepts in hospital architecture or hospital engineering are concerned. Various advancements in science and technology [information technology (IT) revolution, globalisation, etc.] which have vastly affected our quality of life, seem to have left healthcare sector, rather untouched. There have been plenty of changes in economical and sociopolitical spheres at various levels in India. Flyovers and roads are being built all over the country. Metro network is expanding. Malls have mushroomed in epidemic proportion in Indian cities. Even here, in the seemingly progressive atmosphere of all round development, the hospitals (their design building, running and maintenance) have rather been neglected.³

HOSPITAL ENGINEERING: KEY TO EFFICIENT HEALTHCARE

India, with the largest population of young people in the world and the vast pool of technical manpower in the world, has a capacity to create 500 million certified and skilled technicians by year 2022.

The poor institutional environmental health standards and practices have a direct impact on the comfort and recovery of patients. Extensive investments are regularly injected into their modernisation, but mostly go in vain. The good effects are not sustaining when maintenance people are inefficient. In such a situation, running cost of hospital increases. Image of the hospital services is adversely affected. Patient flow may also slow down. This further increases the burden on healthcare services, which are already bursting at the seams.

Recently, during an evaluation of services in some public hospitals in India, it is very surprising that the concept of hiring specialists who were knowledgeable in hospital architecture was totally missing. Even the basic management principles were not being followed for maintenance of hospital equipment. Hospital space was not appropriately utilised. ‘Downtime’ of equipment was high. Stock inventory was not up-to-date.

Hospital engineering service does not follow a uniform pattern and is uncoordinated in most hospitals in India.

Nobody has a clue to the concept of preventive maintenance. Public works department (PWD) engineers managing these hospitals are unknowledgeable in subjects like biometry, incineration, medical architecture, environmental health, ventilation, infection controls, environmental engineering, illumination, laundry engineering, sterilisation, radiation protection, solid and medical waste disposal, diagnostic engineering, clinical engineering, safety engineering, etc. Hence, there is a dire need for inculcating certified training in hospital engineering at all levels, viz. Master's, Diploma and Certificate.

INTEGRATION OF TECHNICAL AND HEALTHCARE EDUCATION: A PARADIGM SHIFT

A recent visible growth drift from manufacturing sector to social sector like healthcare, duly embracing the globalisation of a knowledge economy (KE), spans the obvious prescription of matching developments with requisite Heal-Tech ([HT] healthcare + technical) competencies, as already witnessed in manufacturing sector. The deficient capatence (capacity + competence) of heal technologists has not only put the hospitals into stress but also the allied manufacturing and service sectors into strain. Under such circumstances, the vitality and urgency of developing Heal-Tech manpower (also human capital) that is well-qualified and equipped with higher order competencies is being well-realised. There is a strong need of integration of technical and healthcare education as a new specialisation and hence the need for a revitalisation of the polytechnic education while concurrently including the domain of healthcare technologies (Heal-Techs) therein.

Historically, for converting India into a 'knowledge society', it was envisaged that the industrial training institutions would produce the requisite number of trained manpower to fill the void of mid-level technical experts. But can knowledge progress without health? That brings the Institute of Healthcare Engineering (IHE) into spotlight—the only professional forum in the country that incorporates the concept of commissioning health-promoting hospitals. As indicated in other related chapters in this book, there is a definite role of hospital engineers in ensuring the health-promoting nature and profile of a hospital. The IHE strives to improve the profile of hospitals in India, commensurate with the desirable international standards. The key focus in this regard is on creation of specialist engineering manpower with requisite skills, as outlined below. The principle of health promotion itself states that creation of infrastructure and facilities is the main thing. Rest will follow in due course of time. Thus, if we have trained healthcare technology manpower, the status of hospitals will improve sooner or later. The pool of specialist manpower thus created will certainly do justice with the skills acquired by them.

NATIONAL POLICY ON SKILL DEVELOPMENT: IHES VISION AND BEYOND

The drafting of IHE roadmap recalls the salient features of national policy applied towards Heal-Tech education. For defining the coveted vision, the pertinent features that deserve inclusion are as under:

- Expansion of outreach using innovative approaches.
- Development of a mechanism to offer career advancement opportunities to youth of India for acquiring technical skills and expertise.
- Capacity-building opportunities focusing on under-privileged sections of society, viz. women, people with disability.
- Giving more emphasis on research.
- Emphasising on training courses, which address the changing needs of society.
- Establishing a continuity of training, learning and monitoring.
- Promoting excellence, use of modern training technologies, skill upgradation of trainers, etc.
- Develop entrepreneurship for these certified hospital engineers and technician to raise mobile hospital equipment repair workshops and assist private clinics, hospitals, veterinary hospitals, specialised scientific labs, etc.
- Train multitrade technician (Heal-Techs) to augment support system, thereby reducing numbers in hospitals; such staff potentially supports second and third shifts, as hospitals work for $24 \times 7 \times 365$ days. They are 'ships on shore'.

Hospital Engineering Courses: Scope and Practices

A committee of experts appointed by Ministry of Health and Family Welfare under Chairmanship of Director General-Indian Council of Medical Research (DG-ICMR) in 2006 had recommended capacity building/skill development including research in areas of healthcare infrastructure by starting National Institute of Healthcare Engineering and Architecture (NIHEA) at PGIMER Chandigarh. The suggested organisational pattern of a hospital engineering department at health system level and institute level is provided in Figures 10.1 to 10.3.

The various courses under NIHEA were:

- 2 years Master's in Health Facility Planning and Designing (MIFPD).
- 2 years Master's in Healthcare Engineering and Management (MHEM).
- 1 year dual degree of Master's in Urban Planning (MUP) for holders of MPH and vice versa.
- 1 year dual degree of Master's in Health Facilities, Planning and Designing (MHFPD) for holders of Master's in Hospital Administration (MHA), MARCH, MUP.

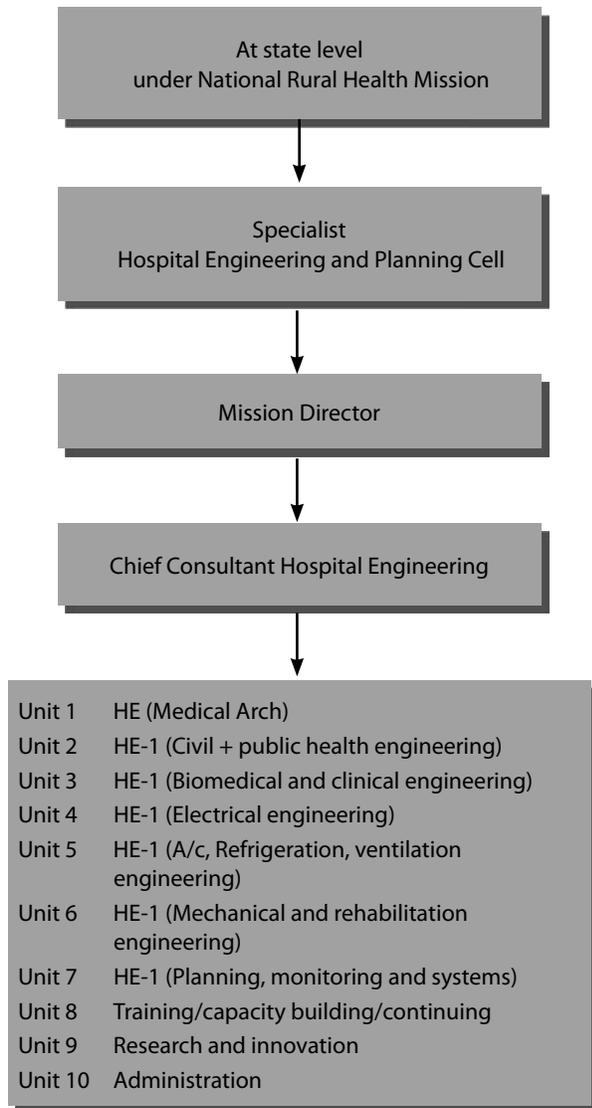


Figure 10.1 Organisation pattern of hospital engineering department (state level).

- 1 year dual degree of MHEM for holders of M. Tech. (any discipline).
- Continuing education programmes in hospital engineering.
- Professional certification programmes in health facility management/engineering/environmental health.
- M Phil/PhD programmes in above areas under active considerations.

It was proposed that two programmes (MIFPD and MHEM) be conducted concurrently as *companion* courses. Some of the courses may be common to both, but the application and the emphasis will be different. The intent is that the two courses would enrich each other.

Master’s in Healthcare Engineering and Management (MHEM) with emphasis on engineering asset and

infrastructure, O & M of 61 hospital engineering services, healthcare project/construction management, etc. (buildings, plants, machinery, services, biomedical equipments, health estate) (Annexure 10.1).

Master’s in Health Facilities, Planning and Designing (MHFPD) with emphasis on architectural designs, ergonomics, patients’ environment, quality of life in hospitals, etc. (Annexure 10.2).

Other courses include post-diploma (1 year) and diploma courses, post-industrial training institute (ITI) certificate courses (6 months). The schedule of post-diploma courses is given in Annexure 10.3.

Health engineering polytechnic has been recommended in each state of India jointly with a medical college. IHE was assigned the responsibility of drafting course details. To meet urgent need, experts have recommended starting of post-diploma programmes with various specialisations in the existing polytechnics in logistic proximity to medical colleges/health universities.

While working out the detailed contents, and study and evaluation of scheme, the following important elements have been kept in view.

- Employment opportunities in health sector/hospitals for managing engineering assets.
- Modified competency profile of the post-diploma holders with a view to meet the changing needs of technological advancement and upgradation of hospitals at all levels.
- Vertical and horizontal mobility of post-diploma pass outs for their professional growth.

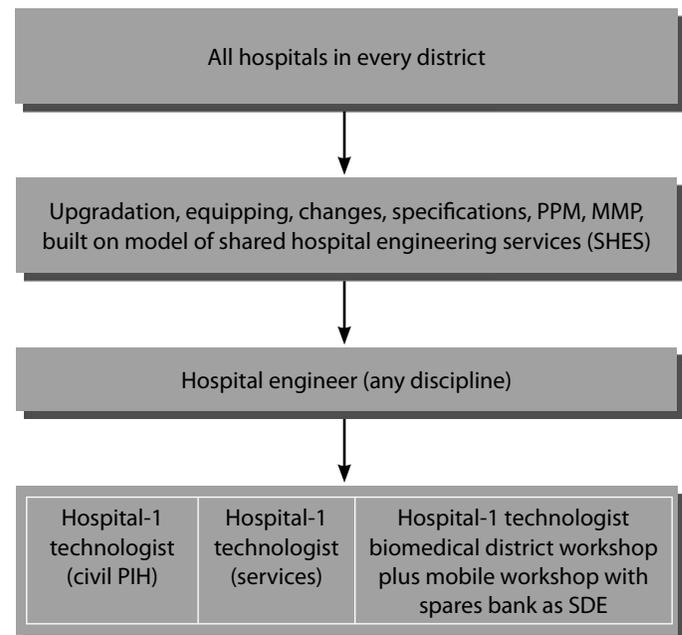


Figure 10.2 Organisation pattern of hospital engineering department (district level).

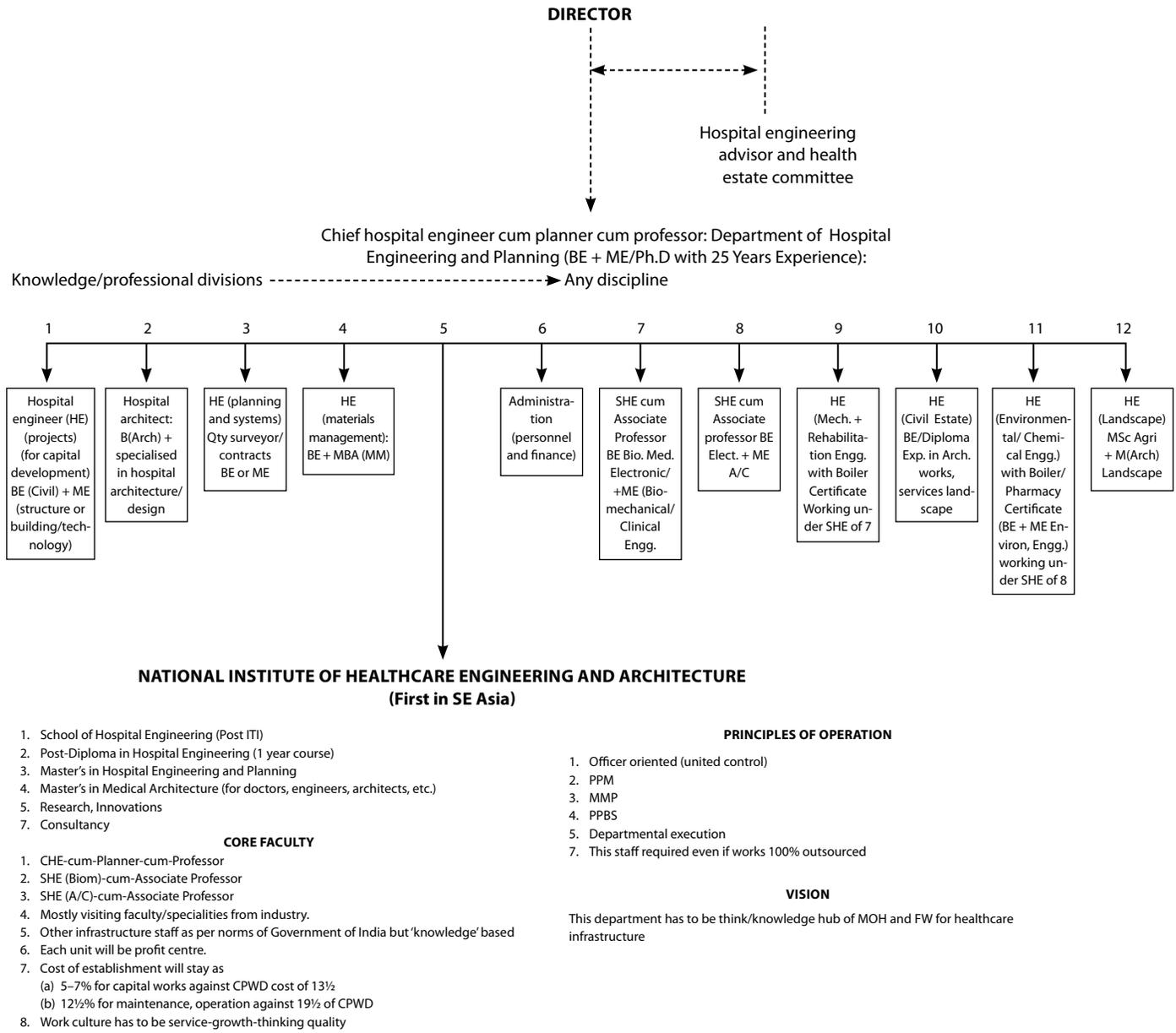


Figure 10.3 Suggested organisation structure of Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh.

- Pragmatic approach in implementing the curricula of post-diploma programmes is hospital/healthcare engineering and management.

The growth of any society presupposes the healthy state of mind and body. India has traditionally maintained a high quality of human health with yoga, and simple living and high thinking philosophy. But new modernisation of society with

globalisation of KE places a new agenda in front of the education sector. This calls for a speedy development of scientific infrastructure for organised healthcare service. Polytechnic education is planned to rejuvenate and support the fulfillment of the gap in availability and demand of the healthcare technologists (Heal-Tech), which would directly or indirectly help in building and running health-promoting hospitals.

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ANNEXURES

ANNEXURE 1

Master's Programme in Health Facilities Engineering and Management

1. All theory classes to be of 3 hours/week duration.
2. Total teaching load of the programme shall be 30 hours/week.
3. Each semester to have one studio subject and four theory subjects, and one elective subject except for the fourth semester, which will have thesis as a major academic load.
4. Bridge course is to be taught in the first semester as block lecturers (2 × 15 hours = 30 hours) and should get completed 1 week prior to start of the regular programme.

Semester I		Hours/Week	Maximum marks
PM-1	Health systems – I (Lecture)	3	100
PM-2	Building engineering studies (Lecture)	3	100
PM-3	Decision tools (Lecture)	3	100
PM-4	Health facilities planning and management –I (Lecture)	3	100
PM-5	Electives 1. Marketing in construction 2. Site management 3. Energy management 4. Service coordination (Lecture)	3	100
PM-6	Health facilities project management -1 (Lecture)	15	500
Total		30	1000
Bridge Courses			
PM-B1	Health facilities planning, design and engineering application (Lecture)	2	Noncredit bridge course
PM-B2	Healthcare concepts (Lecture)	2	
Semester II			
PM-7	Health system-II (Lecture)	3	100
PM-8	Health facilities engineering planning studies (Lecture)	3	100
PM-9	Health facilities planning and management-II (Lecture)	3	100
PM-10	Health facilities economic (Lecture)	3	100
PM-11	Electives 1. Construction France management 2. Building automation 3. Facilities management in specific type of building 4. Asset management (Lecture)	3	100

PM-12	Health facilities project management-II (Studio)	3	100
		15	500
Total		300	1000
Semester III			
PM-12	Health systems-III (Lecture)	3	100
PM-13	Health facilities planning and management-III (Lecture)	3	100
PM-14	Human resource management in healthcare projects (Lecture)	3	100
PM-15	Management system standards (Lecture)	3	100
PM-16	Electives 1. Cost modelling 2. Disaster management infrastructure planning 3. Project procurement planning 4. Management of infrastructure projects (Lecture)	3	100
PM-17	Health facilities project management-III (Studio)	15	400
Total		300	1000
Semester IV			
PM-18	Medical project management and professional practice	3	100
PM-19	Health resources	3	100
PM-20	Dissertation and thesis project	24	800
Total		30	1000
Grand total of four semesters			4000

ANNEXURE 2

Master's Programme in Health Facilities Planning and Designing

Semester I		Hours/Week	Maximum marks
MA-1	Theory of medical architecture-1	3	100
MA-2	Sustainable planning and development of estates	3	100
MA-3	Health system's planning and design-1	3	100
MA-4	Functional planning and hospital engineering-1	3	100
MA-5 E.1 and E.2	Electives	3	100
MA-6	Medical architecture studio-1	15	500
Total		30	1000

Semester II			
MA-7	Theory of medical architecture-II	3	100
MA-8	Sustainable planning of environmental impact assessment	3	100
MA-9	Functional planning and hospital engineering-II	3	100
MA-10	Health system-II	3	100
MA-11 E3 and E4	Electives	3	100
MA-12	Medical arch. studio-II	15	500
	Total	30	1000

ANNEXURE 3

Post-diploma Courses

● Hospital electrical engineering services

- Management of hospital electrical engineering services/systems (quality power, illumination, installation, maintenance of equipment and conservation of energy).
- Hospital electrical distribution engineering.
- Hospital electrical power systems and support services (power station, substation, transformers, invertors, secondary supply, lifts and conveyors).
- Hospital systems and biosafety (including alternative supply and electricity rules).
- Hospital electrical project planning, estimation and management.
- Minor project on hospital electrical system.
- Hospital electrical power system installation and practice.
- Hospital environmental safety health and quality system.
- Modern industrial control and instrumentation.
- Electrical workshop practice.
- Electrical industrial drivers and then control, as applied in hospital.
- Project major.
- Student-centred activities including entrepreneurship and awareness camp.

● Hospital planning and design services

- Management of hospital facility planning services.
- Computer (drawing and drafting) application in hospital architecture.
- Health estates planning.
- Building services and bye laws, as applied to hospitals.
- Quantity surveying, valuation and specification for hospital projects.
- Minor projects.
- Hospital architecture.
- Hospital environmental safety health and quality system.
- Hospital construction management and project.

- Major project.
- Tendering and valuation.
- Green architecture for hospitals.
- Student-centred activities including entrepreneurship awareness camp.

● Hospital, civil and public health engineering

- Management of hospital civil engineering services.
- Hospital engineering estimating and costing.
- Hospital building repair and rehabilitation.
- Hospital systems (public health, civil structure) and biosafety.
- Minor project.
- Hospital architecture and facility planning.
- Environmental safety, health and quality system.
- Structural engineering design.
- Tendering and valuation.
- Hospital construction management and project execution.
- Advance public health and infrastructure.
- Major project.
- Student-centred activities, including entrepreneurship and awareness camp.

● Hospital mechanical engineering services including air conditioning, refrigeration and ventilation

- Management of hospital engineering services.
- Hospital refrigeration and air-conditioning systems I and II.
- Hospital refrigeration and air-conditioning services.
- Hospital mechanical support services (boiler, lift, ventilation, escalator, laundry).
- Minor project.
- Hospital system and biosafety (etymology).
- Hospital operation resources management (workflow, streamlining storage).
- Ventilation, gases management and mechanical infrastructure (workshop beds, etc.).
- Environmental safety health and quality.
- Major project.
- Student-centred activities including entrepreneurship and awareness camp.

● Hospital information and computer services

- Management of hospital information and computer services/systems.
- Computer network and administration.
- Operating system design and management.
- Hospital system and biosafety.
- Minor project.
- Computer organisation.
- Computer peripheral and interfacing devices.
- Computer organisation and maintenance.
- Troubleshooting and maintenance of computer and networks.
- Major project.
- Environment safety, health and quality system.

- Hospital information system design, maintenance and management.
- Student-centred activities including entrepreneurship and awareness camp.
- **Hospital instrumentation and control services**
 - Management of hospital instrumentation services.
 - Biomedical and clinical instrumentation I and II.
 - Analytical and environmental instruments.
 - Hospital system and biosafety.
 - Control and information system.
 - Minor project.
 - Biomedical instrumentation (radiography and ultrasound)-II.
 - Micro controller and PLC-based instrumentation.
 - Hospital process control and instrumentation.
 - Environmental safety, health and quality system.
 - Advance biomedical control and instrumentation.
 - Major project.
 - Student-centred activities including entrepreneurship and awareness camp.
- **Hospital biomedical and clinical engineering services**
 - Concepts of hospital bio and clinical engineering services including telemedicine, trauma and general medicine.
 - Medical and applied electronics and opticals for clinical systems.
 - Chemical instrumentation: Maintenance and repairs.
 - Analytical instrumentation: Maintenance and repairs.
 - Management of bio and clinical systems and disaster management.
 - Minor project in biomedical/clinical engineering.
 - Biomedical applications: Instrumentation maintenance and repairs.
 - Measurement science, reliability engineering and basic control systems.
- Radiology equipment (X-ray engineering: Maintenance and repairs.
- Cardiac equipment, maintenance and repairs.
- Intensive care equipment and OP equipment maintenance and repairs.
- Project major.
- Student-centred activities including entrepreneurship and awareness camp.
- **Hospital chemical/environmental engineering services**
 - Management of hospital chemical/environmental engineering services.
 - Medical wastes: Handling—installation, maintenance, operation, management.
 - Clinical biochemistry, pathological systems management.
 - Sterilisation and decontamination services engineering: failure and disaster management.
 - Laundry systems, water and steam supplies conservation and harvesting.
 - Minor project on chemical/environmental engineering.
 - Haematology, foods and drug society and dynamics management.
 - Incineration, heat and fire, insulations and management.
 - Sustainable hospital systems, solar system + energy management.
 - Environmental health in hospital: air water, noise, systems management, and quality and safety interrelations.
 - Hospital gases, quality, supply chain management and quality system.
 - Major projects.
 - Student-centred activities including entrepreneurship and awareness camp.

Designing Disabled-friendly Hospitals: Need of the Hour

11

Dr Ravneet Kaur, Dr Ruchi Sharma and Dr Amarjeet Singh

“Being disabled does not mean being disqualified from having access to every aspect of life.”

—Emma Thompson

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the concept of disability and various legislations associated with the term.
- understand the need for disabled-friendly health services.
- describe the concept of disabled-friendly hospitals.
- explain various components of physical design and planning required to make a hospital accessible for all.

INTRODUCTION

Disability has been defined as restriction or lack of abilities to perform an activity in the manner or within range considered normal for a human being.¹ Disability is an umbrella term, covering impairments, activity limitations and participation restrictions. There may be any form of impairment—physical, intellectual or sensory, medical conditions or mental illness, which may be permanent or transitory in nature.

What is Disability?

The World Health Organisation (WHO) defines disability as a contextual variable, dynamic overtime and the one in relation to circumstances. International Classification of Functioning, Disability and Health (ICF 2001) also acknowledges that the prevalence of disability corresponds to social, functional and economic status.²

Magnitude of Disability

The World Health Survey (WHS) conducted by the WHO in 2003–2004 covering the domains of ICF framework reported that globally, the average prevalence rate of disability was 15.6%, ranging from 11.8% in high-income countries to 18% in low-income countries. The prevalence of disability in India, as reported by this survey (WHS, 2002–2004), was 24.9%.²

In India, however, the official statistics collected through population census and national sample survey report the prevalence of disability to be 2.1% and 2%, respectively. The ICF framework was not used for identification and measurement of disability in these surveys. Hence, the reported magnitude seems to be grossly underestimated. Estimates from a variety of other sources suggest that actual prevalence of disability could be 4–8%.^{3–7} According to the 58th round survey conducted by National Sample Survey Organisation (NSSO) in 2002, there are 18.49 million people in India who are disabled.⁴ It is further expected that the magnitude of disability will increase in the coming years due to increase in life expectancy, increase in chronic health conditions, increasing incidence of trauma due to road traffic accidents, and medical advances that preserve and prolong life.

BARRIERS FACED AND IMPLICATIONS IN PERSONS WITH DISABILITIES

According to the first world report on disability, there are more than one billion people in the world who are disabled. Out of these, 110–190 million face significant difficulties in their daily lives in the form of stigma and discrimination, lack of adequate healthcare and rehabilitation services, and inaccessible transport and buildings.

Worldwide, there are persons with disabilities (PWDs) at all levels. The disabled are among the most marginalised

groups in the world. As compared to people without disabilities, their levels of health, education and economic participation are lower. While the millennium development goals (MDGs) do not specifically mention disability, it is increasingly being recognised that the MDGs will be impossible to achieve without inclusion of people with disabilities. It has been recognised that PWDs have the right to receive the support they need with respect to education, health, employment and social services.⁸

There is also increasing evidence to suggest that people with disabilities experience poorer levels of health than the general population. The risk of secondary and comorbid conditions is more in PWDs. There is also greater vulnerability to age-related conditions and greater risk of being exposed to violence as well as higher risk of unintentional injuries. The WHS reported that PWDs seek healthcare more than people without disabilities. However, the unmet need was much greater. There has been lot of emphasis these days on disabled-friendly designs. A study by Sharma et al. in Ludhiana, Punjab, India revealed that disabled friendliness of railway transport facility remained a largely unrealised goal in Ludhiana city till date. Score obtained by railway station of Ludhiana city was 41 and its disabled friendliness falls in average grade. Railway transport facility was far from being satisfactory than to be called barrier free.⁹

LEGISLATIONS RELATED TO PERSONS WITH DISABILITIES

The legislations enacted for PWDs in India include:

- *Persons with disability (Equal Opportunities, Protection of Rights and Full Participation) 1995*: This act provides for education, employment, creation of barrier-free environment, social security, etc.¹⁰
- *National Trust for Welfare of Persons with Autism, Cerebral Palsy, Mental Retardation and Multiple Disability Act, 1999*: There are provisions for legal guardianship and creation of enabling environment.
- *Rehabilitation Council of India (RCI) Act, 1992*: It deals with the development of manpower for providing rehabilitation services (*national policy for people with disabilities, 1993*).

These Acts emphasise nondiscrimination in transport on the roads and other buildings. Provisions have been made in this Act for ramps in public buildings, adaptation of toilets for wheelchair users, disabled-friendly lifts and elevators, etc.

In order to create a barrier-free environment, as prescribed by the Act, the Government of India (*Ministry of Urban Affairs and Employment*) is currently amending the existing building bye-laws for all public buildings. The Ministry of Urban Affairs issued *guidelines and space standards for barrier-free built environment for disabled and elderly persons in 1998*. This is a guiding document to central and state authorities in modifying their bye-laws, and applies to most

constructions other than domestic buildings. In addition, the latest 2005 revision of the National Building Code (NBC) includes provisions for buildings, services and facilities for people with disabilities. These building bye-laws have been sent to the state governments and union territories for adoption. All states have been asked to appoint an officer in every district to bring to notice cases of noncompliance to the concerned authorities.

India has ratified the United Nations Convention on the Rights of Persons with Disabilities (UN CRPD) and has undertaken the obligation to ensure and promote the full realisation of all human rights and fundamental freedoms for all PWDs without discrimination of any kind on the basis of disability. The convention makes participation of the disabled one of its principles, stating 'The principles of the present convention shall be full and effective participation and inclusion in society', subsequently enshrining the right of disabled to participate fully and equally in the community, education, all aspects of life (in the context of rehabilitation and rehabilitation), political and public life, cultural life, leisure and sports (*National Policy for Persons with Disabilities Act, 2005*).¹⁰

The National Policy for Persons with Disabilities and 'Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995 recognises that persons with disabilities (PWDs) are an important resource for the country and seek to create an environment that provides equal opportunities, protection of their rights and full participation in society. They seek to create barrier-free environment for PWDs and make special provisions for the integration of PWDs into the social mainstream.¹⁰

It is also endorsed in the Indian public health standards (IPHS) to provide barrier-free access environment for easy access to nonambulant (wheelchair, stretcher), semi-ambulant, visually disabled and elderly persons as per '*Guidelines and Space Standards for barrier-free built environment for disabled and elderly persons*' of CPWD/Ministry of Social Welfare, Government of India. Ramp as per specification, hand railing, proper lightning, etc. must be provided in all health facilities and retrofitted in older one, which lacks the same.

Initiatives on accessibility were taken in the 11th five year plan. The section, '*empowering disabled people*' in the 11th plan document stated 'a national centre to facilitate and support the development of universal design and barrier-free built environment will be established'. It also stated, 'a concerted effort would be made to make all public buildings and facilities such as schools, hospitals, public transport, and so on, compliant with the requirements of a barrier-free built environment'.¹⁰

NEED FOR DISABLED-FRIENDLY HEALTH SERVICES

People with disabilities encounter a range of barriers in accessing and utilising healthcare. These include prohibitive

costs, lack of availability of appropriate services (and equipments), attitude of health service providers and physical access to health facilities. Though an under-researched area, it has been recognised that 'physical access' surpasses other issues when it comes to empowering disabled people. For healthcare facilities, uneven access to building, inaccessible medical equipment, poor signage, narrow doorways, internal steps, inadequate bathroom facilities and inaccessible parking areas create barriers. Traditionally, recognition of the barriers experienced by these groups has been overlooked. Since majority of this segment belong to lower- and middle-income group, it is beyond their economic capacity to utilise private healthcare facilities and are, therefore, dependent on public healthcare system.

Existing health system is either full of obstacles or impossible to use. Disabled people are among the most socially excluded members of society and poorly designed and inaccessible environment can contribute to this situation by restricting access to health facilities.

Accessibility is an important issue to be addressed both in external and internal environment. Most hospitals still lack in terms of good design and facilities for persons with disability. Awareness is now growing regarding need to gradually remove barriers in the built environment. Funding constraints and lack of good practice have slowed down progress. At some places kerbs are provided for accessing footpaths, many are nonusable due to steep slopes, or barriers such as garbage bins or street vendors selling vegetables and fruits on the pavements. This creates anxiety and tension among the disabled-fearing accidents. The environment should enable and empower them at the same time while engaging them.

Access audits conducted in Orissa have highlighted serious access issues in facilities like district hospitals. The main entrance in around half of the hospitals and toilets in around 90% of hospital were not accessible. In the private sector, the access audit of a prominent corporate hospital in Delhi revealed that there was no separate parking for the disabled. Wheelchair users could not access information counters and doctors' examination tables. Toilets were inaccessible. It was not possible for the visually impaired people to use telephones and lifts or move around the hospital. Further, there were no sign language interpreters for the speech and hearing impaired. There were no weighing machines for those unable to stand.^{12,13}

MAKING HOSPITALS DISABLED FRIENDLY¹⁴⁻¹⁶

Barrier-Free Environment to Universal Design

A universal design (coined by the architect *Ronald L. Mace*) is 'the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design'. Universal

design has emerged from the concept of barrier-free environment. Universal design refers to creating buildings, products and environments that are accessible to people, with or without disabilities. For example, a standard door may not be accessible to everyone. If principles of universal design are applied and sensors are installed that signal the door to open when anyone approaches, it makes the building accessible to everyone—a small child, a man carrying a large box, an elderly woman, a person using a walker or wheelchair.¹⁴

Access for All

Access statements: Access statements must highlight conditions where there are areas of noncompliance with planning policy, guidelines or the requirements of the building regulations. They should be submitted as part of planning and building control submissions.

Parking: A disabled-friendly parking should have the following features:

- Parking for two car spaces near the entrance with maximum travel distance of 30 m from entrance.
- The width of parking bay should be minimum of 3.60 m.
- A clear display of the information stating that the space is reserved for wheelchair users (Figure 11.1).
- Guiding floor materials for visually impaired persons and audible signals for hearing impaired.



Figure 11.1 Signage parking for the disabled.

Surfacing and hard landscaping: All surfaces should be firm and nonslip. The path edge should be defined with a colour contrast, textured surface or low rail to indicate changes in level or direction.

Main entrance: The entrance to the hospital building should be accessible. The accessible entrance should be clearly identifiable with signages using the international symbol of accessibility (Figure 11.2). If there are any steps at the entrance, these steps should have a handrail on both the sides. A ramp with a railing on both sides should be provided alongside the stairs.



Figure 11.2 Accessible entrances.

Signages: Signs should be useful to everyone, easily seen from eye level, readable by moving the fingers and well-lighted for right time identification. Signs shall indicate the direction and name of the accessible facility and incorporate the symbol of access.

- The size, type and layout of lettering on signs shall be clear and legible.
- Signs should be in contrasting colours and preferably be embossed.
- Simple symbols and universally recognised contrasting colours should be used.

Reception and counters: The counters should be accessible and well-illuminated. To make a counter easily accessible for a wheelchair user, allow a space about 700 mm high and 350 mm deep under the counter (Figure 11.3).

Doors: The entrance should be provided with automatic doors with sufficient opening intervals. Accessible doors should be placed adjacent to the revolving doors and turnstiles. The width of one of the leaves should be at least 900 mm for double-leaf doors.

Steps/stairs: The following features should be present while designing the stairs.

- Minimum width of 900 mm.
- Continuous handrails, on both sides, at a height between 800 and 900 mm.
- Handrail installed in the centre of the stair having width more than 3000 mm.
- The step edges of a different colour or texture easily identifiable by vision impaired persons.
- Clearly identifiable location of emergency (fire escape) stairs.
- Warning blocks installed at the beginning and end of all flights.
- Nonslip surface of treads.

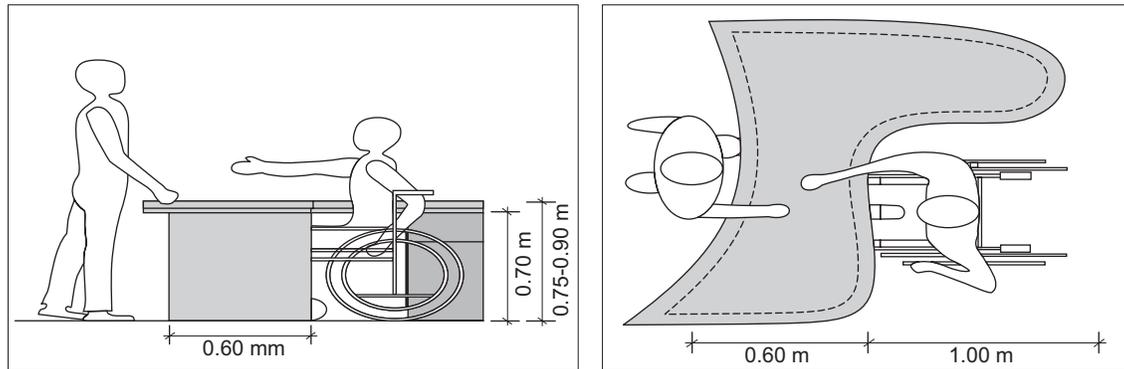


Figure 11.3 Accessible reception counters.

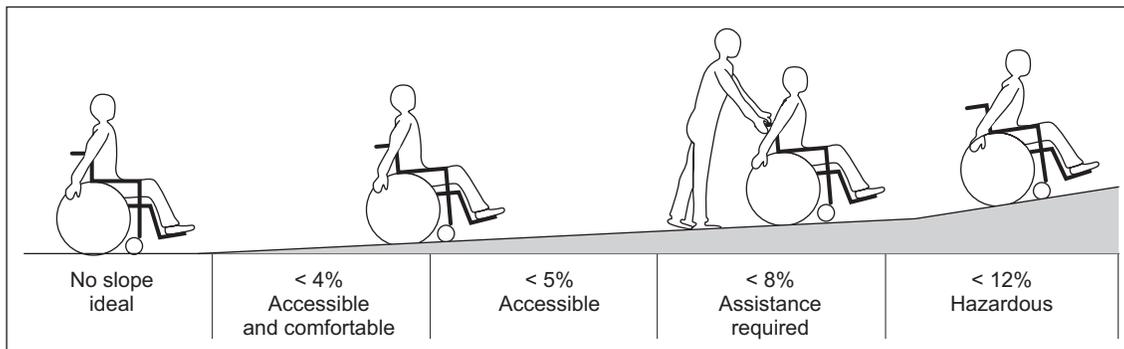


Figure 11.4 Description of ramps.

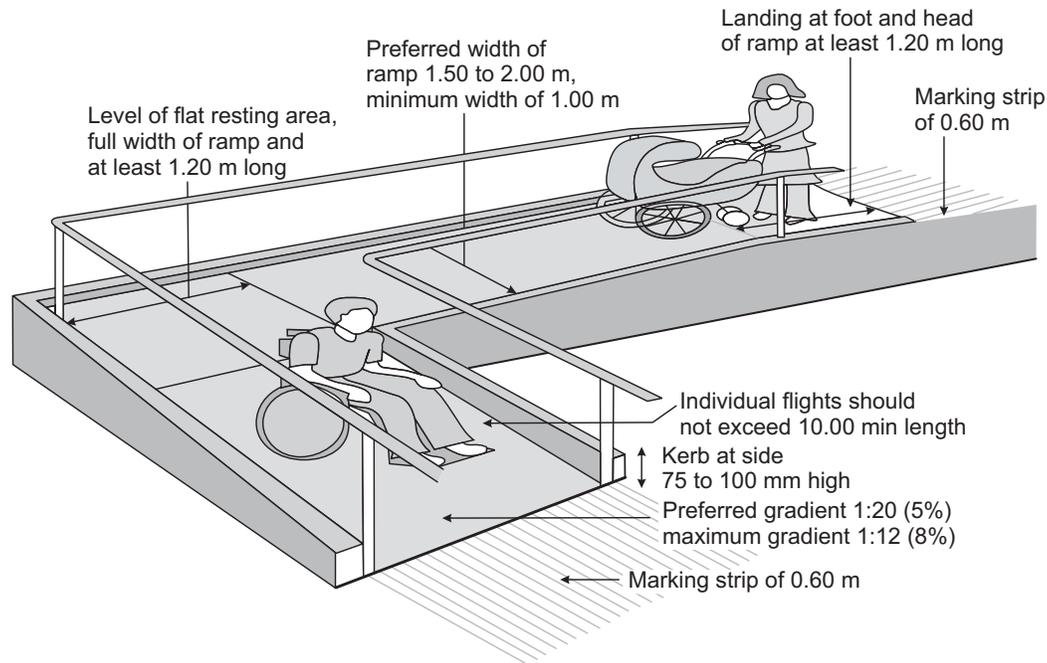


Figure 11.5 Dimensions of ramp.

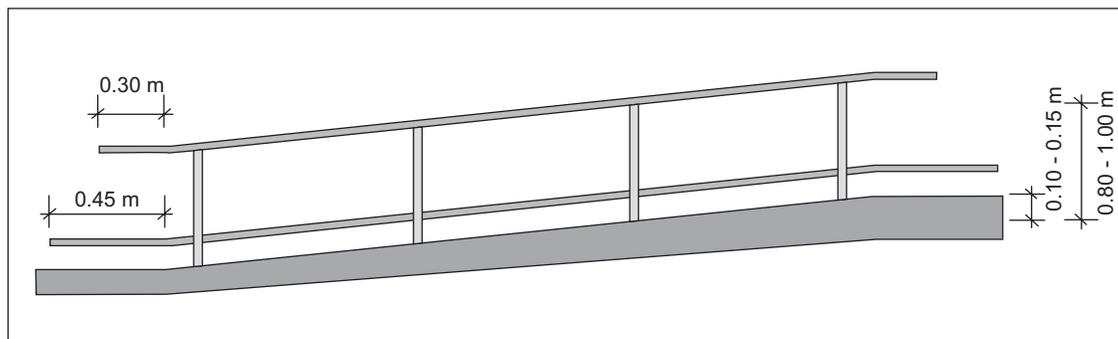


Figure 11.6 Dimensions of handrails.

Ramps: The following features should be the present while designing ramps (Figures 11.4 and 11.5):

- Ramp should be next to the stairs in every building.
- Location of the ramp should be clearly identifiable.
- Ramp gradient no steeper than 1:12.
- Landing of at least 1200 mm of length, at 10,000 mm interval.
- Landing at every change in direction.
- Landing at the top and bottom of every ramp.
- Edge protection on both sides of the ramp.
- Minimum width of the ramp is 900 mm.
- Continuous handrails, on both sides, at a height between 800 and 900 mm.

Handrails: Handrails should be mounted at a height between 800 and 900 mm and should be easy to grip. Handrails should be securely attached and the endings should be grouted in the ground or turn downward. The space between the handrails and the wall should be at least 40 mm for smooth walls and 60 mm for rough walls. The handrails should be painted in contrast colours.

There should be tactile strip identifications on the handrails for emergency stairs and floor levels (Figure 11.6).

Urinals: Urinals with grab bars should be installed for ambulant PWDs (e.g., crutch users). Grab bars should be installed in the front of the urinal to provide chest support and the sidebars to hold on to while standing. An emergency alarm may also be provided (Figure 11.7).



Figure 11.7 Urinal with grab bars.

Toilets: There should be accessible and easily identifiable toilets. Other features of accessible toilets are clear dimensions of at least 1750 mm between opposite walls, water closets (WC) and bidets mounted at a height between 490 and 500 mm, a space of 450 and 500 mm between WC and closest adjacent wall, accessible washbasin at a height of 800 and 850 mm, accessible showers with a folding seat, grab bars and faucets for easy grip and operable by one hand (Figure 11.8).



Figure 11.8 Toilet design.

OVERCOMING OTHER BARRIERS

Besides physical access, other important components of a disabled-friendly hospital are:

- **Organisational support:** The hospital should have commitment to disabled-friendly model of care. An accessibility committee should be constituted in the hospital with one person with disability as an executive member.
- **Processes of care:** Clinical care protocols should take into account the persons with disability.
 - Staff of emergency department should also be oriented towards care of this special group. Staff with special expertise, e.g. sign language may be recruited.
 - **Emotional and behavioural environment:** Staff orientation and education programmes to modulate the attitude and behaviour of staff and doctors for people with

different kinds of disability should be in place.

- **Ethics in clinical care and research:** Due consideration should be given to ethical issues when it comes to research involving persons with disability.

Although making a hospital disabled friendly is a challenging task, it is high time that efforts are directed towards needs of this group, which remained unmet for a long time. Many countries across the globe have initiated disabled-friendly healthcare. Although there is constitutional support for these initiatives in India also, our country lags far behind in providing healthcare facilities accessible to all. Making our health facilities accessible for all is the need of the hour.

Two approaches may be applied for this:

- Make it compulsory for existing hospitals to become disabled friendly:
 - by giving them time frame for compliance.
 - by giving them punishment if they fail to adhere to the rules and regulations.
- Give licence to new hospitals only if these are disabled friendly.

Case Study

Although the PWD Act promotes accessibility in public buildings, evidence shows accessibility is far below desirable standards in India. A cross-sectional study was conducted in a randomly selected district of North India during October, 2012. District hospital, two community health centres, four primary health centres and four subcentres were evaluated for disabled friendliness using a scoring system based on a pretested questionnaire (access survey and audit checklist) designed by Rehabilitation Council of India (RCI) and Samarthyaa (modified according to our study environment). Various study domains in these facilities were selected and scored according to their importance, as described by disabled people interviewed before the commencement of the study. Individual scores were added up at the end to grade disabled friendliness of public health facilities in this district. Here total score of the health facilities was (39.50/500, i.e. 7.9%), thus falling in 'very poor' grade. None of facility had provision of parking, ramps, automatic doors, handrails, elevators, public telephones or toilets for PWDs. There was no declared policy for making the health centres disabled friendly. Health facilities were far from being satisfactory than to be called *barrier free*. Public health facilities were not barrier free for PWDs (Figures 11.9 to 11.12).



Figure 11.9 Steep ramp without handrail at the entrance of CHCs. Difficult to negotiate this gap independently by PWDs.



Figure 11.12 Shabby toilet at one of the primary health centre.



Figure 11.10 No provision of waiting area outside the primary health centre.



Figure 11.11 Poorly lighted corridors of the community health centre.

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Energy Conservation: A New Facet in Hospital Administration

12

Er PS Saini, Dr Vipin Koushal and Er Sandeep Singh

“Often design strategies for energy efficiency can also have direct benefits for patient outcomes. A recent study has found that daylight in patient rooms helped surgery patients maintain lower stress levels and feel less pain resulting in use of less pain medication and reducing, medication costs for these patients by 22%.”

—Jeffrey Walch

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- about various types of energy sources.
- understand Indian energy scenario.
- know the need for energy conservation.
- describe the Energy Conservation Act, 2001.
- explain BEE standard and labelling programme.
- describe energy conservation opportunities in hospital design and renovation, lighting, boilers, hot water system and HVAC system.
- list the challenges in implementation of energy conservation measures in hospitals.

INTRODUCTION

Energy is a vital parameter for assessing the economic development of a country. For developing countries huge investments need to be made to meet the escalating energy demand. Hospitals function round the clock and consume energy in different forms on a very large scale. They are, generally, large building complexes with critical environmental control to ensure speedy recovery of patients. High-

power intensity equipments/plants are used requiring extensive coordination amongst different wings of engineering. As the equipment gets older, it consumes more energy and the cost of maintenance also increases. Similarly higher heat loss is observed in a worn out or poorly insulated buildings.¹

Energy management in hospitals not only reduces energy costs but also protects the environment by decreasing the levels of carbon dioxide (CO₂) and chlorofluorocarbon (CFC) emission, which is responsible for the ‘greenhouse effect’ (Figure 12.1).²

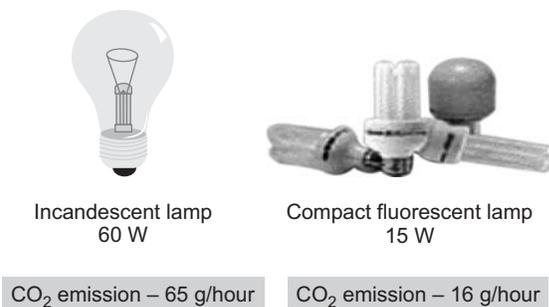


Figure 12.1 Comparison of CO₂ emissions of incandescent and compact fluorescent lamps.

CLASSIFICATION

Energy can be classified as follows:

- Primary and secondary energy.
- Commercial and noncommercial energy.
- Renewable and nonrenewable energy.

Primary and Secondary Energy

Common examples of natural sources of energy are coal, oil, natural gas and biomass (such as wood). Nuclear energy (radioactive substances), thermal energy (earth's interior)

and potential energy (earth's gravity) are some other sources of primary energy. These sources are converted into secondary sources in various industries, for example, conversion of coal, oil or gas into steam and electricity.¹

Commercial Energy and Noncommercial Energy

The energy source that can be purchased from market, irrespective of method of its production is known as commercial energy. It is used mainly for commercial purposes, such as industry, agriculture, transportation, etc. Examples are electricity, petroleum products, etc. whereas traditionally available sources, such as firewood, cattle dung and agricultural wastes constitute noncommercial energy.¹

Renewable and Nonrenewable Energy

The energy generated by replenishable sources like wind power, solar power, geothermal energy, tidal power, hydroelectric power, etc. is known as renewable energy and there is no risk of pollution whereas fossil fuels like coal, oil and gas, which are nonreplenishable are sources of nonrenewable energy.¹

INDIAN ENERGY SCENARIO

The per capita energy consumption in India is 3.8% of world energy consumption. It is increasing rapidly with economic growth and increase in demand of energy.¹

The annual energy consumption in India was 420.6 million tonne oil equivalent compared with the world energy consumption of 11,295 million tonne oil equivalent in 2008. Coal is major source of energy in India and is responsible for more than 50% of the total primary energy generation of the country. India imports about 75% of its crude oil mainly from Gulf nations. At the present rate of energy consumption, oil and gas reserves in India are estimated to last just 20 years and 36 years, respectively, whereas coal is likely to last for 114 years only.¹

ENERGY CONSUMPTION IN HOSPITAL

Figure 12.2 highlights a typical hospital energy use graph. Identifying areas of high-energy use will help hospital administrator to target key areas for improvement and also areas that attract priority for energy conservation measures. From the figure, it can be established that hospitals have an extensive energy demand for heating, ventilation and air conditioning (HVAC), lighting equipment, sterilisation, laundry and kitchen. On an average, lighting (15–20%) along with water heating and HVAC (40–50%) are responsible for major cost of hospital's energy bill (however, in Indian context, energy requirement for water heating is significantly lower). Therefore, these areas present opportunities for significant savings. Studies show that through an

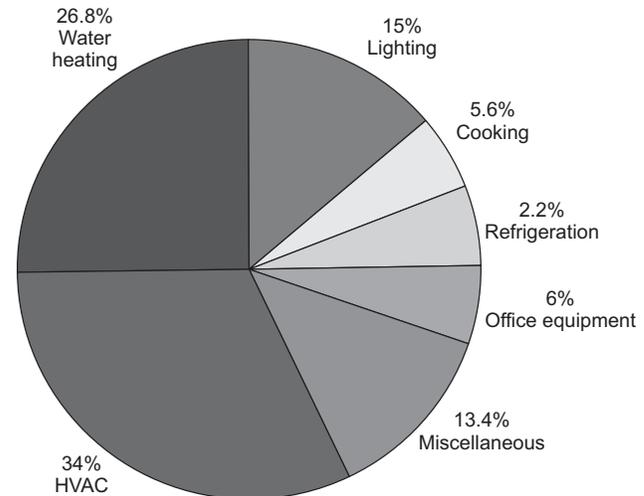


Figure 12.2 Energy consumption in different areas of a hospital.

efficient energy management plan a hospital could save energy from 25 to 45%.³

Various Energy Streams in a Hospital

The energy requirements in a hospital are met by various conversion procedures and there is a lot of scope for energy conservation. Various energy streams used in a hospital are as follows:

- *Electricity* is used in hospitals mainly for cooling/heating equipments, lighting, air compressors, water pumps, fans and ventilation systems. The other areas utilising electricity are medical equipments, laundry equipments, kitchen and canteen equipments.²
- *Heat stream* is used in Central Sterile Supply Department (CSSD), laundry, kitchens and for water heating. It also transports heat from the generating station and is converted to hot water at destination ports. Boilers consume oil or gas for this purpose.²
- *Compressed air* is supplied in two forms: Medical air (4 kg/cm²) and technical air (7 kg/cm²). Former is used for direct treatment of patients by the means of ventilators and medical gas pipeline system, while the later is used in CSSD, workshops and in operation theatres for surgical tools, etc.²
- *Cold stream* in the form of chilled water is used for indoor climate control systems. Large central air conditioning plants using centrifugal/screw compressors are usually installed to generate cold stream.²

Energy Guzzlers in Hospitals

High-energy consumption in hospitals is driven by following specific needs:

- Temperature, humidity and number of air changes need to be regulated to maintain optimum indoor air quality

(IAQ), thus increasing the need for sophisticated heating, cooling and controlling systems.

- Stringent IAQ levels needs to be maintained in operation theatres, high-dependency units, intensive care units, laboratories, etc. with 20–30 air changes per hour. Areas like isolation wards have special positive and negative pressure requirements for protective isolation from air-borne infections.⁴
- High-efficiency particulate air (HEPA). Filtration is required for preventing hospital-acquired infection. With installation of 99.7% efficiency HEPA filters, the electric demand of blowers increases drastically to make up for the pressure drop across the filter.⁴
- Laundry facilities, kitchens and CSSD use equipments that are highly energy intensive and contribute to significant energy consumption.⁴
- Electrical supply in hospitals has to have 100% uptime for ensuring proper functioning of the critical care equipments, viz. ventilators, multiparameter monitors, defibrillators, etc. This requires installation of standby generators which also contribute to increased energy consumption.⁴

NEED FOR ENERGY CONSERVATION

Indian economy is growing at a rapid pace, leading to large-scale industrialisation. A 6% increase in economic growth in Indian context leads to 9% growth in energy consumption. At this rate of economic growth, the installed capacity of electricity generation has to be doubled in the next 5 years from the existing capacity of approximately 205,000 MW. Further, the installed power system is already inadequate to meet the existing demand (shortage of 8–10%). This would require a huge investment as installation of 1 MW capacity power plant costs around 4–5 crore rupees. On the other hand, the energy intensity per unit gross domestic product (GDP) of India is 3.7, 1.4 and 1.5 times that of Japan, Asia and USA, respectively reflecting high-energy wastage. Hence it was realised by the government that there is a huge potential for energy conservation in India and that they need to work on energy conservation and energy efficiency in various sectors. Energy expenses constitute a significant component, estimated to be 15–20% of the operation and maintenance cost of a hospital, thus attracting attention of hospital administrators for potential saving.¹

The Energy Conservation Act, 2001

High energy-saving potential and its benefits to bridge the gap between demand and supply prospective reduction of environmental emissions, through energy saving, led to the enactment of the Energy Conservation Act, 2001 by the Government of India. The act has legal framework and institutional arrangement to ensure energy efficiency.¹

Bureau of Energy Efficiency (BEE) has been established during March 2002 under this act and is responsible for implementation of policy programmes and coordination of implementation of energy conservation activities in the country.^{1–5}

Vital features of the act are as follows:

Standards and labelling

It is a vital activity for improving energy efficiency and to ensure that only energy-efficient equipment and appliance would be manufactured and sold in the country. The main provisions of energy conservation act (ECA) on standards and labelling are¹:

- Evolve minimum energy consumption and performance standards for notified equipment and appliances.
- Prohibit manufacture, sale and import of such equipment, which does not conform to the standards.
- Introduce a mandatory labelling scheme for notified equipment appliances to enable consumers to make informed choices.
- Disseminate information on the benefits to consumers.

‘Star rating’ based upon energy efficiency has already been assigned to number of electrical appliances including air conditioners, motors, fan, refrigerators, transformers, etc. Now, users are able to make an informed decision regarding energy expenditure of the electrical appliance they are buying. Table 12.1 indicates that more the number of stars higher the energy savings. It also gives a glimpse of energy and cost saving.

Energy conservation building codes

The main provisions of the ECA on Energy Conservation Building Code (ECBC) are:¹

- The BEE would prepare guidelines for ECBC.
- These would be notified to suit local climate conditions or other compelling factors by the respective states for commercial buildings erected after the rules relating to ECBC have been notified.
- Energy audit of designated commercial building is prescribed.

The ECBC-2007 has already been published to provide minimum requirements for energy-efficient design and construction of buildings. It would be applicable to building complexes that have connected load of more than 500 kW. ECBC covers building envelope, HVAC system, lighting system, hot water and electrical power system. This code would become mandatory as and when it is notified by the central and state government in the official gazette. However, a number of organisations, including CPWD AIIMS, New Delhi, and PGIMER Chandigarh have already started complying to various provisions of the code.

Table 12.1 Cost estimates of energy consumption by an air-conditioner according to star rating.

Star rating	Cooling capacity (watt)	Minimum energy efficient ratio (EER)	Input power (watt)	Approx. usage hrs/day	Unit consumption/day (kWh)	Per unit charge (approx.) (Rs)	Electricity cost per month (Rs)
1 (One)	5200	2.30	2261	8	18.1	4.00	2170.43
2 (Two)	5200	2.50	2080	8	16.6	4.00	1996.80
3 (Three)	5200	2.70	1926	8	15.4	4.00	1848.89
4 (Four)	5200	2.90	1793	8	14.3	4.00	1721.38
5 (Five)	5200	3.10	1677	8	13.4	4.00	1610.32

Designated Consumers

The main provisions of the ECA on designated consumers are¹:

- The government would notify energy-intensive industries and other establishments as designated consumers.
- Schedule to the act provides list of designated consumers, which covered basically energy-intensive industries, including railways, port trust, transport sector, power stations, transmission and distribution companies and commercial buildings or establishments (Hospitals fall under the category of commercial buildings).
- The designated consumer to get an energy audit conducted by an accredited energy auditor.
- Energy managers with prescribed qualification are required to be appointed or designated by the designated consumers.
- Designated consumers would comply with norms and standards of energy consumption as prescribed by the central government.

The Government of India has already notified designated consumers in nine sectors and notification for commercial building sector, which includes hospitals, is expected shortly.¹

ENERGY CONSERVATION OPPORTUNITIES IN HOSPITALS

Hospitals are unique in design, size and various specialised services they provide. Their engineering services must be designed and adjusted to meet the requirements of many different areas including surgical, clinical, laboratory, administrative offices, etc. These requirements are met through proper design and operation of the building and its technical systems, such as moisture barriers, thermal insulation, heating, ventilation air-conditioning (HVAC) and lighting. When considering energy-saving measures, the critical environment control of different areas cannot be compromised. The maintenance manager is challenged to accomplish energy savings while dealing with many complicating factors. Scheduled maintenance cannot interfere with round-the-clock operation of the hospital. A large amount of outside air is needed to dilute odours, and ventilation is required even when critical spaces are not in use to maintain pressure relationships. Energy conservation opportunities can be

explored in the energy-intensive systems of hospital infrastructure through implementation of following measures.

Hospital Design and Renovation

Hospital buildings, once constructed, are often used for longer period than they are designed for. However, during this period, they are retrofitted and renovated many times. This process of continuous renovations challenges previous system designs as well as offers opportunities for system upgrades to address new and existing energy issues. Ideally energy efficiency measures shall be embedded at the stage of conceptual design of the hospital. However, they can also be introduced while retrofitting work is being envisaged. If a plant or equipment has to be replaced anyway, it is only the additional cost that needs to be considered for calculating the payback period for energy-efficient installation. While calculating payback period it is also important to recognise the thermodynamic linkage between retrofit projects, for example, reduction in the heat generated by lighting fixtures would reduce the load on air-conditioning plant.³

Orientation of building plays a key role in structures that require air conditioning (AC). Excessive use of glass, especially on the western side adds to the AC load. Using material, such as foam, concrete, double wall glazing and insulated roofing reduces AC load.

Lighting

A simple measure to control the energy used in lighting is reduction in the supply voltage to lighting loads from 230 V, using the energy-saver controls. This can bring down the power consumption by, as high as, 5%, without any significant reduction in lumen. Designs to realise the therapeutic impact of daylight, often, result in unwanted effects of glare and overheating. Having sunshades and blinds, etc., which can be automatically controlled by sensors, offers maximum utilisation of daylight.

Motion sensors and photosensors may be installed in administrative offices of staff, doctors and students to reduce the wastage of energy on lighting. Timers may be installed in outside lighting, as appropriate, excluding the emergency access areas. Timing can be adjusted according to different seasons. Zones using alternative lights may be created, with

each zone turning on and off at a gap of time. Zoning can also be implemented in corridors and lobbies of the hospital building along with the faculty offices, which are not operational at night. The zoning is done by using timers for the lights to turn on and off. It is recommended that CFL light fixtures be used as they consume 75% less power than incandescent lamps for the same lumen output. They produce less unwanted heat and last 8–10 times longer. Light emitting diode (LED) based lighting fixtures are now available which have even better efficacy and life. Though installation cost at present is high it is expected to reduce with increased usage.

During the period 2005–2012, PGIMER has taken a number of energy-saving measures in lighting and one of them has been elaborated below.

Case Study 1: Replacement of conventional fluorescent tube fitting with T-5 energy efficient tube fitting (2005–2006)

The Nehru Hospital of PGIMER has an operation theatre complex comprising of 18 operation theatres. The operation theatres were equipped with conventional tube fittings of 1 × 40 W since more than 20 years. Manufacturer of 28 W energy efficient tube fittings 'T-5' introduced their product to us. During the demonstration, following features were noticed:

- No requirement of any ballast, tube starter capacitor, etc. instead an electronic circuitry is used.
- Instant, flicker-free start.
- Saves energy up to 45–50% against conventional tube fittings of 40 W.
- No humming sound or heat decapitation, which enhances the energy saving of 5 W (approx.) on account of air-conditioning load.
- Efficacy of 104 L/W against efficacy 60 L/W of conventional FTL.
- Theoretical computation of energy savings after replacing existing 190 tubes.

Energy consumed by a conventional fluorescent tube light	53 W
Energy consumed by 4' E+ 28 W tube light	28 +/- 1 W
Average power savings/E+	24 W
Power tariff (as prevalent in Chandigarh)	Rs 4.00/kWh
Saving/Tube fitting/year (for 8-hour operation)	8 × 365 × 24/1000 = 70.08 kWh/year = 70.08 kWh @ Rs 4 = Rs 280.32
Therefore annual saving for 190 fittings	Rs 280.32 × 190 = Rs 53,260
Net annual energy saving	Rs. 53,260 per year
Cost of the 'T-5' fittings	Rs. 978 each
Net cost	190 × 978 = Rs 185,800
Simple payback period (net cost/saving)	= 185,800/53,260 = 3.49 years

Boilers and Hot Water Systems

By monitoring multiple points on steam systems, we can detect performance reduction that occurs gradually over a period of years. Scale reduces the efficiency of the boiler and can lead to overheating and cracking of tube ends. Boilers should be inspected for scale deposits, accumulation of sediments, or boiler compounds on waterside surfaces. Good water treatment is essential to maintain efficient performance and also extends boiler's life, thus reducing cost of repair. A proper chemical treatment programme ensures clean surfaces and good thermal exchange in boiler tubes. Periodic inspections of burner adjustments are required to ensure proper fuel-to-air mix.

Decreasing load, significantly, reduces the operating efficiency. Most boilers achieve maximum efficiency only when they are run at their rated output. It is important to evaluate part load performance conditions. Boiler load characteristics should be evaluated to optimise operation for staging and warm-up of boilers. Often, boiler plants are over-designed for the occasional worst-case conditions. Current hospitals boiler designs incorporate modular boilers which can absorb fluctuations of load more efficiently.

To increase energy efficiency of boilers, installation of flue gas and water heat recovery system to preheat hot water and air before they are supplied to boiler may be considered.³

Case Study 2: Installation of boilers with heat recovery devices

While replacing old boilers in central boiler house, new boilers are procured fitted with external air preheater (APH), in addition to economiser and other standard accessories. It is a once through, coil type, instant steam generator and a fully automatic package boiler with all the necessary accessories on a common chassis. Economiser and APH are shell and tube heat exchanger. The new boilers have higher efficiency of 92% compared to 89% of old boilers (without APH) (Figures 12.3 and 12.4).



Figure 12.3 Old inefficient boilers.



Figure 12.4 Replaced boilers.

The original equipment manufacturer (OEM) submitted the energy saving calculations compared to same capacity boiler without air preheater (Table 12.2).

Table 12.2 Energy saving calculations submitted by OEM.

Fuel cost (Rs/Kg)	29.41 (25/L)
Number of operating hours/day	8
Number of operating days/year	250
Cost of Power (Rs kW)	4.5
Capacity FA 100°C (kg/hour)	850
Increase in efficiency	3%
Efficiency of boiler without APH	88%
New efficiency	91%
Fuel saving (kg/hour)	1.78
Annual monetary saving	104699.6
Power consumption in boiler without APH (kW)	1.30
Blower operating pressure (mm WC)	220
APH pr. drop (Additional) (mm WC)	25
New power consumption (kW)	1.40
Increase in power consumption	0.1
Operating cost increase due to increase power (Rs/hour)	0.5
(Rs/year)	1000
Net annual monetary saving (Rs/year)	103,699.6

HVAC System

HVAC system consumes highest energy in modern hospitals. The energy consumed is sensitive to load changes, seasonal variations, operation and maintenance, etc. Hence, performance evaluation of HVAC system is required to estimate energy consumption at a higher/lower load, as compared to designed conditions. HVAC control system is tuned and balanced to a minimum flow to reduce blower/fan pump power requirement, in accordance with the evaluation.

The energy consumed by chillers is the largest operating costs in HVAC system. Energy efficiency of chillers has improved significantly over the years. Chillers with higher energy efficiency ratio may have higher initial cost but consumes lesser energy. New control systems are microprocessor based and can perform control functions, which were not possible with electromechanical type systems. Chiller controls can now be interfaced with building management systems to match the chiller operation, according to requirements of the building. As with boilers, it is important to evaluate part-load performance conditions for chillers.³

Regular maintenance contributes significantly to energy saving in HVAC system. Cleaning of filters, descaling of the heat exchangers, lubrication of friction points such as motors' fans, regular inspection and plugging of leakages in pipeline, setting of thermostats, timers and controllers, etc. should be done regularly. Simple measures like setting indoor temperature to highest point, (5.5°C increase in evaporator temperature reduces electricity consumption of compressor by 20–25%), cleaning of heat exchangers when fouled (1 mm scale on condensers' tube can increase fuel consumption by 40%) can result in significant energy saving.

It is reflected from above that improved maintenance and operation procedures, coupled with moderate investments, yield significant improvement in energy conservation in HVAC system.⁶

DIFFICULTIES IN IMPLEMENTING ENERGY CONSERVATION MEASURES

- *Lack of awareness:* It is the biggest barrier to the implementation of energy conservation and energy-efficiency programme. Decision makers are often not aware of potential gains from improved efficiency. Vital issues, such as tariff credits, benefits of depreciation, electricity price escalations, life cycle costing of the investment needs the attention of decision makers.¹
- *Lack of education and training:* There is a shortage of educational opportunities in the field of energy management. Adequate infrastructure, along with trainers, needs to be created. Though BEE has started creating a work force of energy managers and energy auditors by conducting national level certification exam, it will take some more time to fill the void.¹
- *Economic and market distortions:* The conservation measures do not get optimum response because of inappropriate pricing and other market distortions. It takes higher manufacturing cost to produce an energy-efficient equipment/appliance and cannot match the price of inefficient one.¹
- *Lack of standards and labelling:* Though energy labelling has been implemented for number of appliances in the country, as already mentioned, there is still a long way to go.¹

- *Lack of financing:* Hospital administrators are still concentrating on core activity of patient care while making funds allocation without realizing economics of life cycle benefits of spending in energy efficiency/conservation projects. Enough finances have not been invested in energy conservation/energy efficiency projects in hospitals in our country.¹

Hospitals are large consumers of energy in varied forms. They offer tremendous opportunities for energy savings ranging from 25 to 45%. Hospital administrators need to frame/declare energy policy of the hospital. Regular energy audits and implementation of energy conservation measures would not only reduce energy bill but also contribute towards reduction in environmental degradation.

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Clinical Services

Section IV

SECTION OUTLINE

Chapter 13 Outpatient Department Services

Chapter 14 Management of Wards/Indoor Services

Chapter 15 Operation Theatre Services

Chapter 16 Health-promoting Hospital Emergency Department



Outpatient Department Services

13

Dr Rakesh Sharma and Dr Sonu Goel

“Outpatient department is considered as the shop window of the hospital.”
—Anonymous

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the various aspects of planning and organisation of OPD services.
- Independently evaluate the quality of OPD services of any hospital

INTRODUCTION

Outpatient care was once on the sidelines; and having been originally designed with a limited scope, it offered only basic, minor services. There has been a paradigm shift in outpatient department (OPD) services with the emergence of new concepts in healthcare industry like medical tourism and contractual system. The generation of today no longer desires to remain at the receiving end; so the healthcare providers have to offer the options. The hospitality of the hospital these days should match that of a five star hotel in several aspects. In the present scenario, the outpatient department is named as “the shop window”¹ and the reputation of any hospital can be made or marred by its OPD. In today’s fast-changing world, customers look for hassle free, smooth, efficient and quick services. Therefore, all over the globe outpatient care has emerged as a major service, encompassing a wide range of treatment, diagnostic tests and minor surgeries, several of which required hospitalisation, earlier.

TYPES OF OUTPATIENT DEPARTMENT

Centralised

In this system, all the OPDs of clinical departments are clubbed together in the form of a separate, stand-alone OPD complex. The complex also includes the necessary diagnostic and therapeutic services along with daycare operation theatres.

Decentralised

In this system, the OPD care is provided in the respective department of the hospital along with necessary diagnostic and therapeutic services. With the concept of advanced therapeutic centres within big institutions, these dedicated centres have the provision of inhouse OPD services catering to the needs of that particular specialty, e.g. advanced eye centre and advanced cardiac centre, etc.

IMPORTANCE OF OUTPATIENT DEPARTMENT

In developing nations like India where bed population ratio is low, the OPD services need and assume vital importance. Most of the time, OPD is the first point of contact between community and the hospital staff.² The behaviour, empathy and attitude of healthcare workers help a great deal in shaping the image and generating the trust of the people in the hospital. Human relation skills of the healthcare providers play a vital role in managing overburdened OPD services. The staff to be deployed, therefore, needs to be selected carefully and subsequently trained to be courteous, smiling, efficient, cooperative and last but not the least, practical. The well-developed OPD reduces the number of admissions to a hospital and ensures the admission of only those patients who are really sick and need inpatient care. It reduces the mortality and morbidity, and in general, contributes towards health promotion and disease prevention.

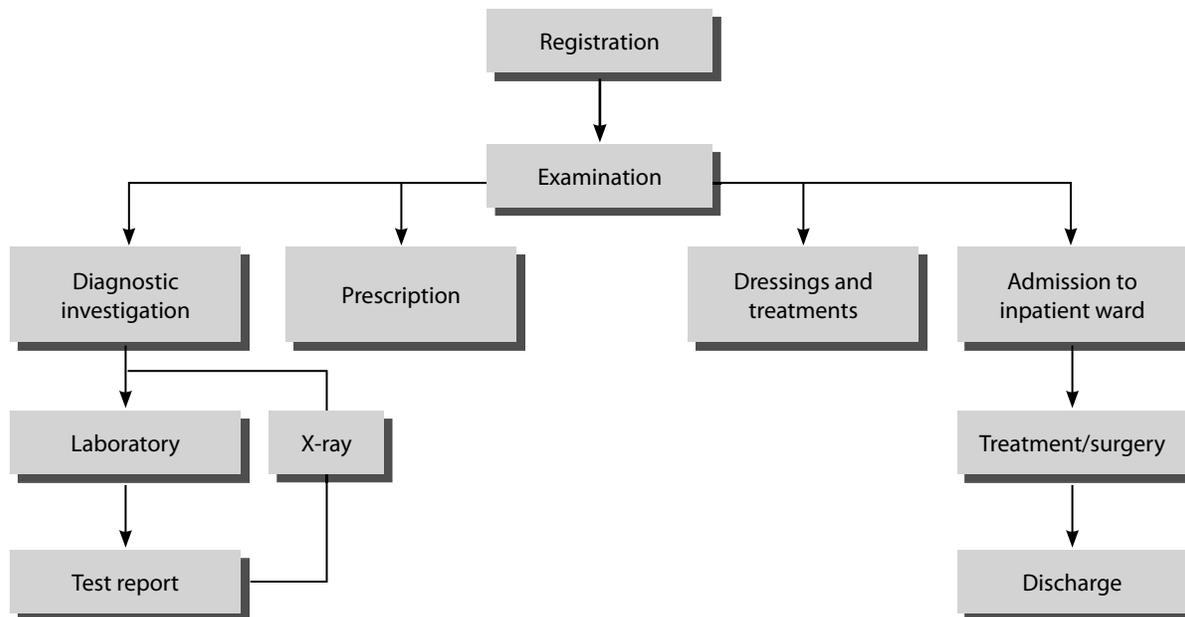
CURRENT SCENARIO

In a hospital, medical care has been traditionally centred on inpatients rather than outpatients. The various activities in a hospital, like the organisation of the hospital, the clinical and administrative services, the nursing, dietary and pharmacy services, teaching and medical research, etc. have been largely focused on the hospitalised patients. Though all this will continue to be true, still emphasis must now also be placed upon the ambulatory patients in need of medical care. Since World War II, the growth in ambulatory services in all hospitals has been tremendous. This growth is the result of overall trends and changes in practice of medicine, the development of healthcare facilities, and the increasing demand for more comprehensive health and medical care. The most important among this is the rising cost of hospital care and relative shortage of hospital beds in relation to the needs. The economic importance of the role of outpatient care can be illustrated by the study in Sweden, where the cost of treatment for one million hospitalised short-term patients corresponded to the cost of 20 million visits in outpatient facilities.³ Moreover, modern medical practice, with the concept of active and early ambulation, aims to shorten the period of rest in bed and/or hospitalisation after the critical period is over. Such patients will need some form of post-hospital treatment and rehabilitation after discharge in order to ensure complete recovery. The outpatient service in an ambulatory care centre, also called polyclinic, health centre, walk-in clinic, day hospital, dispensary, etc., serve as a part of hospital or provide care standing free.⁴

FUNCTIONS OF OUTPATIENT DEPARTMENT

The functions of outpatient services are to provide diagnostic, curative, preventive and rehabilitative services on an ambulatory basis to the people of the community. The major functions as earmarked by the World Health Organisation (WHO) expert committee⁵ are as under:

- Early diagnosis, using the best-possible modern medical techniques, including prophylactic examinations for the detection of undiagnosed diseases.
- Ambulatory and domiciliary treatment of all cases that can be treated at the clinic or at home.
- Admission or referral for admission to the hospital of those patients who need it. About 80% of the total admissions in inpatient departments are admitted through OPD.
- Aftercare and medical rehabilitation when necessary after discharge from hospital.
- Promotion of health of the individuals under their care by means of health education.
- Training of medical and nursing students, paramedics and nursing staff.
- Maintaining of records and collection of data for epidemiological and social research.
- Voluntary counselling and testing centre (VCTC) for human immunodeficiency virus (HIV), acquired immunodeficiency syndrome (AIDS), directly observed treatment supervised (DOTS) centre for treating tuberculosis, etc.
- Screening of patient before hospitalisation.



Flowchart 13.1 Functions of outpatient department.

The functions of OPD are shown in Flowchart 13.1.

The other specific preventive care activities that can be adequately carried out by outpatient department are:

- Well-baby clinics and obstetric consultation, including marriage counselling and planned parenthood.
- School health programme, specially, if the hospital is serving a close community, like the armed forces, factory establishment.
- Early diagnosis and detection of noncommunicable diseases like rheumatic heart diseases, hypertension, diabetes, psychiatric cases, etc.
- Epidemiological surveillance centre for many diseases—both communicable and noncommunicable.
- Sentinel centre for some communicable diseases, e.g. district hospitals are the sentinel centre for the vaccine preventable diseases, mainly polio and tetanus.
- Health education and advice on nutrition and dietetics.
- Rehabilitation and prevention of handicaps and disabilities.

EXPECTED WORKLOADS

There are certain factors that decide the number of patients utilising outpatient services.⁶ Some of them are:

- Location of the hospital.
- Availability of other healthcare facility in the vicinity.
- Policy and available resources.
- Population and their needs
 - Socioeconomic, cultural and educational status.
 - Prevalent disease pattern.
- Transport facilities.
- Season of the year.
- Geographic and topographical factors.

PLANNING OF OPD

Hospitals must pay as much attention to proper planning, designing, organisation and functioning of the outpatient department as for any other department. Some features of the outpatient department are maintained separately from the inpatient services. Nevertheless, the two should be integrated physically, functionally, and also from the clinical and administrative point of view. This is because in most cases the patient is being given treatment in the outpatient department up till the time he is hospitalised. He is then admitted and cared for as inpatient, until he is referred back to the outpatient department, where his treatment is continued. Besides, as an outpatient he has his diagnostic tests and procedures in the ancillary and adjunct services that are integral parts of the hospital. The advantage of treating the patient in the outpatient department is that it eliminates the need for or reduces the length of hospitalisation and consequently the cost to the patient as well as to the nation.

As it has already been mentioned, the main functions of the OPD are diagnostic, curative, preventive, educative, promotive and rehabilitative. Also, the trends indicate that the need for and use of OPD services will increase, and will almost double in every 7–10 years. So, when the planning is done, it should be advanced enough to cater the needs of coming 30 years.⁷ Keeping all these in mind, outpatient department must be developed on certain basic principles. Some of these principles are:

- Form follows function: The building and its facilities must express the primary function or activities to take place within it. Architectural, aesthetic or other considerations must be secondary to the primary function.
- Maximum flexibility and expendability in future should be taken into consideration at the onset.
- External and internal traffic pattern must be simple, clear-cut, easily understood and as short as possible.
- Maintain physical and functional integration with the inpatient department and other services of hospital.
- Labour-saving devices and automations must be utilised to the maximum in order to reduce operational expenses, and gain maximum utilisation of professional time and skill in patient care.
- In building any new facility, the old must adjust to the new. Functional operation of the new facilities must not compromise or not be compromised by existing buildings.

Location and Timings

The OPD complex should be totally detached and stand-alone unit from the main hospital. However, it should have a direct access from the entrance of the hospital/main road, and have sufficient parking space (in fact a multilevel parking). The movements of the patient should be in one direction and undue back trafficking should be avoided. The major diagnostic facilities like computerised tomography (CT) scan, magnetic resonance imaging (MRI) and positron emission tomography (PET) scan, etc. should be shared with indoor area of the main hospital.

It should be decided on the basis of local climatic conditions and organisational needs. Timing must be followed strictly and consultants should reach the OPD in time, which creates a good impression in the minds of general public. It is recommended that OPD shall work 6 days in a week with facilities of morning and evening clinics. The timings for morning OPD may be from 0800 to 1300 h and afternoon OPD shall have clinics from 1400 to 1600 h. The timings can be changed to suit the local and organisational needs.

Size

The size of the OPD depends upon the volume of attendance, the clinics provided, and the extent of other facilities

like laboratory, blood bank, health education programme, operating facilities and an emergency department. As it is already mentioned, it should be so laid that there is always a scope of future expansion.

It is observed that on an average one person roughly visits the OPD three times in a year, from a given community. This means that if the area catered by an OPD is having 1,00,000 population then the number of visits in that OPD in a year will be 3,00,000, i.e. for 1,00,000 population = 3,00,000 patient visits in a year.

There is no universally accepted method available based on which the space requirement of the OPD could be determined. The space requirement calculated by this method will take care for the increase in workload and expansions for next 30 years.

Physical Facility

Physical facilities can be discussed under the following heads:

- Patient's area
- Clinical area
- Administrative area
- Circulation area

Patient's area

- *Entrance:* It should have wide glass doors with locking facility, fitted with closed-circuit television (CCTV) cameras. This should be designed in a way such that:
 - It is easily accessible from the main entrance of the hospital, with direct approach from the main road.
 - It is segregated from the inpatient department.
 - It should be on the ground floor, with wide road and space in front to provide drive-in and landing area to the patient.
 - It has easy access to hospital diagnostic facilities and other support services.
- *Security office:* It should be adjacent to the entrance with a telephone facility and provision of CCTV with monitors to ensure smooth flow of traffics. It also registers the complaints about lost and found items, misbehaviour by staff, etc. Security staff on duty can also help in escorting very-important persons (VIPs) to the concerned clinical area.
- *Trolley and wheelchair bay:* It should have adequate number of clean and serviceable cushioned trolleys and wheelchairs along with dedicated trolley men on duty to help the relatives in loading and unloading the patients from ambulance/personal vehicles.
- *Reception:* Patient-friendly reception counters with telephone facilities and computers for dissemination of essential information to patients and their relatives should also be present near extension. It should have a public announcement system for lost-and-found items, etc. A separate chamber for assistant public relations officer

(APRO) may also be incorporated to supervise the work of receptionists.

- *Registration:* Separate counters for new registration and follow-up cases should be planned. There should also be separate counters for senior citizens and physically challenged persons. This waiting space should be in front of registration counter and must have proper seating arrangements with ceiling fans and provisions for essential commodities like telephone booth, drinking water, separate toilets for ladies and gents, etc. One toilet should be provided for every 200 patients and/or visitors (male and female toilet separately). If the patient load is high for each specialty, registration counter can be placed for each specialty.
- *Fee counters:* There should be a multifacility and multiple counters in OPD complex of hospital where fees of various tests/consultation can be deposited in cash or through credit cards.
- *Medical record room:* This could be created just behind the registration counters for quick retrieval of old files. Some hospitals have policy for the maintenance of old records for 10–15 years. Efforts should be made to maintain electronic medical records, which can easily be assembled on computer by entering name or any other particulars of patient.
- *Help desks:* Help desks are extension of reception wing and could be placed at different levels of OPD complex (essentially at ground floor) with 'May I Help You' signage to guide the patients and their attendants.
- *Display of signage and colour codes:* The adequate bold signage at the main entrance as well as at the ramps, stair cases and circulation/waiting area should be in place—in English, Hindi and the regional language. Floorwise signage on the similar pattern should also be provided. There should be proper signage system for literate patients/relatives and colour codes for illiterate patients/relatives. The signage and the colour codes must be starting from the enquiry and registration counters, and should end at the respective clinic and/or service areas. So the person sitting at the enquiry or registration counter can simply ask the patient to follow the colour line to reach his/her required clinic/department/service area.
- *Citizens' charter:* The rights of the visitors should be known to them; the people must know about the services available in the OPD, the OPD schedule, consultants available, the charges for each service and any holiday on which the OPD is scheduled to be closed.⁷ The entire information should be displayed at OPD complex at multiple sites and also be available on the official website of the hospital. The same should be updated regularly by a dedicated official.
- *OPD booklet:* A booklet must be available in the enquiry/registration counter (given free of cost or on payment of very nominal charges), which should have information about the different clinical and diagnostic facilities available along with names and days of consultants. It might

go a long way to reduce the confusion and waiting time for the patients.

- *Newspaper*: stands should also be provided so that the waiting time can be utilised. Any leading newspaper publisher shall be pleased to provide these stands and daily newspaper free of cost.
- *Basic amenities*: It should have all facilities as mentioned in waiting area outside registration counter. Public toilets and separate washroom facility for males, females and physically challenged persons along with drinking water facility fitted with water filters should be in place.
- *Chemist shop*: There should be a provision of chemist shops in OPD complex, which should cater to the needs of OPD patients.
- *Cafeteria*: A spacious cafeteria with provision of separate enclosures for general public and staff members should be provided. It should operate in OPD timings, i.e. from 8.00 am in the morning till 5.00 pm in the evening; and the quality of food should be regularly checked by the hospital authorities. Tea-/coffee-/soup-vending machines should also be there.
- *Public call office (PCO)*: In spite of the large number of mobile users, the need to have a public call office (PCO) in the OPD continues. PCO kiosk should have the photocopier machine, fax and internet facility.
- *Mobile charging facility*: It is essential these days to provide mobile charging stations with multiple points to the public, since a large number of patients visiting OPD are mobile users. Any mobile company will be pleased to provide such mobile charging stations free of cost.
- *ATM counters*: Since this is an era of plastic money and a large number of visitors come from distant places, there should be a provision of automated teller machine (ATM) in the OPD complex. A space of 3 × 2 m may be rented out to a nationalised/corporate bank for this purpose.
- *Audiovisual and reading material*: It is desirable to have TV sets with cable connection in all the waiting areas to avoid boredom of the patients. These TVs can also be used to disseminate health education by running CDs/DVDs related to health education and promotion. Health-related books/magazines may also be available for sale.

The list is unending and any other facility that is required in the changing scenario may be incorporated in the OPD areas, depending on the space and number/profile of patient load.

Clinical areas

The clinical areas in the form of consultation chambers can be planned on different sections/floors of a hospital. Each clinical area has a subwaiting area where the patients land after the main registration. Every clinical area should have a token display system and calling device (displaying monitor and public announcement system) for patients

(in case patients wait for their turn) so as to avoid long queues outside a consultation chamber.

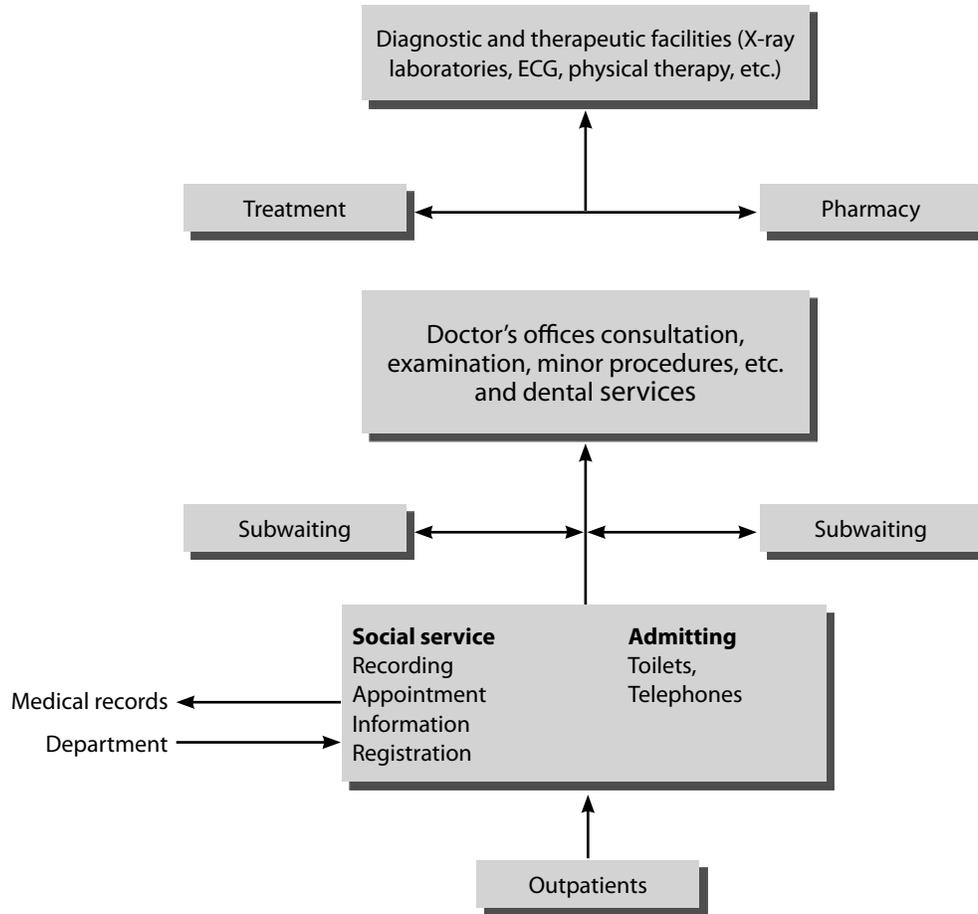
- *Consultation room*: There should be a provision of doctor's chair, table, two visitor's chairs, patient's stool, attached computer table, washbasin, examination couch, examination equipment, investigation forms and X-ray view box. Ideally the area should be 16–18 m².
- *Examination room*: Proper lighting and ventilation should be provided in the examination rooms. The illumination of the examination room should not be less than 500 lux. There should be a provision of emergency light as well. In the current scenario, certain state-of-the-art gadgets are becoming a part of OPD services and there should be a provision to install the same.
- *Minor OT*: Minor surgical procedures like removal of stitches, drainage of abscess and biopsy, etc. are to be done here. This reduces the inpatient load and simultaneously curtails the multiple visits of patients.
- *Dressing room*: There should be a provision of separate dressing room to take care of postoperative cases coming for follow-up.
- *Injection room*: All the injections/immunisations should be carried out here. There should be separate refrigerators for keeping vaccines, sufficient number of staff nurses, emergency crash cart/oxygen cylinder, etc. to handle any anaphylaxis/emergency situation.
- *Plaster room*: This is an integral part of orthopaedics OPD; and there should be separate staff to apply/remove plasters and carry out minor procedures.
- *Day care centre*: OPD complex should have medical day-care centre where the ambulatory cancer patients are retained from 3–4 h and administered chemotherapy on OPD basis. The patients undergoing biopsy of liver and kidney, etc. can also be observed for 2–3 h, rather than admitting them in main hospital for these procedures. This could be in the form of a big hall measuring approximate 200 m² fitted with central oxygen supply and central suction to accommodate 10–12 hospital beds with dedicated and trained nursing staff to administer chemotherapy/patient care. During this period, the prescribing consultants are available nearby in the OPD complex itself to provide medical cover.
- *Pharmacy*: There should be centralised pharmacy in the OPDs to cater the needs of all the patients. Number of counters can be planned, depending upon the patient load. Studies can be conducted by queuing theory—one dispensing chemist dispenses on an average around 80–120 prescriptions/day depending on the number of drugs/prescription. It should store all the essential and adequate desirable medicines. The dispensary should be located in an area conveniently accessible from the clinics and near the exit. The pharmacist must be trained to instruct the patients about the medication (number and times of the day to be taken) and special instructions, if any, such as, keeping medicines in refrigerator, etc.

- **Laboratory services:** One of the major objectives of OPD is effective and efficient functioning so that the number of patients requiring admission can be minimised. To achieve this objective, it is essential that laboratory and imaging investigations should be undertaken to ensure screening of patients at the OPD itself. The various functional units of this zone are as follows:
 - **Central specimen collection centre:** This is the area where all specimens like blood, urine, stool, sputum, etc., which are to be examined for various routine, microscopic, biochemical and pathological examinations are to be collected. After collecting these specimens at one single place, they are further sorted out and sent to the respective laboratories. By doing so, the patients need not roam around all over the places in search of their required laboratories. Also, the arrangement will save lot of time and confusion for both—patients and OPD staff.
The basic haematological and biochemistry investigations can be carried out by using autoanalyzer in the OPD complex itself.
 - **Fine-needle aspiration cytology (FNAC) room:** Fine-needle aspiration cytology (FNAC) is an OPD procedure these days and can be conveniently carried out in the OPD itself to save the second visit of the patient. The samples can be carried to the main pathology department for further processing.
 - **Radiology:** All types of X-rays, ultrasonography, mammography and bone density should be carried out in the OPD itself. The patient may be sent to main hospital for CT scan, MRI and other invasive procedures related to radiology, but the appointment for the same may be given in the OPD itself to avoid inconvenience to the patients.
- **Blood bank:** Though the blood transfusion is not carried out in the OPD of most hospitals, but it is a right place for motivating the relatives of the patients to donate blood in cases of planned surgery. So, the provision for blood donation can be made available in the OPD itself.
- **Medical and social work:** There should be an ear marked room in OPD complex for accommodating a medical social worker able to communicate with patients and their relatives, and should also assist poor patients who cannot afford hospital fees or other such expenses.
- **Counselling services:** This is specially required for pre- and post-HIV test counselling. Trained counsellors—both male and female—should be deployed for this purpose. The confidentiality of the patients must be ensured in every aspect.
- **Family welfare clinic:** The clinic should provide health education besides preventive, diagnostic and curative facilities for maternal and child health, and school health. Treatment room in this clinic should act as operating room for intrauterine contraceptive device (IUCD) insertion and various immunisations, along with proper follow-up. Also the people should be educated to adopt new methods of family planning and comprehensive maternal and child care.
- **Geriatric clinic:** Consequent to an increased life expectancy in India—from 40 years in 1951 to 64 years today—the estimated number of elderly people in the country has gone up to 90 million. This subgroup of population has special needs and thus requires special attention for special subgroups of problems. Geriatric clinic can be planned in the afternoon where all the concerned consultants are available to address the age-related problems of this subgroup.
- **Home care programmes:** Another emerging dimension of ambulatory care is home care programme, which makes it possible to extend needed services to the patients after they have left the hospital. In a coordinated home care programme, all services for the patient care should be arranged by the hospital with the help of another community health agency.
- **Duty room, stores, housekeeping and conference/seminar room**
 - **Duty rooms:** Separate duty rooms for the doctors, specialists and nurses. These rooms must have toilets attached to it and, if possible, some area to prepare coffee, etc.
 - **Stores:** Every OPD must maintain a separate store for drugs, equipments and linen. This store should not be shared with any other departments.
 - **Housekeeping:** Every floor should be provided with janitor closet for housekeeping and cleaning material.
 - **Conference/seminar room:** These rooms are required for academic activities and formal teaching programmes.
- **Physical medicine rehabilitation:** There should be a provision of physiotherapy and physical medicine department in the OPD complex. It should be located on the ground floor. The physical medicine and rehabilitation is an important ambulatory care service. This department would include physical therapy, corrective therapy, occupational and manual therapy, and an outdoor exercise area.
Flowchart 13.2 shows the physical features of an outpatient department.

Administrative area

Administrative zone will consist of:

- A room of 25 m² for a Deputy Medical Superintendent of a 200-bedded hospital.
- Sanitation and housekeeping office.
- Office of Deputy Nursing Superintendent.
- Officer of Senior Medical Record Officer.
- Office of Public Relations Officer.



Flowchart 13.2 Physical features of outpatient department.

Circulation area

This includes:

- *Stairs:* They should be wide, with side railing and signage on every floor and turning.
- *Corridors:* They should be wide, with adequate day light/ tube lights.
- *Ramps:* They should have antiskid tiles and adequate lighting provision. Dustbins should be placed at regular intervals.
- *Lifts:* Separate lifts for patients and staff members. Patient's lift should be spacious enough to simultaneously accommodate at least two patient trolleys.

Roughly the circulation area occupies 30% of the total building area in order to ensure uninterrupted and smooth flow of supplies and personnel. Corridors should be at least 2.5 m wide. The building should have all the provisions of firefighting and fire safety, including fire escape routes and evacuation plan with proper instructions. Before commissioning of the OPD, clearance from the local firefighting authorities is mandatory as per the law of the land and the

same should be obtained. Mock fire alarms and fighting drills should be carried out at regular intervals and reviewed critically.

Staffing

The staffing in OPD should consist of:

- *Medical staff:* The resident doctors and consultants from various departments attend the patients in OPD by rotation as per their OPD schedule.
- *Nursing staff:* Nursing staff is deployed on rotational basis under supervision depending upon the size of the OPD and the workload.
- *Paramedical staff:* This includes technicians, clinical helpers, sanitation and housekeeping personal, security staff, etc.
- *Medical record officer* along with medical record technicians and clerical staff to manage registration and fee counters.
- *Administrative head* of OPD with his supportive staff.

- *Public relations officer* or APRO along with receptionist to manage inquiry and reception counters, and also a medical social worker working directly under APRO.
- *Supervisory staff* to supervise sanitation and housekeeping services.

Procedure and Policies

Standard operative procedures (SOPs) should be in place regarding timings of the OPD hours, appointment system, VIP patient protocol, drug distribution system, billing system and consultation hierarchy so that there is uniformity in the procedures adopted and chances of errors are minimised.

FEW MANAGERIAL ISSUES AND CHALLENGES

- *Parking*: With the ever-increasing number of vehicles in the country, the problem of parking is emerging as a big challenge. The parking should be planned either in the two basement floors (B1 and B2) or a stand-alone multi-level parking. The modern parking should have CCTV cameras for monitoring and a system that displays vacant parking slots available in each block.
- *Overcrowding*: With the ever-increasing population of the country, the overcrowding is inevitable. Efforts should be made to address this problem on a regular basis. Almost all the general OPDs in the big hospitals are facing this problem. Due to overcrowding and limited availability of resources and facilities, the average waiting time for each patient becomes quite longer. This is the prime duty of the hospital administration to solve this problem. Most of these problems can be solved, if one adopts the following aspects:
 - Adequate directional signs for the patient and their attendants to locate their required service area.
 - Quick computerised registrations and electronic record keeping for early retrieval.
 - Multiple and multipurpose fee, and other charges collection zone.
 - Adequate number of physicians in area depending on number of patients. Token display system to ensure unnecessary overcrowding in front of consultation chambers.
 - Multiple blood collection/other diagnostic areas in OPD complex and staffing them based on needs.
 - Adequate sitting space in waiting area with provision of entertainment and health education measures through TV/newspaper in OPD complex.
 - Screening of the outpatient flow through a group of junior doctors.
- *Appointment system*: The appointment system, as practiced in many corporate hospitals, can also be followed. However, it may have a disadvantage for poor and illiterate patients (most visitors of government system) who may find it difficult to utilise it.

- *Queuing theory*: The queuing theory is a scientific and mathematical model for solving the problems of overcrowding in public dealing. In the OPD situations, where the long queues and waiting times are one of the major managerial problems, the queuing theory can be applied so as to meet the requirements of both patients and staff in an optimal way. There are usually three main aspects of the system, which include:

- *Input process*: It is simply a mathematical description of the way the patients arrive in different timings at different zones/clinics/pockets of hospital. The distribution is completely described once the average arrival rate (A) is known.
- *Queue discipline*: It refers to the way in which a waiting line is formed, maintained and dealt with. The simplest arrangement is the 'first-come, first-served' rule. New arrivals join at the end of the queue and the patients at the head of the queue are served in the order of arrival.
- *Service mechanism*: It deals with the outpatient end of the whole process. It is specified in sufficient detail once we know the number of servers and the distribution of service time. The distribution of service time is usually taken to be 'negative exponential distribution'. The distribution is completely determined once the average service rate (R) is known.

The ratio A/R should never be greater than one otherwise the queue will go on swelling indefinitely; patients will arrive at a faster rate than they can be adjusted.

The queue theory can be applied to minimise waiting time of the patients and also minimise idle time for doctors. It suggests additional requirement of manpower in particular area at particular timings.

- *Queue jumping*: It is an unhealthy practice followed in our culture, and more so if the VIPs are visiting and seek out of turn consultation. There should be a well-formulated policy to address this problem. VIPs should be given afternoon appointments to minimise the inconvenience to the general public.
- *Absenteeism and punctuality*: This is a common problem in every hospital. If a consultant or any staff happens to be on leave, it should be planned and necessary arrangements should be made in anticipation to avoid harassment and unnecessary inconvenience to the patients. There should be a well-designed contingency mechanism in case of leave of any staff. To ensure this, the duties of a staff on leave should automatically be taken care of by other staff, which should be planned in advance. Every staff member must also ensure punctuality.
- *Health education*: Health education is one of the most important functions of any outpatient department, which however is neglected. The outpatient department is an important agent in the prevention of disease and promotion of public health. The people coming in OPDs are the

most receptive group and are in right mood to hear about the health as they themselves are undergoing some sufferings. Hence, it is desirable to have space allotted in the OPD area for the purpose and for display of educational materials. Regular poster exhibitions targeting special group like school children, teenagers, diabetic patients and middle-aged people to increase awareness of cancer/HIV, etc. may be held and help of the media may be sought for wider public.

- *Redressal of grievances:* The patient's satisfaction is of paramount importance in improving the quality of healthcare. Complaint (red colour) and suggestion (green colour) boxes should be kept at prominent places in the OPD to receive both complaints as well as suggestions. These boxes should be opened regularly in order to address the grievances and implement the suggestion, if found practical. On day-to-day basis, the administrative head of the OPD should be available to do troubleshooting and sort out a problem on the spot and the mobile number and location should also be displayed on inquiry counters.

The challenges faced and their operational solutions are provided as case studies I to V at the end of the chapter.

PERFORMANCE EVALUATION OF OPD

A mechanism should be in place to regularly assess the performance of OPD services. This could be in the form of random medical audit by Medical Audit Committee, and its report and recommendations should be implemented seriously. There is sufficient documentation in the literature to establish a direct correlation between the final outcome of treatment modalities and overall level of patient's satisfaction.⁸ A prestructured proforma for the same may be developed and the patient may be requested on random basis to fill up these proformas, which will help the hospital administration to improve the services. Time-to-time patient satisfaction survey using the exit interviews should also be carried out. There is enough literature to suggest that patient's feedback in this form is very useful for identifying problems in routine practice.⁹

Critical SWOT (strengths, weaknesses, opportunities and threats) analysis of all the OPD areas on regular basis should be undertaken, which will go a long way in improving the quality of services in OPD as well as ensuring optimum utilisation of services and maximum patient's satisfaction.

The paucity of time and fast-changing life style has drastically affected the need and expectations of the people in every sphere of life. Healthcare services are no exception. Healthcare services are now very well-covered under Consumer Protection Act (CPA). In addition, constantly increasing patient awareness, advanced information technology, corporate culture and right to information (RTI)

has further mounted the pressure on the healthcare providers to meet the desired level of satisfaction of the consumers. With limited resources and financial constraints in public sector, it is not possible to have an ideal hospital beds versus population ratio. The OPD services will thus continue to be the most vital component of the hospital. Properly planned and efficiently managed OPD with all superspecialty services is the need of the hour. Essential components of OPD with health education, prevention, early diagnosis, case findings, advanced diagnostic and therapeutic procedure, day care surgeries, physiotherapy and rehabilitation services will go a long way in substantially reducing the stress on already overburdened healthcare system. The hospital administration should always be geared up and regularly update itself to meet such emerging challenges.

Case Study 1: Equipping outpatient department can save lives of millions

Issue

One patient of coronary artery disease while waiting for his turn in the Cardiology OPD developed sudden cardiac arrest and collapsed. The sister on duty did not know how to manage, as the doctors were busy inside their consultation chambers. A resident doctor was immediately called to institute's cardiopulmonary resuscitation and the patient was rushed to the main emergency located at a distance of 600 yards in the main hospital.

Question

What ideally should be done in such a situation?

Intervention

Though there was an emergency room adjacent to the consultation chambers, it did not have the sufficient provision to revive the patient. It had oxygen cylinder, emergency drugs and cardiopulmonary resuscitation tray; but this was not sufficient. It was decided to upgrade the emergency room in the cardiology OPD, wherein the facility of a laryngoscope and endotracheal tubes of all sizes were made available and more than that a DC fibrillator was made available within 24 h. A standard operative procedure (SOP) was defined and displayed. The sister-in-charge was instructed to regularly monitor this room, keep a check on life-saving drugs and ensure that the DC fibrillator is properly and regularly charged. A log book for the same was maintained. This intervention subsequently saved many precious lives in similar situations.

Case Study 2: Standard operating procedures—key to efficient patient care

Issue

The medical day care centre in the OPD was the designated place for administration of chemotherapy to the cancer patients. Consultants of different specialties availed this facility for their respective patients. These patients were not being admitted in the main hospital but were treated in the day care as outpatients. One afternoon, a terminally ill patient collapsed during chemotherapy. The prescribing doctor was away at the time in the main hospital.

Question

Who shall be responsible and give medical cover to these patients who belong to different specialty like pulmonary medicine, general surgery or haematology, etc.?

Intervention

An immediate decision was taken to define the standard operative procedure for day care centre. It was decided that no consultant (physician or surgeon) will prescribe chemotherapy until and unless he or she is physically present close to the day care centre, i.e. within the OPD complex. All the consultants thereafter started prescribing the chemotherapy only on those days when they were running their respective OPDs in the OPD block and physically present there. This ensured their availability at a distance of 1–12 m from the patient and could attend to their patient in case of any eventuality.

Case Study 3: Managing an epidemic in outpatient department

Issue

A large number of swine flu cases were reported in the region during the months of December 2009 to January 2010. On-an-average, 6000–7000 patients of different ailments were visiting the OPD everyday. There was huge crowd on registration counters leading to mixing of patient population. Some degree of panic and apprehension of contacting the disease was seen amongst the general public.

Question

What ideally should be done in such a situation or in case of an epidemic?

Intervention

A swine flu screening chamber was created just at the entrance of the main gate of the OPD complex. This room measuring about 60 m² area was basically earmarked as store room for wheel chairs/patient's trolleys. This was vacated and two medical officers along with one senior resident from Department of Internal Medicine were deputed during OPD registration hours, with all the prescribed guidelines and precautions; and any patient suspected of swine flu was isolated and examined thoroughly in this room and on string suspicion was routed to the swine flu ward in the main hospital for confirming the diagnoses.

Case Study 4: Using waiting time for providing information to patients and their attendants

Issue

The general public comes to the subwaiting areas outside the consultation chambers at about 7:30 am, whereas the consultants report to their OPD chambers at about 9:00 am after taking rounds of wards and attending to their indoor cases.

Question

How best this time of patients could be utilised?

Intervention

It was decided to impart health education to waiting patients, as they are very receptive at this point of time. The services of B.Sc. Nursing students were utilised to execute the same. A total number of 15 poster-displaying boards got fabricated from the hospital workshop and the B.Sc. Nursing students were briefed about the proposed activity. They used to come around 7:30 am and displayed various simple and handmade health-related posters to the patients' population waiting for the doctors to come. The activity was supervised by their public health instructors. A good response was seen in gynaecology OPD, diabetic clinic, nephrology OPD, hypertension and asthma clinic. The patients were encouraged to ask questions and the sessions were made interactive. The patients raised their queries and doubts, which otherwise they will hesitate to ask from the doctor due to paucity of time and inhibitions. Patients appreciated this exercise as they benefitted a lot from the same. The media also appreciated this patient-friendly activity.

Case Study 5: Small interventions can save precious time of patients

Issue

It was standing practice that the blood samples in the OPD were collected and transported to the main laboratories for processing. The report was available on the next day. The patient, therefore, after giving blood sample, had to wait till the next visit for the final diagnosis and get the specific treatment initiated and/or alter the drug doses, etc.

Question

How this problem could be solved so that the loss of precious time and an extra visit of the patient could be avoided, thereby enabling the physician to take a decision on the same day regarding the management of the case?

Intervention

A room adjacent to the blood sample collection centre was identified and was decided to carry out the haematology and biochemistry tests in the OPD itself. The two analysers—one each for department of haematology and biochemistry were procured and installed there, and all OPD blood samples were processed there itself so that the report could be made available within 1–2 h and handed

over to the patients. The patient could thus go back to his physician on the same day who was available in the OPD and diagnosis could be clinched, treatment could be initiated or modified as per the blood parameters. This step too was widely appreciated and acknowledged by the patients availing OPD services.

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Management of Ward/Indoor Services

14

Prof Anil Kumar Gupta and Dr Navneet Dhaliwal

“How many desolate creatures on earth have learnt the simple dues of fellowship and social comfort in a hospital.”
—Elizabeth Barret Browning

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- give an overview of management of inpatient services in a tertiary-care hospital.
- describe the role of indoor services of a tertiary-care hospital.
- enlist the things to be kept in mind while designing and planning wards of hospital.
- list the policies and procedures of inpatient services.
- mention the newer concepts and advancements in inpatient services.

INTRODUCTION

Indoor services are provided in the wards of a hospital. It constitutes of accommodation where the healthcare team comprising of doctors, nurses, paramedical staff, etc. attend the patients who are admitted for stay at hospital. This stay can be long term or short term, depending upon the severity of illness or condition of the patient. The wards have the area where patients' beds are accommodated, apart from nursing station, sanitary area and storage area. The wards of a hospital should be designed and function in a way to provide high-quality care to the patient at the lowest-possible cost. The wards should also provide smooth conditions for the staff members so that they can put in their best efforts to heal the patient. It should be conducive enough to serve as a temporary home for the patient.

Indoor services are in operation day and night, and are under constant pressure of increasing demand with high operational costs. So, the planning, designing and management of the ward has to be cost effective. It should be remembered that as there are certain variations in the pattern of care as seen in case of paediatrics, obstetrics and gynaecology, psychiatry, neurology, neurosurgery, etc. therefore, these small changes/differences have to be incorporated in the design phase itself.

PLANNING OF INDOOR SERVICES

Location

The inpatient area has to be in a quieter side of the building, away from the OPD noise and constant flow of traffic.¹ It should have easy access to the blood bank, laboratory services, radiodiagnostic services and good internal transport. There has to be ease of communication with support services like the Central Sterile Supply Department (CSSD), dietetics, laundry, stores, etc. It is very important to think of the communication system vertically and horizontally at the time of planning of the wards. The visitors' entrance should be planned to provide access only to the admitted patient areas.

Area

Facilities are still being designed where total area per bed is around 55 m² as against 130–180 m² of area per bed in the West (Integrated Approach to Hospital Planning—Dr Vivek Desai of Hosmac India Pvt. Ltd.). The area per bed within the ward should be 7 m². If it is a single bed then the minimum area has to be 12 m². Many hospitals design single rooms in such a manner that if the need arises, these rooms

can be converted into double rooms. Double-bed room should have an area of 20 m² while four-bed room should have 30 m² area. Distance between centres of two beds should be 2.25 m. Clearance between the head end and the wall should be 0.25 m, while space at the foot end should be 0.90 m.¹ The basic purpose of having this space between beds is to allow unrestricted movement of the treating staff and essential equipment. The optimum number of beds depends on the type of patients, hospital (general or specialty) and staff availability.

Type of Patients

Depending on the type of patients to be admitted in the unit, the ward should have features incorporated in the planning and design stage. The patients can be with acute or chronic or communicable disease. There can be patients of obstetrics and gynaecology, paediatrics, psychiatry, neurology, etc.

Requirement of Staff

A specific number of staff is required to be present in each shift. Maximum patient-related activity takes place in the morning shift followed by evening shift. Minimal work is done in the night shift. Distribution of staff has to be done in three shifts, accordingly. If we take an average-sized unit, the night nurse will not be gainfully employed unless the unit is of 30–50 beds.² On the other hand, the unit is designed considering the ability of the nursing staff to handle maximum number of beds at any given time.

Main Components of the Ward

- Clinical area (patient nursing area, nursing counter).
- Auxiliary area (nurses' room, doctors' room, etc.).
- Ancillary area (pantry, day room, trolley bay).
- Sanitary area (toilets, dirty utility).

Type and Shape of the Ward

The shapes of wards, today, tend to be more compact like rectangles, modified triangles or even circles in an attempt to shorten the distance between the nurse station and the patient's bed. The architectural design should also facilitate for better infection control. The shape of the ward is governed by a number of factors, as to whether it is an open type of ward or a ward with smaller units or double rooms or single rooms. Though nursing units with small rooms give a sense of privacy to patients, but the deployment of a large staff and high operational costs have to be considered along with the challenges of supervision.

Nightingale ward (open ward)

In the beginning, open ward concept was widely followed. This was named after Florence Nightingale and consisted of

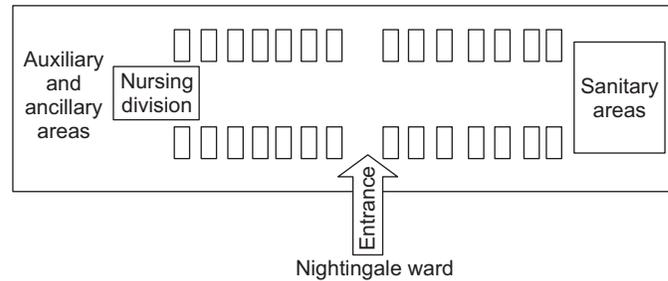


Figure 14.1 Layout of Nightingale ward.

patient beds at right angles to the horizontal walls. This ward, being a self-contained unit, had 35–40 patients with its own kitchen, stores and supplies. The nursing table was at one end of the ward and the washrooms at the other end. Later on, the nursing table was shifted to the centre and so were the washrooms. Still later, nursing table was replaced by the nursing counter. Such wards usually house 30–35 patients and are 28–30 m long (Figure 14.1).

Advantages

- Visibility of the patients.
- Cross ventilation.
- Natural light.
- Economical to construct and maintain.

Disadvantages

- Lack of privacy.
- Cross infection.
- Glare due to large number of windows.
- Difficult to manage critically ill patient.
- Walking long distances.
- Lot of noise.

Riggs' ward

Later on, looking at the shortcomings of the Nightingale ward, Riggs' ward was designed. Such a ward has cubicles, which consist of four or six or eight beds arranged parallel to the longitudinal walls. One hand washbasin per six beds was provided. Floor space area per bed was kept as 7 m². Such wards do not have a nurse area within them (Figure 14.2).

Advantages

- Privacy to patients.
- Walking distance for nurses minimised.

Disadvantages

- Poor communication.
- More nurses required.
- Costly to build and maintain.

Some of the disadvantages of this type of ward have been overcome by using nurses' call bell, signal lights, two-way speakers and closed-circuit television.

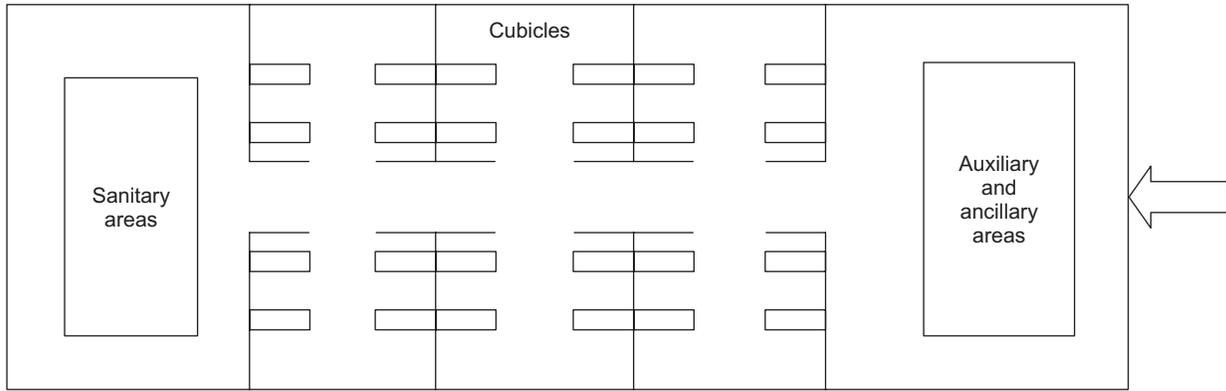


Figure 14.2 Layout of Riggs' ward.

Straight single-corridor ward

The nurses' station should be centrally placed, so that distances for the staff is minimised. The staff can have easy access to both sides and can also keep a watch on the patients. The staff can also be quickly called in case of an emergency (Figure 14.3).

L-shaped ward

In this layout, the patient beds are arranged in L-shape with beds parallel to length of the walls, and the support services and nursing station are at the junction. The supervision and service area is located at the entrance; this prevents too much movement into patient-care areas (Figure 14.4).

T-shaped ward

The patient-care areas are located on the horizontal part of the 'T'. The advantages and disadvantages of this form are similar to those of the L-shaped ward (Figure 14.5).

Race track ward

The patient-care area is located on all peripheral sides, while the services and staff areas are located in the middle. Staffs

have long distances to travel and communication between them is difficult (Figure 14.6).

Cruciform plan

This design is not a very convenient and suitable design as the patient-care areas are at the periphery and nursing station at the centre. It is most commonly used in the settings when two wards are combined together due to shortage of supervisory staff (Figure 14.7).

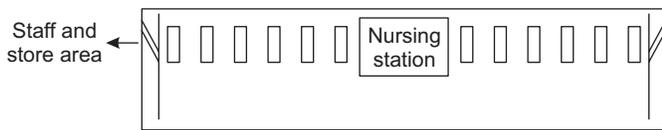


Figure 14.3 Straight single-corridor ward.

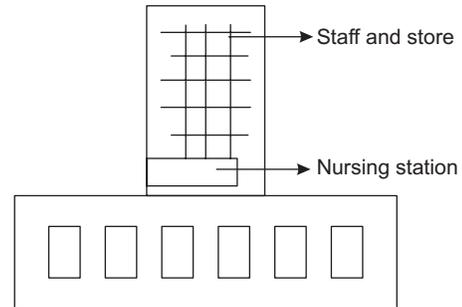


Figure 14.5 T-shaped ward.

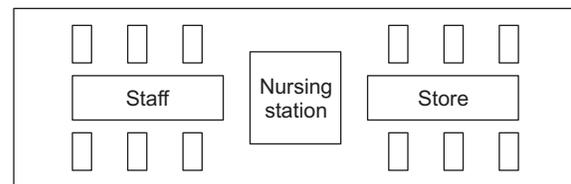


Figure 14.6 Race track ward.

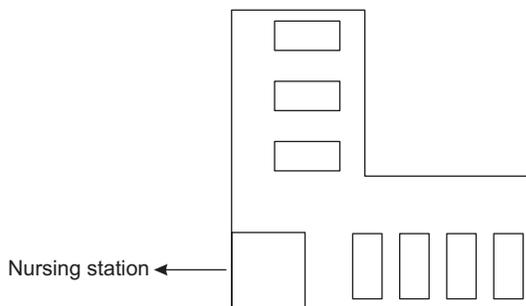


Figure 14.4 L-shaped ward.

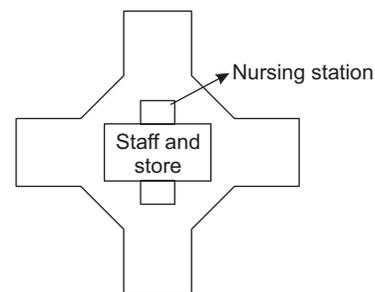


Figure 14.7 Cruciform ward.

Single room

The concept of single rooms and privacy has taken up in a big way in the last two decades in corporate, private and public hospitals as well. In single rooms, the floor-to-ceiling height should be between 3 and 3.6 m. Windows are psychologically important for the well-being of the patients and normally have 20% of the floor surface area and if these are located on the opposite walls, the area should not be less than 15%.

Doors have to be at least 1.2 m wide and should open outwards so that a hospital bed can be wheeled in and out without difficulty. Dado (panel forming the lower part of an interior wall when it is finished differently from the rest of the wall) should be up to a height of 1.20 m in all rooms and corridors.¹ Corridor width for easy movement of trolleys and wheel chairs should be 2.5 m. Each single room, besides a patient's bed, has a built-in wardrobe, a lounge chair for the patient, visitors' chair, bedside locker, overbed table for conducting procedures and dining, sofa-cum-bed for the patient attendant and television, which should be in direct line of sight from the bed.

In single or double rooms, the night light, along with a reading light has to be fixed at the head-end of the bed. Electrical outlet should have a nurse call bell (Figure 14.8).

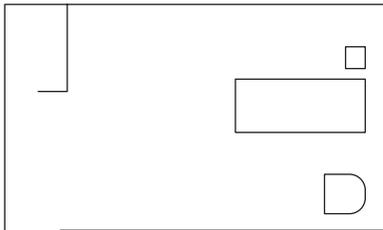


Figure 14.8 Single-room type.

Healthcare Information System

With hospitals installing healthcare information systems, the nursing and resident work stations within the ward should have ports and appropriate hardware to report, retrieve and generate information regarding the patient admitted in the ward. As more of mobile diagnostic equipment and hand-held devices are being used, there will be requirement of computer alcoves and data ports in corridors outside patient rooms in the near future.³

Use of Design and Colours

The use of cheerful and varied colours and textures in the room should not interfere with the patient assessment of skin colour/pallor. Allowing ample natural light inside wherever feasible is beneficial. Internal lighting should approximate natural daylight. Providing views of the outdoors from patient bed should be encouraged.²

Nursing Station

It should provide a positive and reassuring image. The area should approximately be 8 m². In fact, it should be centrally located so that a watch can be kept on as many patients as possible, and open to a corridor but separate from it by a counter, which acts as a desk and a barrier. The rooms on each side (generally kept for acutely ill patients) of the nursing station must have glass partitions. The nursing station should have a sister's room with attached bath, cupboards for storage of medications and essential drugs, and lockable cabinets for narcotics and dangerous drugs. A counter for preparation of medicines and injection trays may be provided in the nursing station area or a separate preparation room may be provided in the ward itself. Electric panel positioning has to be such that it is clearly visible from nurses' call station. Refrigerator for storing antibiotics may be kept. A working counter with a notice board for the staff to do their charting and administrative work should be added. Office space for head nurse has to be provided.

Treatment Room

For examination, dressing and other procedures, a treatment room is required in every ward of 12–24 m² area. There should be a dressing trolley, hand-washing faucets and essential equipment available in this room.

Pantry

Pantry is used for temporary storage of meals and preparation of beverages for the patients. Crockery, cutlery, drinking water, refrigerator and hot case facility is provided for the convenience of patients. Area of 4 m² should be sufficient.

Day Room

It is believed that early mobilisation has a beneficial therapeutic effect on the patients, and day room with place for sitting and relaxing, reading, dining will enhance the patient's confidence and aid in an early recovery. The day room should be of approximately 24 m² area.

Stores

In order to keep ward linen, cleaning material, stationary, disposables, medications, etc. a storage cabinet of at least 10 m² area can be kept under lock and key in every ward.

Clean Utility Room

The clean utility room has an area of 10 m². It is used for storing medicines, intravenous solutions, dressings, CSSD

material, treatment trays, along with counters for preparation and hand-washing facilities.

Dirty Utility Room

It is used to store bed pans, urinals, sputum mugs, temporary storage of sputum, stool samples and dirty/infectious linen. There has to be a bed pan washer and sink. An area of 10 m² is required. There should be special lifts serving the dirty utility rooms in case of multistorey buildings. In single- or double-storey buildings, hatches can be used for collecting the dirty linen.

Isolation Room

It is recommended to have at least 2.5% of the total beds in hospital as isolation beds.² Area of each room should be 22 m² along with an attached washroom and an anteroom. Isolation rooms may be located within the individual nursing unit at the end or may be grouped as a separate unit altogether.

Such rooms have the normal facilities of a single room like the patient bed, bedside locker, overbed table, lounge chair for the patient, etc. There has to be a self-closing door. In addition, such rooms meant for patients with communicable diseases have an anteroom, which has a gowning and storage area for clean and soiled material, and hand-washing basin. Each room has its own individual washroom with bathing area and hand-washing facility.

Isolation room unit, if designed independently, has standard-pressure rooms, positive-pressure rooms and negative-pressure rooms. The patients requiring contact isolation are kept in standard-pressure rooms. This is a room with normal air-conditioning. Negative-pressure rooms are meant for patients that can pass infections to others with airborne droplets. Positive-pressure room is to isolate profoundly immune-compromised patients, such as patients undergoing organ transplants or those admitted in oncology units.

The role of engineering services during the designing, construction and operational phase of the isolation room is very vital. For patients with communicable diseases which spread by contact, droplet or airborne infection, the room has to be maintained at a negative pressure. Exhaust air ducts should be independent of the building's common exhaust air system to reduce the risk of contamination from backdraught. Air changes greater than or equal to 12 per hour are recommended with 100% fresh air. The exhaust air should be drawn from low-level exhaust ducts approximately 150 mm above the floor in the room. The exhaust fan has to be located at a point in the duct system that will ensure the duct to be under negative pressure throughout its run within the building.

The operational and administrative aspects in management of epidemics and communicable diseases:

- With the occurrence of frequent epidemics of contagious diseases like severe acute respiratory syndrome (SARS), H1N1 influenza, personal protective equipment (PPE) for the staff working in the isolation unit area has to be readily available.
- Rotation of the staff posted in that area has to be done every 4–6 weeks.
- Availability of appropriate medications and disposables, and life-saving equipment has to be ensured.
- Proper biomedical waste disposal has to be carried out, as these diseases are highly contagious.
- In case of exposure of the staff, prophylaxis has to be provided by the institute.
- Information to the state authorities has to be provided about the number of cases being admitted, detected positive, discharges and deaths.
- Media has to be provided relevant disease information and constant updates without creating panic.

Bath and Toilets

The washroom should have grab bars and an emergency call button.⁴ The door of the toilet should open outside into the room. The general wards have to be provided with the following facilities:

- Urinal: One for 16 beds.
- WC: One for 6–8 beds.
- Bath: One for 12 beds.

Basin for Hand Wash

According to numerous studies, hand-washing is the single-most important practice to control hospital-acquired infection. Easily accessible wash basins at a comfortable height and at appropriate places in the ward are needed. Containers of sanitizers can be fixed with stands at the most suitable places in the ward. At least one wash basin for 8–10 beds should be fixed at the maximum height of 80 cm, so that wheel chair-borne patients can also use them.^{5,6}

In order to ensure the culture of hand-washing in a dedicated manner, keeping in mind public hospitals the following possible measures can be taken:

- The administration has to ensure regular and need-based supply of sanitizer and soap, along with hand wash basins installation at appropriate places— 1 for 8 beds.
- Posters in the wards encouraging the attendants to wash their hands and also ask the treating staff to wash/clean their hands if they have not done so while attending to their patient.
- Reinforcement of hand-washing practice among the residents and nursing staff.
- Holding regular educative classes for new staff.
- Collecting data about hand hygiene and hospital-acquired infection, and making the results available to all.

Janitors' Room

Mops, brooms, cleaning material, buckets and bags for waste disposal are kept in this room. Large sink with hot water supply is needed for washing the mops and cleaning the buckets.

Water

Around 450–500 L of water/per bed is required with round-the-clock water supply. Three days of water supply should be stored and be available in the hospital in case of any emergency.⁷

Strategies for water preservation:

- Proper use and preservation of water should be a crucial part of initial design. The purpose should be to minimise water consumption, leakage, maintenance and growth of algae in the storage tanks.
- In order to conserve water, fixtures with sensors should be installed. In public hospitals theft of fixtures is a common phenomenon, so good quality but cheap and easily replaceable fixtures have to be used. These will also discourage theft.
- Regular repair and maintenance of broken and leaking fixtures.

Electricity

Electrical demand for general hospital is 2–3 kW/bed/day. For multispeciality hospitals, the requirement increases up to 5 kW/bed/day. One power point and two 5 A points have to be provided at each bedside for using emergency equipment in addition to the normal electrical points. Use of solar energy systems for heating water will help in bringing down the electricity bill.⁸

The lighting in the ward consists of general light, reading light, examination light and night light. The general illumination needed is 150–200 lux; nursing station requirements are 300 lux; while in examination area, the requirements vary from 500 to 1000 lux. Rather than providing general illumination for a whole room, task lighting may be provided in certain areas like work light for a desk, reading light for a chair and general ambient lighting for a ward area. A reduced lighting level in corridors will save energy and create a soothing atmosphere. These provides better healing environment as a result of lower eye strain and reduced fatigue.

Dealing with complaints related to intravenous (IV) fluid bottles:

Issue

The chemists at times sell normal saline, dextrose normal saline bottles contaminated with visible particles. The nursing staff, at the time of administering the medication, detects these particles. Sometimes if they are not careful enough the medication is added to the bottle, leading to its wastage (even chemotherapy drugs, which are very expensive).

Solution

- On detecting such contamination the sealed bottle should be sent to the pharmacy in-charge, who will forward it to the drug controller/inspector of the area for appropriate action.
- The contaminated batch has to be removed from circulation and the company supplying it has to be informed.
- If offence occurs repeatedly, then the institute can take action against the chemist, the contract can be cancelled, penalty imposed and the eviction orders given.

HVAC

The decision, whether to have a centrally air-conditioned ward or window air conditioners or outdoor ventilation, is best left to the engineers based on their judgement. The preference these days is towards a central air-conditioning system for reasons of flexibility, application and maintenance. Most new hospitals have thermostats for every patient.

Manifold Supply

In large hospitals, central manifold supply of oxygen and suction are required. In smaller hospitals the cylinders of oxygen can be used along with suction machines, kept near individual patient bed.

Duty Room

A room for doctors, with a bed, table, chair, and an attached toilet is needed. An area of 16 m² should be sufficient. A seminar room of 24 m² area for conducting seminars in teaching hospitals is a necessity.

Staff Changing Room

Staff coming on duty needs a changing room with lockers for keeping their change and personal belongings. Side room lab for routine tests can serve two to three nursing units. Attendant room should have lockers for patients. There has to be a retiring room for attendants and visitors.

Biomedical Waste Management

The process of generation, segregation and disposal of biomedical waste management (BMW) in hospitals and nursing homes has to be stringently followed. Any offence committed in this regard will invite penalty under the law. The staff of each nursing unit has to be educated about the whole process. All necessary equipment and materials have to be provided. The bins with different colour-coded bags have to be kept in the units. The clean and dirty corridor should facilitate traffic flow of clean and dirty items separately. There should be provision of separate staircases and lifts for garbage and infectious waste removal from wards and departments. A refuse collection point has to be clearly

demarcated where refuse from all areas has to be collected and from here it is shifted to the incinerator or autoclave or landfill. A sewage treatment plant and an effluent treatment plant should be installed by the facility based on the latest norms. Supervision should be done to ensure that no waste is stored beyond 24 hours. Though we may tend to border on disbelief, maximum noncompliance to disposal of BMW is on the part of doctors and residents.

Ensuring compliance to biomedical waste norms:

The disposal of biomedical waste in compliance to biomedical waste handling management and handling rules, 1999 and the amendments need all necessary measures mentioned below.

- To provide all the necessary materials and equipment required for the segregation and disposal of biomedical waste.
- To appoint sanitation inspectors and one senior nursing staff to take rounds of the area, point out the deficits and convey to the concerned departments to rectify the mistakes.
- To have regular classes for the new staff be the residents, nurses, technicians, hospital attendants and sanitation attendant about the process of biomedical waste management generation, segregation, transportation and disposal.
- It should be clearly understood that the generator has to ensure the segregation and disposal of waste.
- Timely renewal of permission for BMW management under the Biomedical Waste Management and Handling Rules, 1999.
- Installation of effluent treatment plant (ETP)/sewage treatment plant (STP).
- Regular repair and maintenance of incinerator/autoclave to ensure timely disposal of BMW.

Mortuary

The mortuary is usually located in the basement of the hospitals. It has a separate entrance and exit. Even the transfer of cadavers to and from the morgue should be out of the sight of patients and visitors. This is possible by designing a separate route along with lifts or ramp for body transfer in the initial planning phase.

Security and Safety

In addition to the general safety concerns of all buildings, hospitals have several particular security concerns. Protection of patients, staff, hospital property and assets falls within purview of security. Safety from threats of terrorism is a must as these are high-vulnerability targets. Patients, attendants being fleeced in public hospitals by fraudulent elements on the pretext of getting things expedited.

To curb thefts in the hospital:

- Installation of CCTV for safety and security of the building and controlling the exit points.
- Posters at important places educating patients/public to beware fraudulent elements.

DESIGN OF SPECIAL UNITS

Nursing unit

Objectives: All vital requirements have to be coordinated and integrated in the final product. Planning has to be in terms of tomorrow, so it should be done on a standardised modular grid, which will enable easy expansion at a later stage. It is often seen that planning focuses on the design and architecture, neglecting the planning and organisation of the equipment. The basic principle to be understood is that the long-term operational costs can be greatly decreased by initially planning equipment requirements along with a proper systems design and functional flow.

- *Design to follow function:* A functional segregation of OPD, inpatients, diagnostic services and supportive services is desirable. Isolation wards for infectious cases should be kept out of routine hospital-movement area. Also to be considered is whether the hospital is general or a multispeciality, as specialist hospitals promote high standards. They deal with a small range of diseases that lead to the development of special features and skills. The number of beds to be made operational is another feature in designing. A hospital with less than 200 beds is made horizontal. It is economically viable up to 300 horizontal beds, beyond which vertical expansion is more feasible.⁷ With the increase in land value, vertical stacking of hospital floors is becoming more important. Vertical stacking also allows more natural light into the building besides saving on operational costs, and reducing wastage. A properly stacked hospital also reduces energy consumption.⁷ Planning should maximise usage of shared support services.
- *Privacy and safety of patients:* The category of patients expected decides the ratio of private, semiprivate, and multibedded ward. In public hospitals in India, the majority of patients prefer ward admissions based on their socioeconomic status. The commonly expected design is Riggs ward with cubicle concept. In private/corporate hospitals, rooms are designed to contain four or six beds, which serve as a ward. Now the concept of single and double rooms is taking up in a big way in the corporate, private and also public hospitals.
- *Efficient nursing care:* The optimum size of one nursing unit is to be decided based on the number of patients the nursing staff can manage efficiently.

Paediatric Unit

In this unit, provision for the parents to live in with the child is provided. The presence of parents, siblings and other children has a positive effect on the admitted patients. The area should also have a play room. The space provided for beds and cribs should be the same as adult beds. Paediatric units also have isolation rooms with an anteroom. As a norm, 25%

of the overall beds space of a paediatric unit should be in single rooms.³ Special need of children and adolescents should be borne in mind. The nursery should be located adjacent to the delivery department to enable quick access in case of an emergency. Sufficient space should be provided for cribs for well and ill babies; for support services that include formula, preparation rooms, feeding rooms, etc.

Obstetrics and Gynaecology Units

Maternity and paediatric wards should be preferably located away from the common access areas of the hospital. Preferably a stand-alone maternity and paediatric unit should be designed.

The delivery department and operating department have the same functional requirements and layout. The two departments can be fused into one, in case of dearth of doctors. This does violate the basic requirements for aseptic conditions in the operating department as the same level of asepsis is not the same in delivery room. It is better to have the delivery room close to the operating rooms to provide ease of transfer. The bigger hospitals have their own independent operation theatres attached to the delivery room, which are used exclusively by obstetrics and gynaecology department. The unit is situated close to the nursery and the neonatal ICU. The nurse provides care during the initial days; the mother learns from her and later on takes over.

In planning such a unit, ultrasound facility and a clinical laboratory is must. Day room for patient interaction and feeding the babies with a comfortable seating arrangement must be provided.

Delivery suite

The delivery suite should have:

- **Reception area:** A pleasant and welcoming area where patients come and register.
- **Preparation room:** The patients admitted here are prepared for labour and delivery. In case of wards, this room is required; while in single rooms, the preparation can be done in the room itself. The room should have an examination table, shower bath, wash basin, preparation tray and also lockers to keep the patients' belongings.
- **Labour room:** In the initial labour stage, till the patient is about to deliver, she is kept in the labour room, where she is observed, examined and monitored regularly. Single labour rooms are preferred as these provide privacy to the patient. Such a room should have a good examination light besides the bed. There should be a provision for oxygen, suction and compressed air outlets and a nurse call system for the patients. Attached toilet with bed pan washing facilities should be provided. The room should be close to the delivery room so that the patient can be easily shifted when required.
- **Delivery room:** The room is made on a pattern similar to the operating room with maximum asepsis. There should

be an operating light, oxygen, suction, compressed air, resuscitation trolley, a scrub area at the entry to the delivery room. All facilities for receiving the baby, i.e. a baby-receiving tray, suction, oxygen, warmer, weighing machine, ambu bag should be present.

Operating room

- **Operating room:** For performing elective and emergency caesarean sections, there has to be an adjacent operating room. It is preferable to have an independent operation theatre (OT) for such surgeries; otherwise the main operation theatre complex has to be used for obstetrics cases.
- **Recovery room:** Postpartum mothers are kept in the recovery rooms, which are similar to the postanaesthesia surgical recovery rooms. Though the patient can recover in the delivery room, a room exclusively for the recovery of postpartum mothers will provide all necessary care. Such a room must have oxygen, suction outlets, along with medication dispensing and hand-washing facilities. Attached toilets with bedpan flushing facilities should be provided.

Labour, Delivery, Recovery and Postpartum (LDRP) Suites

The concept of birthing suites has caught up in a big way. Initially, they were more popular in the west; but now these have acceptability and are in demand in our country. The entire process from labour, to delivery and to postpartum stay are accomplished in one room that has the atmosphere of home, while fully equipped to deal with the whole process except in high-risk cases.

A normal bed can be converted into a delivery bed, along with lights discreetly hidden until required. All equipment for receiving and resuscitating the baby is also available in the room itself. This concept also encourages bonding between the mother and baby and is conducive to an early discharge within 24–36 hours.

This suite is constructed like a hotel with comfortable bed, bed for the attendant, telephone, music, television, cupboards and comfortable chairs. The spouse or a support person can stay with the patient at the time of delivery.

Case Study: How will you deal with allegations of baby exchange by mothers on doctors and nursing staff?

Issue

At times, the administration comes across such issues as allegations of baby exchange by the doctors and nursing staff. To avoid such issues a foolproof system is ought to be devised.

Solution

- After delivery, immediately announce the sex of the baby and show the baby to the mother if she is conscious. If not so then inform the husband and the family members.
- Make an entry in the register and the file of the mother to ensure written record.
- Take an imprint of the foot of the baby.
- Put a bracelet around the arm of the baby mentioning the central registration number (CR No.) and the mother's name.
- The security has to be alert and vigilant that no baby leaves the specific area without the bracelet around its arm.
- Still if the parents insist that baby has been exchanged they can get a deoxyribonucleic acid (DNA) test done at their own cost.
- Double entry doors with audio/visual access and auto lock facility in case of emergency.
- Entrances should be covered by CCTV and security staff to provide double cover.
- The entrance doors should be glazed to allow visitors to be viewed before entry.
- Tagging with alarm to abort an attempted abduction.
- All visitors should wear passes and be challenged if not displaying a pass.
- Play areas should be monitored with CCTV.

Psychiatric Unit

The entrance has to be separate from the main hospital. There has to be an institutional atmosphere with minimum security, but ensuring a safe environment for the patients. The light, paint and colours should be soothing for the patient and provide a desirable therapeutic effect.

In some cases, the patient attendant also stays with the patient during the entire duration of treatment or the patient is looked after by the staff totally. There has to be a single exit, tamper-proof fittings and 24 hour security. Seclusion rooms, for patients who become too violent or suicidal, have to be designed. Such rooms should have padded beds, high ceilings and be devoid of any objects capable of causing harm or injury to patients. Doors should open outwards. Windows should be operated by keys to prevent escape or suicide of the patient.

The unit has subunits for the patients:

- Treatment area
- Therapy area
- Activity area
- Inpatient area

WARD MANAGEMENT

Patient care, treatment and early discharge will be the tangible outcome in the whole process, while the intangible part will be patients' comfort and rehabilitation. The major role in the ward is played by the nursing staff.

Functions of the Nursing Unit

The nurses stationed at the indoor wards have following tasks to perform:

- To render nursing care to admitted patients with minimum nurse fatigue factor.
- To provide essential drugs, equipments and items of store requirements in a systematic manner for the patients.
- To provide a comfortable environment for the patients, taking care of their basic needs.
- Facilitating the research and training work of the medical, nursing and paramedical staff.
- To provide facilities for the patients and attendants.
- To help achieve job satisfaction for the medical and nursing staff.

Operational and Strategic Management

Besides good nursing care of the patient and ensuring that the instructions given by the doctor are followed by the staff, the role of the assistant nursing superintendent (ANS) comprises of supervision of the staff under herself, orientation of the ward staff, evaluation of the ward staff along with proper management of the ward and good housekeeping. Nursing unit is also responsible for the strategic management of the ward like estimation of resources and preparing detailed plans for their wards, after taking inputs from relevant departments, their staff and residents. This will help in improvement and establishment of a system. Nursing students should be educated about ward management.

Staffing

The staffing ratio in the various areas has to be planned in the initial designing phase. According to staff inspection unit norms, it is recommended that:

- One nursing sister for 3:6 staff nurses.
- One ANS for 4:5 nursing sisters.
- One DNS for 7:5 ANS.
- One nursing superintendent for 250–500 beds.
- One CNO for 500 or more beds.

Leave reserve of 55% has to be added while planning the staff requirements. For general wards, there has to be 1 staff for 6 beds; for special wards like paediatrics, burns, neurosurgery and cardiothoracic surgery, the staff ratio is 1:4. In nursery, the ratio is 1:2, while, for ICU it is 1:1. In the labour room, it is 1:1 per table.

POLICY AND PROCEDURE

Various policies govern the functioning of the hospital. Committees or subcommittees are formed to draft, finalise and get approval for the policies and see to their implementation. For example, antibiotic usage, infection control, etc. are approved and put into practice.

Procedures are followed in providing care to the patients. All processes have to be carefully outlined. Patient gets admitted through OPD or emergency; once admitted, a file is made. All the records are added to this file. At the time of discharge, a written discharge summary is handed over to the patient while the case file is kept in the medical records department. During the patient's stay, all the investigations, procedures and treatments are done following standard laid down protocols.

The indoor services are one of the key areas of a hospital. Holistic, patient-centred treatment and environment should be promoted in indoor services of a hospital.

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Operation Theatre Services

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“Constant attention by a good nurse may be just as important as a major operation by a surgeon.”

—Dag Hammarskjold

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the various issues involved in ensuring smooth functioning of operation theatre services in a hospital.
- understand the various aspect of maintenance of operation theatre services.

INTRODUCTION

The operation theatre (OT) of a hospital is a very important unit and forms the backbone of surgical interventions. It is imperative to have OT in a hospital where surgeries can be done to save lives and also to improve the quality of life. In an OT, the surgical procedures are performed with all aseptic precautions, safety/security, along with a consideration of comfort and economy of the patients.

The innovation of sophisticated equipment and skills in the recent past has been spectacular. With the evolution of diagnostic facilities and improved aseptic procedures, the demand for elective surgeries has also increased. But, at the same time, there is augmentation in the cost of healthcare facilities as well. Operation theatre in any hospital is a facility that consumes a major chunk of expenditure in a budget and hence becomes necessary to optimally utilise the resources to ensure maximum cost benefit. Nowadays many hospitals have realised that for optimal utilisation of OTs its scientific and efficient management is crucial.¹⁻³

HISTORY

The operational management and the organisation structure of OT in present time are markedly different from what they used to be 20–30 years ago. Nowadays the OT is a major source of both revenues and expenses for hospitals. Realising this fact, hospital administrators concentrated their efforts in increasing the profits from OT (by increasing the number

of elective surgeries), which in turn will also increase the hospitals profit. The demand for increase in elective surgeries led to increase in number of OTs so that surgeons could schedule procedures as they desired. Historically, the head nurse is primarily responsible for the daily functioning of OT, and hence they were the *de facto* leader of the unit. As surgical procedures became more complex and available OT time for procedures decreased, surgeons became dissatisfied with the control structure of OT management. This is the reason that increasingly many hospitals are hiring a physician medical director for the OT, mostly represented by either a surgeon or an anaesthesiologist.

Historically, ‘open block’ system was used for scheduling cases in the OTs. Open block system means the surgeons (of the specialty and superspecialty) scheduled cases in available rooms on a first-come, first-served basis. This system worked if there was little demand for OT time and each room was suited for all types of procedures. Nowadays, the availability of OTs became unpredictable for surgeons with a short lead time in deciding to operate. Personnel have to move complex equipment from room to room to accommodate demand from multiple types of surgeries. There is also marked variability between busy and light days, resulting in poor overall OT efficiency and difficulty anticipating demand and allocating resources.

Because of the limitations of the ‘open block’ system, OTs moved toward a system of ‘block scheduling’. Block scheduling guarantees a certain degree of OT availability to each specialty and superspecialty. Under this system, the

institution assigns an OT room on a specific day to a surgical specialty, which may then schedule its cases on the day. This arrangement permitted the development of specialised OTs (i.e. rooms with heart–lung machines for cardiothoracic surgery, rooms with ophthalmologic fixed ceiling-mounted microscopes and rooms with dedicated laparoscopic equipments, etc.).⁴

PLANNING AND DESIGNING OF OTs^{1,5}

The key considerations while planning an OT or the objectives are:

- To promote and ensure high standard of asepsis and maximum standard of safety.
- To optimise utilisation of OT and staff time along with the working conditions.
- To maintain patient and staff comfort in terms of thermal, acoustic and lighting requirements.
- To allow flexibility and facilitate coordinated services.
- To minimise maintenance.
- To ensure functional separation of spaces and regulate flow of traffic.
- To provide soothing environment.

Theatre layout directly affects its utilisation and functioning. Following features should be kept in mind while designing OTs.

Location

Operation theatre must be located at suitable distance from other departments to reduce noise, traffic and other disturbances, but near few units/departments like ICU, surgical wards, accident and emergency services, central sterile supply department (CSSD) or theatre sterile supply unit (TSSU) and laboratory/blood bank. Based on the functional considerations, the OTs could be located in a separate wing, an independent building or on a floor of hospital.

Size

The operating room should not be smaller than 6 × 7 m² (42 m²) or larger than 7 × 9 m² (63 m²). The inner height is ideally 3–4.5 m. The larger the air space, the more expensive the air treatment would be. Cardiovascular, neurosurgery and orthopaedic OTs fall in the category of bigger OTs. An additional room adjoining the main OT may be needed for the heart–lung machine in CTVS OT (cardio thoracic and vascular surgery operation theatre), as also for other large equipments like robotic arm, and so on.

Number

The number would depend on the type of hospital, number of surgeons and their specialty, number and type of surgical patients, availability of staff and hospital policy, and procedures. The number of OTs can be predicted from number of

operations per day. Macaulay and Davies suggest that the number of OTs can be determined from total annual operations expected to be conducted in the hospital, divided by average number that can be performed in one OT.⁶ It may be calculated as follows:

$$\text{No. of operations per day} = \frac{\text{No. of surgical beds} \times \% \text{ of BOR} \times 365}{\text{ALS} \times 100 \times \text{Number of working days in that hospital}}$$

Note: BOR = Bed occupancy rate

ALS = Average length of stay

Number of operations per OT also depends on average duration of operations (which, in turn, depends on type of OT and hygienic interval) and number of working hours/day. The number of operations that can be performed in each OT can be determined by studying past trends and by conducting work studies, or by making use of available standard norms. American authorities calculate one OT for 2–3 operations/day, while European authorities recommend that a minimum of six operations to be performed/day in one operation theatre.

American authorities recommend the provision of one OT for every 50 beds. If half of these beds are for surgical patients, then it works out to be one OT for every 25 surgical patients. In the European model, the provision is one OT for every 50 surgical patients. The number of operations/OT/day can be studied from past trends or data from similar hospitals. American authorities calculate one OT for 2–3 operations/day. European authorities recommend a minimum of six surgeries/OT/day.^{7–9} According to COPP 1964, the number of OTs required for number of beds in hospital is as follows (Table 15.1):

Table 15.1 No. of operating suites

No. of Beds	Inpatient department		OPD (inclusive of emergency)	
	Minor	Major	Major	Minor
300	2	3	x	1
500	2	5	1	1
750	2	8	1	1
1000	2	10	1	1

Zoning

It is a well-known fact that design follows the function. A surgery is to be performed under the most aseptic conditions. Hence, the concept of zoning has been advocated. Zones are predicted on the types of activities, patterns of circulation and degree of sterility to be maintained. The bacteriological count will increase from aseptic to clean to protective zone, i.e. from inner to outer zone. Zoning is done to decrease the chances of carrying infection along with the staff member, patient or supplies when they enter the OT from protective to clean to aseptic zone. Operation theatre are divided into four zones as given in Table 15.2.

Table 15.2 Various zones of OT

Protective zone	Clean zone	Aseptic/Sterile zone	Disposal zone
<ul style="list-style-type: none"> • Reception • Waiting room for patient relatives • Changing room • Preanaesthesia room • Stores and records • Autoclave/TSSU • Trolley bay • Control area of electricity 	<ul style="list-style-type: none"> • Preoperating room • Recovery room • Plaster room • Staff room • Anaesthetic store • X-ray unit with dark room/auto-processor 	<ul style="list-style-type: none"> • Operating room • Scrub room • Anaesthesia induction room • Instant instrument sterilisation • Instrument trolley area 	<ul style="list-style-type: none"> • Dirty wash-up room • Disposal corridor • Janitor closet

Walls and Flooring

The OT should have galvanised iron walls, stainless steel panels, epoxy filled and grinded joints, and antibacterial-coated surfaces. Walls and ceiling of OT must have following features—nonporous, resistant to fire, nonreflective surface, stain and water proof (without joints or with joints), which can be sealed, flawless and easy to clean/disinfect. The room walls (inner shell) are formed by removable honeycomb panels with a conductive epoxy roll-coat finish. The outer shell consists of a sandwich layer with insulation, the necessary vapour trap and a waterproof shield. Inset mosaic pattern of flooring with minimum number of joints must be done. Copper strips or conductive copper-mesh flooring must be done to transmit any static electricity produced.

Hermetic Sealing Doors

Electrically operated, hermetically sealed sliding doors with a height of 2.13 m (7 ft) should be present to ensure sterilisation, build effective air pressure by preventing air turbulences and better acoustic and noise control, and maintenance of temperature and humidity levels in case of failure of air-handling unit (AHU) (Figure 15.1).

**Figure 15.1** Hermetic sealing doors.

Air-conditioning and Ventilation

To ensure a high standard of asepsis and proper environment control in the OT, a high-quality air-conditioning with

**Figure 15.2** Air-relief-pressure damper.

proper positive pressure ventilation is essential. For this, the location of air-relief-pressure dampers of appropriate size (Figure 15.2) must be decided strategically, which enables maintenance of differential room pressures and ensures sufficient air flow when doors are opened between clean and dirty areas to prevent cross-contamination.

Central air-conditioning should ensure temperature range of 18–24° C with 50–60% humidity levels. Paediatric surgeries require a higher OT temperature as compared to other OTs. Construction of OT has to cater for the AC duct, laminar flow, high-efficiency particulate air (HEPA) filter and return ducts that take almost 1 m space above the false ceiling. Positive pressure has to be continually maintained in the OT to reduce the concentration of particles in the room, expel odours and released anaesthetic gases. Normal recommendation is 18–20 air changes/hour. The ultraclean or laminar-flow air-conditioning system can reduce the number of bacteria-bearing particles to <math><50/m^3</math> compared with 50–200/

**Figure 15.3** Ceiling fitted with plenum box.

Service Pendent

These are provided for the ease of function and movement of the surgical team and to avoid cluttering of wires on the OT floor. They are ceiling mounted and provide manifold (oxygen, NO, compressed air and vacuum), electrical outlets, anaesthetic gas-scavenging system, etc.

Illumination

Shadowless illumination should be ensured by 27,000–1,27,000 lux intensity operating lamps within OT. The overhead operating light must provide a circular light pattern and focus appropriate for size of the incision. Operation theatre light must produce the blue–white colour of daylight, be freely adjustable to any position or angle by either a vertical or horizontal range of motion, and should be aerodynamically designed to facilitate airflow. Anaesthetist should be able to observe colour changes of the patient's skin. Heat emission should be minimum. Halogen bulbs generate less heat than other types. Backup system as generator supply/uninterrupted power supply (UPS) of adequate capacity for OT light, monitors, cautery and anaesthesia machines should be provided.

Control Panel (Figure 15.4)

The control panel consists of a unique membrane panel that incorporates devices for timing, electrical supplies, medical gas alarm, environmental control, communication points and data points, etc. required by the theatre staff. A separate enclosure must be provided for high-voltage equipment.



Figure 15.4 Control panel.

Scrub Sink (Figure 15.5)

Stainless steel scrub sink must be used. Infrared sensor-operated taps must be used and, if not possible, then at least knee-/elbow-operated taps must be used in OTs. One scrub sink (with 6–8 outlets) for one OT or two adjacent OTs should be there. The working height should be 96 cm with water source 10 cm higher. The gowning area should be co-located, if possible. About 11 m² space would be required for a gowning area and a scrub station with 3 scrub-up points. Photoelectric cell-operated water gushers totally eliminate body contact.



Figure 15.5 Scrub sink.

Plumbing/Sanitary Installation

The sewage shaft should not pass through the OT. The shaft has to be leak proof with impervious lining. There should be no plumbing lines and fixtures above the OT to prevent any leakage and contamination.

Pass-through Cabinets

Pass-through cabinets are the cabinets that allow transfer of material/supplies from outside to inside OT without disrupting the positive pressure inside OT. It contains clean air.

Staff Amenities

There must be changing rooms, toilets, lavatories and locker facilities for the staff. Shower and toilets need to be provided in the changing room area.

Blood Store and Laboratory

One of the prerequisites is refrigerators for blood storage in an OT. Laboratory area for preparation of frozen section and examination of the same may be provided.

Facility for Anaesthesia

If anaesthesia is given in separate room (induction room), the operating room can be used for more number of cases, which, in turn, will increase utilisation.⁵ But at the same time the cost associated with the resources that will be utilised in that separate room must also be considered.

Fire Safety

Fire detectors like ionisation and optical detectors should be provided. Usually heat detectors are provided as fire detectors; but in an OT where equipment are housed, fire will lead to more smoke than heat, and hence ionisation and optical detectors must be provided in OTs. Along with detectors, due attention must be given for fire exits and fire extinguishers. The staff working in OTs must be well aware of the earmarked fire exit routes. Appliances and equipment must be checked and maintained on regular basis. Staff training with respect to fire safety and emergency communication plays a key role in preventing any untoward incident due to fire.

Water Supply

The normal water supply/bed/day is 400 L/day. Other than this, a separate reserve emergency overhead tank must be provided for OTs.

TYPES OF OT

The OT may be divided into two types.

Centralising Versus Decentralising OT

A centralised OT complex (OT of all specialties in one complex) has many advantages in this regard, as there is

efficient use of staff and facilities available, better supervision, flexibility in scheduling operations and efficient use of supplies. If not more than six, all can be placed on one floor. If the number of units is more than six, it becomes necessary to distribute them between two or more floors. In such cases it is recommended that the theatres and the corresponding wards should, as far as possible, be placed on the same floor.

Modular, Integrated and Hybrid OT

The latest in OT planning and designing are modular OT and integrated OT.

Modular OT (Figure 15.6)

The framework of modular OT is made up of steel and is manufactured in a factory setup. The framed module is delivered and installed at the site, which is prepared for the purpose. Preparation of the site and manufacturing of steel-framed building module is done side-by-side. This helps in reducing the time related to construction to half the time required for traditional construction.



Figure 15.6 Layout of modular OT.

Integrated OT (Figure 15.7)

'Integration' in an OT refers to functionally connecting the OT environment. This includes patient information, audio, video, surgical lights and room lights, building automation [heating, ventilation and air conditioning (HVAC)] and medical equipment. Users can easily route A/V sources and effectively control surgical equipment. When integrated, all technology can be manipulated from a central command console by one operator.



Figure 15.7 Layout of integrated OT.

Hybrid OT (Figure 15.8)

The word 'hybrid' originally refers to the result of interbreeding between plants or animals of two different species;

it has been more recently used to combine two different methods (e.g. imaging system and operating table) to achieve higher performance.

Advantages of hybrid OT

- Shorter patient recovery time and decreased length of stay.
- The system of delivering care becomes streamlined.
- The clinical manpower required to provide patient care decreases.
- The cross-specialty consultation and communication becomes easier. It also reduces communication-related errors between clinical specialties.
- The total cost of care is reduced. At the same time, hybrid OT has the potential for revenue growth.

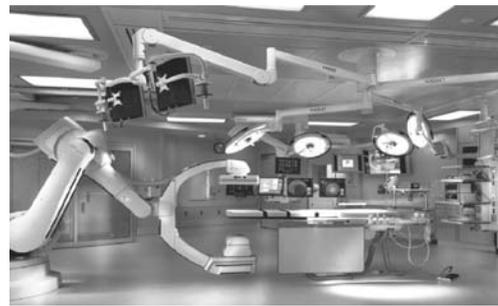


Figure 15.8 Layout of hybrid OT.

STAFFING OF OTS

The OT team per operation table constitutes of operating surgeon, anaesthetist, one senior nurse in charge of theatre, two to three staff nurses, one OT technician, one hospital attendant, one sanitation attendant (for two OTs).

The salaries of operating room staff (surgeons, anaesthetist, nursing attendants, etc.), account for the majority of OT costs followed by logistics, including instruments and various special sets. One way to minimise cost is by hiring less full-time employees as full-time nurses, anaesthesiologists, etc. But at the same time, the number of staff members posted there should be optimal for proper utilisation of OT.

Case Study 1: Adoption of technology for improving productivity

Issue

In a hospital, the zoning of OTs in main OT complex was not proper.

Intervention

When emergency OTs were constructed in the hospital, the concept of zoning was adhered to and proper dirty corridor was constructed. When modular OT came into existence, these were installed in the advanced cardiac centre; the concept was later taken up by various other advanced centres of the hospital.

POLICIES AND PROCEDURES

A written manual with clear job description of personnel is essential for smooth functioning of OT.

Overall in Charge

For effective functioning of OT, a medical director must be recruited who will balance the priorities of each member of OT team while working cooperatively between them. The priorities for surgeons are easy OT access and state-of-the-art equipment; for nurses the priorities are predictable hours and standardisation of cases and for hospital administrators the priorities are high OT utilisation and low cost for personnel and equipment. The purpose of recruiting medical director is to align the forces working in the OT in an efficient and productive manner.

Methods of Scheduling of Operations

'Case scheduling' is selecting the day and time for elective cases of various specialties so as to fill the allocated hours more efficiently. Scheduling can be improved by accurately predicting how long an elective case would last.

Staffing Patterns

The staffing patterns with work hours including emergency duties must be clearly defined so that there is no confusion among the working team.

Cleaning of the Operating Room

- *Preparatory cleaning:* An hour before the beginning of the first operation, a damp dusting with detergent or disinfectant.
- *Operative cleaning:* Areas contaminated by blood and sputum during the operation should receive immediate cleaning with disinfectant.
- *Intermediate cleaning (hygiene interval):* General clean-up of OT room before the next patient is taken. Instruments should be processed in a flash autoclave for reuse, otherwise they may be sent to disposal zone. Furniture must be cleaned with germicide and floor should be cleaned with wet vacuuming. If wet mop is used, a fresh mop must be used each time and buckets should not be used at all.
- *Terminal cleaning:* At the end of day's schedule, a vigorous cleaning of the OT is required.

Acceptable Level of Bacteria

The acceptable level of bacteria is <35 colony-forming units (CFU) of bacteria/m³ of air or less than one CFU of *Clostridium perfringens* or *Staphylococcus aureus* in 30 m³ (Table 15.3). During operation, the level of bacteria must be <180 CFU/m³ of air using ultraclean laminar flow in the theatre, with <20 CFU/m³ at the periphery of the enclosure and <10 CFU/m³ at the centre.

Table 15.3 Permissible bacteria concentration in various OT

Operation theatre	Permissible bacteria concentration	OT
Class I	Up to 70 bacteria/m ³ of air	Highly aseptic operating theatres (transplant OT, heart operations, treatment of severe burns, brain operations)
Class II	Up to 300 bacteria/m ³ of air	Aseptic operating theatres, septic operating theatres, plaster rooms in operating suites
Class III	Up to 700 bacteria/m ³ of air	Emergency OT and delivery room

ASSESSING OPERATION THEATRE UTILISATION

One measure to assess how well an OT functions is its 'utilisation'. Operation theatre utilisation is defined by Donham and colleagues as the quotient of hours of OT time actually used during elective resource hours and the total number of elective resource hours available for use. Various indicators that are suggestive to measure OT utilisation in a hospital are:

On-time Start of OT

To start the first procedure of the day on time is very crucial. It provides tangible (scheduling) and intangible (mood and tone) gains. Efficiency of operating team decreases if there is a delay in starting the first case, as it spoils the mood of the team. On time starts depend on the completion of many factors, including patients, timely arrival and completion of preoperative preparations, including compliance with all preoperative instructions [nil per oral (NPO), medications, laboratory tests], timely arrival of doctors and staff, presence of all necessary supplies and equipment, etc. The admitting process should be streamlined and organised to meet the needs of the surgical patient. Preoperative testing clinics and assessment protocols have helped reduce delays on the day of surgery as well as reduce costs.¹⁰⁻¹²

Reducing Turnover Time Between Surgeries

Reducing turnover time does improve efficiency and focus, which may translate to improvement in surgical preparation and case completion times. The intangible benefits of reducing turnover may be most important. Reducing turnover time depends on effective teamwork of OT team. However, excessive focus on turnover time is often counterproductive. Staff risk losing more time strategising than can realistically be gained from the resulting changes.^{13,14}

Reducing cancellation of surgeries: Cancellation means either no work for scheduled hours or no theatre time left to perform the scheduled surgery. This leads to underutilisation besides psychological trauma, monetary loss to patient and poor rapport of hospital. Therefore, cancellation needs to be avoided by fully preparing the cases and proper scheduling.^{15,16}

Flawless Supportive Services

Proper electricity backup, heating ventilation, air-conditioning system, adequate supply of sterilised equipment, linen and other materials required for surgery, etc. must be available for efficient utilisation of OT.

Operation theatres (OTs) contribute significantly to the smooth functioning in a multidisciplinary tertiary-care institute. Hence, the appropriate management of OT services is essential for efficient utilisation of available resources.

Case Study 2: Utilisation of available operating time

Problem

A study was done in a hospital to analyse time utilisation and cancellation of scheduled cases in the operation theatre (OT) complex where elective surgeries were scheduled. The available operating time was 8 hours (resource hours). The mean 'raw utilisation' (time when patient was inside the OT) was 81.54% and the 'adjusted utilisation' (raw utilisation + room turnover time) was 86.09%. The mean time spent on 'supportive services' (time spent on arranging the sterile trolley, anaesthetising the patient, positioning of the patient for surgery) was 12.02%, on 'actual surgery' was 61.37% and the 'room turnover time' was 5.39%. There were delays in 15.63% cases scheduled in starting the OT table on time. Total of 22.5% of scheduled cases were cancelled due to various reasons. Lack of operating time (78.1%) was the most common reason for cancellation. What could have been done in such case?

Solution

The number of cancellations could have been decreased by proper scheduling of cases. Lack of operating time is the most common cause of cancellation, which represents that either more cases were scheduled than, could have been operated during the available OT time or there were delays in starting the OT and long turnover time between cases. Another option is to increase the available operating time from current 8 to 10–12 hours (which needs resources in terms of manpower and supplies).

Case Study 3: Management of OT services during strike by hospital attendants and sanitation attendants

Problem

There was a sudden call of strike by hospital attendants and sanitation attendants in hospital due to which the work of shifting patients from wards to OTs and cleaning the OTs was affected. What to do in such circumstances as

the strike might have led to delay in starting the OTs and cancellation of scheduled OT cases?

Solution

The situation was managed by hiring workers from outside agencies and the nursing staff posted in OTs supervised the work of newly appointed attendants so that proper sterility could be maintained in the OTs. There were delays in starting the OTs, but none of the scheduled OT cases were cancelled.

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Health-promoting Hospital Emergency Department

16

Dr Sonu Goel, Prof Anil Kumar Gupta, Dr Sonika Raj, Dr Mahesh Devnani and Dr Amarjeet Singh

“The hospital emergency is the antechamber to the tomb.”

—George Orwell

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the concept of health-promoting hospital (HPH) emergency department.
- realise the role of health-promoting hospital emergency department in improving the quality of hospital care.
- apply the concept of health-promoting hospital emergency department in their area.

Accident and emergency units are often the portal of entry in a hospital with highest volume of patients requiring critical care. Hence, a systematic approach needs to be adopted while planning such units.

DESIGN

The design and planning of emergency department (ED) should be done in a way that it does not impede the movement of patients, staff and equipments. There should be easy access for patients and general public to ambulances. ED should be easily identifiable from outside (proper signboards and LED display). It should be preferably located at ground floor. There should be a separate triage area in ED for screening of patients. Enough flexibility should be there for management of patients in ED during disasters. A resuscitation room may be provided for immediate attention of critically ill patients. The doors of emergency should be wide enough to accommodate stretchers, trolleys, portable X-rays and other equipments. The patient waiting area should be sufficiently large, comfortable and welcoming. All the security features and fire safety measures should be properly designed. All the ancillary and supportive services like laboratories, X-ray/USG/CT scan, blood bank, etc. should be available round-the-clock within/near the emergency area. There should be uninterrupted electricity supply with proper backups and water supply within emergency area.

The layout of an ED affects the chances of spread of infection, e.g. open wards with many beds separated by curtains.

Lack of controlled ventilation also contributes to the spread of the infection. PGIMER Chandigarh, emergency medical outpatient department (EMOPD) has a core type of design in which the treatment spaces are situated around a central point where ED personnels work.⁴⁻⁵ At the inception, EMOPD had 40 beds; but now it has 110 beds (sometimes additional trolleys make it a total of over 200), leaving little scope for further expansion.

SCREENING AND SURVEILLANCE

Screening and individual risk assessments aim to screen people who really need emergency treatment from routine cases, thus decreasing the patient load, besides preventing transmission of infection. Recent threats of plague, severe acute respiratory syndrome (SARS), avian influenza and H1N1 influenza have reinforced the need for a screening system in emergency of tertiary-care institutes like PGIMER. It has been observed that patients can transmit their infection to others in EMOPD, as happened in the plague outbreak in Himachal Pradesh.

In February 2002, few cases of a mysterious plague-like disease were admitted in PGIMER. By the time a formal diagnosis was made, infection had been transmitted to a visitor of another patient in the ward, who later died. The need to screen all patients with suspected infectious disease in the EMOPD for control and prevention of infection was then recognised. Two community physicians were deputed to assess the situation, and an outbreak-control committee

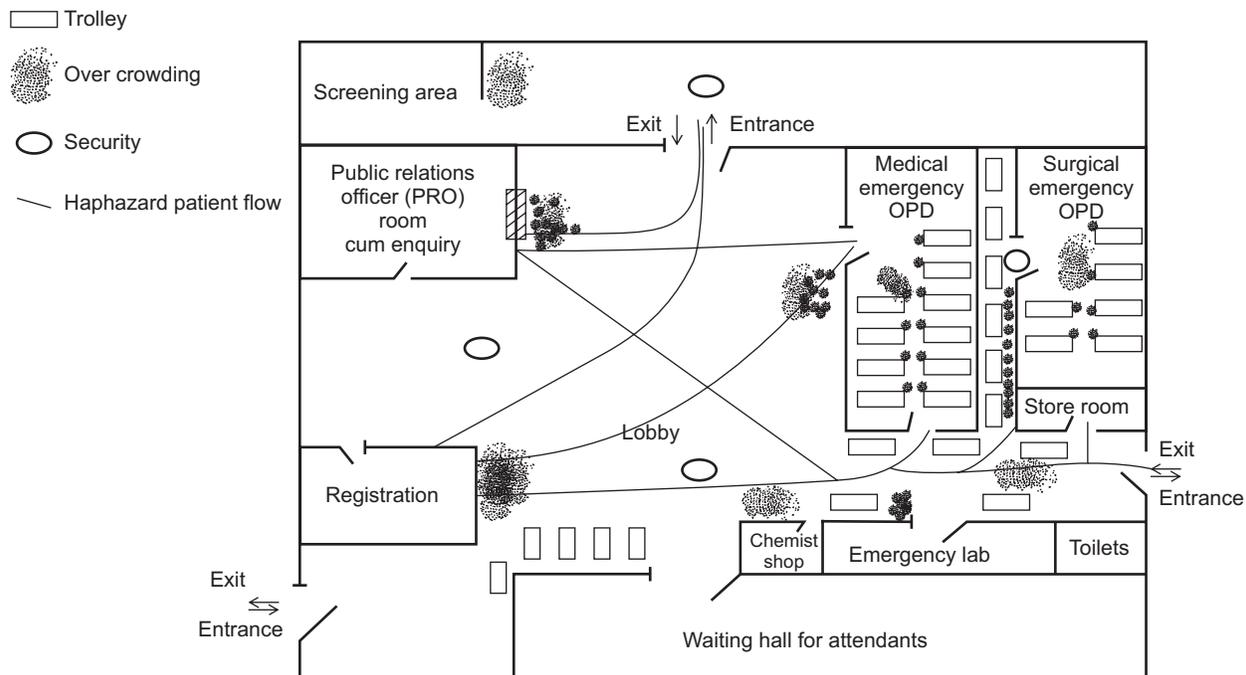


Figure 16.1 Status of overcrowding in the EMOPD of PGIMER.

was formed. But this system lapsed soon after the plague situation was over.⁶ During SARS epidemic of 2003, screening of febrile patients was started at EMOPD of PGIMER Chandigarh. PGIMER established a 'control room' near the reception to screen all patients with respiratory symptoms for SARS. A senior resident (MD) in community medicine with 6-years' experience sat with a public health nurse (PHN) in a lobby near an EMOPD entrance from 08:00 to 17:00 and was on call for the rest of the day. The security guards directed patients with respiratory symptoms to the principal investigator, who asked them and their relatives the SARS screening questions specified in the protocol.⁷

In 2009, India along with more than 100 countries of the world faced the H1N1 influenza pandemic.⁸ The screening system was strengthened during H1N1 influenza epidemic, where all the patients coming to the EMOPD of PGIMER had to pass through the first level of screening (viz. security guards).

The guards were told to direct the patients to screening area who gave history of cough/cold/fever/breathlessness/respiratory difficulty or travelling outside the country. At level-2 screening, the concerned physician manned at screening area examined the patient. The suspected patients and their attendants were given triple-layer face masks and those requiring admission were guided to the communicable disease (CD) ward. The staff (doctors, nurses, guards) in ED was using triple-layer face mask or N-95 mask, as recommended by WHO. In Taiwan, the role of hospitals in the spread of infectious diseases was emphasised by experiences with SARS, where 31 cases occurred after exposure to the

index case in the EMOPD itself.⁹ Therefore, the promptness and quality of emergency medical care may be crucial in preventing the spread of infection.

EMOPD should follow a strict protocol of screening and surveillance at all times, especially during the outbreaks. Patients arriving in EMOPD should first be examined thoroughly to rule out the chance of patients with acute infectious disease from mixing with the OPD crowd. For this, a permanent 'triage/control room' should be established near reception for screening patients. This should include a cubicle for examination of critically ill infectious-disease patients. A PHN with an emergency medical officer—surveillance and screening (EMO—S&S) should be posted permanently in the EMOPD. Only the patients screened by the EMO—S&S should be allowed to enter along with one attendant. Restriction of patient movement is crucial for ensuring infection control. If a doctor/nurse suspects that she/he is dealing with a highly infectious disease, she/he should have an option to isolate the suspected cases in an isolation room/ward located nearby.

Surveillance is also an essential part of hospital control of infectious diseases. Many countries have tried to incorporate surveillance in their emergency medical services, and the role of national government in strengthening infectious disease control in an emergency has been debated. In India an Integrated Disease Surveillance Project (IDSP) has been implemented in many states to focus on early detection and control of spread of infectious diseases. A draft contingency plan for avian influenza has been included in the IDSP training of medical officers; but the IDSP lacks the necessary

focus for the EMOPD.¹⁰ Surveillance and contact tracing of the cases was done in case of H1N1 influenza pandemic in PGIMER. Hospital- and school-based health activities were also initiated. A standard operating procedure (SOP) (Figure 16.2) of triage, treatment and admission protocol of patients was developed, which may be replicated and adopted/adapted in other similar settings.

ISOLATION FACILITY

There should be an isolation facility with negative pressure isolation cubicles within an institution. The facility should be near to emergency screening area and simultaneously should have access to the suspected patients, their attendants and hospital staff bypassing hospital area so as to minimise the spread of infection. It should have all the personal protective equipments (PPE) and life supports facility, and has round-the-clock availability of staff and supplies. It has been observed that grouping infectious patients in a centralised location at an early stage of infection may reduce the extent of an epidemic.¹¹ Although PGIMER has an isolation facility, negative-pressure isolation room is not available to examine the infectious cases. During SARS outbreak, suspected patients in emergency were straightaway shifted to the isolation room (in a different block, 300 m from the EMOPD). However, the chances of infection spreading to patients/attendants during transfer of the patient remained as some of the patient/attendants were shifted through the emergency area.

OVERCROWDING AND FLOW OF PATIENTS

Studies have proved that overcrowding in EMOPD threatens quality to healthcare. Overcrowding makes ED a potential space of infection spread. Miró et al. stated that ED effectiveness and overcrowding are not only determined by external pressure like high load of patients and limited infrastructure but also by internal factors such as mismanagement of space and improper patient flow.¹² During SARS and H1N1 influenza outbreaks at PGIMER, overcrowding was noticed within the EMOPD. Moreover, the flow of patients and their attendants was not systematic.

There was initial confusion on entry to EMOPD resulting in clustering around the reception area (Figure 16.1; area 1). At most of the times, more than two attendants accompanied one patient. The corridors were overcrowded at most of the times. This left little space for movement of patients and staff. It was observed that on an average there were around 60–80 persons present in these corridors. Most of the attendants remained in the corridors so that they could hear when called by doctors or nurses. These corridors were also crowded with the admitted patients on wheeled trolleys who could not get a bed in the ward (Figure 16.1; area 5).

There were many other factors contributing to crowding in an EMOPD. These included presence of other areas like laboratories, X-rays/CT scan, blood bank within the

premises. At PGIMER, it has been seen that substantial number of attendants entered the emergency area to deposit the samples and collect the reports (Figure 16.1; area 4). In the observation period of 6 days at EMOPD of PGIMER, it was seen that a total of 66.5% ($n = 1811$) biochemistry samples, 53.9% ($n = 1554$) haematology samples came from the emergency patients and rest of the samples were from the wards. 28.5% ($n = 1135$) of the samples were brought before noon, 33.3% ($n = 1397$) in the afternoon, and 38.1% ($n = 1612$) during evening and night. Reports were sent to respective units (till 10 pm) through the hospital attendants. Thereafter, the reports were kept in bundles outside emergency entrance in a shelf from where these could be taken by the attendants. These bundles were not systematically arranged and contained the outdated reports.

The other major contributing factor of overcrowding in the corridor was the location of chemist shop at PGIMER (Figure 16.1; area 3) within the EMOPD premises, where significant number of people (attendants of the patients of ED as well as from indoor wards) gathered to buy medicines. Many commuters used EMOPD corridors as a thoroughfare (Figure 16.1; area 7). This overcrowding posed a major obstruction to wet floor mopping, which was done two or three times every day.

The problem of overcrowding could be tackled by multi-disciplinary approach, the prime being by strict security arrangement. Attendants should not be allowed to stand and loiter in the corridor. Only one attendant (at the most two, in case of serious emergency) should be allowed into the EMOPD. The waiting area should be used to the optimum and attendants should be guided to wait there. There should be a loudspeaker in the waiting hall, which could be used to call the attendants as and when required by the staff. There should be a policy that limits the stay of the patients in the ED. There should be sincere efforts from the departments to shift their patients to the wards as early as possible (within 24 h preferably). The high burden of patients on the PGIMER (bed occupancy rate = 94.9) could be tackled by sharing the patient load with other major hospitals of Chandigarh, viz. General Hospital and Government Medical College. There should also be a strict admission and discharge policy to regulate the patient turnover. The trolley bay, canteen, chemist shop and toilet facilities for the attendants could be relocated outside the main premises of EMOPD, since these were the major source of chaos and overcrowding. The improper management of laboratory samples and reports could be tackled by engaging ward attendants who would collect reports and deposit the samples. Such simple reorganisations can lead to major improvement in the problem of overcrowding at EMOPD.

HEALTH INFORMATION AND COUNSELLING

Improving people's access to health information enables them to make informed choices about their behaviours and use of

healthcare services. Emergency departments can be effective providers of health information. In addition to the range of posters and brochures that ED offer, EMOPD should provide health information to parents/patients about standard precautions and preventive measures for common diseases during their stay/after discharge from ED. At PGIMER ED, there is provision of television and newspapers in waiting hall. During epidemics special brochures, pamphlets and newsletters are also made available to patients and their attendants. However, it was observed that the information, education and communication (IEC) material display during H1N1 influenza and SARS outbreak was minimal.

APPROPRIATE SIGNAGE SYSTEM

A sign should be placed at the entry of EMOPD, instructing people where to report first. Proper directions to patients/attendants should be displayed inside the emergency areas. It was observed routinely and during SARS and H1N1 outbreaks that patients and attendants were seen enquiring about things like the location of wards, doctors, etc. from the emergency reception counter of PGIMER. There is no parking space for the vehicles of patients or the staff who came to EMOPD and neither signage system for their appropriate direction. EMOPD of a hospital should include proper signage about location of the OPD, reception, wards, doctors-on-duty, screening areas so that people do not gather around the reception counter for the queries.

COMMUNITY ACTION

Community action aims to help and empower people during their illness. There should be appointment of trained community volunteers and medical social workers in emergency to support patients and their attendants. They also can act as patient advocates on nonmedical issues. An assistant public relations officer (APRO) is appointed in the emergency of PGIMER Chandigarh for help of needy people. A helpline is also operational at emergency reception to provide information to patients. During public health emergencies like influenza pandemic, special helpline was established to provide information. PGIMER, Chandigarh in liaison with various social and nongovernmental organisations (NGOs) like Seva Bharti, Lifeline, Red Cross, Sahayata, etc. for organising various camps for public awareness and monetary help to the patients. An organisation namely Pingalwara provides assistance to unknown patients admitted to EMOPD at PGI. The sarais and dharamshalas inside PGI campus facilitate the stay of patient's relatives and unknown patients (till they are discharged).

ORGANISATIONAL DEVELOPMENT

Organisational development aims to create a supportive environment for health-promotion activities within agencies

by building sustainable skills, resources and commitment to prevention. Health promotion then becomes an integrated part of an organisation and not a side issue. To embed health promotion into emergency departments, the hospital emergency mission statement and job descriptions of various workers in the emergency should be well-established and displayed. The protocol of screening and surveillance of patients (recognition, interviewing, assessment, interventions of health education/safety planning, referral, follow-up), and infection control should be established. The staff (medical, nursing and administrative staff) should be trained in the protocol. At PGIMER Chandigarh, although regular training programmes are organised for staff on various issues like hand hygiene, motivational and behavioural training, sound biomedical waste management practices, etc., training is also required in the early recognition of presenting symptoms of infectious diseases.¹³

The resident doctors of medicine and surgery should be aware of the locally endemic diseases and impending outbreaks. Accordingly, they should watch for the suggestive symptoms in every case. This should be included in their training/teaching curriculum. A set of standard protocols for screening and management of infectious disease patients should be framed and displayed prominently. These guidelines should be regularly updated whenever any new emerging or re-emerging disease is reported. The latest updates from Communicable Disease Alert and Global Infectious Disease Alert should also be prominently displayed in the EMOPD.

WHO has established a global alert and response network to monitor and track infectious diseases outbreaks, which should allow EMOPDs to anticipate future problems.¹⁴ In case of SARS outbreak, the WHO protocol was used in EMOPD of PGIMER to classify the cases as having suspected of probably SARS. The SOP developed by PGIMER for triage, treatment and admission protocol for the H1N1 influenza patients was a commendable step, as SOP maximises operational efficiency (Figure 16.2).

LABORATORY AND OTHER INVESTIGATIONS

Availability of quick and reliable laboratory investigation facilities is vital for the early diagnosis of acute infectious diseases and allows initiation of prompt treatment and control measures. Standard protocols for specimen collection and transport in appropriate culture media/temperature conditions for infectious diseases should be developed and used following standard guidelines. All the necessary emergency investigations for probable/impending outbreaks should be performed in emergency. In case of SARS outbreak, since laboratory investigations for SARS were not available in the EMOPD of PGIMER, there was delay in collection and transport of samples, which resulted in delayed confirmation of diagnosis.

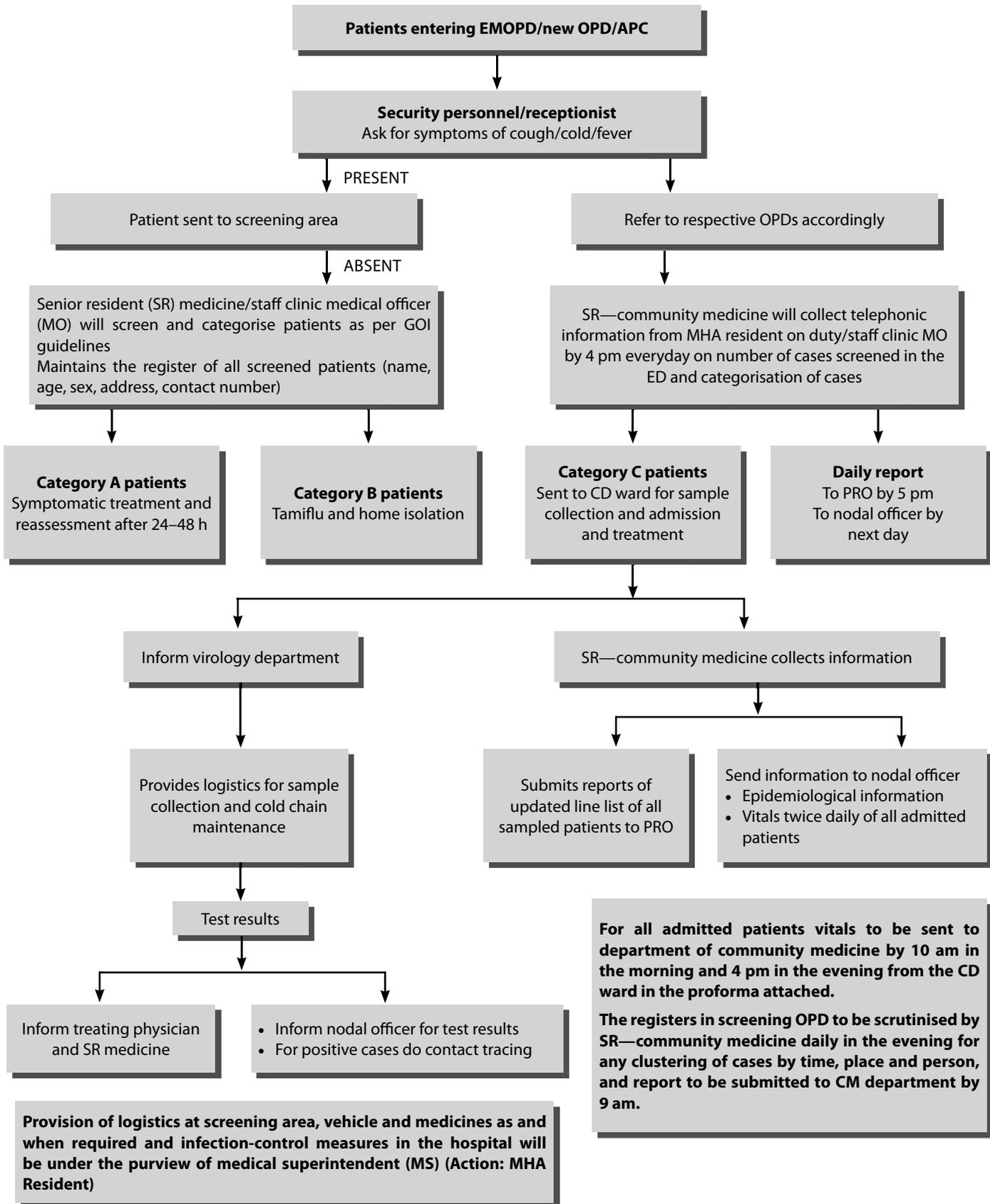


Figure 16.2 Standard operating procedure (SOP) adopted during H1N1 influenza outbreak for screening at PGIMER in 2009.

VENTILATION

A sound ventilation system of hospital is a key to prevent nosocomial infections and also to maintain a patient-friendly environment. It should be designed and maintained to minimise microbial contamination. Emergency department of PGIMER Chandigarh is centrally air-conditioned system with different airflow control units as per accredited international norms. The air-conditioning system is water-cooled-reciprocating-type chiller and contains Microvee (in EMOPD and wards) and high-efficiency particulate air (HEPA) filters (in emergency OT area), which filters particles up to 0.03–0.003 μ . It maintains a temperature of 20–24° C (in OT areas 20–22° C) with relative humidity at 55–65%. Different areas have different air changes/hour, e.g. operation theatre 20–24 air changes/hour, ward 7–8 air changes/hour, which are as per international norms. It runs 24 \times 7 for 365 days a year for more than 12 years, maintaining all the requisite parameters. Frequent maintenance/validation of efficacy of filters, ducts, diffusers and grills are done in accordance with manufacturer's requirements.

PROTECTION OF HEALTH WORKERS

No harm should come to patients, their relatives, doctors and other staff by being in the hospital (c.f. 'First Do No Harm' policy). There is a definite need to make the EMOPD safer for already immune-compromised and susceptible patients and their attendants.

Medical personnel are also a recognised source of transmission of infectious diseases in hospitals.^{15–16} Emergency department workers in large hospitals are generally more severely affected by an epidemic. Personal protective equipment (PPE), namely gloves, gowns and surgical masks, should be permanently available in an EMOPD. They are important in preventing transmission of communicable diseases to relatives, other patients and healthcare staff, especially during an outbreak. Failure to implement a policy of universal PPE use early in an outbreak enables the spread of infectious diseases. Use of fitness-tested PPE in all patient-care areas has been shown to prevent nosocomial spread of SARS.¹⁵ In case of SARS outbreak at PGIMER, provision of the recommended N95 masks was delayed due to late procurement. However, they were timely provided during H1N1 influenza outbreak.

PGIMER Chandigarh, provides vaccination to its employees for all the necessary vaccinations under WHO schedule. The institution also provides vaccination during the outbreaks and other emergency situations, if needed. Recently all the healthcare workers were provided H1N1 influenza vaccination in the institution.

Beside above-mentioned activities, following activities should be a regular feature of ED:

- Weekly round of top management to review various activities.

- Provision of hygienic and nutritious food for patients.
- Supply of washed and clean linen.
- Provision of safe water.
- Biomedical waste management.
- Sanitation and housekeeping.
- Prevention of hospital-acquired infection.

Because health is more than not being sick, the responsibilities of healthcare, including ED, go beyond simply treating the sick. The EMOPD of a hospital should be well-prepared to tackle any infectious disease pandemic. Such preparedness should be maintained and this should not be a stop-gap arrangement, since it is likely that in the near future we would be facing many infectious disease outbreaks.

Case Study 1: Overcrowding in ED as a result of increased waiting time in certain areas within ED

Emergency department (ED) of tertiary healthcare institute in India is mostly overcrowded, overutilised and inappropriately staffed. The challenges of overcrowded EDs and an archaic patient flow and admission processes result in excessively long waits for patients. To understand the scheme of things, a study was conducted in ED of one such institute in May 2011 to analyse the patient flow system by assessing the inter arrival time and waiting time distribution of patients. Arrival time pattern of patients in the ED was highly stochastic, with the peak arrival hours to be '9.00–12.00 hours', in which around 26.3% patients arrived in the EMOPD. The primary waiting areas of patients included patients 'under observation' (29.6%); 'waiting for routine diagnostic tests' (16.4%) and waiting 'for discharge' (14.6%). Around 71% patients were waiting due to certain reasons within emergency complex. It was suggested that more attention is given to these areas so as to reduce overcrowding.

Case Study 2: Developing health-promoting emergency department in a tertiary-care institute of India

Since 1986, WHO has been advocating to increasingly move towards health-promoting emergency departments (EDs). Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, established in 1962, has over 1600 beds of different specialty and superspecialties, and caters around 1.4 million outpatients, 60,000 inpatients and 65,000 emergencies per year. On-the-spot observation was done by principal author and one researcher in year 2011 to evaluate various health

promotion activities undertaken in PGIMER emergency. For this, the researcher used the general concept of health promotion (the settings approach) focussing more on physical structure rather than WHO—HPH concept. Few interviews with healthcare staff and patients were also done. It was observed that there was no designated assignment of any responsibility related to health promotion. Based on an objective scale devised by WHO on standards of HPH related to ED, the score of PGIMER was low. The staff of hospital was unaware about and also not involved in ED health-promotion activities. Around 65% patients were satisfied with overall preventive and health-promoting services of ED of PGIMER. Based on these findings, the author along with medical superintendent of the institute wrote a proposal to WHO, after which institute got a 1-year financial grant for developing PGIMER—a health-promoting institute.

Case Study 3: Management of polytrauma patients in emergency department

Emergency department of a tertiary-care institute receives an average of six to seven patients of polytrauma every day. There are frequent complaints, in particular, regarding the management of the polytrauma patients, which leads to delay in discharging the patients. Delayed discharge of these patients leads to inevitable increase in average length of stay (ALS) of the patients, which further leads to unavailability of the beds to other patients requiring emergency treatment. A retrospective cross-sectional study was done on 210 patients in the emergency OPD (EMOPD) for a period of 2 months, where the problems faced by patients during their management were assessed against six predetermined management steps (step I–VI). The younger generation—predominantly the males—were the primary victims of polytrauma injury, road traffic accident being the predominant aetiological factor. The patients with injuries involving more than two specialties faced maximum problems during the management of polytrauma patients. Out of 210 patients studied, 32 patients faced problems at various steps and maximum problems were faced in step III, i.e. coordination between various specialties in the management of polytrauma patients. A proper polytrauma management team and a well-defined standard operating procedure (SOP) are the essential keys for the effective management of polytrauma patients.

Case Study 4: Preparedness for H1N1 influenza in the emergency department

With the threat of the H1N1 influenza in mid-2009 in northern India, a study was conducted to analyse the

preparedness for H1N1 influenza by a pioneer tertiary institute of North India. Data was collected pertaining to patient flow, overcrowding and infrastructural inadequacies in the emergency department (ED). The information on existing policy, planning and its implementation along with laboratory registers was obtained. It was observed that the planning regarding pandemic influenza was initiated in the institute. A multidisciplinary committee was constituted, nodal officers identified and channel of flow of information within the hospital and with the local health departments was established. A standard operative procedure (SOP) was developed for the patients of H1N1 reporting in the hospital. According to the hospital pandemic planning checklist, the institute fared well. It was a lesson for ED of other institutes to prepare themselves timely, so as to prevent the brunt of outbreaks of emerging and re-emerging infections.

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Specific Diagnostic Services

Section V

SECTION OUTLINE

- Chapter 17 Clinical Laboratory Services
- Chapter 18 Haematology Services
- Chapter 19 Parasitology Services
- Chapter 20 Virology Services
- Chapter 21 Immunopathology Services
- Chapter 22 Radiodiagnosis and Imaging Services
- Chapter 23 Radiation Oncology Services
- Chapter 24 Nuclear Medicine Services
- Chapter 25 Experimental Medicine Services



Clinical Laboratory Services

Dr Arnab Pal

“A first-rate laboratory is one in which mediocre scientists can produce outstanding work.”
—Patrick MS Blackett

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand how to establish a clinical laboratory.
- describe total quality management.
- understand the process of accreditation of a clinical laboratory.

INTRODUCTION

Tertiary-care hospitals are planned to provide specialised consultations primarily to inpatients and referral cases from primary- and secondary-care centres. These hospitals are generally equipped with facility and personnel for providing medical care with advanced medical investigations and clinical facility. Clinical laboratory is an integral part of a tertiary-care referral hospital. With the advent of evidence-based medicine, the importance of a laboratory and radiological investigations become complementary to clinical diagnosis and management. Every tertiary-care hospital should include a meticulously planned clinical laboratory to achieve the best output from its laboratory services.¹ Concept of *laboratory medicine* was envisaged to include all the clinical laboratory services to achieve the goal of efficient and quality clinical laboratory reporting. The subspecialties of laboratory medicine include histopathology, cytopathology, clinical chemistry, clinical microbiology, clinical immunology, etc.

ROLE OF LABORATORY MEDICINE

Importance of clinical laboratory services for estimation of various metabolites including carbohydrates, proteins, lipids, enzymes, etc. established in nineteenth century when Hugo Wilhelm von Ziemssen started a laboratory attached to General Hospital, Munich.

There are 2.1 lakhs approved clinical laboratories in USA alone, as per the Centres for Medicare and Medicaid

Services–Clinical Laboratory Improvement Amendments (CMS–CLIA) database on 2010. Currently there are over 12,000 hospitals and 15,000 diagnostic laboratories functioning in India, including both public and private sectors.

Laboratory medicine is often referred to a discipline involved in diagnostic testing of the patient samples; but its role in the (i) teaching programme, (ii) research activities and (iii) hospital administration cannot be of any less value other than from the vital role played by the discipline (iv) clinical service and (v) analytical testing. More than 60–70% of the most important decisions on admission, discharge and medication are determined by the results of laboratory investigations.

Four major indications are there for which a clinician orders a laboratory test²:

- **Diagnosis:** For confirmation or ruling out a disease process.
- **Monitoring:** Effects of the treatment or drug therapy offered to treat the disease.
- **Screening:** For identification of metabolic and congenital conditions before the clinical symptoms appear.
- **Research:** To understand the disease process in a better way for development of newer management protocols.

With very-high degree of dependence on the laboratory results for the healthcare management, the quality of laboratory testing and reporting has become crucial for the better outcome of the healthcare delivery system, particularly in case of tertiary-care hospitals. Even though, there is significant improvement of analytical reliability of laboratory

investigations as a result of technological advances, including automation laboratory errors generated during different parts of analysis, which includes the process of sample collection, analysis of the samples and reporting the test results, still interfere with the reports.³

Thus utmost care is required to generate accurate, precise and validated results for the better outcome of the laboratory services.

ESTABLISHING CLINICAL LABORATORY

Establishment of a clinical laboratory starts with identification of need of the investigations. Determination of patient's needs and assessment of the laboratory's test menu and selection of test methodologies is the key to a successful clinical laboratory, taking into consideration type of tests, cost effectiveness and number of tests before implementation of new systems.

Clinical laboratories in USA are established following the Clinical Laboratory Improvement Amendments (CLIA) programme under The Centres for Medicare and Medicaid Services (CMS). In India, the establishment of a clinical laboratory is guided by Clinical Establishments (Registration and Regulation) Act, 2010.

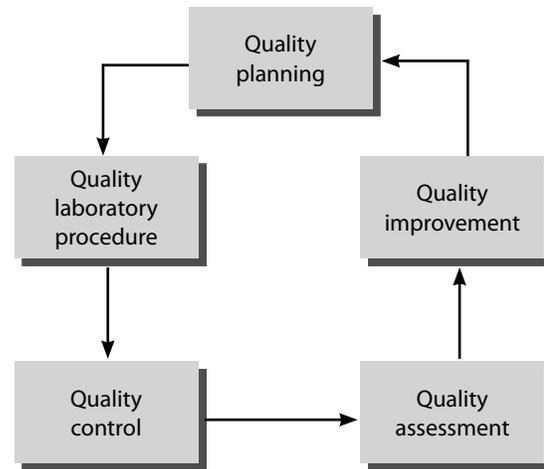
The keystones of establishing a successful clinical laboratory has the following aspects:

- Identification and development of quality management
 - Identification of space in accordance with the need and guideline for the establishment of clinical laboratory.
 - Recruitment of efficient, dedicated and quality manpower.
 - Purchase and procurement of quality equipment and reagents.
- Establishment of quality laboratory procedure and maintenance of the same after validation.
- Identification of new methodology for the development of the newer techniques and their validation.

TOTAL QUALITY MANAGEMENT

Total quality management (TQM) has become fundamental foundation in establishment and running of a successful clinical laboratory. The term *quality* refers to the conformance to the need and expectations of the customers and end users. To achieve the goal of TQM, the quality improvement has to be permanent and can only be achieved when the problems are fully eliminated. It has been documented that 85% of the problems can be solved at the managerial level and the rest 15% requires involvement at the worker level.⁴

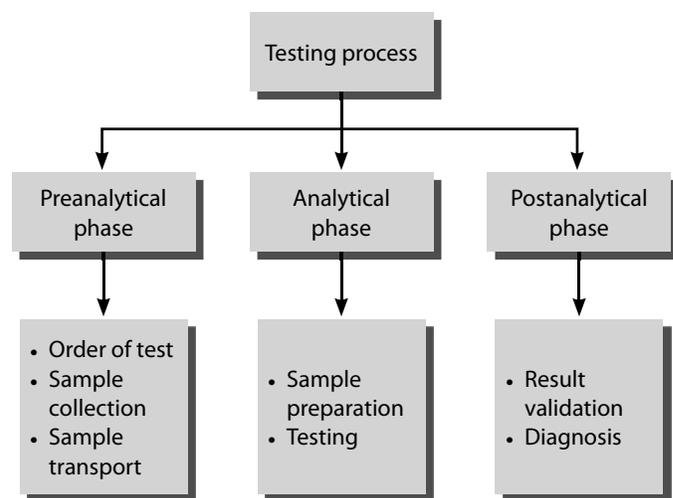
The concept of TQM in a clinical laboratory is generally managed in a cycle of 'five Qs', i.e. quality planning, quality laboratory procedure, quality control in the laboratory, quality assessment and quality improvement (Flowchart 17.1).⁴



Flowchart 17.1 Cycle of total quality management (TQM). Adapted from Tietz Textbook of Clinical Chemistry, 5th Edition.

Total testing process is a multistep process that starts with ordering of the test by the clinician and ends with the analysis of the result data. It consists of *three major phases* (Flowchart 17.2):

- *Preanalytical phase*: The preanalytical part of clinical testing includes the ordering of the test to the collection of sample specimens from patients, labelling the samples, transport of the samples to the laboratory and submitting those to the laboratory concerned for analysis.
- *Analytical phase*: The analytical part involves actual analysis of the sample, i.e. processing of the sample, testing, examination, and analysis and interpretation of the investigations, including the validation of the data by the laboratory.
- *Postanalytical phase*: The postanalytical phase deals with the postprocesses required after the analysis is over, which includes printing the test reports and despatching the same to the clinicians and their patients.



Flowchart 17.2 Testing procedure in a clinical laboratory.

Any deviation from the *standard operating procedure* followed by a clinical laboratory in any of the above phases results in laboratory errors. Preanalytic phase errors, particularly the collection, labelling and transport of the samples, result in nearly 70% of the total errors generated in a clinical laboratory.⁵ It is estimated that errors during analysis or analytical errors only accounted for a minor 7.9% of the total laboratory errors and the rest is by postanalytical errors.⁶ Although the analytical process is minimally prone to errors in comparison to preanalytical and postanalytical processes, it is very much necessary to understand the type of analytic errors so that appropriate measures may be initiated to reduce the controllable errors to a minimum.² Analytical errors can be of two types, i.e. *systematic errors* and *random errors*. A *systematic error* results from a defectively designed analytical method or by an improperly functioning instrument or an error performed by an analyst. This kind of error produces bias in the sample value and either overestimates or underestimates the result, thus deviating from the accuracy. While *random errors* are independent of the equipment, methodology and operator performing the measurement tend to occur randomly during the measurement process.⁷ This kind of error is essentially unavoidable as it results from the technical limitations of physical measurements and leads to imprecision of the result.

The final goal of the TQM in a clinical laboratory is to achieve analytical reliability generally measured by *accuracy* and *precision* in testing a sample. *Accuracy* may be defined as 'the degree of conformity of a measured or calculated quantity to the actual or true value'. Accuracy of any instrument is generally established and maintained by regular *calibration* of the instrument as well as the method of the estimation. *Calibration* is a measurable value related to a substance of known value or concentration or other reported result. Drift in the calibration result indicates the systematic error in the process and needs to be corrected to achieve accuracy in the results. *Precision* refers to 'the closeness of agreement between independent test results of same sample obtained under varying operating conditions'. The precision of the measure of reproducibility of the estimation and *internal quality control* depicts an estimation of the precision of an instrument and the analytical process. The acceptability of internal quality control data is determined by six sigma quality level estimation.⁸ Levey–Jennings chart along with the Westgard Rules is generally followed in a clinical laboratory to achieve quality assurance.⁹

External quality assurance services (EQAS) programmes help a medical laboratory to identify the shortcoming analytical process with respect to the peer laboratories as well as the improvement opportunities to increase confidence in proficiency testing.¹⁰ The National EQASs available in India are as follows:

- The department of haematology at the All India Institute of Medical Sciences—Haematology EQAS programme.

- The department of biochemistry at the Christian Medical College, Vellore—biochemistry EQAS programme.
- The microbiology department at the Shankar Nethralaya Eye Institute—a microbiology EQAS programme.

International EQAS programmes segregate data obtained from participating laboratories based on type of instrumentation/kits used. The commonly subscribed EQAS programmes include:

- College of American pathologists (CAP)
- UK national EQAS
- BioRad.

ACCREDITATION OF A MEDICAL LABORATORY

With increase in use of the laboratory services for diagnosis and treatment, the credibility of a clinical laboratory has become most important to the healthcare systems and treatment safety of the patients has become highly important depending on the quality testing services provided by these laboratories. The international standard for the accreditation of medical laboratories is International Organization for Standardisation (ISO) 15189, which deals with particular requirements for quality and competence of medical laboratories. The College of American Pathologists (CAP) started accreditation of clinical laboratories in 1961.¹¹ In India, National Accreditation Board for Testing and Calibration Laboratories (NABL), an autonomous body under the aegis of Department of Science and Technology, Government of India, is entrusted with the scheme for third-party assessment of the quality. It has been established with the objective to provide government, industry associations and industry with the proper quality-assurance guidelines for formulation and implementation. NABL has been authorised by Government of India as the accreditation body for Testing and Calibration Laboratories. Laboratory accreditation services to clinical laboratories are provided by NABL in accordance with ISO 15189:2007 for medical laboratories. These services are offered in a nondiscriminatory manner and are accessible to all testing and calibration laboratories in India and abroad, without any bias to their ownership, legal status, size and degree of independence.¹²

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Haematology Services

Prof Reena Das

“The modern hematologist, instead of describing in English what he can see, prefers to describe in Greek what he can’t.”

—Richard Alan John Asher

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- realise with the importance of haematology services in tertiary-care hospital.
- describe a typical setup of a haematology laboratory in a tertiary-care hospital.
- understand about common managerial issues related to haematology laboratory.

BACKGROUND

A haematology laboratory plays an integral role in the diagnosis and management of all patients visiting the hospital. Hence it is important that a convenient and strategic location is assigned to the laboratory in the main hospital building. The salient role of the laboratory is to ensure that accurate results of the patient samples are provided to the physicians and nursing staff in the minimum possible turnaround time (TAT). Various tests that are provided by a hospital is dependent on the expertise and interest of the stakeholders—in this case doctors and the patients. Effective manpower being employed is an integral part of the haematology department of a hospital.¹

Essential role of a haematology laboratory is to provide the following services:

- Diagnose diseases and exclude conditions being considered in the differential diagnosis based on the clinical profile of a given patient.
- Determine prognosis.
- Guiding patient management.
- Monitoring efficacy of therapy.
- Provide reliable services to ensure research activities of the hospital.

To successfully achieve its goal, a laboratory must use (i) medical and technical expertise; (ii) resources such as manpower, laboratory equipment, supplies and facilities and (iii) management and communication skills. Continuous

monitoring on the quality aspects of all results generated in the laboratories are of paramount importance for the reputation as well as achieving the goals of haematology department.²

The baseline investigations that are provided such as a complete haemogram and a coagulogram are relatively inexpensive. However, the results lead to more sequentially complex investigations to reach an appropriate diagnosis depending on the clinical scenario.

The major areas involved in tests on blood samples include preanalytical components such as generating request forms, collection of blood samples in various vials (with appropriate anticoagulation whenever necessary), and labeling and transportation of samples till the laboratory. Each and every step in the process is amenable to errors and needs continuous audit. Analytical variables pertain to problems that are related to sample processing in the laboratory. Postanalysis variables pertain to generation of reports and transport of the reports to the patient’s file for further action by the treating physicians.³

PROCESS OF HAEMATOLOGICAL ANALYSIS

Sample Collection

Collection of blood samples are usually from the following areas:

- Collection centre for outdoor patients (for many of the cases they are centralised).

- Collection of blood samples of inpatients (from individual wards).
- Collection of samples for special investigations by appointment obtained from the specialised laboratories.
- Emergency laboratory providing round-the-clock services for inpatients of the emergency and various wards.

The workflow of the blood collection at Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh (a tertiary-care institute of North India) is shown in Flowchart 18.1. The collection area of busy outdoor services should be well lighted, spacious and airy. The phlebotomists are required to take various types of samples from the same patient who may have been ordered many tests from different departments. They are also needed for difficult collections such as infants, children or elderly patients. In the recent years, comfortable 'blood-drawing chairs' are available where the patient has an arm rest and the phlebotomist can efficiently collect the required quantity of blood with a clean aseptic prick. Sample identification by generating barcodes is important, barcode printers generate stickers and the information of the patient is linked through the computer networking using the hospital information system (HIS) or laboratory information system (LIS), which can integrate patient details with the sample. Barcode readers are available in most high-end automated blood cell counters and coagulation analysers. Such measures ensure that the patient identity and tracking of samples can be carried out effectively.

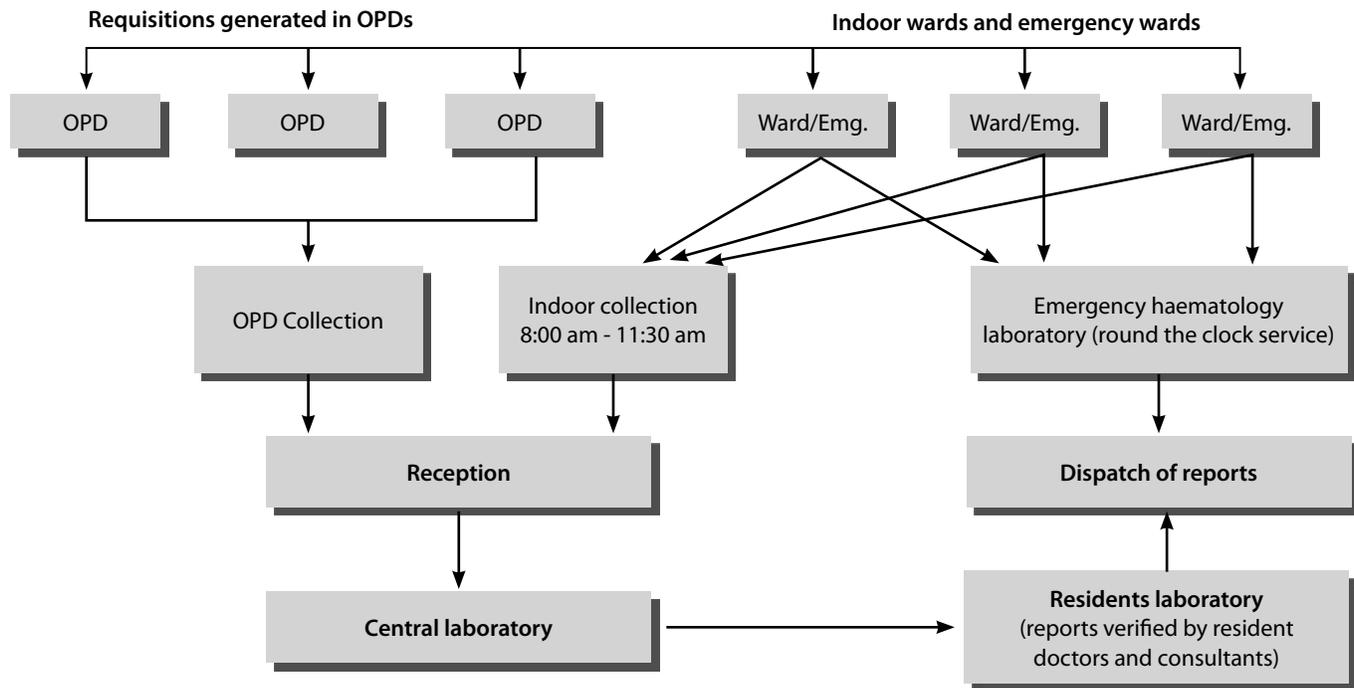
Sample Transportation

It should be done at the earliest and samples should be stored in a cool place before transportation. Manual transportation is laborious, time consuming, and inconvenient to staff and patients. Many large centres have shifted to pneumatic tube system where pneumatic conveyors use air pressure to convey materials through a system of vertical and horizontal tubes. Figure 18.1 shows the pneumatic chute plan and chute jars in which samples can be gently and safely transported to the various laboratories.

Report Generation

Since all results generated from the samples are from patients, sound laboratory practices need to be in place. The head of the department—who is the medical director of the laboratory and the team of medical faculty—is deemed responsible for all the results generated from the department.

The report generated needs to be timely disseminated to the concerned person in their respective outpatient department (OPD) ward. Many a times, it is observed that reports are kept at a place (most commonly outside haematology laboratory) and patient crowds over the area. This leads to not only unnecessary harassment of relatives of patient but also loss/tearing up of reports. To minimise this, a ward attendant should disseminate the report (3–4 times daily) to all wards. As mentioned earlier, all the reports can be



Flowchart 18.1 Workflow of blood collection for routine tests in the Department of Haematology, PGIMER, Chandigarh for haemogram (routine blood cell counts) and coagulogram.

uploaded in haematology department, which can be easily accessible by every patient area through HIS.

A close coordination is required among the medical staff of the laboratory and the clinicians of the hospital so as to minimise wastage of precious resources such as:

- Ordering tests that may not benefit the patient.
- Ordering tests too frequently.
- Ordering cheap tests that are labour intensive indiscriminately, e.g. an incubated osmotic fragility test.

Similarly, a close coordination is required between the medical staff of the laboratory and the laboratory personnel to ensure a smooth functioning of the work. The head of department is responsible for determining the long-term (usually up to 5 years) strategic progression envisaged of the department.

MAJOR COMPONENTS OF HAEMATOLOGY LABORATORY

Major components of a haematology laboratory in a tertiary-care centre are enlisted below:

Manpower

- Medical coordinator (head of department).
- Consultant haematologists who look after designated sections.
- Chief technical manager.
- Sectional technical heads.

Sections

- Haemogram laboratory.
- Coagulation laboratory.
- Haemolytic anaemia laboratory (including haemoglobinopathy work-up).
- Nutritional anaemia laboratory.
- Bone marrow aspiration (including cytochemistry).
- Trepine biopsy processing laboratory.
- Flow cytometry laboratory.
- Cytogenetics laboratory.
- Molecular laboratory.

In most setups in India, laboratory managers and safety officers are not recruited; however, they constitute an important component of a well-organised department. Computerisation of the department has become the need of the hour and a storekeeper who manages the store inventory is required. With the help of HIS it is possible for the laboratory to monitor the charges, which may happen during the stay of patient in the hospital. Some of the tests are performed on a regular basis and others in specialised laboratories are done on appointments and in a sequential order.

Case Study: Series of tests in correct diagnosis of disease and timely treatment initiation

A 50-year-old male patient presented with fever and weakness. Investigations showed a high total leucocyte count with atypical lymphoid cells/blasts. On examination, a large spleen extending 7 cm below left costal margin was found. Differential diagnosis would include chronic lymphocytic leukaemia/acute leukaemia/hairy cell leukaemia variant/splenic marginal zone lymphoma. For an accurate diagnosis, bone marrows aspirate and trephine biopsy was ordered. This could not confirm the disease. Then, a panel of flow cytometry needs to be ordered to ascertain morphology of cells. The result of the flow cytometry is largely different in all the above disorders, and final diagnosis has different therapeutic and prognostic implications. This depicts the importance of a battery of tests ordered serially so as to diagnose a disease and initiation of correct and timely treatment.

COMMON MANAGERIAL ISSUES IN SETTING HAEMATOLOGY LABORATORY

Purchase of Equipments

Manual time-consuming methods have been largely replaced by automation because of speed, accuracy and reproducibility of results that are generated. Automation reduces human errors and increases the efficiency of the laboratory. Selection of equipments for the laboratory is dependent on the workload of the hospital. Therefore, because of capability of giving results in an hour, small volume of the samples required for the tests govern the need of making specifications. At present, there is a range of haematology analysers that can be purchased depending on the requirement. Adequate time and effort need to be given while preparing the specifications.

Considerations while purchasing equipment for the department will include:

- Verification of requirement and allocation of space for the equipment.
- Determining the linearity, precision, carry over, sensitivity and specificity.
- Throughput time (number of specimens that can be processed in a working day).
- Cost per test that will reflect in the revenue generation for the hospital.
- Provisions for a back-up instrument in case of a breakdown.
- Time frame in which repairs can be made.
- Recurring costs (cost of reagent, maintenance) should not be large.

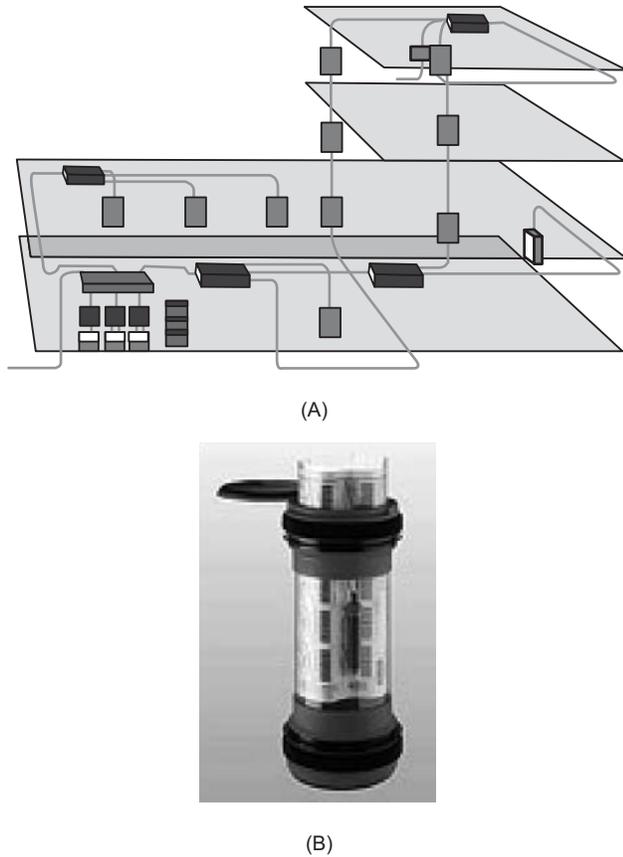


Figure 18.1 (A) A pneumatic chute plan depicting passage through different floors of the hospital and (B) a close-up of the chute jar.

Training of Manpower

While equipments are being installed, the staff needs to receive adequate and satisfactory training by the engineer. Also time-to-time updating of the technical aspects is required by the process of continuing medical education wherein systematic learning to date on developments related to the profession ensures their continued competence.

Purchase of Reagents

Maintaining an inventory for reagents procured and keeping a record of usage based on the date of opening a new pack is useful. Depending on the time required for procuring reagents, a timeframe needs to be kept by the laboratory managers so that adequate time for processing purchase of reagents can be done. Quantity of reagents being procured is determined by the monthly requirement as well as the stability of the product, which is linked to the expiry of reagents. Larger packs are more cost effective if the reagents purchased can be consumed within the stipulated time. Both calibrators and controls need to be purchased for the smooth running of the equipments and therefore need to be budgeted for while procuring the equipment.

Quality Assurance

Every laboratory should invest time and energy to develop standard operating procedures (SOPs). Standard operating procedures are written instructions that are prepared with an intent to maintain optimal consistent quality of performance in the laboratory. They should cover all aspects of work, details pertaining to the test procedures and others relating to specimen collection, laboratory safety, handling of urgent requests, data storage, etc. With the help of the HIS, it is possible for the laboratory to monitor the charges that may happen during the stay of the patient in the hospital.

The reliability of a quantitative test is defined in terms of the *uncertainty of measurement* of the analyte, which is based on its accuracy and precision. *Accuracy* is the closeness of agreement between the measurement that is obtained and the true value; the extent of discrepancy is the *systematic error* or *bias*. *Precision* is the closeness of agreement when a test is repeated a number of times.

Maintenance logs: All laboratory equipments should be inspected regularly and specific maintenance procedures should be carried out.

Laboratory Accreditation

The purpose is to allow external audit of a laboratory's organisation, management, quality assurance programme and level of user satisfaction. The advantage to the accredited laboratory is that a defined standard of practice that has been independently confirmed by external peer review. Such reviews should include assessment of basic functional structure of laboratory facilities such as adequacy and competence of staff and equipment, test analyses, quality of test results including TAT, and interpretation and optimal use of resources.

Research and Development

The laboratory plays a leading role in education and research, information technology design and implementation, and quality improvement. It is high time to incorporate operation research issues in designing or setting up haematology laboratory in a hospital.

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Parasitology Services

Prof Rakesh Sehgal and Dr Kapil Goyal

“Great things are not done by impulse, but by a series of small things brought together.”
—Vincent van Gogh

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand why is it important to study parasites.
- know diagnostic tests are available for the diagnosis of parasitic infections.
- list the duties of parasitology laboratory at tertiary-care level.
- describe the recent advances in diagnostics of parasitic infections.

INTRODUCTION

Parasitic infections are very important from public health point of view and their detection is usually carried out by using morphological criteria rather than culture or biochemical tools. Parasite identification is frequently based on light microscopic analysis of concentrated or stained preparations. Thus, microscopy is considered to be the backbone of routine diagnostic parasitology. There has been a tremendous growth in the field of diagnostic parasitology during the last 50 years. In the present chapter, we will be discussing essentials required for setting up a department of parasitology at a tertiary-care level. Besides this, future prospects and recent advances in diagnosis of parasitic infections for routine patient care have also been summarised.

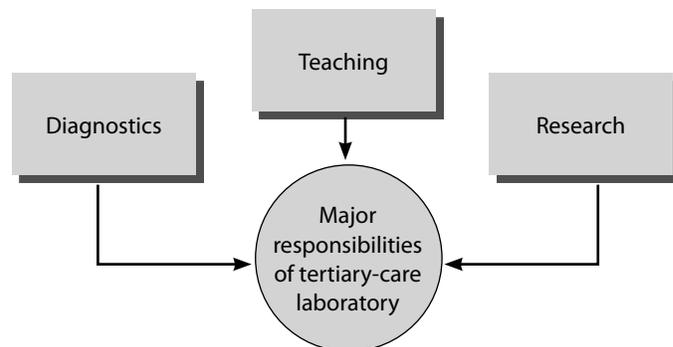
OBJECTIVES

There are three main objectives of department of parasitology at a tertiary-care level (Flowchart 19.1):

- Patient care
- Teaching and training
- Research

Patient Care

Diagnosis of parasitic infections is an essential component where timely diagnosis can lead physician to initiate appropriate treatment. Diagnostic tests should have a good



Flowchart 19.1 Major responsibilities of tertiary-care laboratory.

sensitivity and specificity that can provide results in a short span of time. They should be economical, so that all groups of patients can be benefitted.

At a tertiary-care level, parasitology laboratory also works as an apex laboratory where advanced diagnostic facilities are available (which are not found in the periphery). There has been a tremendous progress in the last 50 years with new commercial test kits designed especially for detection of antigens [(e.g. coproantigens of *Giardia*, *Cryptosporidium*, and *Entamoeba histolytica* or circulating *Plasmodium* antigens, filarial antigen (Ag)] expanding the methodical repertoire. In recent years, molecular methods such as polymerase chain reaction (PCR) and sequence analysis of selected genes have replaced the electron microscopy, which was considered essential for detection and identification of

microsporidia. In addition to the methods for direct parasite detection (morphology, antigens and DNA), methods for indirect detection of parasite infections demonstrating specific antibodies directed to a variety of native or recombinant parasite antigens have been developed and partially commercialised. Diagnostic techniques are available to detect a large range of parasites and are generally characterised by a variety of methods depending on clinical specimens and the biology of the parasites.

Teaching and Training

It is one of the major responsibilities of the department to provide training regarding diagnosis of parasitic infections to ensure good diagnostic facilities all over the country, and to achieve this goal, trained personnel, specifically in the field of parasitology are required. Integrated teaching should be incorporated along with group discussions, seminars, tutorials and presentations of latest research articles for optimal training. Patient-oriented problems should be discussed along with the clinicians to have a proper and in-depth knowledge of the subject. Teaching is carried out at different levels, which are as follows:

- *Undergraduates*: MBBS, BSc, MLT
- *Postgraduates*: MD, MSc
- *Short-term training courses*: Workshops and training regarding newer techniques, CMEs (continued medical education), highly specialised courses after postgraduation, particularly in the field of parasitology.

Research

Keeping pace with upcoming technology, research should be carried out for development of good quality diagnostic services that aid development of new to be used as point-of-care tests. Besides diagnostic services, research can be carried out in pathogenesis, immune biology, molecular evolution, molecular epidemiology, molecular basis of drug resistance or developing a vaccine for particular parasite. Experienced faculty members should be available to guide research scholars. In India, various funding agencies Indian Council of Medical Research (ICMR), Department of Biotechnology (DBT), Council of Scientific and Industrial Research (CSIR), Department of Science and Technology (DST) provide financial assistance for carrying out research and upgrading laboratories.

LABORATORY DESIGN

Laboratory must be well-designed, safe and pleasant place for laboratory staff to work efficiently.^{1,2} Workers' needs should be kept in mind while planning a new laboratory or renovating an existing one. An efficient clinical laboratory reduces chances of errors as well as shortens the test turnaround time (TAT), thus help in improving patient care.

Good parasitic laboratory should have the following three features:

- *Safety of the individuals*: Good laboratory practices should be followed by considering every patient sample hazardous. Procedures such as culture of the parasites involving isolation, propagation and handling of pathogenic parasites must be carried out using the specified biosafety cabinet.
- *Minimal contaminants*: Avoid contaminants while maintaining the cultures or while doing the molecular work by carrying out these procedures with great care in biosafety cabinet or in laminar flow.
- *Scope for expansion*: Design laboratory so as to accommodate newer and advanced equipment in future.

General Design Principles

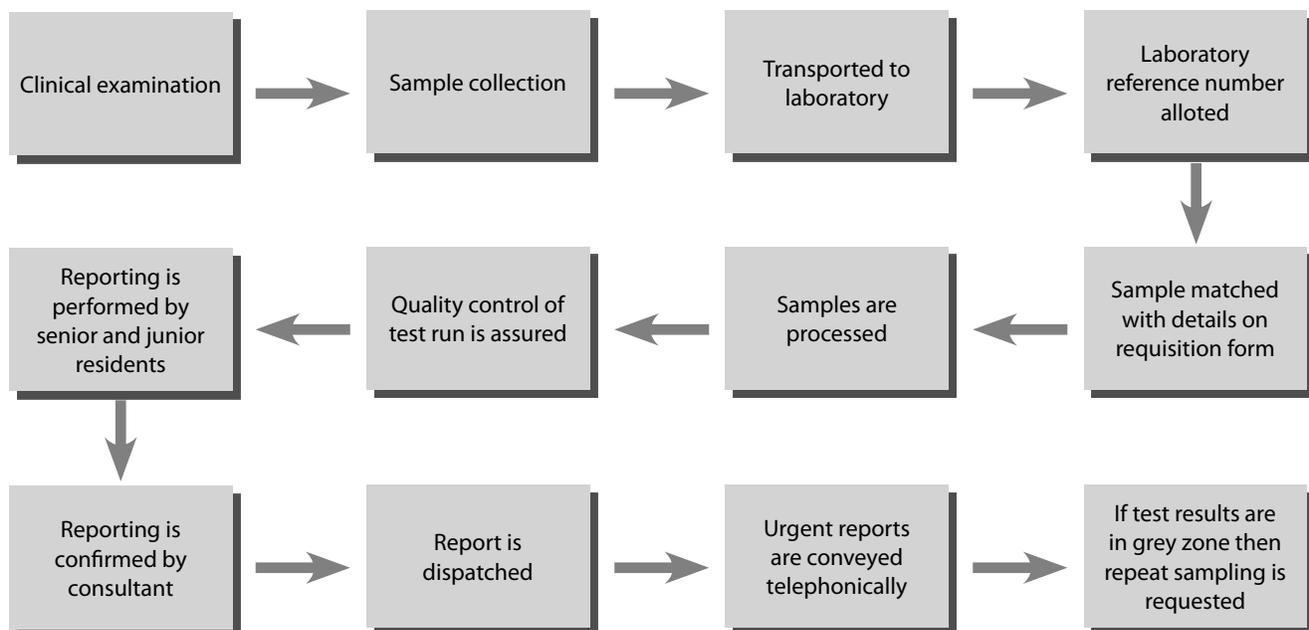
- *Laboratory location*: It should be located near the hospital or outpatient department to avoid any delay in receiving samples. It should provide emergency diagnostic services in emergency area round-the-clock to avoid any delay in reporting. For highly specialised tests, samples can be stored in the emergency laboratory and can be transported to the main laboratory for further processing.
- *Laboratory size*: It depends upon the work load of the samples being received. As a general rule, each bench technologist needs a minimum of 50 ft to work, excluding space for large pieces of equipment, walls, corridors, storage, lockers and offices.² At tertiary-care level, different subsections can be made and different diagnostic laboratories can be established as follows:
 - Routine microscopy: For routine microscopy of stool samples and peripheral blood smear examination.
 - Serology laboratory: For carrying out antigen and antibody detection by rapid kit method, ELISA, etc.
 - Antigen preparation room: For preparing and standardising antigen to be used for inhouse ELISA.
 - Animal house: For maintaining the culture in small animals, raising antisera or carrying out in vivo research experiments.
 - Molecular laboratory: Different compartments for DNA, RNA extraction, preparation of reaction mixture and amplification to minimise carry over.
 - Room for washing and autoclaving: In case of high work load, separate room may be used for carrying out washing and autoclaving.
- *For teaching and diagnostics*: Following infrastructure is required for these purposes:
 - Lecture theatre
 - Practical demonstration room and laboratory
 - Teaching purpose microscope
 - Research laboratory
 - Library
 - Museum

- **Offices and administrative support:** Office space should be located close to laboratory. It should represent efficient managerial, administrative, research and teaching functions of the laboratory. Individual offices should not be smaller than 100 ft.² Efficient modular furniture should replace traditional furniture.
- **Storage room:** Separate store room for storage of materials belonging to various subsections for uninterrupted supply of services.
- **Cold room:** For storing the material that requires temperature of 4°C.
- **Equipment:** Ample space for equipment such as centrifuges, refrigerators, deep freezers, incubators, CO₂ incubator, water bath, autoclave, microscopes, fluorescent microscope, ELISA reader and washer, sonicator, thermocycler, gel electrophoresis apparatus, gel documentation system, sources of high-grade deionised water, wet ice and dry ice, fume hood and storage cabinet for solvents and flammables.
- **Electrical power supply:** Sufficient electrical outlets and emergency electric supply for uninterrupted functioning of critical pieces of equipment.
- **HVAC:** To meet the necessary biosafety level while maintaining a constant ambient temperature and pressure.
- **IT and telecommunication:** A robust computer workstation along with online reporting and dispatching of reports to speed up the laboratory services and provide expert opinion to distant places.
- **Work environment:** Emphasis on ergonomics should receive emphasis so that working staff can work comfortably and efficiently. Signs, bulletin boards and other means of communication should be placed where laboratory staff and visitors can easily see them.
- **Safety and security:** Eyewash stations, safety showers, sprinkler systems, fire extinguishers and blankets, fire alarms, spill-control kits along with emergency power and lighting should be installed. The laboratory should be designed so that it can be secured during off-hours.
- **Cleaning and waste handling:** It should be easy to clean and disinfect the floor and working bench of laboratory. Adequate numbers of properly colour-coded waste containers should be placed for segregation of waste at source only. The equipment should be adequately autoclaved or disinfected.
- **Standard operating procedures (SOPs):** Standard operating procedures should be placed in each laboratory along with quality assurance check at frequent intervals to maintain good laboratory services.

The workflow in the laboratory has been summarised in Flowchart 19.2. The design of a laboratory should be such that latest technology can also be added in future.

RECENT ADVANCES IN DIAGNOSTIC TECHNIQUES

Though economical, conventional techniques usually have low sensitivity and specificity. Nucleic acid-based amplification techniques like polymerase chain reaction (PCR) and



Flowchart 19.2 Workflow in parasitology laboratory.

real-time PCR represent a major breakthrough for the diagnosis of parasitic infections, as they are highly sensitive and specific, and can be used for almost all species of parasites. However, these are expensive and are not available in routine microbiology laboratories. When conventional techniques fail to provide an established diagnosis, molecular techniques are useful. For example, routine diagnosis of malaria is done by peripheral blood smear examination, but submicroscopic parasitaemia is usually not detected by microscopy; and in such cases, especially in pregnant women, PCR has been shown to be a good alternative. Cutaneous leishmaniasis is another example where low-parasite levels demand for a highly sensitive and specific technique. PCR is also found to be very useful where immune response is not informative such as acute infections, short-term follow-up after therapy and congenital infections. Sometimes, organisms are morphologically indistinguishable and in such cases molecular techniques can only establish their identity, e.g. to distinguish *Entamoeba histolytica* from *Entamoeba dispar*.^{3,4}

Molecular techniques are widely used for molecular evolution of parasites and understanding the phylogenetic relationships. Conventional techniques related to study of drug resistance, an area not explored much, in parasites require a viable parasite that is very difficult to isolate and maintain in culture as it is very laborious and time consuming. Molecular techniques provide a better alternative in such situations.

Standard techniques for counting parasites are often time consuming, difficult and inaccurate, and occasionally unpleasant. Real-time quantitative PCR and other techniques recently applied to parasitology, specifically *Plasmodium*, *Toxoplasma* and *Leishmania*, are truly quantitative, giving results over a range of 6–7 orders of magnitude, are quick to perform, require no manipulations postamplification, provide a rapid alternative for detecting the parasite load and can also be used to study the mutations by melting curve analysis.

Widespread use of simple, fully standardised (commercialised) kits for diagnostic PCR is very cost effective due to implementation of pre- and post-PCR automated techniques. Furthermore, the possibilities to detect, identify and quantify organisms, and determine their genotypes by analysing the diagnostic PCR product extend the diagnostic power of PCR. Polymerase chain reaction coupled with genetic characterisation will be useful in parasitology to address questions such as parasite host range and host specificity, ways of transmission, molecular epidemiology, genetic variation in parasites and features related to virulence.^{2–4}

An important limitation of PCR-based diagnosis is that sensitivity dramatically decreases with material stored for

more than 1 day in formalin due to the fragmentation (fragment length of a few hundred base pairs) of the DNA. However, by selecting primers that produce PCR products as short as possible, which is recommended for real-time PCR, sensitivity might be reasonably high. Such tests, however, are not yet widely available in parasitology. Therefore, it seems to be the best choice to avoid formalin fixation if PCR analyses have to be considered.

DNA sequencing can be performed to validate the results of PCR or to study the mutations. However, this is performed for research purposes as it is costly. Whole-genome sequencing is also being carried out to study the various aspects of host and parasite interaction. These projects will unveil the hidden aspects of pathogenesis and immunobiology, and will revolutionise the vaccine development against various parasitic infections.

Microarray is an upcoming technique in which multiple targets of the same pathogen or different pathogens can be studied simultaneously. Historically, microarrays were used exclusively for gene-expression studies; but these days they have been applied differently to areas such as detection and characterisation of microbial pathogens, determination of antimicrobial resistance, typing of pathogens and monitoring of microbial infections by investigating host genomic expression and polymorphism profiles. However, further research is required to establish the quality assurance and formulation of the standard protocols before these can be introduced for routine patient care.

Another upcoming technique is the mass spectrometry, which can be utilised for the identification of the pathogen in short span of time. However, there is a need of an hour to develop a point-of-care test for parasitic infections that can be used at bed side for the rapid diagnosis of parasitic infections. Though rapid card tests are available for some parasitic infections such as malaria, filariasis, giardiasis, cryptosporidiosis, etc. more research in this field is required so that rapid diagnosis can be done with higher sensitivity and specificity.

Automation can really help laboratories at a tertiary-care level where work load is too high. Automation in molecular work can really help to provide molecular diagnostic techniques at a cost-effective level. Thus, regular upgradation of parasitology laboratory is must for a parasitology department in a tertiary-care hospital.

Parasitic infections constitute an important public health issue. The diagnosis of parasitic infections is of utmost importance, as timely diagnosis can help in early initiation of therapy with antiparasitic drugs. The parasitology division provides the diagnostic services at tertiary-care level, which varies from conventional diagnostic techniques to highly sophisticated techniques such as PCR and real-time PCR. Apart from providing

diagnostic services, the department of parasitology at a tertiary-care level provides teaching and research opportunities also. The department also organises workshops to train the laboratory technicians from peripheral areas, so that they can establish new techniques at their respective centres. Thus, in a nutshell, the department of parasitology at tertiary-care level not only provides diagnostic services but also provides platform for teaching and research in the field of parasitology.

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Virology Services

20

Prof RK Ratho and Dr Abhishek Mewara

“By doing surveillance we know what is circulating, we know what is out there and which most serious contenders are.”

—Malik Peiris

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- get an overview of planning model virology department in a tertiary-care hospital of India.
- provide snapshot of resources required and managerial problems faced in setting up of model virology department.

INTRODUCTION

Viral infections are amongst the most widespread of all infectious diseases and are of immense public health importance. During the past three decades several new viruses have been discovered including human immunodeficiency virus (HIV), severe acute respiratory syndrome (SARS) virus, influenza virus H5N1 (bird flu), pandemic influenza virus H1N1 (swine flu) and Crimean–Congo hemorrhagic fever (CCHF). These viruses are of public health concern affecting human life in the areas like economy, international travel, social practices, etc. Besides, there are several already existing viruses of concern like dengue virus, Japanese encephalitis (JE) virus, chikungunya virus, hepatitis viruses (hepatitis A, B, C, E), cytomegalovirus (CMV), measles virus, mumps virus, rubella virus, varicella zoster virus, respiratory syncytial virus (RSV), etc. An efficient virus diagnostic laboratory is, thus, essential for early diagnosis and management, carrying out surveillance activities, and conducting epidemiological studies for the prevention and control of such viral diseases. The objective of present chapter is to provide overview of resources required and managerial problems faced in setting up of model virology department in a tertiary-care institute. The detail about guidelines for establishment of virology laboratory,¹ PCR laboratory and district laboratory practice in tropical countries are beyond the scope of this chapter.^{2,3}

PLANNING MODEL VIROLOGY DEPARTMENT

Human Resources

The number of persons in staff to be hired will depend on the patient load and the type of viral diagnostics needed by the attached hospital. At referral level, a virus diagnostic laboratory should have at least two qualified microbiologists with 2–3 years of experience in virology, who will bear the overall responsibility of the functioning of laboratory and reporting of the routine viral diagnosis. There should be at least three technologists to conduct all the tests and maintenance of the records. They should be trained in conducting serological tests and at least one of them should be trained in cell culture and one in molecular techniques. Apart from these, there should be at least two support staff to provide assistance in conducting the tests and to take care of the storage of samples and reagents. The staff should be updated in the current virus diagnostics by continuous education, training and certification courses.

Physical Infrastructure

Location

A virus diagnostic laboratory should be located in a separate dedicated building or at least one part of the building, thereby restricting entry of unauthorised people and help maintain biosafety standards.

Biosafety

Virus diagnostic laboratory should be designed for biosafety level (BSL) 2 or above, preferably with negative pressure, as most clinically important viruses fall in risk groups 1–3 [risk group 1: herpes viruses, foot-and-mouth disease (FMD) viruses, adenoviruses; risk group 2: HIV, hepatitis B virus (HBV), hantaviruses, JEV, rabies virus, rift valley fever virus and yellow fever virus; risk group 3: Saint Louis encephalitis virus]. It is notable that the specimens suspected of risk group 4 viruses (Lassa fever virus, filoviruses, smallpox virus, Crimean–Congo haemorrhagic fever virus, avian influenza viruses, Nipah virus, Russian spring–summer encephalitis virus and Kyasanur forest disease virus) should be sent to the national referral laboratories, as it is not possible for every laboratory to be equipped with biosafety level 3 or 4 (BSL 3 or 4) facility.

Equipment

A virus diagnostic laboratory will require a whole range of equipments and reagents of high standards. Table 20.1 lists some essential items.

Table 20.1 Equipments and reagents for virus diagnostic laboratory

Equipment
<ul style="list-style-type: none"> Autoclave, hot air oven, CO₂ incubators, water bath, freezers (4°C, –20°C and –70°C), ice flaking machine, filtration apparatus, water purification/distillation system Cold centrifuge, liquid nitrogen containers, electronic balance, pH meter, vortex mixer ELISA reader and washer, fluorescent microscope, inverted light microscope Flasks, reagent storage bottles, measuring cylinders, multiples of micropipettes (100, 200 and 20 µl), multichannel pipettes—8 and 12 channel (20–200 µl and 50–300 µl) PCR machines (conventional and real time), gel electrophoresis apparatus, UV transilluminator Biosafety cabinets (class II) Computer with printer, fax machine
Reagents and supplies
<ul style="list-style-type: none"> Analytical-grade fine chemicals for preparation of buffers Diagnostic kits, antibodies and fluorescent conjugates ELISA plates, petridishes, V-bottom polystyrene microtiter plates, tissue culture plasticware Cell lines, foetal bovine serum, tissue culture media DNA and RNA extraction kits, PCR tubes, PCR reagents (Taq polymerase, reverse transcriptase, primers, probes and agarose) Micropipette tips, cryovials and boxes

Diagnostic Tests

All virus diagnostic tests performed usually target either the detection of virus-specific antibody, viral antigen, viral nucleic acid and/or isolation of virus in some cases.

Viral serology

The detection of virus-specific antibodies is the most common method employed for diagnosis of most viral infections. The conventional detection of haemagglutination

inhibition (HI) antibodies had limited clinical utility because of the need of fourfold rise or fall in antibody titer in paired sera (acute and convalescent phase). However, following the development of μ -capture enzyme-linked immunosorbent assay (ELISA), the detection of IgM antibodies in a single acute phase specimen is useful for diagnosis of viral infections like dengue, JE, chikungunya, rubella, CMV, hepatitis-A virus (HAV), hepatitis-E virus (HEV), etc.

Detection of viral antigen

Detection of viral antigen is commonly done by virus-specific fluorescent antibodies or ELISA. It is especially useful for detection of RSV in respiratory specimens, adenovirus in conjunctival swabs, herpes simplex virus (HSV) and varicella zoster virus (VZV) from skin scrapings, CMV pp65 antigen in polymorphonuclear cells, and detection of rabies virus in antemortem and postmortem samples. Enzyme-linked immunosorbent assay has been reliable in the detection of rotavirus antigens in stool and dengue NS1 antigen in blood.

Detection of viral nucleic acid

The establishment of state-of-the-art polymerase chain reaction (PCR) laboratory for detection of viruses is becoming the need of the day. The detection of viral nucleic acid is extremely helpful in diagnosis of several viral infections due to the advantage of rapidity, and high sensitivity and specificity of these techniques. Since the culture of viruses is labour intensive and the turnover time for isolation is too high to be of any clinical utility, the nucleic acid detection tests are rapidly becoming the methods of choice for diagnosis of viral infections. The qualitative detection of nucleic acids is commonly used for many viruses like CMV, HSV, influenza H1N1, adenovirus, dengue virus, JEV, etc. whereas quantitative detection is useful for establishing the diagnosis in CMV infections (congenital CMV disease, transplant, carcinoma) or for therapeutic management of Hepatitis B and C and HIV.

Isolation of virus

Many clinically important viruses can be isolated in cell cultures, embryonated hen's eggs and small animals. A cell culture laboratory is an integral part of any virus diagnostic laboratory. Many viruses can be cultured in cell lines and hence a good virus diagnostic laboratory should maintain several cell lines, as different viruses require different cell lines to support their growth. The cell lines commonly used for the isolation of clinically important viruses are Vero cells for HSV, Hep-2 for RSV, C6/36 for arboviruses like dengue virus and JE virus, Madin–Darby canine kidney cells (MDCK) for influenza virus, and HeLa cell lines for enteroviruses. The conventional cell culture techniques take 4–7 days or more for diagnosis of viral infections, whereas the techniques like shell vial culture help in rapid diagnosis of infections like CMV within 2–3 days.

The use of embryonated hen's eggs has been conventionally employed for detection of influenza viruses from respiratory samples. On the other hand, the use of animals in a routine virus diagnostic laboratory should follow the national standards for use of laboratory animals and should comply with the guidelines of the animal ethics committee of the hospital.

REPORTING

A very integral but often neglected part of diagnostic laboratories is the timely communication of report to the treating physician. This is especially common in resource-limited countries, where the use of hospital information systems (HIS) is not universal and most of the work is done manually on papers. A flawless reporting system and good rapport with the physicians can be extremely beneficial to patient care in terms of corroborating the laboratory results with clinical features, early request for repeat sample in case of inappropriate sample or for confirmation in doubtful cases, early initiation of therapeutic management as well as timely control of the spread of the disease in community.

Case Study: Managing swine flu pandemic

A virus diagnostic laboratory should constantly work on capacity building and be prepared to handle not only local outbreaks, but also pandemics as well as those caused by pandemic influenza virus H1N1 (like that occurred in 2009). The factors that helped in successful control of the pandemic included a good collaboration of laboratories with government agencies, timely accreditation of laboratories by Indian Council of Medical Research (ICMR) and National Centre for Disease Control (NCDC), Government of India, centralised distribution of all reagents and personal protective equipment to the laboratories, timely training of doctors and technologists, use of uniform protocols for specimen collection [using personal protective equipment (PPE) and N-95 masks] and transport, timely issuance of guidelines for testing, treatment and hospitalisation of the patients. Thus, strong infrastructure and rapid response by virology department are of paramount importance to handle viral outbreaks.

WASTE MANAGEMENT

Infectious waste must be segregated from general wastes because they need to be autoclaved or incinerated before being removed from the area in which they are generated. The waste should be separated into colour-coded containers/bags as per the national/hospital guidelines. The waste generated can be treated by autoclaving and chemical disinfection in the laboratory itself, which is preferable, or by incineration outside the laboratory.

QUALITY SYSTEMS

The establishment of quality systems in clinical diagnostic laboratories is of extreme importance as several factors like the complexity of the tests, storage conditions, stability of reagents, environmental conditions, interpersonal variations may affect the final outcome. A fallacious report, if conveyed, may lead to mismanagement of the patients and is unacceptable. A good quality system aims to improve the diagnostic quality, to produce reliable and reproducible results, to establish interlaboratory testing comparability, to promote credibility of the laboratory among patients, doctors, other institutions, collaborators and accrediting/regulatory bodies, to motivate staff for further improvement and to preclude poor results that could cause legal complications.

The routine procedures of the laboratory should be described in standard operating procedures (SOPs), which should be regularly updated. The records of the tests conducted should be stored for long periods for easy retrieval. The quality systems of the laboratory should be assessed regularly by internal staff [internal quality assessment scheme (IQAS)] or by participating in the programmes run by an external agency [external quality assessment scheme (EQAS)].

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Immunopathology Services

Dr Biman Saikia and Prof Shobha Sehgal

“Any significantly advanced technology is indistinguishable from magic.”
—Arthur C Clarke

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- realise the importance of immunopathology in modern medicine.
- describe the typical setup of an immunopathology laboratory in a tertiary-care hospital.

BACKGROUND

‘Immunopathology’ is derived from the words ‘immunology’ and ‘pathology’ and hence can be defined as a branch of medicine that deals with the study of immune responses associated with disease, which can be both infectious and non-infectious in aetiology. It includes the study of the pathology of an organism, organ system, or disease with respect to the immune system, immunity, and immune responses. It is a subspecialty of clinical pathology. It is also imperative that it requires personnel of both basic science and medical science working in tandem for a meaningful translational medicine.

Immunopathology has emerged as a major discipline in the last three decades, and has gradually created a niche in all modern clinical laboratory setups. As advances in understanding disease mechanisms progress with advancing scientific knowledge, the contribution of the immune system in disease causation unravels in the majority of the disease entities encountered in clinical practice today. Newer therapeutic strategies continue to evolve based on basic immune-regulatory mechanisms and targeting various molecules involved in immune homeostasis.

The immune network is perhaps the most complex system in the human body and any mistake in its intricate signalling pathway can lead to malfunction of the network leading to either defective or deficient immune function or heightened activity with immune-inflammatory responses/autoimmunity. This intricacy is further complicated by the inherent redundancy in the signalling cascades or pathways resulting from a crosstalk between pathways. When lymphocyte subsets were first recognised, the scientific community

had difficulty in accepting their role in health and disease. The most striking impact of this knowledge was exemplified by HIV/AIDS, which proved beyond doubt, the role of CD4 cells in immunity.¹ Understanding the immune system and investigating it for patient management hence is of utmost necessity in any clinical setup and patient-care facility.^{2,3} This chapter aims at providing a very basic algorithm or guideline to setup a laboratory to provide ‘immune status information’ to the clinician. The scope of a laboratory however can expand much beyond what the authors advocate, and would depend entirely on the laboratory team involved to go to the extent feasible in setting up an immunopathology laboratory.

PROCESS OF IMMUNOPATHOLOGICAL ANALYSIS

For establishing an immunopathology department in a tertiary-care setup one requires some key equipment and reagents to perform tests that provide adequate information for diagnosis and management of patients. The laboratory setup can be discussed under the following heads:

- Sample collection and triage
- Sample testing and setups/equipment required
- Manpower/office space
- Quality control
- Infection control and waste disposal

Sample Collection and Triage

A centralised sample collection and triage area where samples are sorted, tested and properly labelled requires an

efficiently manned station. The triage area should be isolated from the main testing area. Each laboratory needs to design their own set of workflow and the critical point is strict adherence to the set workflow and not the workflow itself. Laboratories can opt for barcoding of samples, which needs to be done at the triage area.

Sample Testing and Setups/Equipment Required

Sample collection and triage area

- **Laboratory centrifuge:** Serum constitutes one of the major sources of testing in an immunopathology laboratory and hence a proper separation of serum constitutes one of the most critical steps of testing. Needle destroyer/cutter should be available in the sample collection area, if samples are collected.
- **Sample storage:** Laboratory refrigerators for sample storage till testing.

Laboratory work area

- *Shared setup/equipment*
 - Laboratory incubators including BOD incubators
 - Vortex, water bath, centrifuges, pH meter, weighing balance, autoclave, etc.
- *Specialised setups*
 - *ELISA assays:* The scope of immune assays in diagnostics today is immense and readily available commercial ELISA kits for almost every disease marker has made ELISA-based serologic testing easy, high throughput, fast (the test can be performed in 2–3 hours) and of immense utility. Tests like antinuclear (ANA), dsDNA, PR3, myeloperoxidase (MPO), Ro/La and glomerular basement membrane (GBM) for autoimmunity work-up, and tumour immunology [β HCG, carcinoembryonic antigen (CEA), prostate-specific antigen (PSA), CA125], antibody transplant immunology (anti-HLA antibodies, donor-specific antibody DSA, panel-reactive antibody PRA) need a good ELISA reader for day-to-day clinical testing.

(Additional equipment required: A set of good micropipettes, dilution plates and incubator. Optional: ELISA washer).

To further categorise conditions characterised by specific antibodies, or to characterise ANA specificities, western blot assays may be performed, which require a shaker and strip holders so that incubation can be uniform.

- *Electrophoresis workstation:* For laboratories that do clinical serum and urine electrophoresis, a good automated workstation for electrophoresis and immunofixation electrophoresis together with a nephelometer for estimation of C-reactive protein (CRP), serum immunoglobulins and serum-/urinary-free-light-chain assay, a complete work up for plasma cell dyscrasias can be provided (Figure 21.1A). A densitometric evaluation of the different serum protein components and quantitative calculation of these fractions based on biochemical estimation of total serum proteins and total albumin can be provided for various disorders like nephrotic syndrome, liver disease, etc. (Additional equipment required: Micropipettes).
- *Nephelometry:* For estimation of serum immunoglobulins, immunoglobulin subclasses, α -1-antitrypsin, CRP, serum complements, etc. For laboratories handling moderate loads, a semiautomated endpoint nephelometer would provide good efficiency. For handling a larger sample load, a fully automated nephelometer would be a better choice (Figure 21.1B). (Additional equipment required: Micropipettes)
- *Fluorescent microscopy:* A fluorescent microscope is an invaluable and a key instrument in any immunopathology laboratory. Sera samples, tissues, cells, cell supernatants can all be used to elicit vital information (Figure 21.2A)
- *Indirect immunofluorescence (IIF):* Autoimmune diseases are a predominant diagnosis for which an immunopathology laboratory is requisitioned in daily clinical practice. The key tests for evaluating cases of autoimmune diseases involve IIF assays and hence a

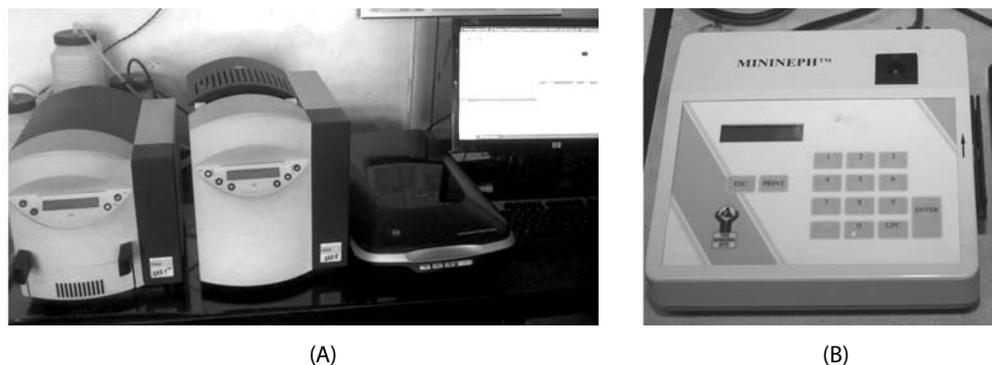


Figure 21.1 (A) Automated clinical electrophoresis workstation. (B) Table-top semiautomated endpoint nephelometer.

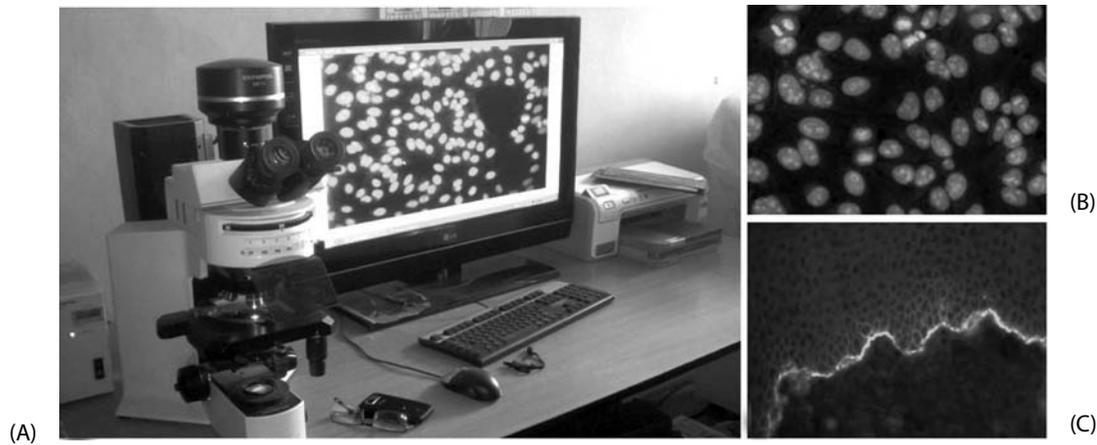


Figure 21.2 (A) Fluorescent microscopy setup. (B) Indirect immunofluorescence of HEp2 cells for ANA. (C) Direct immunofluorescence of skin in a case of bullous pemphigoid.

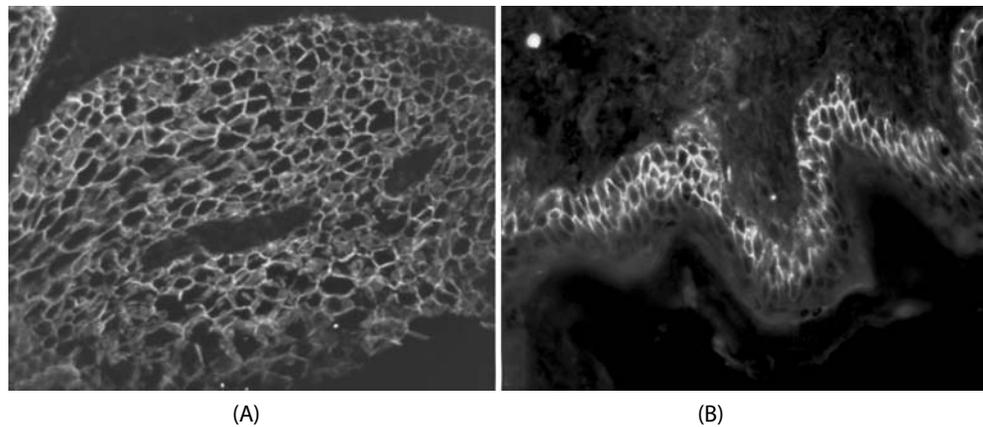


Figure 21.3 (A) Indirect immunofluorescence in monkey oesophagus for Pemphigus Vulgaris showing typical positivity in the intercellular spaces. (B) Direct immunofluorescence in patient's skin biopsy showing the same pattern in a case of Pemphigus.

fluorescent microscope is essential equipment. The various tests that can be performed relate to antinuclear antibodies, HEp2 cells being the commonest substrate used, which can guide the clinicians (Figures 21.2B and 21.3A). Currently, LED-based systems offer a good choice of longer lamp life and cost effectiveness. An instrument preferably equipped with a digital camera helps documenting the abnormalities and are vital for teaching and reference. A relatively dark room should be selected for microscopy.

- **Direct immunofluorescence (DIF):** In DIF, patient's tissues are 'directly' examined for deposition of immune complexes or antibody binding. Frozen sections are required to preserve the antigens and antibodies. In renal diseases histological examination has to be supported by immunofluorescence studies that help to distinguish seemingly similar but pathogenetically dissimilar conditions. It is of great use in diagnosis of IgA nephropathy, in classifying mesangiocapillary glomerulonephritis, confirming a diagnosis of Goodpasture's

syndrome, to establish the extent and type of damage in lupus nephritis and SLE.

Immunodermatology is another area where direct fluorescence is regularly performed to substantiate a diagnosis, e.g. pemphigus vulgaris, dermatitis herpetiformis, Henoch–Schönlein purpura, systemic lupus erythematosus, herpes gestationis, bullous pemphigoid, etc. (Figures 21.2C and 21.3B)

Equipment required: A cryostat hosted in an air-conditioned room is the key instrument for these studies (*Additional equipment required:* Micropipettes, incubator, petri dishes, optimum cutting medium and cryostat knife sharpener).

- **Flow cytometry:** Flow cytometry has become one of the most powerful tools to study the immune cells, their surface characteristics, functional characteristics, gene regulation, gene expression and many more (Figure 21.4A and B). The usage of this technique is ever expanding and is beyond the scope of this chapter.⁴ Though a two-laser configuration would cater to most

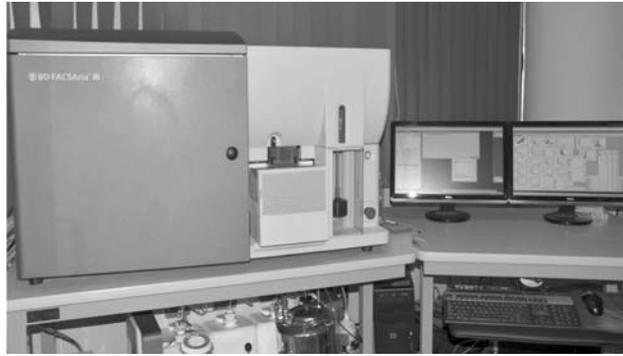


Figure 21.4 (A) A flow cytometry setup.

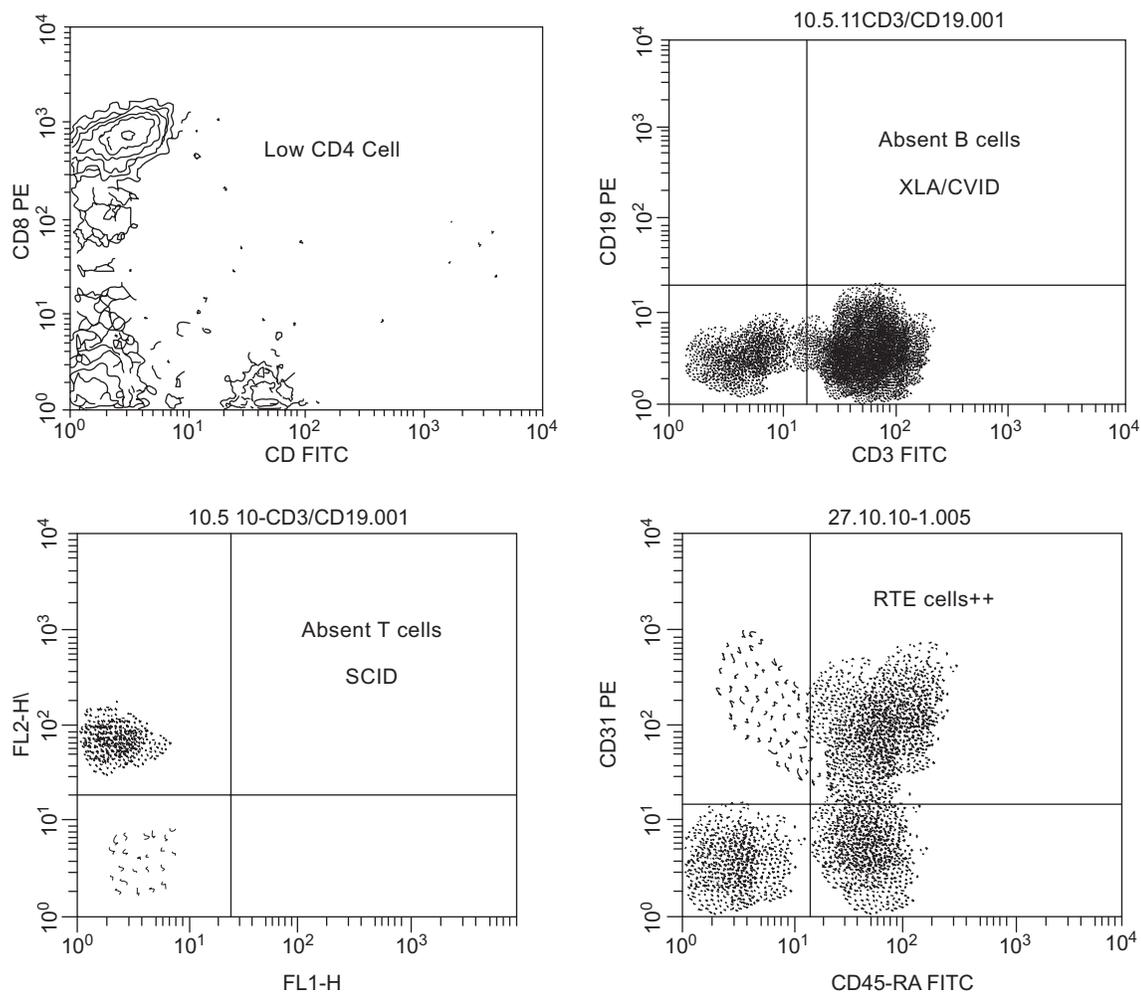


Figure 21.4 (B) Flow cytograms.

of the basic needs of a routine diagnostic laboratory, a three-laser system would be the best choice. Lymphocyte subset analysis (CD3, CD19, CD4, CD8, CD16/56) for work up of suspected primary or secondary immunodeficiency states, and more specialised testing for Btk, CD18, WAS, CD40L, gp91phox, TACI, etc. Testing for CD3 counts are also required for mentoring antirejection therapy in renal transplantation

and CD19 for monitoring patients on anti-B cells therapy, viz. rituximab.

- *Tissue typing and cross-matching:* Both serological methods (based on the CD technique) and DNA-based methods can be adopted, depending upon the preference of the laboratory but serological methods, backed up by the DNA-based techniques is the best, if adopted.

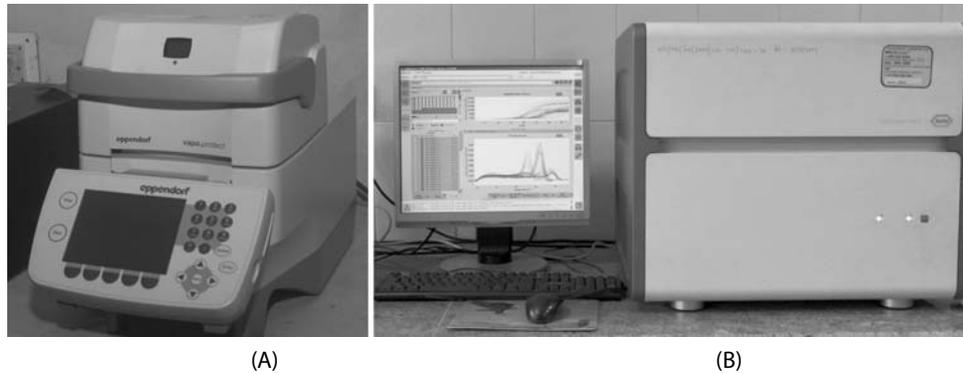


Figure 21.5 (A) Gradient thermal cycler. (B) A real-time PCR setup.

➤ *Serological methods*

- Cold centrifuge: Required for lymphocyte separation by density-gradient centrifugation and an ordinary light microscope to check the quality (viability) of lymphocytes.
- Inverted phase contrast microscope for reading the Terasaki plates.
- Dispensers: 5 and 50 μ L volumes.
(Additional equipment required: Incubator, Neubauer chamber and incubator).

➤ *DNA-based methods*

- Spectrophotometer for estimation of DNA
- Thermal cycler for carrying out PCR (Figure 21.5A and B).
- Gel documentation system

(Additional equipment required: Micropipettes)

- *Real-time PCR*: Quantification by real-time PCR can be a great asset to a setup, be it for estimating viral loads in an HIV-positive individual or for estimating cytokine mRNA expression levels. Research meets a great boost with such equipment available (Figure 21.5).

- *Luminex platform*: State-of-the-art Luminex xMAP technology provides rapid multiplexing of up to 100 analytes in a single sample in a single test well, and that translates to 9600 tests in a single 96 well-format assay. This kind of technology can be utilised by laboratories dealing with a high sample load requiring rapid turnover of results. These kinds of assays can be designed for detection of proteins, nucleic acids or antibodies, which means that all immunoassays that are currently done by ELISAs can be done utilising this kind of a platform. High-resolution HLA typing required for a successful bone marrow transplant or antibody screening can be done in a cost-effective, less-labour-intensive and rapid manner.

For manual communication of laboratory reports, a separate window should be allocated at the reception counter/entrance of the department so that patients and attendants do not have to waste time enquiring from different laboratories. A hospital information system (HIS) or laboratory



Figure 21.6 A walk-in cold room facility for sample and consumable storage.

information system (LIS) for online transmission and availability of reports to the clinicians goes a long way in improving laboratory efficiency.

Sample storage, biobanking

- Walk-in cold room facility for storage of kits and reagents, blood samples, etc. (Figure 21.6).
- Refrigerators: Dedicated refrigerators for each individual section.
- For storage of perishable components like complement, *Taq* polymerase and other enzymes -20 and -80 deep freezers are essential. Biological material that requires long-term storage, viz. serum, DNA, RNA, etc. also needs to be stored thus.
- Cell lines are best stored in liquid nitrogen cylinders that are kept in the cold room (to prevent the liquid nitrogen from dissipating). Storage of cell lines and biological material for future reference/usage however needs proper consent from the patient/individual concerned, and should be specially taken care of.

Manpower/Office Space

The manpower for an individual laboratory though is a total discretion of the laboratory concerned, but should work on the optimal workforce. Each workstation should have a dedicated technician and laboratory attendant. The laboratory

supervisor looks after the overall functioning of the laboratory.

Office space should be intelligently designed. The chambers should be big enough that three to four members can hold discussions, a table and space for computer, cabinets for files and other documents, etc. A separate area for autoclaving and sterilisation should be provided, which should preferably be next to the common washing area. There should be separate refreshment area as eating and drinking is not allowed in labs. Separate refrigerator should be supplied for eatables.

Quality Control

Both internal quality control and external quality assurance are an integral part of testing and a prerequisite. Laboratory accreditation and certification through agencies like National Accreditation Board for Testing and Calibration Laboratories (NABL) and College of American Pathologist (CAP) gives added credit of quality assurance in a laboratory.

Colour-coded waste disposal system should be strictly adhered. The policies followed by different laboratories for waste disposal would vary, but the importance lies not in the policy followed, but strict adherence to it. An incinerator attached to the hospital should be used for infected organic waste. For handling sharps, viz. needles and surgical blades,

puncture-proof boxes should be used, which can be disinfected with sodium hypochlorite and later are discarded in specified areas.

Vaccination for HBV of all laboratory personnel should be mandatory. All work benches with specially treated nonporous surfaces should be equipped with 1% sodium-hypochlorite solution to handle accidental spillage.

A good immunopathology department with all necessary (basic and advanced) equipment, reagents, manpower and quality control mechanism is an utmost requirement of a tertiary-care hospital.

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Radiodiagnosis and Imaging Services

22

Dr Vivek Gupta

“A goal without a plan is just a wish.”

—Antoine de Saint-Exupéry

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- get a brief overview of a modern radiology centre.
- know key points for planning a radiology centre.

BACKGROUND

Radiology department is one of the focal point of any hospital or a medical centre. Setting up such a facility requires very careful planning and a vision for the future. The scope of a modern radiology setup is now not only limited to imaging studies but also has a therapeutic role in the form of minimal invasive ‘interventional radiology’ setup.

STRATEGIC PLANNING FOR SETTING RADIOLOGY CENTRE

Feasibility of setting up an imaging centre in a given area is the first step in planning of any centre. This depends upon the conditions like need for such services in the given area, presence of other centres, status and acceptability of referring physicians, presence of larger hospitals in the area, etc.¹⁻³ Once it is clear that there is need, further planning can be undertaken.

Two types of radiology centres are in place in our country. First is the radiology departments in a hospital setting and the other type is dedicated radiology centres, which work on referral from different hospitals and physicians. The major difference is the patient referral—in the former type the referral is assured from the different departments of the hospital itself but in the latter type efforts are required to generate the patient referral from in-and-around the area.

Location

The location should preferably be on the ground floor. The reason for this is twofolds. One, some of the sophisticated machines like computed tomography (CT) and magnetic resonance imaging (MRI) are best placed on ground floor due to technical reasons and, second, because in addition to walk-in patients the department also caters to emergency patients who may not be able to walk or need urgent scanning for establishing the diagnosis.

The second consideration in the location is that the facility should be easily accessible to OPD patients, inpatients as well as emergency department. Access should be both by ramps and elevators.

Equipments

The type of investigations available defines any good radiological setup. In a fast-changing technological world, keeping update with the advances in imaging is essential.

The must-have equipment for any model radiological setup should be:

- Digital X-rays.
- Fluoroscopy units.
- Mammography unit.
- Dual-energy X-ray absorptiometry (DEXA) unit.
- Ultrasonography units.

- Multislice CT
- 1.5-T/3-T MRI.
- Digital subtraction angiography unit.
- Positron emission Tomography-computed tomography (PET-CT).

Layout

Reception area

A modern imaging department should be such that the patient entering it should immediately know where to go and whom to approach. For having this, a reception area is essential. Reception area should be well-lit, should have adequate space for sitting as well as to accommodate sick patients on trolleys and wheel chairs. The person-in-charge of reception should be a qualified person, well-versed with various types of radiological studies, and has prime responsibility of scheduling the studies to give preprocedure checklist, guiding the patients to the appropriate rooms and dispatching the reports.

The reception is one room where the patients may have to wait for sometime before his examination is scheduled. To utilise this time, information regarding various radiological investigations should be available at reception in print and/or audio-video format. The information should include how the machine (e.g. CT/MRI) will look like, what the patient will experience during or after the procedure, etc. This kind of information takes care of anxiety of the patients as well as improves workflow, as less time is required to explain these things to the patient just before the procedure.

Preprocedure and changing rooms

Nearly every radiological investigation needs some type of preparation. It could be simply removing any metallic rings and clips, etc. for X-rays or more extensive like putting in intravenous (IV) line and changing into hospital gown. Also, some investigations like MRI need very comprehensive screening to rule out presence of any metallic item on the patient. For all this a dedicated room with nursing station is required.

Patients can be prepared here and along with that their queries if any regarding schedule investigations can be answered. Since many of the investigations require written informed consent from the patient (like for investigations involving contrast media and radiation exposure) this room can also be utilised for that purpose.

Investigation rooms

A modern radiological setup should have minimum of one digital X-ray unit, one sonographic unit, a mammographic unit, one CT scan, a fluoroscopic unit and an MRI unit. Portable X-ray and sonographic unit is required in case of a larger hospital. Out of this, X-ray, fluoroscopic and CT scan units emit ionising radiation, so special care is required for the construction of rooms for these equipments.

Investigation rooms housing equipment using ionising radiation

Construction of any room that houses a unit with ionising radiation like X-rays, CT scans, fluoroscopic unit, mammography unit and PET-CT needs special consideration for the safety of the operators, patients and people near that unit. The detailed guidelines regarding this can be seen at 'Atomic Energy Regulatory Board (AERB)' website that gives specifications of the room, its construction, layout and shielding, etc.⁴

In short, the room should be of specific dimensions depending upon the equipment installed, should be made up of mortar and bricks, walls of specific thickness, lead protection of doors and lead glass partition between the console room and X-ray unit should be there. The unit in the room should be placed in such a way that it is not possible to direct primary radiation towards entrances, windows or areas of high occupancy. Other considerations are that the number of doors and windows should be minimum, so as to prevent any radiation leakage outside the room.

The minimum size of a general X-ray and fluoroscopic room is 18 m² and 25 m² for CT room.

Ultrasonography room

Since ultrasound machines do not emit any ionising radiations, it is possible to house them in a general room without any special construction guidelines. However, a well-designed sonography room should have ambient light control, an examination trolley/bed, a changing room and a washroom.

MRI room

A magnetic resonance (MR) unit is pride of any modern imaging centres. An MR machine has a large magnet, which emits strong magnetic field in all directions, so its installation and housing is different from any other radiological equipment. In addition to magnetic fields, the system is very sensitive to radiofrequency fields.

While planning and designing any MR installation these things are to be kept in mind. Every manufacturer provides the details about installation of their equipment with adequate safety precautions. Basically an MR unit has to be shielded in such a way that its magnetic field does not exist outside the room. For this, active shielding, passive cladding and room shielding are done.

Also for patient safety the access to the MR room should be controlled and clear printed instructions should be displayed at the point beyond which only patients with adequate screening can go.

In any MR installation, it is necessary to see the effect of emitted magnetic field in all directions. Any device or equipment, which is sensitive to magnetic fields, should be away from the MR unit or adequately shielded for, e.g. power transformers, CT scanners, ultrasound equipment, PET scanners, X-ray machines, etc. Special care is taken in planning

to see that the MR unit is away or well-shielded from steel pipes and structural steel, elevators and automobiles.⁵

Also, since device that emits radiofrequency (RF) waves (e.g. cell phones, mobile phone towers, radio transmitters, phones, etc.) can cause interference in image reconstruction, the MR unit also needs to be shielded from RF pulses.

Reporting room

This is the nerve centre of any radiological setup. In modern department, nearly all reporting is done on dedicated workstations. This is different from conventional setups where first X-ray, CT or MRI images are printed on films and then send for reporting. A filmless setup is cheaper, environment friendly, easier to maintain and useful than the one with films. Every modern setup should aim for a filmless functioning.

A reporting room should be big enough to house separate reporting consoles for all the radiologists who are working. Their consoles should be independent and at the same time should be designed in a way that interpersonal communication is not hindered.⁶

ADVANCES IN RADIOLOGY SETUP

Moving to Filmless Radiology

Traditionally, the idea of radiology department is associated with image of X-ray films, CT scan films, etc. being seen on view boxes and reports being written by radiologist and then sent to concerned doctor or patients. But with the advent of modern technology, more and more radiology departments are moving towards filmless departments. What it means is that instead of printing films the images are viewed on monitor for reporting and then given to patients either on CDs or paper prints or sent to referring doctors electronically via net to their computers. This can be achieved mainly in two ways—one, the images (X-rays, CT, MRI, etc.) can be acquired digitally with the use of modern equipment or images can be digitalised by scanning the films. The former way is preferred and being done in majority of centres in western countries.

Digitalisation of images is very helpful. For example, if during acquiring a conventional X-ray, the factors (like tube voltage and current) are not optimal or during developing the films there is some problem the image on the films may not be useful. If this happens another X-ray needs to be taken, giving the patients additional dose of radiation. Whereas if digital X-rays are acquired the image can be manipulated, even if acquisition is not optimal, in such a way that repeat X-ray can be avoided. Also, storage of films takes a lot of space and due to atmospheric conditions the films are degraded after sometime making them useless, whereas digital images can be stored very easily on a server for years together without risk of degradation. Another major advantage of digital images is that they can be sent electronically to a higher centres for second opinion if desired in matter of seconds, thereby helping in reaching at a diagnosis quickly.

PACS and HIS

A modern radiology department for achieving this rapid reporting, transfer and storage of images install a system, which is known as PACS. PACS stands for 'patient archiving and communication system'. Simply put all the radiology machines where images are acquired and are linked to a central server where all the images are sent. From there the images are sent for long-term storage and also for reporting to individual workstations of the radiologists. PACS can also be installed in smaller centres where few machines are there but multiple radiologists are working. In a larger hospital setup, the PACS is linked to HIS or 'Hospital Information System'.^{7,8} Once this is done, the acquired images can be made available to the referring physicians very soon after they are acquired. Also, the radiologists have access to the clinical and laboratory details of the patients, which go a long way in reaching to a correct diagnosis.

The digitalisation of the department should be in such a way that it ensures fast and efficient retrieval of the studies, accessible from anywhere; it is secure and ensures patient privacy, no loss of resolution takes place in transfer of images, is easy to use, is cost-effective and lastly is robust for large volume.

Setting up a model radiology centre involves a very detailed planning and a vision as to what is desired out of it. Layout of the department is very crucial as imaging involves many sophisticated machines, with some of them emitting radiation. Digital imaging is the way to future and needs to be implemented in any modern setup.

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Radiation Oncology Services

Dr Narendra Kumar and Dr Ritesh Kumar

“I am now almost certain that we need more radiation for better health. It is likely that we need more radiation to improve our longevity.”

—John Cameron

LEARNING OBJECTIVE

After reading this chapter, the reader should be able to:

- get an overview of types of radiotherapy units, personnel requirements, radiation protection and radiation waste disposal in a tertiary-care hospital.

INTRODUCTION

World Health Organisation (WHO) has reported that the incidence of cancer will rise by 50%, from 10.1 million in 2000 to around 15.3 million new cases in 2020.^{1,2} Radiotherapy plays an important role in integrated cancer treatment and 50–60% of cancer patients needs radiotherapy at some point.³ Therefore, for an effective management strategy for cancer, radiotherapy facilities should be within easy reach of patients. Radiotherapy facilities are expensive, and different newer machines are required in a tertiary-care centre to deliver the state-of-the-art treatment to the people.⁴

Location

The department must be carefully located as per the radiation protection guidelines for the design of structural shielding for radiation installations [National Council on Radiation Protection and Measurements (NCRP) Reports 49 and 51]. Radiation therapy is best located where it will adjoin the earth on several sides and has no departments below. Thus basement floor or ground floor is the most suitable location. The location should have mandatory thick walls and ceilings for radiation protection and required access for the placement or removal of equipment. It should be close to the outpatient department and vertical transport facilities, as most of the patients are outpatients.

RADIOTHERAPY FACILITIES

The radiotherapy facilities required in a tertiary-care institute comprises of teletherapy units and brachytherapy units. Teletherapy machines deliver radiation from a distance i.e. radiation sources are at a distance of 80–100 cm from the patient. Brachytherapy machines deliver radiation from a short distance, i.e. radiation sources are placed inside or near the tumour.⁵

Teletherapy Units

- **Telecobalt:** Earliest and one of the most widely used machine for teletherapy treatment. A radioisotope (Co-60) emits the γ -rays, which are used for treatment. It is a simple and relatively cheaper machine. The radioactive source has to be replaced every 5–10 years.
- **Linear Accelerator:** Linear accelerator (LA) uses electrically produced high-energy X-rays for treatment. It is now the most widely used machine worldwide. With improvement in technology, various modifications have been incorporated in a LA to deliver high-tech radiation modality in form of:
 - 3DCRT (three-dimensional conformal radiation therapy)
 - IMRT (intensity-modulated radiation therapy)
 - IGRT (image-guided radiation therapy)
 - SBRT (stereotactic body radiotherapy)

- **Gamma Knife:** This is a high-precision radiotherapy machine for treating small intracranial tumours. It delivers very-high dose of radiation to a small area in brain with a high degree of accuracy, while effectively sparing of critical normal structures. It uses Co-60 as radiation source. This technique is known as *stereotactic radiosurgery* (SRS).
- **Simulator:** A simulator is a machine that simulates the teletherapy machine and is used for radiation treatment planning. Various types of simulators are required as per the treatment plan, i.e.
 - Conventional simulator: Two-dimensional treatment planning.
 - CT-simulator: Three-dimensional treatment planning (3DCRT/IMRT).
 - 4D-simulator: Respiratory gating is possible (IGRT).

Brachytherapy Units

- **Sources:** Radioisotopes are required to deliver the brachytherapy treatment. The most common and widely used radioisotope for brachytherapy is Iridium-192 (Ir-192). Other radioisotopes used are cesium-137, iodine-125, palladium-103 and gold-198.⁶
- **Equipment:** The machine stores the radioisotope in safe position and the isotope is moved near the tumour as per the required dose and treatment planning. Thus, a very-high dose to the tumour is delivered in a short time sparing the normal tissues.
 - **LDR (low-dose rate) equipment**
Delivers radiation at low-dose rate (0.2–2 Gy/hour)
Radium-225 is used as a radioisotope
Requires inpatient admission. Cannot be done on outpatient basis.
 - **HDR (high-dose rate) equipment**
Delivers radiation at high-dose rate (>12 Gy/hour)
Iridium-197 is used as radioisotope
Can be done on outpatient basis
- **Operation theatre:** Brachytherapy facilities require anaesthesia in most of the cases. Thus, operation theatre facilities are required. A dedicated brachytherapy suit operation theatre is preferred.

Personnel Requirements (Table 23.1)

The organisational team consists of radiation oncologists, medical physicists, radiation technologists, nurses, counsellor and a dietician.⁷

- **Radiation oncologist:** The head of the radiotherapy department is a radiation oncologist. Radiation oncologist is trained in radiotherapy and is responsible for prescribing and supervising radiation treatment.

Table 23.1 Personnel requirements for clinical radiation therapy

Category	Staffing
Radiation oncologist-in-chief	One per programme
Staff radiation oncologist	One additional for each 200–250 patients treated annually. No more than 25–30 patients under treatment by a single physician at any one time.
Radiation physicist	One per centre for up to 400 patients annually. Additional in ratio of 1 per 400 patients treated annually.
Dosimetrist	One per 300 patients treated annually
Radiation therapy technologist: Supervisor	One per centre
Radiation therapy technologists	Two per megavoltage unit, up to 25 patients treated daily Four per megavoltage unit, up to 50 patients treated daily
Radiation therapy technologist: Simulator	Two for every 500 patients simulated annually
Radiation therapy technologist: Brachytherapy	As needed
Nurse	As needed
Social worker	As needed
Dietician	As needed
Maintenance engineer	One per 2 megavoltage units or 1 megavoltage unit and a simulator if equipment serviced 'inhouse'

- **Medical physicists:** A radiation expert is a person who helps in planning the treatment with the oncologist. Together they will decide the best way of giving the prescribed amount of radiation. The physicist is also responsible for making sure that the radiotherapy equipment is used accurately. He monitors the technical issues and radiation safety issues.
- **Technologists:** Operate the machine and deliver the prescribed radiation dose to the patient. They are trained in delivering radiotherapy and inpatient care. They play an important part in helping patients with treatment, give information, support and counselling. They work closely with radiation oncologist and a physicist to plan and execute radiation treatment.
- **Mould room assistant:** A technical staff is the person who prepares accessory devices used for patient treatment and radiation beam modification.
- **Nurses:** Nurses look after patient's general needs, such as dressings and medicines. The nurses also give information, advice, support and counselling.

- *Dietician*: A dietitian gives advice regarding dietary modifications during radiotherapy and regarding problems of eating and drinking during radiotherapy treatment (e.g. difficulty in swallowing or a dry mouth).
- *Speech and language therapists*: A speech and language therapist helps the patients receiving radiation to neck region regarding the voice changes and recovery after radiotherapy.
- *Social worker*: Social worker gives advice about any non-medical problems including practical and financial help. Social workers can also provide or arrange counselling and emotional support for the patient and family.
- *Palliative care team*: Gives extra help, support, psychosocial support to people with painful symptoms or side effects of treatment that are causing problems. Palliative care is especially important for terminally ill patients.

Requirements and Guidelines for Procurement of Radiation Equipment⁷

- Clearance of the radiation therapy unit by the national regulatory board.
- Approval of room layout plan of radiation therapy installation.
- Appointment of radiation therapy staff.
- Nomination and approval of radiological safety office.
- Procurement of personnel-monitor devices for monitoring of radiation dose.
- Measuring and monitoring instruments.
- Authorisation to procure radiation sources.
- Road transport approval.
- Receipt of sources.
- Installation of the unit.
- Loading of the source/switching on radiation in case of radiation-generating equipment.
- Quality assurance/acceptance test.
- Commissioning approval for patient treatment.
- Periodic performance/quality assurance test.
- Annual status report.

Radiation Protection

A radiation protection programme is defined as the sum of all methods, plans and procedures used to protect the health and environment of personnel from exposure to sources of ionising radiation. The principle of ALARA (as low as reasonably achievable) is followed. The authority of the radiation safety programme is delegated to the Director, Radiation Safety Officer (RSO), and ultimately to the Radiation Safety Committee.

Monitoring in radiation protection is essentially required to assess compliance with established dose limits. Personnel

area and environmental monitoring needs to be performed to ensure radiation safety.⁸

- *Personnel monitoring*: Personnel monitoring is performed by making external and internal dose measurements. Thermoluminescent dosimeters (TLDs), film badges, fast neutron monitors and direct-reading dosimeters are used for external dose measurement on personnel.
- *Area monitoring*: Area monitoring includes measurement of radiation dose rates, airborne activities and surface contamination. Monitoring devices like ionisation chamber, proportional counter, Geiger–Muller tube and scintillation detector is used.
- *Environmental monitoring*: Environmental monitoring is used to detect any significant increase of radiation dose above background.

Disposal of Radiation Waste

Improper disposal of radioactive waste presents potential hazard to the general public. The programme director and the RSO are responsible for proper storage and disposal of radioactive waste. Radioactive waste should be stored properly in closed containers and should be labelled with a 'caution radioactive material' sticker. The standard operating procedures for disposal of radioactive sources are mentioned below.⁸

- The licensee/authorised user initiates necessary regulatory procedures with the help of RSO.
- The RSO helps the licensee in filling up the relevant regulatory forms and coordinating with the atomic energy regulatory board (AERB) for obtaining necessary approval for the safe disposal of radioactive sources.
- The permission to transport the radioactive waste is also obtained from AERB.
- The decayed/disused radioactive sources are sent to the original supplier of the source.
- Under no conditions, the radioactive waste is treated as ordinary waste or abandoned/disposed-off in public.

Radiotherapy facilities form an important part of comprehensive cancer care in a tertiary-care institute. It requires a team approach including radiation oncologists, medical physicists, radiation technologists, mould room assistants and other support staff. Radiation machines have high technological requirements, and radiation safety issues are the most important aspect that cannot be overlooked.

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Nuclear Medicine Services

24

Prof BR Mittal and Dr Saumya Kumari

“Diagnosis is not the end, but the beginning of practice.”

— Martin H Fischer

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the concept, brief history and regulatory bodies of nuclear medicine department.
- list the guidelines for setting a nuclear medicine department in the hospital.
- plan the layout of nuclear medicine department.

BACKGROUND

The science of nuclear medicine involves the administration of minute quantity of compounds labelled with radioactivity also called radionuclides that are used to provide diagnostic information in a wide range of disease states. The power of nuclear medicine lies in its ability to provide dynamic knowledge of biological processes in the body. The diverse biological processes that can be measured by nuclear medicine techniques include tissue perfusion, glucose metabolism, the somatostatin receptor status of tumours, the density of dopamine receptors in the brain and gene expression. There is a delivery of small radiation dose associated with performing nuclear medicine studies, with specific doses to the different organs depending on the radionuclide, as well as the spatial and temporal distribution of the particular radiolabelled compound that is being studied.

Brief history of nuclear medicine

The origins of nuclear medicine can be traced back to the last years of the Nineteenth Century following the discovery of radioactivity by Henri Becquerel (1896) and of radium by Marie Curie (1898). Both X-rays and radium sources were quickly adopted for medical applications and were used to make shadow images in which the radiation was transmitted through the body and on to photographic plates. The biological foundations for nuclear medicine were laid down between 1910 and 1945. In 1913, George de Hevesy developed the

principles of the tracer approach and was the first to apply them to a biological system in 1923, studying the absorption and translocation of radioactive lead nitrate in plants. The invention of the cyclotron (Lawrence) paved the way to artificially produce new radionuclides, thereby extending the range of biological processes that could be studied. Finally, at the end of the Second World War, the nuclear reactor facilities that were developed as part of the Manhattan project started to be used for the production of radioactive isotopes in quantities sufficient for medical applications.

The 1950s saw the development of technology that allowed one to obtain images of the distribution of radionuclides in the human body rather than just counting at a few measurement points. Major milestones included the development of the rectilinear scanner in 1951 by Benedict Cassen, Anger camera- the forerunner of all modern nuclear medicine single-photon imaging systems developed in 1958 by Hal Anger, use of ^{131}I in diagnosis of thyroid disorders in 1960s, use of $^{99\text{m}}\text{Tc}$ for imaging in 1964 by Paul Harper and colleagues, mathematics to reconstruct tomographic images from a set of angular views around the patient, and development of PET by Phelps and colleagues and SPECT by Kuhl and colleagues during 1970s.

REGULATORY BODIES

- International Atomic Energy Agency (IAEA) has laid down the safety code for proper functioning of any department, which involves dealing with radioactivity.

- The Atomic Energy Regulatory Board (AERB) is the regulatory authority in India, constituted by the President of India on November 15, 1983 by exercising the powers conferred by the Atomic Energy Act to carry out certain regulatory and safety functions under the Act. AERB published a safety code on nuclear medicine facilities in 1989, which was subsequently revised in 2001. This present code under the Atomic Energy (radiation protection) Rules, 2004 is *AERB/SC/MED-4*.

CATEGORISATION OF NUCLEAR MEDICINE DEPARTMENT

AERB had categorised the nuclear medicine setups according to the procedures performed:

- *Category I:* In vitro radioassays with ready to use kits for RIA.
- *Category II:* In vitro radioassays with inhouse preparation of kits (involving radiolabelling of ligands).
- *Category III:* In vitro assays + *in vivo nonimaging procedures*.
 - RIA with inhouse preparation of kits (involving radiolabelling).
 - Thyroid iodine uptake studies.
 - Renography.
- *Category IV:* In vitro assays + *in vivo nonimaging procedures + in vivo dynamic/static imaging*
 - RIA
 - RAIU studies
 - Planar/SPECT imaging
 - Therapeutic procedures which do not require hospitalisation (radioiodine therapy for thyrotoxicosis, bone pain palliation therapy using P-32 or Sr-89).

However, it is more practical to use the revised system of classification given by IAEA according to three levels of need:

- *Level 1:* This level is appropriate where only one gamma camera is needed for imaging purposes. The radiopharmaceutical supply, physics and radiation protection services are contracted outside the centre. A single imaging room connected to a shared reporting room should be sufficient, with a staff of one nuclear medicine physician and one technologist with backup. This level is appropriate for a private practice.
- *Level 2:* This level is appropriate for a general hospital where there are multiple imaging rooms in which in vitro and other nonimaging studies as well as radionuclide therapy would generally be performed.
- *Level 3:* This level is appropriate for an academic institution where there is a need for a comprehensive clinical nuclear medicine service, human resource development and research programmes. Radionuclide therapy for inpatients and outpatients is provided.

GUIDELINES FOR SETTING A NUCLEAR MEDICINE DEPARTMENT¹

As per AERB safety code, the key considerations in the planning and design of a nuclear medicine department are as follows:

- Unnecessary radiation exposure to staff, patients and visitors must be avoided, or kept within any limits required by the BSS or a local regulatory authority.
- Walls, doors and observation windows may require shielding; a calculation should be made on a case-by-case basis, depending on the distance to occupied areas, the rate of occupancy and estimated workload (e.g. GBq-h/week) for the various radionuclides to be used.
- The equipment used for imaging and radiation measurement should be highly sensitive.
- Moveable shielding should be used wherever possible to minimise fixed shielding, for example to shield technologists.
- Therapy areas must be well-separated from diagnostic areas; ideally there should be separate access, i.e. corridors for patients and staff.
- Traffic patterns must be designed to keep movement of radioactive sources, including radioactive patients, away from imaging equipment.
- The ventilation of any airborne radioactive material must be considered.
- Surface areas (floors, work surfaces and walls) of rooms and corridors must allow for easy decontamination.

PLANNING OF NUCLEAR MEDICINE DEPARTMENT^{2,3}

Site Selection

Space requirements vary according to the level of the service (simple in vitro or in vivo imaging laboratory or in vivo imaging therapeutic procedures). Space should also be allocated for an inhouse radiopharmacy if unit doses are being prepared on-site from 'cold' kits and ^{99m}Tc generators.

Ideally, this facility should be located away from general patient wards and public occupancy areas so that there is no impact of radiation hazards on general public and environment. When located within a hospital there should be no interference from other radiation emitting instruments. It should preferably be located at the end of the hospital block and yet should be well-connected to other departments.

Design

Design of department shall be as per plan approved by the competent authority, which is AERB for our country. Radiation protection is an important issue and following features should be incorporated in the design:

- Walls, floor and doors of the active areas shall have hard, washable, nonporous and leak-proof covering.
- Work surfaces shall be covered with nonporous and nonreactive material.
- Floors should be impervious to liquids.
- Plumbing shall provide direct flow of liquid effluents from active areas either directly to the delay tank or to the ultimate discharge point. Drain pipes and delay tank (for interim storage of high-level radioactive waste) shall be leak-proof and corrosion resistant.
- Ventilation system shall be of once-through type with unidirectional airflow from areas of lower activity to higher activity. The exhaust from fume hoods shall be let out directly into the open after filtering.
- Radiation levels at the nurse station outside the wards shall not exceed $1\mu\text{Sv}/\text{hour}$.
- Walls and doors of laboratories should be painted with good quality washable paint.
- For diagnostic imaging, ordinary wall thickness is usually sufficient.
- Radioactive waste disposal must follow local radiation protection guidelines and space must be available for waste storage.
- Active rooms, wards and areas of source storage and handling shall be marked with radiation symbol and legend denoting the identification of active area and presence of radiation hazard.
- Physical barriers should demarcate areas of high activity and contamination.

- Active areas shall be arranged in increasing order of the activity with entrance from lowest active area.
- There should be an adequate supply of lead containers and shielding lead bricks.

Design and Layout of Various Rooms

A typical layout plan, as proposed by AERB, is shown in Figure 24.1.

Imaging rooms: Imaging rooms should be at least as large as given in the manufacturer's recommendations, but preferably larger, to accommodate patients on stretchers. A larger area reduces the risk of radiation to staff. Tight fitting over-size doors and efficient heating, air-conditioning and humidity control units are also required. All rooms should have their own separate power supply and stabilizers and be equipped with hand wash basins with hot and cold running water. An intercom and/or telephone are important for facilitating communication.

Cardiac stress laboratory for nuclear cardiology: The cardiac stress laboratory should be planned in consultation with the cardiologists and equipped for treadmills and bicycles or pharmacological stress studies. Drug and life support facilities should be available in cases of emergency.

Conference room: The conference room can be used primarily for interdepartmental conferences, consultations with physicians and support activities for nuclear medicine staff. Space for scan interpretation, computers and ancillary equipment such as LANs should be provided. A library,

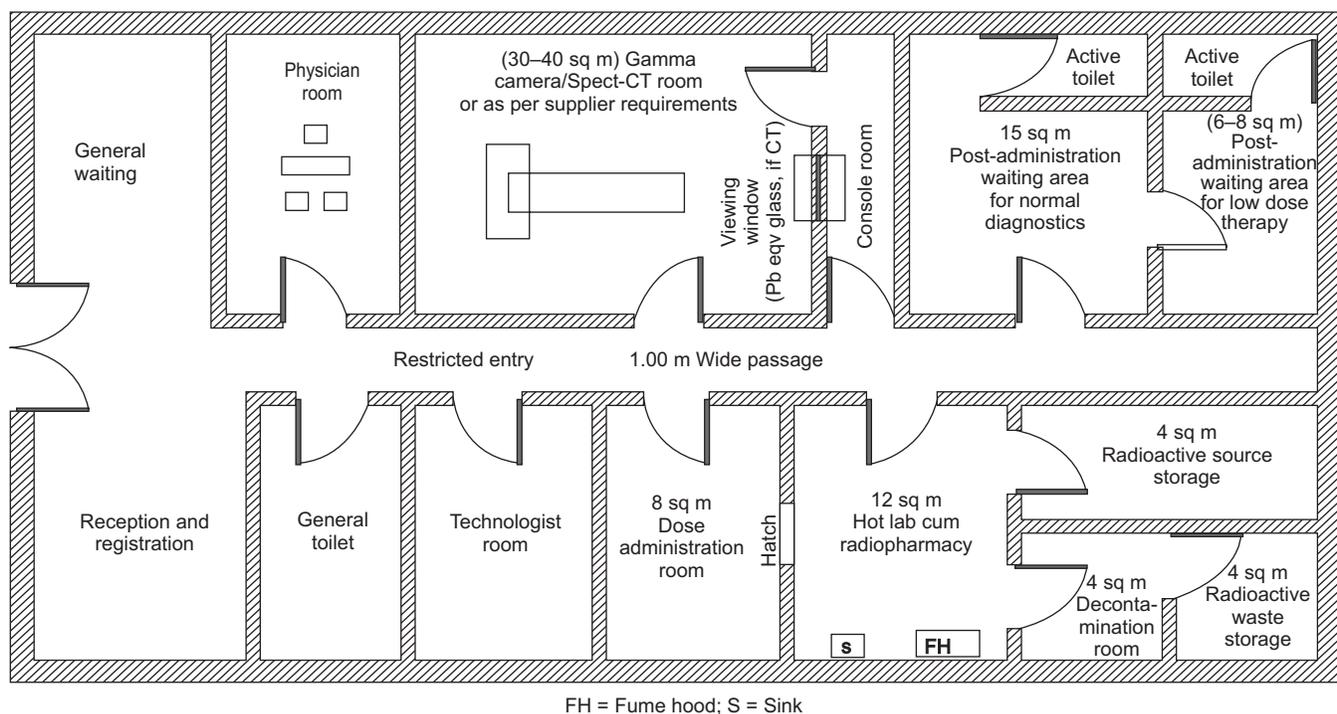


Figure 24.1 A typical layout plan of nuclear medicine department.

internet access and other teaching aids should be available to the conference room(s).

Offices: There should be sufficient office space for physicians, radiopharmacists, physicists, chief technologists, managers and secretarial staff. The number of offices depends on the size of the service.

Other space requirements: Postinjection patient waiting, Storage of clean supplies; radioactive waste disposal; toilet facilities for patients; staff restroom and toilet facilities; showers for decontamination purposes.

Radiopharmacy: This area should include radiopharmaceuticals preparation room, dose injection room, radioactive storage room, general storage room, waste disposal collection area, etc.

The layout of the department should enable an orderly flow of work and avoid the unnecessary carriage of radioactive materials within the department. Attention must be given to the location of the laboratory in relation to the facilities and other working areas of hospital. In order to avoid unnecessary radiation exposure, access to the radiopharmacy should be restricted and for security reasons, laboratories should be lockable.

Radiation protection will require the use of shielding made from lead or other dense materials. This may be incorporated into the walls of the laboratory or can be used locally, adjacent to the source that yields the highest dose rate. This means that floors, benches and other work surfaces must be sufficiently strong to bear the weight of shielding. It is imperative that dose rates outside the laboratory, especially in areas to which the public have access, be kept below specified limits. In particular, the siting of ^{99m}Tc generators needs to be carefully considered. Although the generators contain internal shielding, additional external shielding may also be required depending on the activity of molybdenum present.

Ancillary requirements⁷

- A stable uninterrupted power supply is vital and it has to be secure. Prior to installation of the gamma camera and electronic instruments, and during their service lives, the equipment needs to be protected from disturbances, such as power outages, voltage and frequency fluctuations in the mains power supply. A power stabilizer is important.
- Air-conditioning is essential to maintain a clean, dust free and dry environment for electronic instruments that are sensitive to heat and moisture changes; high humidity is bad for electronic components, causing corrosion as well as current leakage.
- Instruments must be housed in an air-conditioned environment, and a dehumidifier may be needed to maintain humidity at about 50%.
- Running hot and cold water must be available.

Area Required

Category I = 30 m²

Category II = 50 m²

Category III = 100 m²

Category IV = 200 m² (for a big teaching hospital, area should be more depending upon the number of equipments to be installed).

Staff

Each department must have a nuclear medicine physician, technologist, nuclear medicine physicist-cum-radiological safety officer (RSO) and other supporting staff for the proper functioning of the department.

Equipments and Supplies

- Gamma camera(s) – SPECT, SPECT/CT, PET/CT.
- Thyroid uptake system (if required).
- Dose calibrator(s).
- Various equipments' quality control phantoms.
- Hot laboratory instruments and accessories.
- Radiation monitoring instruments.
- Treadmill, defibrillator. Infusion pump Vitals monitor for cardiac stress lab.
- Accessories like colour and black and white printers, computers, etc.
- Radiopharmaceuticals (recurring expenditure).
- Furniture, as per requirement.

PLANNING OF INDIVIDUAL UNITS^{4,5,6}

PET Department

Currently PET is the most advanced, most expensive and most sophisticated service in the field of nuclear medicine. The decision to have a cyclotron depends on the clinical, academic and research demands as well as the ability to distribute ^{18}F FDG to nearby nuclear medicine facilities.

If the PET equipment is part of the main department, requirements are limited mainly to PET equipment room, dose dispensing and administration area, postinjection patient waiting area, etc. However, if this facility is stand-alone, the requirements are exhaustive as per the AERB guidelines. A typical layout plan by AERB is shown in Figure 24.2 (standalone) and Figure 24.3 (combined nuclear medicine and PET).

An average facility should include:

- *Rooms for reception:* Scanner, control, waiting, injection, blood testing, reporting and administration rooms.
- *Cyclotron specific rooms:* Cyclotron, control, hot laboratory, quality control, preparation, gas store and administration rooms.

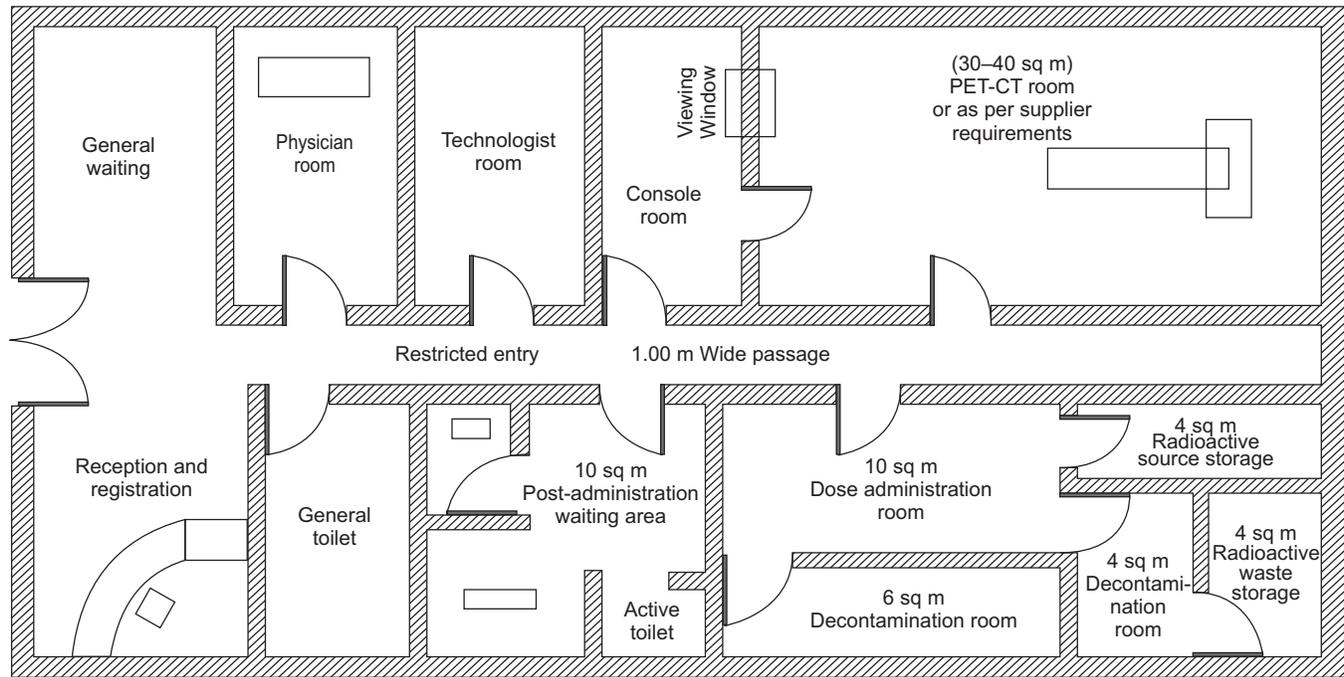


Figure 24.2 Layout of PET (standalone).

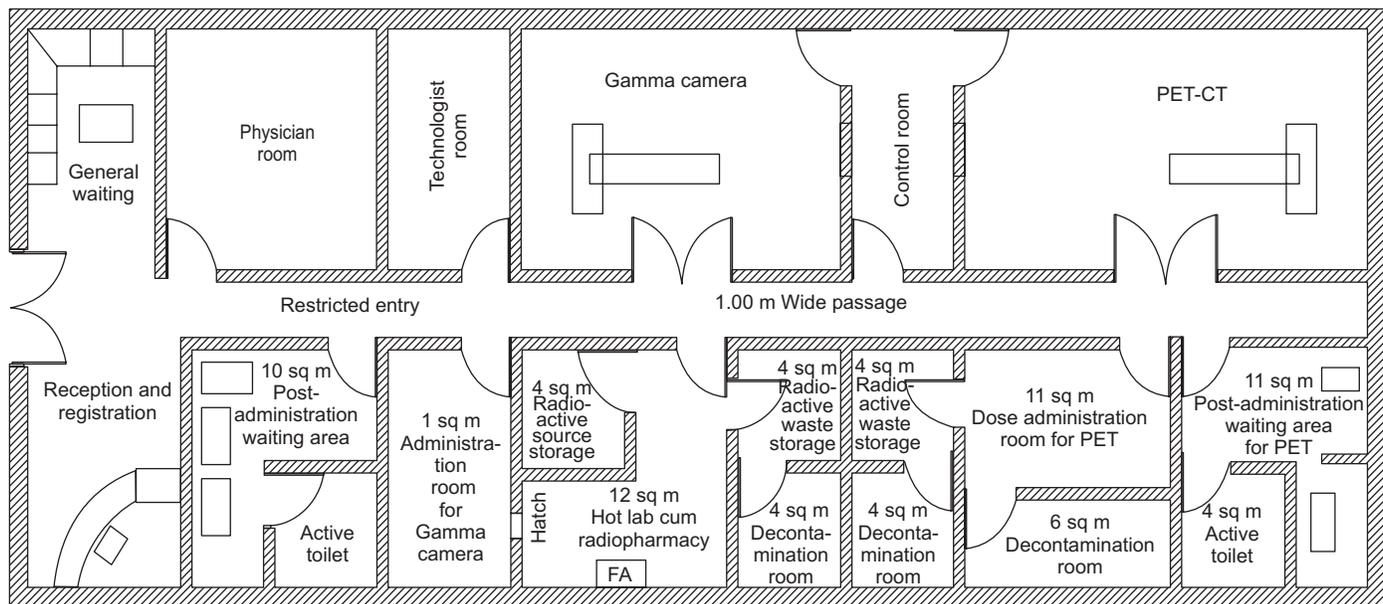


Figure 24.3 Layout of combined nuclear medicine and PET.

- *Other rooms:* Electricity, air-water cooling, ventilator-conditioner and waste control rooms.

Staff requirements

- *Medical staff:* One or two doctors; one or two technologists; one nurse.
- *Professionals:* One or two radiochemists/radiopharmacists; One physicist; one or two engineers and/or technologists.

- *Other staff:* One receptionist.

Similarly to space requirements, the number of staff members depends on whether the PET facility is separate or forms part of an existing nuclear medicine service.

Radionuclide Therapy Ward⁸

The location is similar to general nuclear medicine department described earlier. The isolation room in the ward must

be preferentially air-conditioned, equipped with bed shields, barrier entrance, attached toilets and windows at a height of 2 m from the floor.

Shielding requirement

The shielding should be such that radiation level outside isolation ward should be within prescribed limits for general public, i.e. 1 mSv/year. For adequate protection following should be ensured:

- Concrete walls of approx. 20 cm thickness.
- Room size $3 \times 5 \text{ m}^2$ (distance factor used to reduce radiation level).
- If room size is small, mobile lead shields should be used.
- Adequate buffer area outside the ward for movement of nursing staff.
- Nurses room should be located at a suitable distance to avoid exposure yet to be able to monitor the patient: radiation level $< 1 \text{ mSv/hour}$.
- Dose administration room should be adjacent to the isolation ward, should have well-ventilated fume-hood for storage and dispensing of radioiodine and the duct from the fume-hood should open outside into the atmosphere at up to 2 m height from top of the building.
- About 70–80% of the administered activity is excreted in urine within 48 hours. Hence, this should not be directly discharged into the sewerage. The drainage of the toilets of the isolation ward should be through a **delay and decay tank**, which allows large amount of radioactivity in the toilet waste of the isolation ward to decay before it is discharged into the public sewerage system. For a two bed-

ded ward – capacity of 6000 litres is adequate for each tank. It is left for decay up to 10 half lives.

Nuclear medicine provides very important diagnostic and therapeutic applications and most of the surgical and medical specialties benefit it. Despite logistic and financial difficulties in setting up of a new department, it is an important department in any medical setup.

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Experimental Medicine Services

25

Dr Dibyajyoti Banerjee and Prof Anuradha Chakraborti

“In a word, I consider hospitals only as the entrance to scientific medicine; they are the first field of observation which a physician enters; but the true sanctuary of medical science is a laboratory; only there can he seek explanations of life in the normal and pathological states by means of experimental analysis.”

—Claude Bernard

LEARNING OBJECTIVES

After reading the chapter, the reader should be able to:

- understand the role, scope and potential of the department of experimental medicine in a hospital.
- know the importance of experimental research in improving the quality of patient care.
- explain the role of a hospital administrator in fostering the growth and development of experimental medicine in a hospital.

INTRODUCTION

Tertiary healthcare is a highly sophisticated specialised level of healthcare that includes diagnosis and treatment of disease and disability. A tertiary-care hospital comprises of all the specialty and superspecialty departments that are directly engaged in high-quality patient care, often in collaboration with each other. Maintaining such high-quality technically competent patient care in the changing dynamic world requires ancillary departments that support the latest technical competence for the benefit of the patients. They do not directly provide healthcare to the patients but support the care-providing departments for effective patient care. One such department is of experimental medicine, which is relevant in today's tertiary-care hospitals; although, it may not provide patient care directly. An attempt is made to unravel the role of experimental medicine in a tertiary-care hospital in the monograph below.

EXPERIMENTAL MEDICINE—WHAT IT MEANS?

It is difficult to document a precise definition of experimental medicine. Unlike the service-providing departments like cardiology, neurology, surgery, etc., it lacks a defined domain. In common terms, it primarily involves research topics that are in preclinical or early clinical phases with a potential of translation in days to come. Popularly, it is believed that

experimental medicine is science and art of experimentation in animals relevant to human disease. Perhaps in earlier days, majority of experiments dealing with human health required animal models and therefore, the above idea about experimental medicine dominated over terminology framers. But over time, various modalities of experimentation relevant to human health have been developed ranging from in-silico tools to cell-based in vitro models that do not require animal model systems for a successful experimentation. These new generation methodologies are currently in extensive use by the experimental medicine community throughout the globe. The research aspect of experimental medicine division of a tertiary-care hospital may span through basic health science research to various experimental parts of clinical trials. Like all branches of medicine, the historical legacy of experimental medicine in modern sense begins from the days of renaissance; although, its roots were imbibed earlier in medieval or ancient times.¹ Today without a functional experimental medicine unit, an advanced healthcare system is unthinkable that aims both for high-quality patient care and sophisticated research. At the present moment there are periodicals dedicated exclusively for experimental medicine that focuses on findings with clear-cut in vivo relevance, and priority of publication is commonly offered at articles that has a definite translation potential. There are professional bodies throughout the globe to promote experimental medicine research in medical schools.

RESEARCH IN EXPERIMENTAL MEDICINE²

To keep pace with ongoing dynamic change of diagnostic or therapeutic modalities, research in experimental medicine is must in a tertiary-care hospital of the modern world. Experimental medicine deals with various specialised disciplines for the research purpose.

Bioinformatics and Computational Biology

It deals with computer-based technology for management of rapidly generating biological information. Today when the human genome is known and there is freely available public databases storing huge amount of diverse biological information, in-silico tools help the experimental medicine specialists to design rational experiments or to analyse research findings. Computational approach makes the health research cost effective, but less time consuming. Now there are public databases that store specialised information materials relevant to human health, like information regarding genetic diseases that focuses on genotypes and phenotypes or information regarding clinical trials of drug molecules in human subjects.^{3,4} Without accessing these information materials through World Wide Web, successful practice of experimental medicine is far from reality in recent times. Basic research in experimental medicine is also guided by recorded information in databases regarding biomolecules like protein database, which is a protein sequence database or micro-RNA-sequence database.^{5,6} Moreover, there are computational tools that aid in analysis of data and prediction of results. For example, gene sequencing provides the nucleotide sequence information that can be utilised for understanding disease pathogenesis at molecular level with the help of computational tools. In-silico validation is gradually becoming a prerequisite for new drug development and computational drug development has become a vibrant reality in today's experimental medicine research that makes new drug development faster, rational and cost effective.

Molecular Biology

It is a study of biological process at molecular level. It is a vibrant area of research in today's health sciences and exploration of biological processes at DNA, RNA and protein level generated enormous information, which is rapidly getting translated for the benefit of the patients. This branch of medicine mostly stemmed out from biochemistry and other related branches of science. Exploring molecular biology of individual disease process is a hot spot of medical research attracting considerable current interest.⁷ Linking traditional medical approach with molecular biology is a phenomenon of today's practice of experimental medicine.⁸ Disease process are rapidly getting classified on the molecular subtypes, which is believed to contribute for understanding the prognostic significance of the concerned disease and plan for rational management. Molecular diagnostics is also

gaining widespread popularity that explores various tools of molecular biology for diagnosis or predicting prognosis of various diseases, e.g. single nucleotide polymorphism (SNP) analysis for gene level variations. The limitation of reductionist approach of molecular biology has been currently being addressed by study of functions of individual biomolecules (particularly genes) in organophenotypic context. This approach is currently known as *integrative physiology*, which has the potential of development of data pool with chance of revolutionary translation and is possible only due to the advent of the molecular biology techniques.⁹ In a tertiary-care hospital, experimental medicine department is expected to deal with such aspects of biological research.

Cell Biology

It is a study of biological interactions in health and disease at cellular or subcellular level. Currently cell biology researchers use state of the art technologies that are relevant to generate novel data with the potential of rapid translation.¹⁰ The present era where cell therapy is a practical reality with the potential to offer permanent cure of several diseases that are thought to be incurable or manageable by doing symptomatic treatment.¹¹ With the advent of stem cell biology and corresponding stem cell therapy for various diseases (particularly degenerative diseases), regenerative medicine is a booming field and currently extensive research is being carried out in the field concerned aiming to regenerate degenerated organs that can function in a physiological manner.¹²

Immunology

It is the study of immune system in living organisms. In a medical institution, practice of immunology is an ongoing reality. Development of vaccines for many infectious diseases has paved the path for its prevention and has reduced human mortality from a variety of infectious diseases. Newer vaccines like cell-based vaccines or DNA vaccines are in the pipeline of research with tremendous potential to prevent diseases that are not preventable using classical vaccination strategy.^{11,13} Understanding of immunological aspects are cornerstone of understanding molecular pathophysiology of plenty of diseases and so research in immunology is indispensable for a department of experimental medicine.

Medical Biotechnology

With the advent of recombinant DNA technology, biotechnological research is of considerable current interest in the context of medical research. It has gifted several bioactive molecules derived in the laboratory using tools of biotechnology that resulted huge impact in management of human disease.¹⁴ Coupled with genetic engineering, biotechnological approach has revolutionised modern medicine in its all aspects. It is an active area of research in the context of

experimental medicine. In reality, almost all branches of modern biology are an active area of research for experimental medicine, if it has a translation potential for the benefit of the patients in days to come.

TECHNICAL EXPERTISE OF EXPERIMENTAL MEDICINE UNIT

Experimental medicine unit (EMU) of a healthcare institution is endowed with specialists having clinical or research experience from multiple field and focuses on necessary clinical and experimental needs. The multidisciplinary expertise with novel research strategies is a unique feature of experimental medicine department. Experimental medicine specialists frequently utilises advanced technological tools like next generation gene sequencing (NGS), 2D electrophoresis coupled with mass spectrometry, flow cytometry, live cell imaging for dynamic activities at subcellular level, molecular modelling and simulation of biological processes, etc. that are less frequently used by other specialists. Several clinical and laboratory units of a tertiary-care hospital generally has to collaborate with specialists working at experimental medicine division to fulfil their research goals. Experimental medicine unit also bridges the gap between academic slide and pharmaceutical/clinical frontier by collaboration. In recent years, EMUs role in healthcare is revolutionised with the emergence of 'omics' including transcriptomics, genomics, proteomics, metabolomics and lipidomics.¹⁵ Generally 'omics' is the comprehensive study of molecules in living cells. Underpinning 'omics' has the potential to provide a way for unravelling biological processes at a system level formulating the raw data for mathematical modelling, e.g. multifactorial effects of complex diseases. Experimental medicinal unit has become a linker as the novel technology is applied to a wide range of research.

Apart from its role in superautomation, EMU serves as an indispensable research platform for a tertiary-care hospital by providing basic research needs like cell culture facility, advanced animal house facility, etc.

CONTRIBUTIONS OF EXPERIMENTAL MEDICINE IN HEALTHCARE

Experimental medicine department's contribution in healthcare is known to be dynamic because of ever-changing spectrum of diseases, environment and lifestyle. The healthcare system must have investigatory research units to cope with these changing scenarios for efficient clinical services. Experimental medicine unit serves preclinically in two broad ways: Firstly the evaluation of new, safe and efficient treatments and secondly vast research contributing to the development of novel therapies with 'proof of concept'. A new paradigm of EMU is translational research; it focuses on iterative feedback loops between the basic and clinical

research. This accelerates knowledge translation from the bedside to the bench and back again.

Research within experimental medicine spans fundamental basic science to translational and experimental medicine approaches, including clinical trials like immunology, behavioural science, infectious diseases, gastroenterology, oncology, pharmacology, palliative care and respiratory medicine. Some major contributions of EMU are listed.¹

Human Genome Project identified hereditary traits and body functions controlled by specific areas on the chromosomes. Gene therapy offers possible abatement of hereditary diseases by the replacement of faulty genes.

Genetic engineering has led to the development of important pharmaceutical products. It also generates the use of monoclonal antibodies, offering promising new approaches to cancer treatment. The discovery of growth factors has opened up the possibility of growth and regeneration of nerve tissue. Stem cell research has the potential to contribute to regenerative medicine. In vivo, in vitro and in-silico evaluation and validation of human and animal models of disease. Biomarker development and evaluation is an indicator of a biological state or process in disease diagnosis, heterogeneity, underlying mechanisms, susceptibility, exposure or response to interventions, e.g. in various cancers.

Clinical Therapeutic and Drug Potency Trials

Experimentation on animals to test the safety of drugs and surgical procedures. Evidently, EMU maintains a bidirectional interchange between clinical medicine and science in order to open up new avenues of research and to apply scientific discoveries to improve medical care.

POTENTIAL SERVICE OF EXPERIMENTAL MEDICINE DEPARTMENT IN A TERTIARY-CARE INSTITUTION

In tertiary-care institutions, noninvasive procedures are encouraged. One such contribution of experimental medicine unit is biomarker development. Experimental medicine research encompasses the new drug development and consultation service for bioethics in human, animal and stem cell. This unit supports modern therapeutics (like cell therapy) and helps in creation of established animal models for testing of new drug molecules. Apart from these, consultation for biosafety, physicians training in research, teaching postgraduates are among EMUs top priorities. New era of experimental medicine has emerged with research in personalised medicine, gene therapy and clinical trials.

SEVERAL ADMINISTRATIVE CHALLENGES OF THE NEW ERA AND EXPERIMENTAL MEDICINE

With the exponential growth of research-derived new products that are used considerably for diagnostic and therapeutic purpose, all civilised nations started regulating use of new

kinds of molecules both for research and therapeutic purpose. Increasingly recombinant DNA products, gene therapy, cell therapy and other novel approaches are getting accepted under control of various regulations approved for the purpose from the appropriate governments. It is also posing new kind of ethical and administrative issues that were not relevant in the past. These newer modalities are also affecting health policy and planning at a considerable rate. The published regulatory requirements about modern biological products are currently enforced in various nations. These regulations are needed to be interpreted by the competent authority as per peculiar facts and circumstances of a given case. The decision-making factor may be quality of a procedure of conducting research with stem cells in human volunteers or problems regarding administration of a DNA vaccine or concerning other novel biological product relevant to human health, understanding of which requires specialised knowledge.¹⁶ This specialised knowledge of interpretation of facts concerning modern biological process or product is currently practiced by specialists of experimental medicine. Improper interpretation of situations may invite legal and social problems, and has the potential to cause administrative pandemonium. There are several precedences that unethical modalities of modern biological research like performing gene therapy in humans and violating ethical guidelines resulted in lawsuits against the institute and the researchers.¹⁷ Therefore, it is needless to emphasise that if experimental medicine specialists are available at a healthcare institution in such problems, hospital administrators can seek their expertise to decide over the matter. For quality governance in an advanced healthcare institution dealing with modern biological process or product, establishment of experimental medicine and involvement of such specialists for administrative purpose, at least on demand, will be a crucial step. Concerns about the biosafety of biotechnological products used in modern healthcare institutions are a practical reality that posed serious ethical questions in the recent times. A biosafety regulatory framework of biotechnological products used for healthcare is an area of considerable current interest, even in the developing nations.¹⁸ Interpretation of such technical guidelines and act in accordance with that is many times needed by the modern day health administrators, particularly in the context of disputes regarding use of biotechnological products for healthcare. This may be successfully assisted by specialists in experimental medicine. In fact, to address the challenge of biosafety of recombinant DNA products at the administrative level of advanced healthcare institutions, active research in the field is necessary.¹⁹ Such specialised biosafety research in a hospital is possible only at a department with research specialisation in experimental medicine. Research in human subjects is an absolutely essential task for new drug development-related clinical trials that are generally conducted in a tertiary-care hospital. Naturally, such acts are guided by strict ethical principles and mandatory regulations for

enforcements of human rights of the individuals subjected to drug trial. In this area also, there are technical areas which an experimental medicine specialist can interpret as per the particular situation concerned and assist the hospital administrator for taking appropriate decisions. Particularly it must be remembered that in the context of human experimentation literature records a number of unethical practices in the past, which should not be repeated again for testing and applying modern biological products.²⁰ Therefore, the health administrator should be aware of the relevant ethical, legal and technical issues of governance of modern products for efficient administration, which is very well possible using the expertise of the experimental medicine specialist of a tertiary-care hospital.^{21,22}

The new era will experience substantial change of medical practice in the context of application of experimental medicine research, developing new process or product every day. It is needless to emphasise that such new tool will pose novel administrative challenges, which we should be ready to handle at an appropriate manner. We believe experimental medicine in a tertiary-care hospital is ready to accept such challenges.

Experimental medicine department is an integral part of modern tertiary-care hospital. It does not provide patient care directly but it has expertise in modern research related to healthcare. It plays important role in conducting clinical trial and interpreting laboratory result that includes sophisticated modern parameters. It contains the seed of tomorrow's booming areas of practice like vaccination for cancer, tissue engineering, gene therapy, regenerative medicine, integrative physiology, etc.

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Support and Other Utility Services

Section VI

SECTION OUTLINE

- Chapter 26** Support Services
- Chapter 27** Hospital Pharmacy Services
- Chapter 28** Dietetic Unit Services
- Chapter 29** Food Safety in Hospitals
- Chapter 30** Efficient Ambulance Services: Key to Patient Care
- Chapter 31** Transport Services
- Chapter 32** Medicolegal Services
- Chapter 33** Building Public Image of Hospitals
- Chapter 34** Public Relations in Hospitals



Support Services

Dr Pankaj Arora and Prof Anil Kumar Gupta

“When does life start? When does it end? Who makes these decisions?... Every day, in hospitals and homes and hospices... People are struggling with those profound issues.”

—Hillary Clinton

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the concept of support services.
- identify different departments under support services.
- know the importance of major departments providing support services for smooth functioning of the hospital.

INTRODUCTION

Patient care being provided by healthcare personnel is at the heart of hospital care. Hence the focus is always on provision and delivery of clinical care. However the role of supportive services in running of healthcare facility is often understated. In fact, the safe efficient and effective clinical care is largely dependent on the uninterrupted support services. One can imagine the state of sanitation in the hospital, if the housekeeping services are disrupted. Similarly no procedure in the hospital can take place if sterile supplies are not received from Central Sterile Supply Department (CSSD). It is also a known fact that once the clinical care is provided, most common dissatisfiers for the patients/attendants are support services like housekeeping (sanitation), laundry, CSSD, etc. In fact, a common differentiating factor between public and private hospitals can be gauged by the support services like level of sanitation, quality of food and clean clothes.

However, the role of the above-mentioned support services is not usually acknowledged by healthcare organisations. CSSD, laundry and housekeeping services may appear to be entirely distinct as far as the organisation, functions and output are concerned, yet all of them have certain common features.

GLOBAL SCENARIO

The support services have become highly specialized and evolved in the world with agencies having expertise in different aspects. A large number of globally known

organisations like 3M, J&J, Steris, etc. are in the business of manufacturing autoclave, gas-based sterilizer and other equipment being used in CSSD. Similarly laundry has progressed from manual washing to automatic machines with predefined washing formula solutions to take care of different kinds of clothes, i.e. coloured, white, of different composition, i.e. cotton, polyester, etc. Smart and efficient housekeeping have replaced brooms made of rug. Vacuum cleaning, cleaning with jet washer and other sophisticated equipments have not only made sanitation work effective and efficient but also probably more respectful. Internationally, hospitals have recognised their importance and have established ‘state of the art’ CSSD, laundry and housekeeping facilities. They are given equal importance as to critical areas like operation theatre (OT) or intensive care units (ICUs) in a hospital.

INDIAN SCENARIO

Sadly, the picture is not so promising in India. Manual washing and drying in the sun is still seen in large number of hospitals. Old rusted autoclave, washing of surgical instruments with common soap is the order of the day in these hospitals. About sanitation, lesser said is better. However, few corporate hospitals have taken the lead in establishment of modern and sophisticated CSSD, laundry and housekeeping facilities. Certain public sector hospitals have also equipped themselves with good support services. The process is slow, but expected to be hastened as awareness regarding the importance of these services is increasing among general

public and they prefer to visit those hospitals, which have better hygiene, good cleanliness and clean clothes for patients. Accreditation and additional focus on hospital infection control (HIC) has further augmented the process.

UNIQUE FEATURES OF CSSD, LAUNDRY AND HOUSEKEEPING SERVICES¹⁻⁴

All the three supportive services have evolved over the years to become highly specialised services which require a decent level of technical knowledge. The advent of advanced equipments like plasma steriliser, automatic washing machine, and cleaning implants has meant that it requires certain level of training and expertise before these can be used. In the past such training-skills were not considered necessary to take up the above-mentioned services. Furthermore, their role in hospital infection control and prevention of health-care associated infection (HAI) needs no re-emphasis.

The details regarding the physical infrastructure are available in a number of books and other publications. However, certain key principles of these services are listed below.

- CSSD, laundry and kitchen should be housed in close proximity to utilise the common facility of boiler.
- Additionally CSSD and laundry can be established in proximity to each other since linen after washing is sent for autoclaving for linen packs.
- CSSD should be close to stores since supplies are received in CSSD from stores.
- Principle of zoning is as applicable to both CSSD and laundry as to OT. This includes physical separation between zones as well as functional separation.
- Physical separation is more relevant to CSSD than laundry. There should be unidirectional flow of material as well as men.
- Lighting should be adequate, i.e. 300 lux in all the areas and more in the inspection area in CSSD and repair area in laundry.
- Both CSSD and laundry should be well-ventilated and if possible should be air conditioned since autoclave in CSSD will emit a lot of heat and laundry will have lot of humidity.
- Dirty receiving area should be under negative air pressure while sterile/clean storage area should be under positive air pressure. Hence air should flow from clean area to dirty area.

Infact, the scope of CSSD and linen can be summed up as provision of material of right quality in right quantity at right place at right time. This dictum also holds true for housekeeping services.

CENTRAL STERILE SUPPLY DEPARTMENT¹

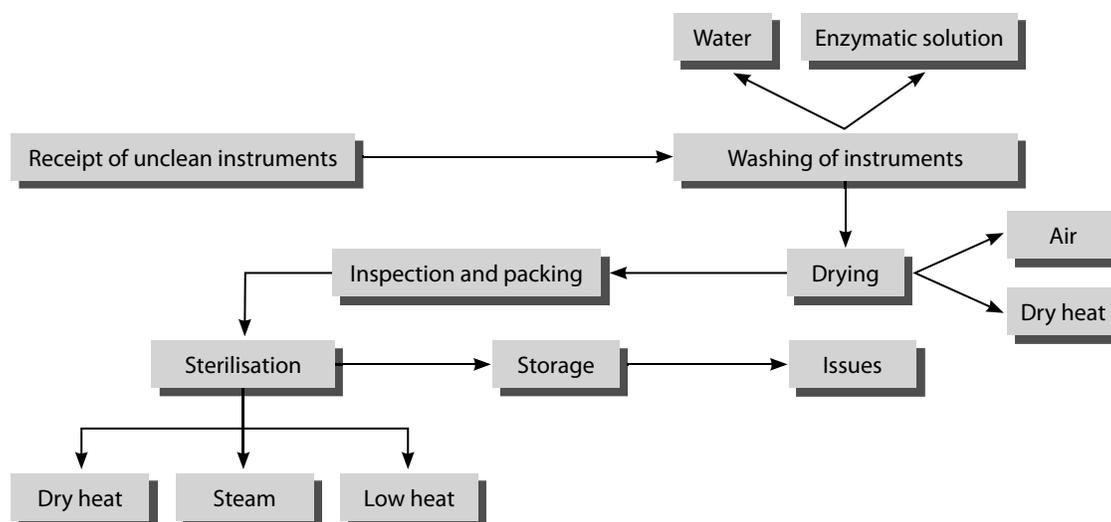
Scope

CSSD is primarily responsible for provision of sterile supplies in the patient-care areas. The key functions are:

- Receipt of used supplies and instruments from different areas of the hospital.
- Processing of these equipments and linen and other items to be sterilized.
- Sterilisation and assurance of the sterilisation, i.e. use of physical, chemical and biological indicators.
- Storage and issue of sterile supplies.
- Maintaining the inventory of the goods.
- Maintenance of equipment for maximum uptime of equipment.
- Handling of any sudden demand, e.g. disasters etc.
- Maintenance of records
 - Administrative
 - Procedure

Physical Infrastructure

The process followed in CSSD for sterilisation is shown in Flowchart 26.1.



Flowchart 26.1 Sterilisation processes pursued in CSSD.

Besides common features discussed, CSSD should also have following features:

- The floor should be made of nonslippery material which is resistant to chemicals and easily washable.
- Use of personal protective equipment (PPE) should be at all stages of sterilisation.
- Use of appropriate chemicals during washing of instruments.
- Fans should not be used in packing area as it may cause rising of lint and other dust particles and setting on the instruments packs.
- Receipt and issue counters should be separate with physical distance between them.
- Trolleys for dirty/unclean supplies and clean/sterile supplies should be separate.
- Facility safety should be kept in mind while designing CSSD. However, fire sprinklers should not be installed in the sterile storage area.
- Conveniences and lockers for the employees should be built in the CSSD.
- Administrative area should also be catered to in the planning itself.
- The corridors should be wide to take out or bring in heavy and wide equipment. Also space should be kept for future expansion.
- Sterilisation capacity – ½ cubic ft./bed/day. Number of sterilisers will depend upon the number of shifts the facility is operational.
- Quality control indicators should be regularly used as per hospital's protocol.
- Shelf life of sterilised material is 'event dependent' rather than 'time dependent'. Hence it is advisable to have covered shelves for keeping the sterile sets.

Case Study 1: Fine tuning the specifications of a product

A hospital purchased an autoclave of a multinational company for over Rs 30 lakhs. The equipment was installed but remained nonfunctional due to lack of water softening plant. The hospital refused to install water softener saying it was vendor's responsibility. However the vendor refused saying that he had been awarded contract for autoclave only. The issue was resolved eventually after 3 years leading to losses on both sides on account of non-utilisation of equipment and nonpayment to vendor.

Lesson: while making specifications for a product, all the requirements for making equipment 'functional' must be stated or it should be specified that installation and functional status has to be ensured by the vendor.

Case Study 2: Comprehensive maintenance contract should be an integral part of tender document

A steam sterilizer was purchased by a hospital and it remained functional for about 2 years when it broke down as it developed a crack in the door. Since the maintenance contract was not entered into with the vendor, he estimated the cost of repair equivalent to half of the original cost of the equipment. The hospital is in dilemma since the steriliser cannot be condemned within 2 years of purchase and the cost of repair looked exorbitant. The hospital cannot buy a new e equipment immediately to meet it's needs without resolving the above-mentioned issues.

Lesson: For costly and vital equipment, AMC/CMC should be a part of the original tender whose payment may be made upfront.

LINEN AND LAUNDRY SERVICES^{2,3}

Scope

Linen services encompass procurement of linen as well as running laundry services so that clean usable linen can be provided to the stakeholders including patients and health-care providers. The key functions of linen store are:

- Assessment of linen requirement of the hospital.
- Procurement of appropriate quality of linen, i.e. cotton, polyester, etc. depending upon the need.
- Maintaining the inventory for routine use as well as emergent needs, e.g. disasters.

The chief objectives of laundry are:

- Receipt of used linen from the hospital areas.
- Disinfection of infected linen, if not done in the wards/ hospital care areas.
- Processing of dirty linen, i.e. washing, drying and calendaring.
- Storage and issue of clean linen.
- Supply of the clean linen to wards as well as CSSD.
- Collection of dirty linen from different areas.
- Repair of torn linen, if possible.
- Maintenance of records.
- Quality control.

Physical Infrastructure

Some of the common requirements have been described in the previous section. The others are illustrated below:

- Floor should be nonslippery and able to withstand chemicals.
- Appropriate machines, i.e. washers, hydroextractors, dryers or fully automatic washing machines, calendars of appropriate size should be used.

- The capacity will depend upon the hospital's policy
 - Daily working /alternate day washing.
 - Washing of patient's clothes and or healthcare worker's clothes.
 - Ironing of all or certain specific types of clothes.
- Adequate supply of hot and cold water.
- Receipt and issue counters should be separate with physical distance between them.
- Trolleys for dirty/unclean supplies and clean/sterile supplies should be separate.
- Facility safety should be kept in mind while designing CSSD. A shower facility should be available in the laundry premises so that in case of any accident involving chemicals, it can be used.
- The corridors should be wide to take out or bring in heavy, wide equipment. Also space should be kept for future expansion.
- Conveniences and lockers for the employees should be built in the laundry.
- Administrative area should also be catered to in the planning itself.
- In quality control swatches can be used as well as determining the accepted level of stains and tears.

The relevant policy and guidelines related to laundry services like policy for infected linen, e.g. sluicing in wards and separate washing machine, unidirectional flow, PPE, vaccination of the healthcare workers, medical checkup especially ENT and dermatology checkup, needle stick injury, quality control (rewash rate, swatch test), acceptable holes and tears, etc. should be taken care.

Case Study 3: Addressing linen and laundry problem in PGIMER Chandigarh

Frequent complaints were received in a hospital that linen is getting torn very fast, stains are not getting removed and that new dirty clothes are replaced by torn old washed clothes. On close inspection it became evident that the problem was multifactorial.

Possible solutions: Specific coloured clothes for different areas of hospitals can address the complaint of exchange of linen. Quality of linen procured has an impact on the quality of washed linen hence procurement has to be improved. Dirty linen is generally stacked with soiled linen in wards for long time rendering permanency of stains. This should be avoided. Excess bleach should not be used to remove stains or for convenience which impacts life of cloth. Besides this the conditions of machines have to be looked into. It may be pertinent to mention here that the factors listed above, i.e. quality of linen procured, washing formula, quality of machines will have an impact on the life of linen. A common notion is that life of linen/cloth in Indian hospitals is 30 washes; however, the western literature puts that number to 75–100 washes.

HOUSEKEEPING SERVICES⁴

Historically housekeeping encompassed all those activities which are required to “keep the house running”. These include dietary, sanitation, laundry and engineering services among others. However with passage of time and specialisation the ambit of housekeeping services has become limited and now the housekeeping activities comprise of:

- Provision of assistance to healthcare workers, i.e. doctors, nurses and paramedics in their jobs by, what is commonly referred to as, hospital attendants.
- Provision of sanitation services in the hospital by, what is commonly referred as, sanitation attendants.
- The scope of sanitation includes cleaning of hospital areas, disinfection of surfaces and biomedical waste management.

It should be understood that sanitation not only depends upon the men and material, but also depends upon the type of construction. For example, if for cosmetic reasons wall tiles with grooves and crevices have been used, the cleanliness can be a victim at later stages. Similarly coving the corners can render cleaning more effective.

The various related policies like disinfection policy, PPE, vaccination of health workers, needle stick injury, postexposure prophylaxis, quality control – satisfaction surveys, and compliance with BMW management rules should be taken care by the administration.

Physical Infrastructure

Besides the common features discussed earlier in the chapter, it should also have following features:

- Appropriate storage space in the patient-care areas to keep day-to-day sanitation material as well as to keep used implements.
- Stores in different areas to keep bulk sanitation material as well as machines.
- A wide variety of cleaning material and equipments are available in the market. The institute has to plan and take decision regarding a particular material based on its requirements and cost.
- Machinery to remove biomedical waste/garbage from different areas of the hospital to final disposal site/collection point.
- Transportation facility in conformance to BMW management rules.
- Administrative area should also be catered to in the planning itself.
- Lockers for the workers should be provided in different work areas.

CHALLENGES IN SUPPORT SERVICES^{3,4}

First and foremost challenge is to maintain the uninterrupted quality of services. This challenge encompasses three aspects.

- Structure
- Process
- Outcome

The above-stated objective/challenge can be achieved by adopting a multi-pronged strategy.

Structure: The above-mentioned services must be planned keeping in mind the current and futuristic needs of the organisation as well as the healthcare professionals who will work in them. Some principles like unidirectional flow, etc. should be kept in mind when constructing these. However, it has been seen that this variable is seldom under the control of those responsible for running these services.

Equipment: Planning and procuring appropriate equipment is essential for provision of these services. Market is flooded with a variety of sterilisers, washing machines, etc. These are indigenous as well as foreign, basic as well as advanced. Following factors need to be considered:

- Estimation of the requirement.
- Finance available
 - Capital cost
 - Recurring cost
- Availability of back up facility.
- Availability of servicing facility for equipment.
- Availability of water of appropriate quality.

Manpower: Nowadays, a lot of stress has been put on outsourcing of the services. Various models are in vogue, e.g. outsourcing of manpower only, outsourcing manpower and consumables, outsourcing of manpower as well as equipment. Another variable is whether to have equipment in house or not. Each option has its own pros and cons. In the views of the author, in public sector hospitals which have inherent social responsibility, equipment should always be in house, whatever model of outsourcing is adopted, so that services can be provided through them in case of all exigencies.

Standard operating procedures: These should be formulated for each activity that takes place towards the provision of supportive services. This ensures that everybody is aware what to do and how to deal with each situation. This also ensures that service is system dependent rather than

individual dependent. The key is to train and retrain the manpower and monitor the functioning and compliance to SOPs.

Case Study 4: Key result areas should be a vital part of a service

A complaint was received by the hospital administrator that the floor cleaning solution being introduced in the hospital is ineffective and is rendering the floor black. On close scrutiny it was revealed that the solution was of good quality however it required to be diluted before use. But the sanitation staff was not making correct dilutions. Instead they were pouring the concentrated solution directly over the mop which was causing blackening of the surface and overall ineffectiveness of cleaning.

Audit: KRAs/KPIs must be identified so that the quality of service can be monitored, e.g. rewash rate, recall rate, complaint rate, etc.

Hospitals are like giant cruise ships. What is evident is the variety of activities that take place on the cruise but the engine room is not visible. The support services of CSSD, laundry and housekeeping are an important components of the engine room of the hospitals which help hospitals achieve their objectives of provision of safe, effective and efficient patient-care services.

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Hospital Pharmacy Services

Dr Harmanjit Singh and Dr Bikash Medhi

“The best and most efficient pharmacy is within your own system.”

—Robert C Peale

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the role and functions of hospital pharmacy services in a hospital.
- comprehend various divisions of hospital pharmacy services.
- realise the intricacies involved in managing hospital pharmacy including hospital formulary.

BACKGROUND

Comprehensive hospital pharmacy services are crucial to hospitals for achieving their medication safety goals. Pharmacy is premises licensed for retail sale or supply to the hospital, which has qualified licensed persons and indulged in compounding of drugs. The pharmacy act was passed in 1948, which rationalized the pharmacy services. The act was amended in 1959 and 1976. The act regulates the practice of pharmacy as stable responsibility. The pharmacist is responsible for providing safe medication to the patients.

WHAT IS HOSPITAL PHARMACY?¹

Hospital pharmacy is a department or service in health institutes dealing with the:

- supply of medications to the various hospital units.
- filling of prescriptions for inpatients and outpatients.
- manufacturing of pharmaceuticals in bulk.
- dispensing of the prescribed drugs.
- preparation and sterilisation of injectables.
- stocking of drug supplies.

GOALS OF HOSPITAL PHARMACY SERVICES

There must be some long-range goals directed towards daily activities of an organisation, so that it can lead to a successful outcome. Important goals of a hospital pharmacy are:

- To help in adequate provision of qualified hospital pharmacists and strengthen the patient care.
- To establish and maintain the standards of ethics, education and economic welfare.
- Promotion of research in hospital setup and pharmaceutical sciences, in general.
- Sharing of information among hospital pharmacists and with members of different specialties and professions.
- To help in expanding the knowledge and scope of hospital pharmacists so that they can efficiently manage an organised service, can take part in providing clinical practice, and in conducting clinical and pharmaceutical research and educational programs for health practitioners, students and the public.

The above goals can only be transformed into reality if every member is dedicated towards his duties. In a nut shell, the prime purpose of hospital pharmacy services should be the promotion of rational drug use in hospitals and other healthcare settings.

MANAGEMENT OF PHARMACY SERVICES IN A HOSPITAL¹⁻³

In organising hospital pharmacy services, staff organisation and the physical layout of the building must be considered.

Staff Organization

Hospital pharmacy personnel can be divided into three major categories:

- **Management:** Management includes the chief pharmacist and sometimes deputy chief pharmacists who have responsibility towards procurement, distribution and control of all medications used within the hospital.
- **Professional staff:** These professionals are qualified pharmacists who procure, distribute and control medications by supervising and supporting the staff for these activities. In some facilities, pharmacists provide clinical consulting services and medicine information.
- **Supporting staff:** The supporting staff category often includes a combination of trained pharmacy technicians, clerical personnel and others. The small hospitals may have only 2–3 pharmacy staff members, with the chief pharmacist as the only pharmacist. Larger teaching hospitals that provide extensive pharmaceutical distribution and clinical services may have more than 100 staff members.

Physical Layout

Location should be in the ground floor with storage in basement, readily accessible to elevator, easily accessible to all areas of hospital, OPD unit to serve OPD patients.

- **Finishing floor:** Floor should be smooth, tough and resistant to acid and base. Heavy linoleum flooring is preferred.
- **Walls:** Walls should be smooth without crevices, washable and light coloured.
- **Light:** There are plenty of windows for daylight. To make it dust free, Venetian window blinds to be used. Florescent lights should be made available in prescription and distribution area. There must be adequate provision of electric sockets.
- **Prescription area:** Must be provided with prescription desk having cabinets and drawers. Computer and telephone services should be available. List of drugs that are available and information must be provided.
- **Preparation area:** Should contain work table for manufacture of solutions and empty adjustable glass storage shelves. Sterilisation facilities should be present and acid proof sinks should be provided.
- **Storage area:** Should contain—
 - Storage cabinet with proper levelling.
 - Space for loading of wood packs.
 - Space for pharmacy lab with testing equipments.
 - Equipments for compounding and dispensing.

The extent of the pharmacy's physical facility is determined by the size of the hospital and the services provided. A large pharmacy department might have the following sections, within one physical space or in separate locations throughout the hospital:

- Administrative offices
- Bulk storage
- Narcotic or dangerous drug locker

- Manufacturing and repackaging
- Intravenous solution compounding
- Inpatient dispensing
- Outpatient dispensing
- Medicine information resource centre
- After-hours pharmacy
- Emergency medicine storage

Divisions of Hospital Pharmacy Services

Hospital pharmacy works through coordination among its various divisions. Following are the various divisions and their main functions:

- **Administrative division**
 - Responsible for planning and coordinating various activities.
 - Development of hospital pharmacy policies.
 - Helps in administrative needs of the pharmacy and therapeutics committee.
 - Supervision of various departmental office staff.
- **Education and training division**
 - Coordinate education programmes for undergraduate and graduate pharmacy students and participate in educational programs involving nurses, doctors, etc.
 - Training newly employed pharmacy department employees.
- **Pharmaceutical research division**
 - Development of new formulations and dosage form of drugs.
 - Improvement in formulations of existing medications.
 - Involvement in projects involving drugs.
- **Inpatient services division**
 - Provision of drugs to all inpatients of the hospital.
 - Inspection and control of drugs in all treatment areas.
 - Cooperation with other staff involved in drug research.
- **Outpatient services division**
 - Compounding and dispensing of outpatient medications.
 - Inspection and control of emergency service medication station.
 - Maintenance of outpatient prescription records.
- **Drug information services division**
 - Provision of information related to drugs and drug therapy to physicians, nurses, medical and nursing students and other staff.
 - Maintenance of the drug information centres.
 - Preparation of the hospital's drug newsletters.
- **Departmental services division**
 - Control and dispensing of various intravenous fluids.
 - Control and dispensing of controlled substances in hospital.
 - Deals with coordination and control of all drug-delivery and distribution systems.

- *Purchasing and inventory control division*
 - Maintenance of drug inventory control and purchasing of drugs.
 - Receipt, storage and distribution of drugs.
 - Interviews of medical representatives.
- *Central supply services division*
 - Helps in developing and coordinating distribution of medical supplies and irrigating fluids.
- *Assay and quality control division*
 - Performing analyses on drugs manufactured and purchased.
 - Developing and revising procedures used for assay.
 - Assisting the research division in special formulations.
- *Manufacturing and packaging division*
 - Manufacture of wide variety of products commonly used in hospital.
 - Coordinate overall drug packaging programme.
 - Coordinate programmes in product development.
- *Sterile products division*
 - Production of small-volume parenteral formulations.
 - Manufacture of sterile ophthalmologic and irrigating solutions.
 - Preparation of aseptic and other 'unstable' sterile injections for administration to patients.
- *Radiopharmaceutical services division*
 - Centralisation of the procurement, storage and dispensing of radioisotopes used in hospital.
- *Intravenous admixture division*
 - Preparation of intravenous (IV) solution admixture.

Review of each IV preparation for physiochemical incompatibilities.

It is the committee designated to ensure the safe and effective use of drugs in the hospital setup. The American Society of Health System Pharmacists guidelines on DTCs state that 'medication use is an inherently complex and dangerous process that requires constant evaluation. Organisations need to implement tools and processes necessary to meet the goals of using medications effectively and safely'.

Members of Drug and Therapeutic Committee (DTC)

The drug and therapeutic committee (DTC) requires the members that participate in meetings and assist in other committee activities. Membership should include representation from:

- Medical superintendent as chairman of the DTC.
- All heads of departments in hospital (including representation from each department).
- Chief pharmacist as member secretary for hospital pharmacy.
- Nursing superintendent.
- Hospital administration.
- Quality assurance staff.

Total of 8–15 members are often required. They may occasionally invite a specialist to attend the meeting and provide advice on a particular issue. For example, a cardiologist may attend a committee meeting to advise members regarding a formulary decision on a new drug used in cardiovascular disorders.

The DTCs may have subcommittees to address particular issues, such as antibiotic use, evaluation of drug use and medication errors. Subcommittees manage specific issues without consuming much time of the DTCs meeting.

- Hospital drug formulary preparation.
- Selection of drug manufacturer and supplier, and mode of procurement.
- Addition of new drugs and deletion of old drugs.
- Arrangement of medications to be supplied in OPD.
- Policy formulation for pharmacy.
- Monitoring of budget demand and drug quality.
- Maintenance of drug standard and quality control.
- Disposal of expired medications.
- Promotion of the rational drug use by developing relevant policies and procedures for selecting medications, procurement, distribution and use, and through the education of patients and staff.
- Decisions on buying medicines (from where to buy and how many).
- Improving the safe and cost-effective use of drugs.

In most settings, daily purchasing decisions are handled by the chief pharmacist, with supervision by the DTC or another committee responsible for procurement.

HOSPITAL FORMULARY MANAGEMENT

The formulary is a continually revised compilation of pharmaceuticals and plays a role to specify particular medications that are approved to be prescribed in a particular condition. It is based on evaluations of efficacy, safety, and cost-effectiveness of drugs; it may also contain additional information, such as side effects, contraindications, and dosage.

The **formulary system** is a method whereby the medical staff of an institution evaluates, appraises and selects the medications that are considered most useful in patient care. Only these selected medications are routinely made available from the pharmacy. It is an important tool for assuring the quality of drug use and controlling its cost.

Benefits of the Formulary System

The potential benefits of a formulary system are threefold: (i) Therapeutic, (ii) economic and (iii) educational.

- *Therapeutic aspect* of a formulary system provides maximum benefit to the patient and physician because only

the most efficient and cost-effective products are listed and made available.

- *Economic aspect* carries a double benefit because the formulary eliminates duplication, thus reducing inventory duplication and the opportunity for volume purchasing means lower charges to the patient.
- *Educational aspect* has a significant benefit for the resident staff, nurses and medical students because a good formulary contains various prescribing tips and additional drug information.

The hospital formulary is the cornerstone of medication management in the hospital, and it must be the primary concern of DTC. The following list provides general guidelines for the hospital setting:

- Limit the formulary list to conserve resources. Stocking all medicines on the national formulary is usually not necessary.
- Eliminate generic duplication. Only one brand or label of each generic medicine should be routinely stocked.
- Minimise the number of strengths stocked for the same medication; multiples of lower strengths can be used for infrequently needed higher strengths.
- Select medications for the formulary based on diseases and conditions treated at the facility.
- Specify formulary medicines of choice for common therapeutic indications.

Medicines of choice should be selected by comparing efficacy, safety, toxicity, cost effectiveness, pharmacokinetic properties, bioequivalence, and pharmaceutical and therapeutic equivalence.

- Include second-line alternatives to medicines of choice as needed, but minimise therapeutic duplication.
- Ensure that the hospital formulary corresponds with any national or regional standard treatment guidelines that have been formally approved by the health system.

In addition to the basic formulary process, many hospitals add two more features—therapeutic substitution and use restrictions for certain medications in the formulary.

Therapeutic substitution (sometimes called therapeutic interchange) is based on the hospital formulary. The DTC provides guidelines for substituting specific formulary medicines for specific nonformulary medicines (or a specific category of medications), usually for specific disease conditions. Whenever a prescription is written for a nonformulary medicine that is covered by the therapeutic substitution policy, the designated formulary product is automatically substituted by the pharmacy department and this substitution is usually not generic—the two products are chemically different.

The DTC should develop formal written policies specifying which medicines (or categories of medications) are suitable for automatic therapeutic substitution. These programs usually start with relatively noncontroversial medication

categories, such as antacids and vitamins, and progress over time to other therapeutic groups, such as antibiotics and certain cardiac medications, as physicians become comfortable with therapeutic exchange.

Use restrictions are most often applied in larger hospitals where specialist physicians are on staff. Restrictions may apply to certain individual formulary medicines or to certain categories of medicines; the principle is that restricted medicines can be prescribed only by certain specialists or can be used only on certain wards. Such restrictions are generally applied to particularly expensive medications (such as anti-clotting medications) or particularly toxic medications (such as cancer chemotherapy).

Role of chief pharmacist

- Implementation of decision of therapeutic committee dispensing of drugs, pharmaceuticals and chemicals to different areas.
- Maintenance of approved stock of emergency drugs and antidotes.
- Dispensing of narcotic drugs and accounting specification for various fluids.
- Inspection of drugs at various points of use.
- Preparation of indents, issue and receipt voucher.
- Maintenance of stores, ledgers and records.
- Provision of alternate electricity supply inspection.
- Quality control.
- Teaching and training of pharmacist.
- Patient education.

Other Services of Hospital Pharmacy

- *Maintenance of records and registers*: Various records and registers that must be maintained are:
 - Stock ledger of different group of drugs.
 - Indent and receipt voucher.
 - Expiry date register.
 - Adverse reaction record file.
 - Condemnation record of nonconsumables and consumables.
 - Annual stock verification record.
 - Hospital formulary antibiotic policy.
- *Indenting of drugs*
- *Receipt of drugs*
 - All drugs received must be checked for batch number, weight, quantity and date of expiry.
 - Random sample of each batch sample should be sent to lab for quality testing.
 - In case of any suspicion of substandard, drug should be used only after lab test.
- *Storage of drugs*
 - General drugs
 - Drugs must be arranged alphabetically in cabinet or as per use, i.e. antibiotics, antihypertensives, etc.

- Short expiry drugs must be placed in front and long expiry drugs at the back.
- FIFO (first-in-first-out) method to be followed. The drugs must be used before date of expiry or transferred to other hospitals.
- Expiry drugs must be disposed up as per rule.
- Narcotic drugs
 - There should be separate, special arrangement for narcotic drugs like morphine, pethidine and other drugs having high abuse potential.
 - Proper records should be maintained.
 - Always to be kept under lock and key.
- Inflammable items
 - Separate enclosure to be made for inflammables like spirit, gases and chemicals.
 - Adequate ventilation and fire fighting arrangements should be there.
 - Provision of exhaust fans and sky scrapers for air to pass through must be there.
- Cold storage
 - Drugs such as antibiotics, vitamins and liver extracts should be stored in cold room temperature of 15–20°C. The room should be air conditioned with temperature control facility.
 - Drugs like vaccines, sera, hormones, etc. to be stored at 2–8°C in deep freezers or walk-in cooler.
 - Temperature monitoring through dial thermometer and temperature charting should be done.
- *Distribution of drugs:*⁴ Drugs are distributed to various areas of hospital, OPD and emergency. Three methods of indenting are usually practiced.
 - Floor stock method: Here drugs to the patients are provided from the nurse's stock. Usually a 15-day emergency indent is made. This method has some disadvantages, e.g. drugs may or may not be available and there can be delay in treatment.
 - Unit stock method: Here medicines for each patient are packed separately as per prescription and are dispensed in one packet. Chances of pilferage are less and this method suits for computerisation.
 - Patient-specific drug order: When a drug is not available in stock, prescription is sent for emergency indent in patient name and drug received is given to the specific patient.
- *Disadvantage:* There may be a delay in medication.

RECENT ADVANCES IN PHARMACY SERVICES

Clinical Pharmacy⁵

Clinical pharmacy is a newer concept in pharmacy services. It is related to the activities and services of a clinical pharmacist in development and promotion of the rational and appropriate use of medications.

It includes all the services performed by pharmacists working in hospitals, community pharmacies, nursing homes, home, clinics and other centres where drugs are prescribed and used.

Difference between clinical pharmacy and conventional pharmacy⁶

The conventional pharmacy describes the knowledge on synthesis, chemistry and preparation of drugs. Clinical pharmacy is mainly concerned with the analysis of population needs with regards to drugs, methods of drug administration, and patterns of drug use and drug effects.

The clinical pharmacy focuses on whole population receiving drugs rather than the single patient.

Overall goal of clinical pharmacy

The goal of clinical pharmacy activities is to:

- *Promote the correct and appropriate use* of medicinal products and devices.
- *Maximise the clinical effect* of medicines, i.e., using the most effective treatment for each type of patient.
- *Minimise the risk* of treatment-induced adverse events, i.e., monitoring the therapy course and the patient's compliance with therapy.
- *Minimise the expenditures* for pharmacological treatments trying to provide the best treatment alternative for the greatest number of patients.

Role of a clinical pharmacist

- To take part of the medication management in hospitals, which deals with the way in which medicines are selected, procured, delivered, prescribed, administered and reviewed to optimise the contribution that medicines make to produce informed and desired outcomes.
- To improve the safety and quality of all medication-related processes.
- To ensure that the 'rights' are respected, i.e. right patient, right dose, right route, right time, right drug with the right information and documentation.

Computerized Physician Order Entry (CPOE)^{7,8}

CPOE (patient-management software) is a system dealing with electronic entry of physician's instructions and orders for treating hospitalised patients. The orders are communicated through computer network with other medical staff and hospital departments. Since orders are communicated electronically, no paper charts are needed.

Advantages: It shortens the delay in order completion and reduces errors linked to handwriting or transcription; orders are directly entered at the point of patient care. It simplifies the inventory and posting of charges.

Bedside Barcode System or Barcode Point of Care (BPOC)⁹

Barcode point of care (BPOC) software is an advanced system using touch screen and barcode scanning technology to provide full information on medication orders, patient problems, treatment history, clinical observations, blood or tissue samples withdrawal, transfusion orders, etc. A BPOC system uses bedside computer to communicate data, real-time, with other hospital information systems, including patient orders and registration systems via a dedicated server. The BPOC gives information on admission, discharge, referral, pharmacy, billing, and electronic prescriber order entry.

After a doctors' order is reviewed and verified, it is entered into the pharmacy computer system; this is communicated to the server. The message is then sent to the bedside software, real time, and it alerts the nursing staff that a new medication is prescribed or a change in an already prescribed medication has just been made. After the confirmation of this order or order change by the nursing staff, the new medication is automatically and electronically transcribed to the medication administration schedule. Each medication is mapped to a specific barcode in the hospital formulary for recognition by the barcode scanner.

National Drug Codes (NDC)^{10,11}

- The national drug code (NDC) is a unique 10-digit, three-segment number that acts as a universal product identifier for drugs used in humans in the US. All over-the-counter (nonprescription) and prescription drugs in the US contain this code. The three segments of the NDC identify the labeller, the product, and the commercial package size and formulation of a drug for a specific manufacturer. Finally, there is third set, which is the package code that identifies package sizes and types. The food and drug administration (FDA) assigns the labeller code, and labellers assign the product and package code.
 - The **labeller code** is 4–5-digits long code assigned by the FDA upon submission of a labeller code request. A labeller is any firm dealing with the manufacturing, repacking or distribution of drug products.
 - The **product code** is 3–4-digits long, which identifies the strength, dosage form and formulation for a particular firm.
 - The **package code** is 1–2-digits long that helps in identifying the package forms and sizes.

Automated Dispensing Cabinet (ADC)¹²

It is also called unit-based cabinets (UBCs), automated dispensing devices (ADDs), or automated dispensing machines (ADM)s).

It is a computerised drug storage device or cabinet designed for use in hospitals and other healthcare settings. Medications can be easily stored and dispensed near the point of patient care. This system can help in improving

patient safety and the accountability of the inventory, and ultimately can lead to increased nursing and patient satisfaction. It can reduce the healthcare cost and delay in treatment (patient safety will be improved).

Satellite Pharmacy¹³

Inpatient dispensing is sometimes done from satellite pharmacies throughout the hospital. In larger hospitals, satellite pharmacies are beneficial because they enable a shorter turn-around time for individual medication orders, especially in distribution systems that dispense medications packaged for individual patients. Satellites also increase the pharmacist's presence in the patient-care area, facilitating interactions with medical staff, nursing staff and patients, and thus ultimately improving patient care.

Medication Errors and Their Prevention at Pharmacy Level¹³

It is defined as any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is in the control of the healthcare professional, patient, or consumer. Such events may be related to professional practice, healthcare products, procedures, and systems including prescribing; order communication, product labelling packaging, and nomenclature, compounding, dispensing; distribution, administration, education, monitoring, and use. The common causes and prevention of medication errors at pharmacy level is given in Tables 27.1 and 27.2.

Table 27.1 Common causes of medication errors

<ul style="list-style-type: none"> • Improper strength given on labels or in packaging • Drug product nomenclature (look-alike or sound-alike names, e.g diltiazem and diazepam, both drugs belongs to entirely different classes) • Equipment failure or malfunction • Illegible handwriting 	<ul style="list-style-type: none"> • Improper prescription • Inaccurate dose calculation • Untrained personnel • Inappropriate abbreviations used in prescription • Labelling errors • Excessive workload on staff • Drugs unavailable
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Table 27.2 Recommendations to reduce the risk medication errors at pharmacy levels^{14,15}

<ul style="list-style-type: none"> • Check for the clinical appropriateness of the prescription. • Go for accuracy check of the dispensed medicine(if possible by a second person). • Staff should be accurately trained in prescribing and dispensing drugs. • Environmental conditions in the dispensing area should be ideal to ensure safe practice, and minimise fatigue and distractions. • Facilities and staff should be appropriate for workload. • HELP mnemonic can be used for accuracy checking. It's components are: <ul style="list-style-type: none"> ➢ How much has been dispensed ➢ Expiry date check ➢ Label check ➢ Product check • Read drug labels at least three times. • The patient's or patient's care taker's understanding of the medicine should be checked on issue.
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So, it can be said that pharmacy services and pharmacists play a very important role in patient care in a hospital setup. There are many emerging roles of pharmacy and pharmacists which are aimed at improving the healthcare systems.

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Dietetic Unit Services

Dr Nancy Sahni, Dr Puja Dudeja and Dr Sonu Goel

“Prepare with care as what you sow, so shall you reap.”

—Bible

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- define the role and responsibilities of a dietetic unit in a hospital.
- describe the functioning of dietetic unit of a hospital.
- understand the challenges faced.
- explain the problem-solving approaches in functioning of a dietetic unit.

BACKGROUND

Dietetics/nutrition department is a vital organisation that carries multiple responsibilities, which include meal services, institute hospitality, equipment management, human resource management, clinical services, education and training.^{1,2} All this involves resource management, policy analysis, finance as well as accounting and budgeting.³

The main goal of nutritional services in a hospital is to serve wholesome food apt for patient's requirement, which is prepared and served hygienically, sufficient in quantity and there is no compromise in quality.⁴⁻⁶ It seems to be a breeze of a thing; but, if someone sitting on the seat responsible for these 'basic' requirements for patient-care nutrition is questioned, undoubtedly, he or she would not describe it as 'breeze' but more or less as a storm!⁷ If you see the administrative side of managing nutrition, it needs a lot of planning and implementation. Therefore, nutritional management in healthcare administration is the field relating to leadership, management, and administration of hospital kitchen and nutritional services.⁸

MANAGEMENT OF DIETETICS UNIT

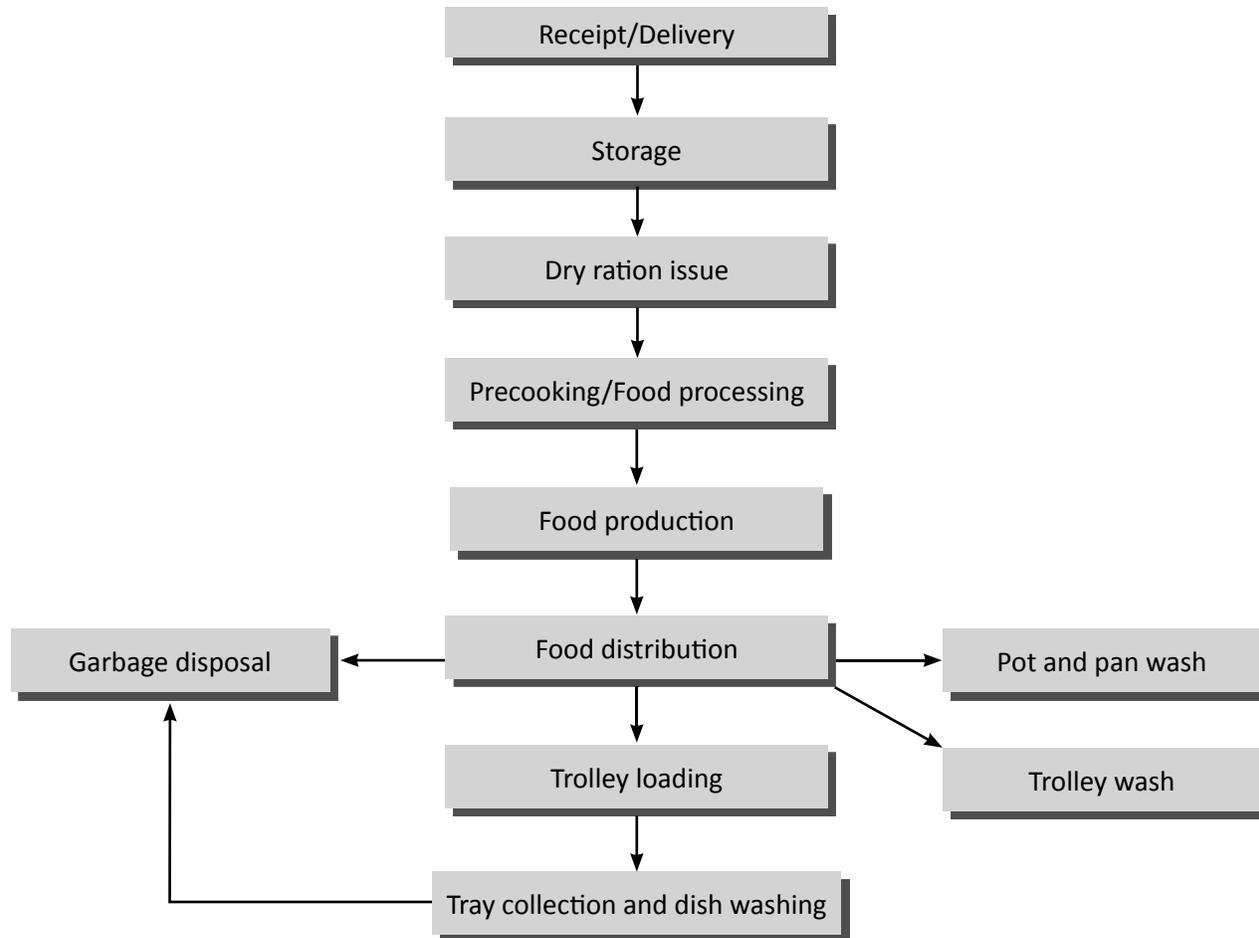
The flow of a dietetics unit from receipt/delivery of raw food items till food production and distribution is provided in Flowchart 28.1.

Procurement of Raw Food

Quality and quantity of raw material and finished products has to be maintained up to a certain standard. Quality standards need to be maintained while procuring raw food items. Perishable items such as milk, bread, nonvegetarian items, vegetables and fruits as well as nonperishable food items like wheat and other cereal flour, rice, pulses, dry 'masalas', etc. are usually purchased on tender basis. It should be kept in mind that good government agencies like Verka, Hafed, Britannia, etc. may be roped in for the supply of milk, cheese, bread, rice, etc. since they have their own quality standards. Regarding nonvegetarian food items, vegetables and fruits, lowest tender bids are usually taken in by the administration, but a hawk's eye has to be kept on the quality like freshness of fruits and vegetables and nonvegetarian items. Fulfillment of benchmarks kept for quality analysis is a must.

Fruits and vegetables

Usually these are not procured on daily basis; let us say, twice a week. A team comprising of a nutrition expert, store officer and member of hospital administration is usually there along with the vendor when these items are received. All gunny bags containing fruits and vegetables are emptied and the kitchen working staff sees each and every piece for its freshness. Then these are again repacked and weighed on an



Flowchart 28.1 Dietetic unit of a hospital.

electronic weighting scale to record the final weight after taking out the wastage. This whole task takes almost 1½ hour. Then the fruits and vegetables are transferred to the cold storage room where they are again weighed so that they tally with the initial weight. This is done to check any pilferage on the way!

Nonvegetarian items

Procurement of nonvegetarian items in the hospital is thrice a week, e.g. eggs, chicken, fish. Since mutton being red meat, it is best avoided in hospital's menu. The quality of fish becomes dicey in summer months, hence it is avoided in hospitals.

Eggs come in numbers and are checked randomly for quality by putting them in water. If an egg floats, then its quality is under suspicion since it is a sign of a rotten egg. Storage of eggs is in cold room. Chicken is checked for its quality by visual analogue scale; seeing the toughness of skin that it is clean from inside, free from any liver and other fillers. Quantity is weighed after ensuring that there is no water in the chicken packets, since these are kept in cold storage after being slaughtered; therefore thawing may add some

water to the packets. If it is so, some weight is subtracted. Secondly, the necks have not to be more than 2 inches, since it is just a waste and adds to weight. If so, again some weight is subtracted after giving warning for the next supply. It is kept in cold storage.

Milk and milk products

Milk is a daily-supply item. Milk supply should be from a genuine government agency. It is best to receive milk in packed packets for industries, e.g. a 5-l packet. This way, the hygiene part is ensured. Receiving milk in 'dampoo's or big drums might not be that hygienic, since it involves manual handling. Same way, it is best to procure cottage cheese and tofu in packets like 'Verka' cheese supply. The manufacturing date and 'best before' should be taken care of. All these milk products are stored in separate cold storage and not where nonvegetarian items are stored.

Dry ration

Ration items like cereal grains, pulses, masalas, etc. are checked by a team consisting of the head of the dietetics department, store officers, officials from administrative

department along with the vendor. These are checked for grain size, colour, unwanted polishing and any foreign material in the grains. When the quality is approved, these are weighed and stored in dry ration storage area.

Case Study 1: Key role of supervision of eating establishments

A study was done to check the status of conformance of Eating Establishments (EE) to Food Safety and Standards Regulations (FSSR) 2011.^{9,10} There are 34 eating establishments inside the premises of study institute. They cater to the outpatient department (OPD) patients, visitors and relatives of patients, residents, doctors, students and employees of the institute. They can be grouped into messes, dhabas/restaurants, tea/snack bar, juice shops, Verka milk booths and the hospital dietetics department with its kitchen. Some of these EE are with kitchen and the rest of them sell precooked food like sandwiches, burgers, patties, cold drinks, juices, biscuits, tetra packs of juices and chips, etc. They are conveniently located and spread over the entire study institute. Approval of rates of the items sold is done by the authorities of the hospital. It is mandatory for all the EE to display the rate list outside. Fresh water is supplied through hospital sources that are used for drinking and cooking in these EE. Overhead tanks are used for storage of water maintained by hospital resources. The food handlers working in these EEs are employees of various contractors running these eateries. There is a committee constituted by various faculty of teaching institute to inspect these EE from time to time and give a feedback to the authorities. The members collectively conduct a surprise inspection of the EE from time to time. Another committee has been constituted, which looks after the various issues of the employee's welfare canteen. This committee is different from the previous one, as apart from faculty members it has representatives of the food business operators also. Regular meetings are held to dwell on the issues of rates of various items being sold and procurement of items for the kitchen, etc.

Storage of Food

Walk-in cold stores and deep freezers are a boon, since the things can be stalked and reached easily and also can be accounted for. Walk-in storage also has enough capacity for storing various food items. For dry ration storage, the store should be well-ventilated and lighted, free from dampness and the pesticide and insecticide treatment should be carried periodically.

Pilferage

Pilferage is the biggest issue in food industry and that too when the workers employed are from lower social strata. Pilferage at all the stages, whether it is dry ration or cooked food has to be controlled since if not taken care, will make all the previous exercises of quality and quantity control futile.

- Pilferage from the storage area: Responsible officers have to be posted over there who monitor the issuing of ration items according to the ration calculated for hospital diets. The records have to be maintained in registers with signatures of the officers who are responsible for computing of ration items. All the food items need to be kept under lock and key.
- Pilferage while cooking: Milk is the most vulnerable item to be misused. Checking the solid-not-fat (SNF) will tell about the milk purity; but since it can be done only on raw milk, it becomes almost impossible to gauge how much water has been added to milk while boiling it as the milk supply has to be received early morning at 5:00 o'clock (tea and breakfast has to be ready by 7:30 am). So it becomes mandatory for some officers to be present at that time when the milk is poured in boilers for boiling or to install devices like hidden CCTV cameras.

Other items like pulses, rice and vegetables need to be weighed again before being put in the cooker for cooking to see if any pilferage has taken place 'since issuing to cooking' process. Oil for cooking also needs to be rechecked for weight before adding it in pulse or vegetable preparation.

- Pilferage while distribution: Its best to give the meal in preplated packed and sealed trays or measuring tumblers to avoid any pilferage while distribution. By ensuring the portion size, it becomes easier for nutrition officers to gauge the nutrient intake per meal or per day by just monitoring how much portion was really consumed by the patient. It should be ensured that every patient received the meal.

But on second thought, if an institute cannot afford prepackaged machines for various reasons, may be financial or space related or any other, then food distribution is done in insulated trolleys. Different containers in these trolleys carry dhal, vegetable, curd, chapattis and rice, etc. and milk and soup for liquid-dieted patients. The trolleys are loaded according to the calculated meals of a particular ward. Patients receive the meal in compartmental trays issued by the ward sister. To ensure proper portioning of the food, the serving ladles and containers have to be properly calibrated, for example one ladle full is 150 g of cooked vegetable or 200 g of cooked dhal. The meal service has to be monitored by responsible officials to ensure proper distribution and to avoid any pilferage.

Case Study 2: Simple solution works—caramelising milk to check pilferage

At one point, the hospital staff used to get the patient complaints that the morning milk, which is distributed by ward servants (since ward servants collect the morning breakfast), is not 250 ml (the sanctioned amount). Despite our efforts, it was difficult to cover every nook and corner of hospital while morning breakfast distribution. So we thought of an idea. We started caramelising the sugar and putting it in milk (except for diabetic patients). The colour of milk turned brownish. As a result, there were so many queries from the wards about the milk being supplied. We told them that we have added a medicine for patients after discussing with the doctors. From that day all patients got full milk supply, since the others were scared to consume the milk or did not find it palatable in their tea preparations!

Organoleptic and Therapeutic Analysis

This should be done by tasting the normal meal as well as therapeutic diets and feeds (hepatic, renal, antiobesity, diabetic, burn feeds, etc.) by a team of nutrition experts. The trolleys should be allowed to leave the kitchen area only when the team is satisfied.

The meals and feed portions should be periodically standardised to ensure correct calculation and delivery of nutrients. The measuring units for meal, especially feed preparations, have to be correctly calibrated and preparation needs to be closely monitored to ensure proper intake of macro as well as micronutrients by the patients. Kitchen layout should be glass enclosure for preparing all therapeutic feeds so that the counter for feeds remains separate and can be monitored from outside.

Case Study 3: Checking the taste of meal must be well before serving it to patients

Once team of the nutrition experts collated to taste the hospital diets. The time was 12:00 o'clock, exactly half-an-hour before dispersion of trolleys to various wards. The trolleys were already loaded with 'khichdi' (mixture of rice and pulse) diet packets. As we started our duty of tasting, we found that 'khichdi' diet was giving a burnt flavour. On investigation, it was found out that a new bulk cooker was installed that day and khichdi was prepared in that cooker. Since all the controls were new to the operator, it resulted in burnt khichdi. Now almost 400 patients had 'khichdi' diet. If we withhold it, it would have taken minimum 2 h in preparation of new 'khichdi', if the time of issuing ration,

preparation and cooking, etc. is calculated. Then, it is going to also tamper the ration for the next shift. We could not think of any other replacement for 'khichdi' and 'dahi' in 15 minutes flat. So at the end, the whole 'khichdi' was reloaded in the bulk cookers by emptying all 'khichdi' packs, and lots of cardamoms and cinnamons were added to camouflage the burnt flavour. There was no time left for repacking, so it was put in a big casserole to be served to patients. The trolleys were late by half-an-hour and we were in the muddle of attending calls from wards enquiring about lunch! So the lessons learnt were that you cannot withhold a food trolley. The food has to go to wards. The time for tasting should be at least 1½ h before delivery of food, and trolleys should be loaded with diets after food tasting.

Equipment Management

The institutional kitchen's efficiency depends on how efficient the equipment installation is in its vicinity. Equipment range from knives and strainers to chapatti-making machines, packaging machines, garbage disposal unit, dish washing units, big peelers, dough kneeding machines and what not. Small equipments like cutlery and crockery can be managed by keeping a tab on its periodical purchase according to wear-and-tear, but regarding machines that might have to be procured from outside the city or may be even the country needs compressive maintenance contract (CMC), trained technicians at hand and a backup to tackle any untimely breakdowns.

Case Study 4: Always think of backup of any mechanised work

In the hospital kitchen, chapattis were used to be made manually on a huge griddle and 6–8 men made dough balls or rolled the dough. Seeing their plight in humid summer and increasing inpatients, the staff with the help of hospital finance department purchased a chapatti-making machine. All workers were overjoyed. Till 6 months, making chapattis was a breeze till one (un)fine day, the machine broke down! It was 6:30 in the evening, the time when all the officers have almost left for home and no mechanic can be reached since the nearest machine mechanic was available in Ambala! Frantic calls by the workers bought all the officers back to office, but of little use as there was no backup! So that night, patients had to be distributed bread along with rice! The lesson learnt was that there has to be a manual backup for all machine work! After that day, we reinstalled that big humble griddle as a quick remedy to any such incident! But then one can also think of installing another chapatti-making machine as a backup.

Accountability for equipments: It is the responsibility of the officer-in-charge to conduct stock checking and maintenance. The team of officers has to do the stock verification periodically to check any missing or damaged crockery and cutlery, thermos, tea sets, salt and pepper sets as well as bigger equipments like water filters, heaters, grillers, etc. Anything missing has to be reported by the workers working in that pantry, the reason behind the lost or damaged equipment has to be dealt with firmly and the equipment needs to be replaced promptly so that the delivery of food is a smooth process. Annual maintenance contract (AMC) and comprehensive maintenance contract (CMC) of the various machines need to be checked for expiry dates so that help can be reached when needed. Equipment like vegetable washers and peelers, packaging machines, conveyor belt for tray loading, heated tray rack trolleys, commercial dish washer units with plate sterilisers should be a part of an advanced institutional kitchen. Any new innovative tools/equipments should be added to add some excitement and variety.

Human Resource Management

In fact, the most crucial and important resource is HR management. There is always a mix of regular and contractual workers. A lot of responsibility is required for a team of healthy happy working force. The officers have to take care about their being disease and germ free, since they are working in a very vulnerable area of the hospital, i.e. food preparation, handling and distribution. So it calls for regular medical checkups for any allergies, skin disease, tuberculosis, etc. In addition to their blood and urine tests, nail, nose and sputum swabs are also tested for any infection. The workers found to be having any kind of infection are given a break along with a course of medication. Before joining, they have to ensure their fitness through medical tests.

To ensure good health of workers, the working conditions have to be apt. Daily monitoring of clean uniforms, shaved beards, nails cut neatly, regular hand wash when they enter kitchen, prepare meal, handle the food and come back after distribution has to be ensured by the dietetics staff. Clean aprons with a pocket for keeping paper towels, disposable caps and gloves are an essential part of their attire. Heavy fines should be imposed for defaulters. To facilitate workers health and hygiene as well as comfortable working conditions, chimney having appropriate suction capacity should be installed. Adequate number of porcelain/stainless steel washbasins should be there, having soap dispensers installed to wash hands, and neat and clean towel to dry hands (Figure 28.1). Hand dryers would be a better idea along with paper towels.

Separate sinks should be provided for washing raw food and a separate area for washing pots and pans. Conveyor belt for preparing chapatti makes it convenient for workers to roll out chapattis (Figure 28.2). Bulk cookers are a convenient option to cook food for say about 1000–1200 patients.



Figure 28.1 Availability of chimney and washbasins.



Figure 28.2 Conveyor belt for chapattis in preparation area.

It becomes mandatory to clean food preparation areas and equipments. The staff should be given clear instructions about what needs to be cleaned, how often and the way to do it. It should be ensured that all repairs are made as early as possible by instructing the staff to report all breakdowns immediately (Figure 28.3). Food trolleys are being used to carry cooked food to various wards. Food trolleys, if used in hospital for delivering food to patients, should be dedicated for this purpose and not used to carry anything else. Time required for transportation should be kept to minimum to avoid microbial proliferation. The trolleys have to be kept covered during their journey from kitchen to the wards. Handling of cooked food should be minimal. Food handlers must use disposable gloves while distributing food in the wards after ensuring hand hygiene. All surplus and unused food should be discarded to animal houses.

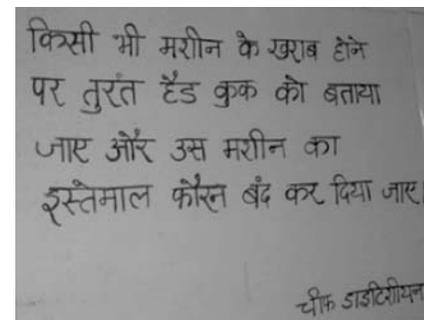


Figure 28.3 Notice for food handlers to report breakdowns.

Staying healthy also calls for well-ventilated kitchen with proper air circulation and cooling system so that workers remain perspiration-free in long Indian summer months.

The kitchen area should not be a thorough fare. Either there should be card system that only swipe of card at the door allows entry to officers and workers of the kitchen department or a guard should be sitting at the entrance prohibiting any patient or an outsider to walk in. Separate route and a room for catering to indoor diet grievances should be there, which is not enrooted through the food preparation area. This way, seepage of infection in the food area would be minimised.

Safety of workers

Since the cooks and bearers are the people who will have direct contact with machines, their work safety should be one of the priorities. Working with machines has its own risk of accidents like getting injured or hurt; therefore, workers should have thorough knowledge, training to work on the machine and strict instructions about the dangers of mishandling or being careless while handling any machine-related work. For example, in our hospital kitchen twice the workers got injured and nearly lost their hands while working on chapatti making machine and slicer. One worker's hand came beneath the dough roller and was compressed since he tried to manually pick up a dough ball just before it was being getting rolled! The other one was talking and his hand nearly got sliced in a slicer!

Clinical Services

Nutritionists/dieticians are responsible for maintaining/upgrading the nutritional status of inpatients, advice the OPD patients to facilitate their medical treatment being given and help in speedy recovery since no medicine can be effective to its capacity if nutritional status is poor. Disease-specific diets and feeds need to be carefully prepared, administered and compliance is noted along with the effect on improving overall condition of patient during his hospital stay. A workman is never complete without his tools. An institute's nutrition department must be armed with latest tools to access the nutritional status and carry out clinical studies with perfection. Special training on 'how to use' these equipments should be imparted to the dietetics students so that the work can be carried out with efficiency. For this, help may be taken from the experts of the growth lab, which is usually situated in the paediatrics department of the hospital, since correct assessment goes a long way to improve medical outcomes. Equipment such as height scale/bed scales, electronic weighing scale/bed scales, basal metabolic rate (BMR) and body mass index (BMI) calculator, body fat analyser, lean body mass analyser, Harpenden Skinfold Caliper, metallic inch tapes, etc. should be an essential part so that proper clinical services along with state-of-the-art

research and training can be carried out for the patients in any premier medical institute.

Education and Training

This is an important part of the nutrition wing in a medical research institute. Students are admitted for internship as well as short-term attachment courses varying from 3 to 9 months. It involves theoretical and practical application of the knowledge in ward and OPDs. Students are required to take up cases under the guidance of nutrition officers and present them before completion of their training.

It would be desirable that the nutrition department has tie-ups with biochemistry lab and growth lab of the institute so that some micro and macronutrient tests like urinary urea protein to access dietary protein intake, serum vitamins and mineral levels, trace element levels, which are not sometimes routine tests for the patient, can be conducted for case studies and other research work. Growth lab can facilitate in anthropometric measurements or in training the students to use the tools for the same. All project work done by the medical faculty must make nutrition intervention an important part, since nutrition forms the backbone for favourable medical outcomes. Only thing is that this needs to be realised by the medical fraternity!

Community outreach

It should be made mandatory that the nutrition department has community services in their agenda, since no matter what you 'Google' down from internet for community preaching, imparting theory after practically experiencing it can never take a beating. Separate days for community services should be laid out, while some staff should be back there for clinical services.

Institute Hospitality

It is one of the major areas of meal service in a medical research institute, since such type of institutes invite a lot many delegates and foreign faculty for their conferences, convocations, examinations, meetings, research agendas and what not. Usually it is the responsibility of dietetics/nutrition department of the institute to cater to all the institute hospitality. In wake of huge gatherings, it might be that the caterers from outside are roped in, but still the onus of how good or bad the result was lies on the dietetics department. Many a times it leads to a clash between the standard of patient meal and institute's hospitality. To be true, the patient meal always takes a back seat. It is not that it is not been taken care of, but to participate in a race and to participate to win differs a lot. The spirit to win is diverted towards hospitality and meal service in hospital caters to only participation at such times! This happens because all the best cooks and bearers are given the job to dish out various delicacies and serve them with utmost care. Monitoring of clinical side of

the hospital also takes a backseat. It is like serving a guest who has come to your home with your best-possible capabilities, even at the cost of your health!

The best-suited way might be to bifurcate the clinical and hospitality side of the institute. This job is best suited for hotel management pass outs. The able candidates from there should be recruited for a separate wing of hospitality for the institute. They can use their creative ideas and take hospitality to the next level. Nutritionists/dietitians should be made to concentrate on clinical and research side of the hospital meals so that important breakthroughs in therapeutic nutrition may be reached to take the nutrition in a hospital to the next level!

Management of dietetics unit of a hospital requires concerted and dedicated efforts by all members of the team to ensure that quality food reaches the patients of the hospital. It involves multiple components of management apart from cooking and serving food to ensure smooth functioning of the unit all the times.

Flowchart 28.1 describes the workflow chart of hospital kitchen.

Managing of dietetics unit can only be possible if technical knowhow, business administration knowledge, expertise in nutrition knowledge, art and craft of cooking, and presentation is blended into one for a perfect mixture called dietetics unit of hospital. Awareness about technical knowhow becomes a basic need in planning the very infrastructure of the dietetics unit along with the machinery and the equipment required; business administration skills are required right from procurement of raw material, be it perishable or nonperishable food items or any other material like packaging material, etc. to their storage, usage and accountability. In addition, handling manpower and maintenance and

upgradation of all equipments definitely requires this skill. Expertise in nutrition along with art of making and presentation of diet of course forms the backbone of the dietetics unit, since this is the main thing that needs to be delivered from here to the patients in form of nutritious therapeutic diet as well as diet counselling sessions to support their medical therapy and enhance quality of life.

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Food Safety in Hospitals

Dr Puja Dudeja, Dr Amarjeet Singh and Dr Sonu Goel

“Delivering safe food to the dinner table is the culmination of the work of many people. Everyone’s challenge is to perform these individual actions as well as possible.”

—The President’s Council on Food Safety, United States

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the importance of food safety in hospitals.
- describe the sources of food contamination in hospitals.

INTRODUCTION

Foodborne transmission of pathogenic and toxigenic microorganisms has been a recognised hazard for decades.¹ Globally, foodborne illnesses are a major health concern leading to high morbidity and mortality.² Worldwide load of diarrhoea involves 3–5 billion cases and approximately 1.8 million deaths annually, mainly in young children, which is caused by infected food and water. According to the Centre for Disease Control and prevention (CDC), about 76 million cases of foodborne illnesses are reported annually in the United States with approximately 5000 deaths.³ Approximately 500 outbreaks of foodborne diseases are reported annually to the CDC Atlanta. Foodborne illness is a serious public health problem in India also.⁴ Food poisoning outbreaks are ranked second after diarrhoea outbreaks in cumulative number of disease outbreaks, as reported by end of 52nd week by integrated disease surveillance project (IDSP) in the past 5 years (2008–2012).⁵

In India, the concept of food safety has been looked into seriously and the felt need for an integrated law has been met by promulgation of **Food Safety and Standards Act (FSSA)**, 2006. This seeks to ensure implementation of food safety in all kinds of eating establishments (EE). **Food Safety and Standards Regulations (FSSR)**, 2011 have also come into force that makes all EEs (those inside the hospital premises also) to put into place, implement and maintain a permanent procedure based on these guidelines.⁶

Hospitalised patients usually have a weakened immune system. During their stay in hospital they are also exposed to nosocomial infections. Hospital authorities, accordingly have to often face the difficult task of satisfying the ever increasing demand for quality care. An added burden of an outbreak of a food poisoning inside a hospital will not only add to the burden of sickness but would also damage the image of a hospital. Hence, food safety remains a vital issue in our hospitals.

There are many reports of outbreaks of foodborne illness originating in hospital. For example, an outbreak involving 34 nursing students has been reported from a tertiary-care hospital in Mangalore. However, most of these foodborne illnesses are preventable through proper implementation of food safety measures and strict enforcement of food hygiene standards. The present status of food hygiene in EE in medical institutions of India is dismal. Sooner or later, the hospitals in India will have to comply with the prescribed standards of FSSR 2011. The patients and the hospital staff would be the greatest beneficiaries by strict enforcement of food safety practices in hospitals, as it would result in better quality of care and safety.

Eating establishments in hospitals cater to a large population group comprising of patients, doctors, nurses, hospital staff, medical students, visitors of patients, etc. An outbreak of food poisoning in hospital kitchen/canteen/EE inside hospital premises can affect not only the hospitalised vulnerable patients who are more susceptible to infection but also

their relatives and staff. Therefore hospitals need to provide food that is microbiologically safe to prevent morbidity and mortality to a wide variety of consumers who are dependent on the EE for their meals within the hospital premises.

CHANGING ROLE OF HOSPITALS IN 21ST CENTURY

In this modern era, the image of hospital is changing and it is important to understand the reason for increasing importance of food safety in hospitals. The traditional role of a hospital was equated to providing curative services only.^{7,8} The role of hospitals underwent a paradigm shift in the past 50 years. In the present time WHO encourages hospitals to think away from disease- and illness-oriented care to towards more holistic healthcare, as *health-promoting hospitals* (HPH).⁹ As per this approach, the hospitals are not just seen as curative centres but also as a place that actually promotes healthful living. Nutrition/dietary/catering services are important aspects of HPH concept. In a health-promoting hospital, food safety is a vital concern. Food safety in a hospital requires special attention so as to minimise the hazard of foodborne diseases. Hospitals should take a lead in providing safe food to patients, hospital employees and visitors. The **health-promotion approach** also necessitates that the hygiene of EE in hospital premises as well as the hospital kitchen is maintained at an optimal level. So, in the present context, the concept of HPH and food safety can be integrated to ensure good quality of services.

NEED OF FOOD SAFETY

Hospitals, as a setting and as a place of work, engages cadre of employees and caters to thousands of patients and their relatives. Table 29.1 classified the customers/clients in a hospital who need food safety.

Food service facilities are used by hospital staff and patients as well as their visitors. For the admitted patients of the wards, provision of good quality and safe food is responsibility of the dietetics department. Patients are prescribed special diets as per the disease suffered by them (renal/diabetic/hypertension diet). Good nutrition can promote speedy recovery. These groups of patients are also exposed to the food available outside hospital premises through their visitors.

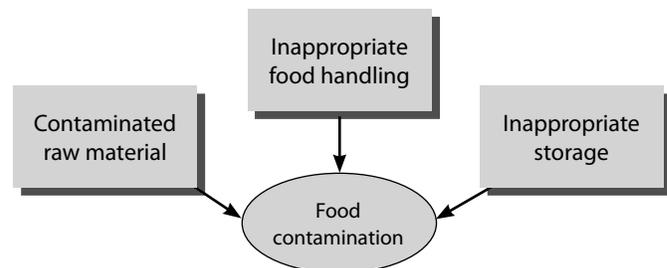
On a typical day a patient comes (alone or with attendants) to a hospital and gets registered. From here he is directed to one of the departments [outpatient department (OPD)/inpatient department (IPD)/diagnostic services/

blood bank/pharmacy, etc.]. All the processes in hospital take time. They need to start early in the morning from their homes in remote areas to reach hospitals in time. Patients and their relatives may not get enough time to take a proper meal from home. He has two options available—one is to carry his food from home and the other is to procure food available in the hospital premises. In most of the cases, latter is a preferred choice due to sheer inconvenience of carrying cooked food. The same holds good for the people accompanying the patients.

The employees of a hospital, like anywhere else, often spend as much as 60% of their working hours in their place of work. They are also exposed to all the eating options available inside hospital premises. The food options made available to them by employers can greatly impact upon their health. The good health of medical and paramedical professionals is also important for setting an example to the local communities within which they are based. Hence, canteens/EE play a very important part of hospital support services.

SOURCES OF FOOD CONTAMINATION

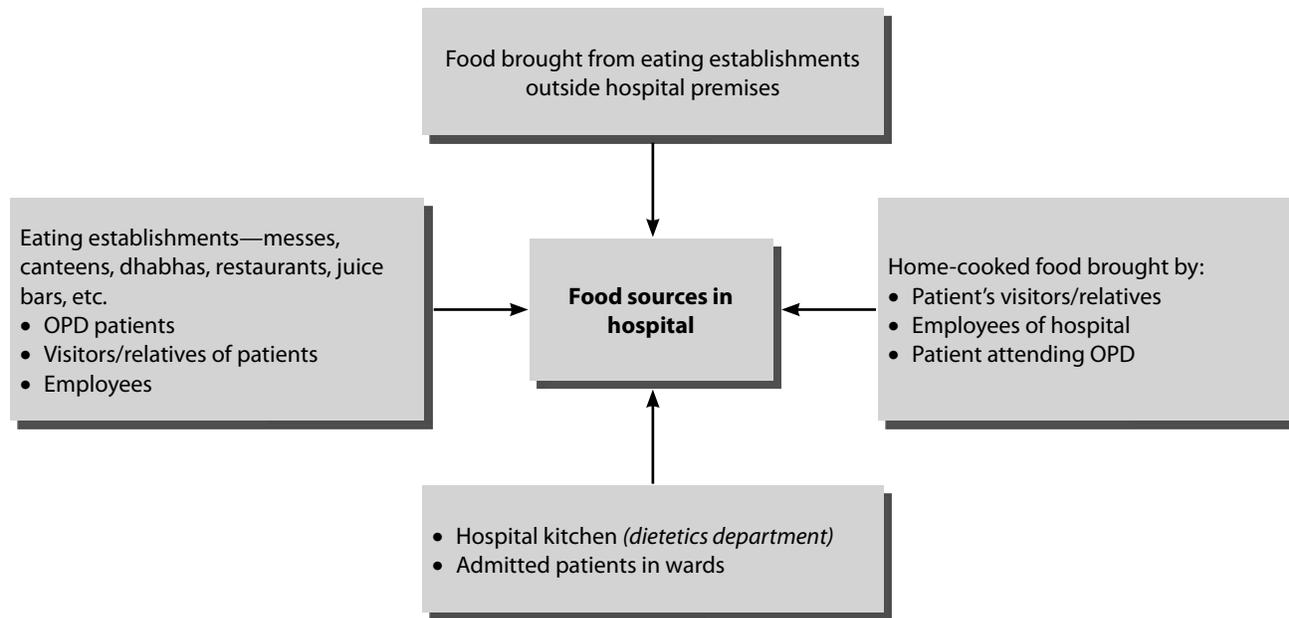
Food safety in hospital is a daily challenge. Large volumes of food are prepared/brought in by contractors, kept warm at safe temperatures, distributed though long corridors and served to a large number of patients by many hands. Food contamination can occur at any point from its journey to procurement of raw material to it being served to the client. Various causes of contamination are given in Flowchart 29.1. Unhygienic raw material can make the food unsafe by cross contamination with cooked food or during inadequate cooking. Improper handling of food permits contamination, existence and growth of infectious organisms. The common errors in food handling are contamination by food handlers during transportation and/or serving of food through unclean utensils. Improper storage (storing food at room temperature) or inadequate refrigeration, inadequate reheating can also lead to food contamination. This will depend on the source of food (Flowchart 29.2). Though desirable as of now, hospitals can do little to monitor or control the quality of food brought in the hospital by patients, relatives or employees.



Flowchart 29.1 Sources of food contamination.

Table 29.1 Clients in a hospital in need of food safety

Patients	Nonpatients
Ward patients	Relatives/visitors of patients
OPD patients	Employees (permanent, contractual)



Flowchart 29.2 Sources of food availability inside a hospital.

The next sources of food are the EEs inside hospital premises. This is commonly used by the OPD patients, their attendants and the hospital staff. Food may also be procured from EEs outside hospital premises brought for consumption in the hospital. In addition, the hospital dietary services department caters to the patients and the staff based on their specific requirements as per the disease condition. The main kitchen in a hospital daily prepares food for distribution among patients as well for employees. This may be distributed in the form of traditional meal delivery system in trolleys or room service system in hospital kitchen. Let us discuss here the food safety aspects in respect of hospital kitchen. Safety of food can be ensured through good hygiene practices (GHP), good manufacturing practices (GMP), ISO 22000 certification, adaptation of **hazard analysis and critical control points (HACCP)** principles, etc.

Actions that are required to be done at various levels to ensure food in a hospital are summarised in Table 29.2.

For every hospital kitchen there should be a specific food safety policy. It is proposed that a multidisciplinary 'food safety team' should be constituted in a hospital to make the

Table 29.2 Actions for food safety at various levels of prevention

Level of prevention	Actions
Primary	Good hygiene practices, legislations, monitoring, inspections, food safety plan and policy
Secondary	Surveillance of nosocomial infections, early diagnosis and management of outbreak of foodborne illness
Tertiary	Treatment of complicated cases (victim), rehabilitation of victim of foodborne diseases

food safety plan for the hospital and ensure implementation of the plan. Various functions of the food safety team suggested are given below:

- Organise training for food handlers.
- Organise and maintain medical records of food handlers.
- Should hold the responsibility of getting registered/obtain a license in accordance with the FSSA 2006.
- Hold meetings and review the food safety plan of the hospital.
- Maintain records and documentation.
- Surveillance of foodborne diseases in the hospital.
- Maintenance and actions required as per the suggestion/complaint register.
- Investigate and control any foodborne outbreak in the hospital.
- Keep a check on the other EE inside the hospital premises.

It is also recommended that there should be a food safety officer (trained in food safety) for the hospital. The proposed functions of food safety officer are given below:

- Inspection of hospital kitchen.
- Inspection of EE inside hospital premises.
- Periodic tasting and testing of food.
- Conduct training of food handlers.
- To facilitate implementation of food safety plan of the hospital.

FARM-TO-FORK MODEL FOR FOOD SAFETY IN A HOSPITAL

Food safety is a systems approach-based concept. The concept of food safety begins at the farm where food animals

are raised, crops are grown, extends through the various processing procedures and continues to the final stage of preparation in the kitchen. Hospital industry has high potential for establishment of a viable setting that could make available safe and nutritious food to its clientele. Lapse at any point/link can compromise the food safety and thereby the health of the people. Farm-to-fork is a holistic concept to make safe food available. It starts with the quality of seed, quality of soil, farming practices, use of pesticides/fertilisers in farm, quality of water used, transportation, food processing units, storage, and handling of the food and food products. One of the main objectives of this concept is that in case there is an outbreak of foodborne illness, the food, its processing and its source can be easily traced and investigated. The reverse 'fork-to-farm' shall help in traceability and recall in case of an outbreak.

The kitchen has been described as the front line in the battle against foodborne disease. To ensure food safety plan, it is of utmost importance that following points are taken care of in the hospital kitchen.

- *Design and layout:* Materials used for making structures within food establishment should be durable, easy to maintain and clean. Impervious material should be used to make surface of walls, floors and partitions. The surface of walls and floors should be smooth. Drainage should be adequate. Ceilings, overhead fixtures and windows should be constructed in a way that there is minimal collection of dirt. Material used to make doors should be smooth, nonabsorbent, and easy to clean and maintain. Food contact surfaces should be durable, easy to clean, maintain and disinfect.
- Appropriate food temperatures should be attained during cooking, heating, cooling, freezing, cold storage, etc. as necessary-to-ensure food safety and suitability. There should be a food thermometer available in all kitchens. Kitchen equipments used for various processes should be able to achieve the desired temperatures for different food items. Waste containers and containers used for storing dangerous chemicals should be easily identifiable items and made of impervious material.
- Potable water should be available in adequate quantities. There should be facilities for storage and distribution of water in the kitchen. System of nonpotable water, if any, should be separate and easily identifiable from the potable system.
- There should be provision of adequate drainage and waste disposal system. The design and construction should be such that the risk of contaminating potable water is not present. Waste must not accumulate in working areas. Cleanliness of waste storage containers and places must be ensured. Proper monitoring of sanitation system should be done and verification also should be done by periodic inspections.

- Various facilities depending on different food items like heating, cooking, cooling, refrigerating and freezing must be available. Effective monitoring system of temperature through various processes should be available. These should be specifically developed depending upon the nature of food, its shelf life and method of distribution. Temperature recording devices should be calibrated and tested for adequacy.
- Construction and design of ventilation system should be such that air does not flow from contaminated to clean areas. Adequate lighting should be provided to carry out work in a hygienic manner. Fixtures of lighting should be protected so that there is no contamination by breakages.
- Facilities for storage of food and nonfood items should be separate. Design and construction should be done in a way as to permit adequate maintenance and avoid entry of pests. All holes and drains should be sealed so that there is no access to pests. In case there are pests, the issue should be dealt with immediately without adversely affecting food safety and hygiene.
- All the equipment should be kept in utmost state of repair and condition. Cleaning and maintenance programmes should be made and followed so that no food residues and dirt are left in the equipment, which can be a source of contamination. All parts of establishment should be cleaned.
- *Raw material:* Source of raw food is of reputed quality (from reputed supplier). This will ensure good quality farm produce/animal produce reaches hospital.
- *Personal hygiene and training:* Food handlers who are known, or are suspected to be suffering from/or a carrier of disease that can be transmitted through food should not handle food. In case of any illness, the food handlers should report to the manager. All food handlers should be medically examined for any infectious disease. Training of food handlers on various issues of food safety should be conducted. All visitors entering food preparation area should wear protective clothing and adhere to personal hygiene provisions. Personnel handling hazardous chemicals should also be trained on various precautions, which need to be taken care of. Training programmes for food handlers should be organised by the hospital authorities.
- *Transportation:* Trolleys used in transportation of food from the kitchen to the wards should be designed and constructed so that they can be effectively cleaned and maintain the temperature, humidity, atmosphere and other conditions necessary to protect food from microbial growth. Conveyances and containers for transporting food should be kept in a state of cleanliness, repair and condition.

Bed strength of the hospital, size of the kitchen, nature of its activities and types of food involved will decide the type of control and supervision required. Managers and

supervisors should have enough knowledge of food hygiene principles and practices. Records in respect of processing, production and distribution should be maintained for a period, which is more than the shelf life of the product. An efficient documentation system can enhance the effectiveness of food safety system.

Hospital authorities have a key role in setting and providing legislation that lays down minimum food safety standards at all levels. It must ensure that these are implemented through training, inspections and enforcement. The promulgation of FSSA 2006 is an attempt to achieve food safety. According to this law all EEs inside the premises of the hospitals and hospital kitchen need to be licensed/registered. Good storage practices and maintenance of appropriate temperature for various food items have an important role in maintenance of food safety. Misbranding, adulteration and use of expiry date items can make the food unsafe.

Food safety, particularly in hospital, is an area of extreme importance as people receiving healthcare are more vulnerable and require food that is safe and not contaminated. EE as canteens, messes, hospital catering services, restaurants inside the hospital premises provide food to a large number of people. There are many hurdles in the road to food safety. It is essential that food provided in the hospital environment is managed and handled in a manner that it does not pose any risk to patients or staff. It is imperative that food preparation, storage and handling is done to the highest

standards and poses no risk to already sick or compromised patients or the valuable manpower resource working in the hospital.

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Efficient Ambulance Services: Key to Patient Care

30

Dr Geetu Malhotra, Dr Tejinder Kaur, Er Narendra Kumar Prarthi, Dr Amarjeet Singh and Dr Sonu Goel

“Delivery of the effective first aid is one of the activities in the management of the causality which is crucial determinant of the severity of the injury eventually received and the chance of survival.”

—The European Transport Safety Council

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- define various types of ambulance.
- describe staff involved in manning ambulance services.
- describe various physical facilities and equipments in ambulance.

BACKGROUND

An ambulance service is a link of hospital with community. An effective ambulance service reduces burden on hospitals, decreases mortality rate and will in turn increase survival rate. So, hospital management system cannot be delinked from ambulance services. Both should be integrated. It should be considered to be an essential part of well-organised emergency and critical care service in hospitals.

An ambulance as defined in Webster's dictionary is an 'Organisation for rendering first aid'. It is 'a vehicle equipped for transporting those who are wounded, injured or sick'. According to the definition given in Hospital 0 and M Services Report No 8 (1964) has defined ambulance as: 'Ambulance transport includes all ambulances, sitting case cars, hospital car service vehicle and railways accommodation provided at the expense of local health authority'.¹

TYPES OF AMBULANCES

It may be divided by the types of life supporting system (basic or advance) provided to the patient.

Division Based on Types of Life Support System

Basic life support (BLS)

BLS provides transportation of the patient needed for such basic services such as control of bleeding, splinting fractures,

treatment for shock, airway/respiration, total physical response (TPR) and first-aid. These ambulances carry necessary equipments and trained technical staff.

Advanced life support (ALS)

ALS is used for transporting critically ill patients, (usually ventilator ventilator-supported septicaemia, multiorgan failure on various life support equipment), transport of patients for investigations [such as computerised tomography (CT) scan, MRI scan, etc.] and life-saving surgeries, to tertiary-care centres or specialised centres.¹

Utilisations of ambulances

- General practitioners, police and members of the community calling ambulance to the scene of accident or other emergencies.
- General practitioners/nursing homes arranging outpatient booking of ambulance by telephone.
- Hospitals requesting transport on long and short notice for:
 - Patients to be admitted.
 - Outpatient or accident or emergency cases to go home.
 - Outpatients attending by appointment.
 - Discharged ill patients to go home.
 - Patients to be transferred from one hospital to another.
 - Transfer to patients for special investigations.
- Local health authorities for the conveyance of children, pregnant women or handicapped persons to-and-fro establishments.

- For conveyance of children and staff for immunisation programmes.^{1,2}

Division Based on Route Plied by the Vehicles

It may also be divided based on the route plied by the vehicles.

Surface ambulance

These ply on roads. The manufacturing and body varies, depending upon the manufacturer. In the present era, light body ambulances are designed and built. These can go on congested roads and narrow streets in cities, being smaller in lengths, width and short in height.

Air ambulances

Air ambulance is the timely and efficient movement and enroute care provided by medical personnel to the wounded being evacuated from the remote location or to injured patients being evacuated from the scene of an accident for receiving medical facilities using medically equipped aircraft (air ambulances). Examples include civilian EMT vehicles, civilian aeromedical helicopter services, and army air ambulances. This term also covers the transfer of patients from one treatment facility to another by medical personnel, such as from a navy ship to a shore-based naval hospital.²



Figure 30.1 Air ambulance.

Air ambulance aircraft and helicopters are fully equipped with intensive care unit (ICU) facilities (ventilator/oxygen), etc. to ensure safe and effective treatment of patients during the flight, or up to the time they reach their destination. No matter what the condition of the patient is, and where they are supposed to be shifted, such patients need to be airlifted and brought at a safer place, as quick as possible. Air ambulance includes a stretcher bed for patient onboard (Figure 30.1).

Many developed countries have airplanes converted or modified into ambulance. These are suited and ideal for mass casualties, disaster medical relief and such rescue missions. France, Russia and Australia have these ambulance services since long and well-recognised all over the world for their efficient and prompt emergency care services. In India, this kind of ambulance is yet to take off (only in army and

hilly area this is being practiced). Besides this, some cities also have such service in Bangalore, Mumbai, Delhi, Bhubaneswar, Kolkata, Hyderabad, Surat, and Katra (Jammu and Kashmir).³

Who are onboard the aircraft?

In every ambulance flight, there will be at least two highly qualified doctors or else one doctor and one paramedic (depending on case to case) to ensure proper onboard medical assistance to the patient. All concerned doctors and paramedics are expected to undergo rigorous training for emergency rescue operations, flight safety operations, etc. A team of doctors and paramedics, including those with many years of experience in handling adverse medical situations, need to be deployed in such ambulance. The team includes cardiologist, neurologist, anaesthesiologist, orthopaedic, critical care consultants and so on. Depending on the kind of aircraft used, authorities may also allow two to three family members to accompany the patient.³

Helicopter ambulance

A helicopter (also known as a 'chopper') is a type of rotorcraft in which lift and thrust are supplied by one or more engine-driven rotors. This allows the helicopter to take off and land vertically, to hover and to fly forwards, backwards, and laterally. These attributes allow helicopters to be used in congested or isolated areas where fixed-wing aircraft would usually not be able to take off or land. The capability to efficiently hover for extended periods of time allows a helicopter to accomplish tasks that fixed-wing aircraft and other forms of vertical take-off and landing aircraft cannot perform. Most of the developed countries have helicopter ambulances for ferrying sick and wounded patients. These are well-equipped with trained staff in rescue and resuscitation task. Their response time is very short (Figure 30.2).³



Figure 30.2 Helicopter ambulance.

Ambulance trains

For rushing the medical relief team to accidents or disaster site and evacuation of mass casualties, railways have accident medical relief van and armed forces, ambulance trains. These have been specially designed and suitably modified coaches for lying and sitting patients with all necessary fitments for medical and surgical treatment during transportation. Ambulance trains are supposed to be having trained and dedicated staff for movement at short notice. Such practices have not been initiated in India, till date.³

REQUIREMENT NORMS OF AMBULANCE

A report of the hospital review committee on a Delhi hospital (KN Rao Committee 1968) recommended following scale of authorisation and states that 'number of ambulance should be sufficient to meet the requirement':

- 100–200 beds : 3 ambulances
- 200–300 beds : 4 ambulances
- 300 beds and above : 6 ambulances

In each section, one ambulance besides those provided by municipal corporation should be earmarked for conveying the cases of infectious diseases. However, it is evident that scale recommended can meet hardly for only intramural requirement and not the requirement outside hospital on regular basis for accident and emergency cases. One or two ambulances will always be off-road for preventive maintenance or breakdown maintenance; and while planning for number of ambulances, this also has to be kept in view. Scales recommended in 1968 requires review in view of population-explosion-fold increase in number of vehicles and consequent increase in number of accident, trauma and emergency cases. Number of ambulances authorised will have direct effect on manpower authorisation and planning for facilities and training.⁴

STAFFING PATTERN OF AMBULANCE

Each ambulance should carry with it at least two-trained stretcher bearers (besides driver) for lifting and carrying patients to ambulance. It would be preferable to have nursing orderlies who have higher educational qualification and better knowledge of patient care. They should be trained how to lift cardiac patients, spinal cord injury patients and a case of fracture femur. The ambulance service like the casualty department is required to work 24 hours of the day (in all shift) and works on all holidays and sundays. Hence, staffing pattern should cater for three-shift duty, relief duty, and sundays and holidays. So far as doctors are concerned; they may go with the team depending upon the type of emergency, accidents or disaster. A critical care medicine (CCM)-trained nurse in each ambulance would be ideal for better management and supervision of emergency case.¹

Nursing orderly and stretcher bearer: Each ambulance is required to have minimum two nursing orderliness or stretcher bearers all the time for lifting the accident victims and serious or comatose patients to ambulance. All these paramedical staff members are to be trained in first-aid, resuscitation procedures and lifting of various types of serious accident cases without causing further damage or pain to the patient.

Call response time: Ambulance along with team should be in a position to move in less than 2–3 minutes after a call is received. Staff should be particularly alert and checked randomly for their alertness at night, since ambulance,

public vehicles and medical facilities are not easily available and emergencies need to be attended promptly. Periodic rehearsals and practices should be carried out to keep/staff, equipment and vehicle in a state of readiness and also to train new staff joining the team on account of leave relief, hospitalisation and superannuating.

Training of staff: Training of all categories of ambulance staff is necessary. There should be laid down syllabus and periods for the basic capsule course for orientation of doctors, nurses, and nursing orderly, nursing technicians, stretcher bearer and drivers. Subsequently for updating the knowledge and skills, refresher course should be planned and held throughout the year. Minimum every 3 months, there should the mock rehearsal or exercise to know the preparedness of staff in case of air strike or bombing, etc. Each ambulance crew members should be fully trained in emergency medical and surgical procedures, resuscitation techniques, electrocardiography (ECG) recording, wireless communication system and telemedicine relay system. Doctors and paramedicals from peripheral hospitals, primary healthcare (PHC) and general practitioners should also be encouraged and given due opportunity to attend such courses.

Patients must be lifted and loaded by trained and experienced staff. It is important that trained staff handles the patient, depending upon the nature of urgency, e.g. a case of fracture T-3-4-5 vertebra or fracture of femur would require expert and delicate handling, then a case of fracture rib or ulna is delicate. Cases of asphyxia or mine blast, poisonous gas poisoning, crush injury of leg or eighty per cent burns due to explosion need special handling. Prompt removal of foreign body, objects causing penetrating injury, positioning of patient to avoid further injury to tissues, nerves and vessels causing pain and likely gangrene are immediate tasks of ambulance crew. Immediate simple first-aid measures like tying of tourniquet and packing by gauze piece if there is a bleeding wounds, preventing further blood loss, and consequent shock and death are immediate concern and responsibility of ambulance staff. Subsequently, maintenance of treatment intravenous drip, truckling of any cardiac arrest or fall of blood pressure (BP), etc., while transporting patient to the hospital for treatment is the responsibility of ambulance staff.^{1,2}

COMMUNICATION SYSTEM IN AMBULANCES

Two-ways communication system should be used for effectiveness and efficiency of ambulance-based emergency medical care system. All ambulances should have wireless communication system linked with concerned hospital or ambulance control organisation.

An electronic keyboard with memory system that can convey the patient-related call and information system to a similar display panel in the receiving hospital emergency

department should be installed. In the present era of satellite communication system, computers, global cordless telephone and e-mail, no difficulty is visualised in providing communications system in ambulance. The system should be on 24 hours × 7 days so that any emergency call can be received by hospital ambulance control organisation or centralised accident trauma centre (CATS), who can then direct, and ambulance staff is then directed to proceed at the site of emergency or accident. The global positioning system (GPS) system and control room should be enabled for microsupervision of the system. This system has been efficiently used in India in various cab services to ferry passengers.

The drivers should be familiar with the various areas and roads of city or concerned area of operation beforehand. Ambulance should have detailed map of city roads so that, if required, they can be asked to refer to the map. All doctors, nurses, paramedical and driver staff of ambulance transportation system are required to be trained in operating communication system with ease and for this training in handling of communication system needs to be given to staff. To check efficiency and call response time, day and night exercises needs to be carried out at periodic intervals. This will enable organisation to maintain state of alertness. It should keep a record of telephone number of fellow colleagues/hospitals and it should also keep a map of the city/area for faster and accurate movements.

In order to check the misuse of ambulances, many hospitals have installed global positioning system (GPS) in its ambulances. The system will help the hospital act faster in the first and most crucial hour for a victim after an accident. The GPS installed in the ambulances ensures that operators at the base centre locate the patient's location and inform the driver. Other than enhancing patient assistance, the GPS plays a vital role in ensuring the safety of attendants. The cost of implementing implementation is low.⁴⁻⁶

EQUIPPING OF THE AMBULANCES

It is not necessary that all ambulances should have only one scale and kind of equipment. Ambulances meant for different roles, e.g. mobile emergency, burns unit. Coronary care unit, mobile dialyses unit and mobile operation theatre should possess specialised equipments. But few certain essential equipment must be present in all ambulances, as laid down by bulletin of American College of Surgeons and these are:

- Portable suction apparatus, wide-base tubing, rigid pharyngeal suction tip.
- Hand-operated bag mask ventilation unit with mask of all sizes.
- Oropharyngeal airways: All sizes.
- Mouth-to-mouth artificial ventilation airways: Adult and children.

- Portable oxygen equipment.
- Mouth gags.
- Sterile intravenous infectious (plastic bags with administration kit).
- Universal dressings, sterile gauze packs.
- Bandages of all types.
- Sterile burn sheets (two).
- Traction splints (lower limbs).
- Padded splints assorted.
- Spine boards.
- Safety pins.
- Sterile obstetrical kit.
- Anti-poison kit.
- BP instrument and stethoscope.
- Two-way communication system.

In addition, some of the ambulances should have equipment like, instant X-ray film-processing equipment, operating tools, operation theatre (OT) table and OT lights, etc. for carrying out surgical procedures, ECG monitoring equipment, defibrillator, respirator—portable, Ambu bag with facility for attachment of various sizes of tubes, suction apparatus (paddle and battery operated), drinking water storage containers, blood bottles of common blood groups, facility for doing cross-matching of blood, generator on wheel to be towed by ambulance to keep the equipment functional, OT light, X-ray machine, monitoring equipment, etc.).⁴⁻⁶

PHYSICAL FACILITIES OF AMBULANCE SERVICES DEPARTMENT

The parking should be easily accessible to patients and public. Ambulance should have well-known fixed covered parking places, so that these special vehicles do not deteriorate due to extremes of weather. The floor of the parking space should be cemented, nonslippery and easily washable with sloping surface. Ambulances parking should have adequate space for easy turning around of ambulances. In accident and emergency service department or centre, it should be able to go right at the entrance gate of the department. The parking should be at a prominent place and in such a way that patients can easily be loaded and unloaded.

The parking area should be well-lighted during day and night. Illumination of 400 lux can be considered as basic light level in most of the areas. There should be provision for emergency lighting system to overcome problems of power failure. As large number of visitors, relatives, police and staff personnel would be visiting ambulance services department, urinals (male and female separately) for public and patients including wheel chair patients are required at a convenient place. Janitor closet of the size of 40 sq feet for housekeeping and cleaning material is essential.¹

TRANSPORT SYSTEM LINK WITH GOVERNMENT SCHEMES: SOME EXAMPLES

Janani Suraksha Yojna

Problem

Maternal mortality remains one of the most daunting health challenges in our country and reduction in the same has been one of the focus areas of work. National rural health mission (NRHM) goal is to reduce maternal mortality rate (MMR) to 100/1,00,000 live births by 2012. Sample registration systems (SRS) estimates that 9% of all maternal mortality is due to unsafe abortions. One of the key contributing factors for this situation is the lack of efficient transport system in rural and remote areas for pregnant women. It is well-proven that a significant number of maternal and neonatal deaths could be saved by providing timely referral transport facility to the pregnant women.

Solution

Under Janani Suraksha Yojna (JSY) scheme, Government of India provides transport facilities at various levels of health-care centres for transport of pregnant women from home to hospital. The ambulance is well-fitted along with all necessary lifesaving equipments along with trained technician (doctors in some cases). The free referral transport services (for pregnant women and sick neonates is up to 3 days) includes transport from home to health facility, referral to the higher facility in case of need and drop back from the facility to home. This had led to tremendous decreases in MMR in different parts of country. Same types of services are provided in various parts of our country. This has led to tremendous decrease in MMR of our country (Figure 30.3).⁴

Mobile Medical Unit (MMU)

The mobile medical units (MMUs) are operationalised in every district of the country under NRHM to provide access to healthcare, especially in underserved areas (Figure 30.4).

Types of services to be provided

Every MMU has to provide the following services:

Curative

- Referral of complicated cases.



Figure 30.3 Vehicles support under JSY scheme.



Figure 30.4 Mobile medical unit.

- Early detection of tuberculosis (TB), malaria, leprosy, kala-azar, and other locally endemic communicable diseases and noncommunicable diseases such as hypertension, diabetes and cataract cases, etc.
- Minor surgical procedures and suturing.
- Specialist services such as paediatrician and physicians.

Reproductive and child health services

- Antenatal check up and related services, e.g. injection-tetanus toxoid, iron and folic acid tablets, basic laboratory tests such as haemoglobin, urine for sugar and albumin, and referral for other tests, as required.
- Referral for complicated pregnancies.
- Promotion of institutional delivery.
- Postnatal check up.
- Immunisation clinics (to be coordinated with local sub-centres/PHCs).
- Treatment of common childhood illnesses such as diarrhoea, acute respiratory infections (ARI)/pneumonia, complication of measles, etc.
- Treatment of reproductive tract infection (RTI)/sexually transmitted infections (STI).
- Adolescents care such as lifestyle education, counselling, treatment of minor ailments and anaemia, etc.

Family Planning Services

- Counselling for spacing and permanent method.
- Distribution of nirodh, oral contraceptives, emergency contraceptives and IUD insertion.

Diagnostic

- Investigation facilities like haemoglobin, urine examination for sugar and albumin.
- Smear for malaria and vaginal smear for trichomonas.
- Clinical detection of leprosy, tuberculosis and locally endemic diseases.
- Screening of breast cancer, cervical cancer, etc.

Specialised facilities and services: X-ray, ECG, ultrasound test.

Others: Emergency services and care in times of disaster/epidemic/public health emergency/accidents, etc. Disseminating information, education and communications (IEC) material on health for personal hygiene, proper nutrition, use of tobacco, diseases, prenatal diagnostic techniques (PNDT) act, etc., RTI/STI, human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS).

Health Team

Tow medical officers, one of whom will be a lady medical officer. Radiologist, nurse, laboratory technician, pharmacist, helper, drivers, specialists [obstetrics and gynaecology (O and G) specialist, paediatrician and physician] depending on state-to-state.

Type of vehicle

Three vehicles will be provided for the purpose with the NRHM logo. One with ten-seater passenger carrier to transport medical and paramedical personnel. The other vehicle-carrying equipment/accessories along with basic laboratory facilities. The space at the back will be utilised for placing a couch. This couch will be used as the examination table during camps and for transfer of patients at times of emergency. The third vehicle is , a mobile van with diagnostic equipments such X-ray, ultrasound, portable ECG machine and generator, etc. At states' level district health society/Rogi Kalyan Samitis/NGOs are involved in deciding the appropriate modality for operationalisation of the MMU. At periodic intervals, specialists from the district hospital accompany the vehicle.

Revised norm for deployment of MMUs under NRHM

- District with population up to 10 lakhs: 1 MMU.
- Districts with population of more than 10 lakhs and up to 20 lakhs: 2 MMUs
- Districts with population of more than 20 lakhs and up to 30 lakhs: 3 MMUs
- Districts with population of more than 30 lakhs and up to 40 lakhs: 4 MMUs
- Districts with population of more than 40 lakhs and up to 50 lakhs: 5 MMUs and so on.

Uniform colour code of MMU

To establish a uniform branding of vehicles sanctioned under NRHM, it was suggested that a universal name and colour with emblem of Government of India and State government be used on all the vehicles apart from the logo of NRHM. 'Rashtriya Mobile Medical Unit'.^{4,7}

Case Study 1: Dial-an-ambulance service in Patna, Bihar

In Bihar, two systems of referral transport have been initiated by the government. 'Dial-an-ambulance service (102)' was started in November 2006 in which ambulance owners were empanelled on the rates fixed by the government. Funding is done by the local Rogi Kalyan Samiti (RKS) and is free for BPL population, while APL client is being charged at per kilometre rates. A small percentage of this amount is deposited by the driver in the RKS fund. In few other PHCs, local member of parliament (MPs)/

member of legislative assembly (MLAs) have donated vehicles for this purpose. Maintenance of the donated vehicles is done from annual PHC funds.

The second mechanism runs through state health society (SHS), Bihar. SHS Bihar pays an annual fee of Rs 41,000 (38,000 if a control room is provided by the government) per region to a nongovernmental organisation [(NGO) (Aryabhatta computers)]. The NGO has setup six regional control rooms, one of which is in Patna. When a patient calls 102, the control room staff arranges the nearest ambulance (including the one existing in the PHC) to pick up the patient. They also charge the same per kilometre fare from the client.

Case Study 2: Emergency response services through ambulances in states of Punjab

The Department of Health and Family Welfare, Government of Punjab has started providing emergency response services (ERS) from March 31, 2011 in the State of Punjab at free-of-cost to all the citizens of the state. It is envisaged that around 240 ambulances (i.e. one ambulance after for 1.20 lakhs population) will be positioned in the state in a phased manner. The services of ambulances are provided through emergency response centre, which will work 24 hours x 7 days a week. The services of the ambulances can be availed from anywhere in the state of Punjab by dialing 108 from landline or mobile phone. These ambulances shift the trauma cases and other emergency in the designated earmarked health institutions. Ambulances provide services in case of road side trauma, suicide, cardiac emergency, neonatal paediatric emergency, diabetic emergency, respiratory emergency, maternal emergency, epilepsy emergency, animal bite, burns, fever/infection, etc. The emergency ambulances will reach the place in 20 minutes in urban areas and in 30 minutes in rural areas.

These ambulances are being monitored through general packet radio service (GPRS) for deployment to the site. An ambulance gets instruction from highly trained doctor sitting in the control room. It is manned by specially trained medical technician and driver. An ambulance has all the emergency medicines, and is equipped with emergency medical equipment. An ambulance and control room simultaneously interact with the nearest hospital where the patient needs to be taken. Similar services have been started in various states of India. This had improved the health services of the states.

The ambulance services play a key role in early management of patients. The efficient ambulance services have demonstrated a decrease in overall mortality rate in various parts of country.

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Transport Services

Dr Tejinder Kaur, Dr Amarjeet Singh, Dr Geetu Malhotra, Er Narendra Kumar Prarthi and Dr Sonu Goel

“We must be part of the general staff at the inception, rather than the ambulance drivers at the bitter end.”

—Lane Kirkland

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the intricacies involved in hospital transport system management.
- describe the process of transport management system in hospitals.
- describe the various means of transport in hospitals.
- plan the future perspective of transport management in hospitals.

INTRODUCTION

Hospital is a place for care (of patient) and cure (of disease). Here patients are attended either in outpatient department (OPD) or in wards. Patients use public or private ambulances to reach hospital. Staff members also use transport for their daily activities—on-campus or off-campus. Vehicles are also used for indent of various supplies from within the hospital or from sources located outside its vicinity. Equipments like lifts, dump waiters (small freight elevators or lifts intended to carry objects rather than people), trolleys, escalators, lorries and trucks and aircrafts, etc. are also a vital part of hospital transport system and cannot be neglected. Roads within hospital campus and around its premises are often observed to be crowded with personnel vehicles. This comprises the capacity of a hospital to provide efficient patient care. Thus, volume of traffic in hospital is substantial, making appropriate management of transport services in the hospitals mandatory. An efficient hospital transportation system leads to minimal use of personal vehicles by staff or patients. Besides it, smooth traffic flow within campus enables convenient commutation. Management of hospital transport system goes beyond its premises.

MEANS OF TRANSPORT WITHIN HOSPITAL

Hospital transport services can be broadly divided into following four types: (i) staff transport service (ii) material

transport service (iii) patient transport service (iv) other utility transport service—hospital transport, staff transport, material transport, staff or cars trolleys (diplast) store van, other patient vehicles transport, free shuttle ambulances, hearse van, basic life support (Flowchart 31.1).¹

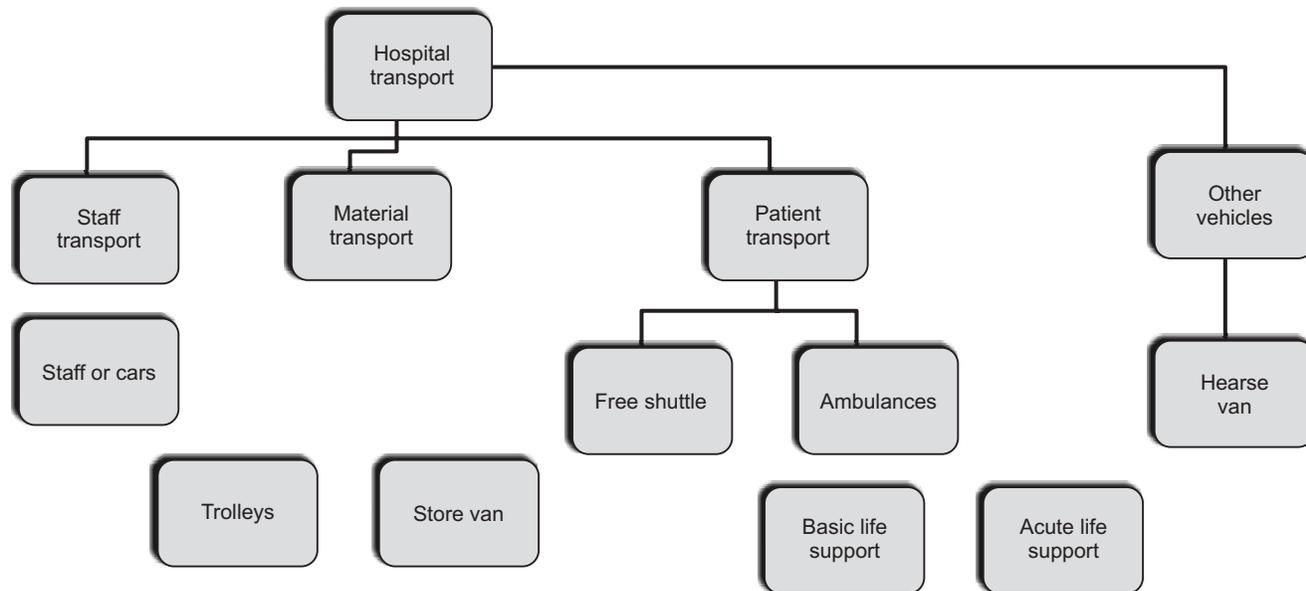
Staff Transport Services

Any good hospital will attempt to provide comfortable working environment to its staff, so as to reap maximum output. This includes providing convenient commuting facilities. Buses are provided for to-and-fro movement of staff between the hospital and their respective residences. In medical colleges and teaching hospitals, transport services are provided during teaching-cum-training programme of doctors/nurses/paramedics, especially for field visits. Vehicles are also required during conferences, workshops and other in-service education programmes. Individual staff cars are used, particularly, by the higher authorities in a hospital, e.g. Director, Administrator, etc.

Material Transport Service Store Van

It is used for the transportation of store equipments and materials between distantly located departments.

Trolley (laundry and other purposes): These trolleys are used to conveniently carry soiled and contaminated linen from hospital to the laundry plant and vice versa. They are



Flowchart 31.1 Transport services in hospitals.

also used to carry biomedical waste, drugs, equipments and supplies from different areas of hospital.

Biomedical waste van: The most important aspect of the hospitals' environment is the management of its waste. Large hospital and its various sections, i.e. research laboratories, operation theatres, catheterisation labs, cardiac care unit (CCU) and intensive care unit (ICU) wings, and nursing homes generate the biomedical waste in the form of human anatomical waste, blood, fluids, disposable syringes, gloves, intravenous tubes, cathedral, etc. All of this is hazardous in nature. If not properly disposed off and handled, it may lead to problems like hepatitis B, tuberculosis (TB), human immunodeficiency virus (HIV) and many other infectious diseases. To ensure its proper handling, both legislative as well as educative approaches are needed.

Therefore, biomedical waste vans should be there in every hospital.²

Patient Transport Services

Good transport services can help the sick or injured from peripheral areas to reach the hospital within time. These services are not only a vital part of a hospital but also a link between the healthcare delivery system and the community. For example, after head injury the 'first hour' is said to be the 'golden hour'. This golden time, if utilised properly, helps in saving the life of the patient. Delay in providing emergency medical care to casualties can also be avoided by providing optimum transport services in the hospitals. This service is a boon for healthcare delivery system, if preceded by effective medical care in a timely manner.

Ambulances: An efficient ambulance service is considered to be an essential part of a well-organised segment of emergency and critical-care service in hospitals.

Free Shuttle Services (see related chapters): In bigger hospitals (esp. the teaching hospitals) where different units or centres are distantly located, patients and their families have difficulty in commuting. In many such hospitals vehicles are provided as free shuttle services for transporting the patients as well their attendants within the hospital premises. In such a scenario, usually sign boards are displayed at various locations for the information of public. This facility reduces the rush of private vehicles within the campus of hospitals.

Others Vehicles Hearse Van

A hearse van is deployed for shifting dead bodies within hospital premises. It is often reported that hearse vans are often arranged in hospitals (privately or through some NGOs). But these are not usually used by the people due to expenses and tedious hiring procedures involved. Many people do not want to wait and prefer to hire private vehicles to transport the dead body of theirs kins at almost same cost. The hearse van should be provided 24 × 7 free services within a hospital.

Security services van: The security services are also necessary for a check on the traffic inside the hospitals premises. If there is any infringement of law inside the institute then security should resolve the issues. The tow away zones, no-horn zones and no-parking areas are taken care by the security services vans and officials.

these types of agencies are that it saves the doctor's time who may, in turn, devote more time on patients. On-campus booking can be done even through phone.

Court cases: Vehicles are provided to the doctors for attending the various court evidences at Chandigarh and adjoining states of Punjab, Himachal, Jammu and Kashmir, Haryana and Uttaranchal. A total of 739 requests were received by the transport section during the year 2011–2012.

Condemnation: A vehicle with 16 horse power and above that has been run for up to 6–7 years and also covers the prescribed kilometres according to guidelines can be condemned according to the procedures of Government of India (GOI). The condemned vehicles are disposed-off through auction by public newspaper notices.

Quality control measures: Fuelling of vehicles is done from CITCO petrol station (operated by Chandigarh administration) to ensure pure fuel for PGI vehicles. Repair of vehicles is done at authorised workshop to ensure use of genuine spare parts. Regular pollution checking of vehicles is also done. Personnel attention is paid day-to-day in day-to-day functioning or deployment of vehicles.

Expenditure in last fiscal year 2011–2012: An expenditure of Rs 1.26 crore was incurred on fuel and maintenance of vehicles.

Problems and solutions: No new ambulance has been bought since 2003 (as per GOI guidelines of not purchasing vehicles). There are no workshops and trainings for transport staff. Parking space was a perennial problem for which a multilevel parking has been built near new OPD (Figure 31.3). Another such parking was planned for faculty members of institute. PGIMER proposes to take a few steps to decongest the campus. Apart from designating some area into 'no-vehicles zone', the institute plans to widen all the roads of the institute and also constructs pavements along them for the benefits of the pedestrians (Figure 31.4). It has also banned the entry of autorickshaws and cycle rickshaws on the campus on the pretext that they lead to congestion to PGIMER.



Figure 31.3 Multilevel parking near new OPD.



Figure 31.4 'No-parking' and tow-away zones in PGIMER premises.

Future perspective: An emergency medical technician, trained nurse is planned to be employed for ambulances. A disaster management van with qualified doctors, nurses, paramedical staff with well-equipped facilities is planned to be provided in PGIMER campus. To avoid hassle in hospital premises, a plan for synchronisation of hospital and public transport system is made by PGIMER Chandigarh (Figure 31.5).

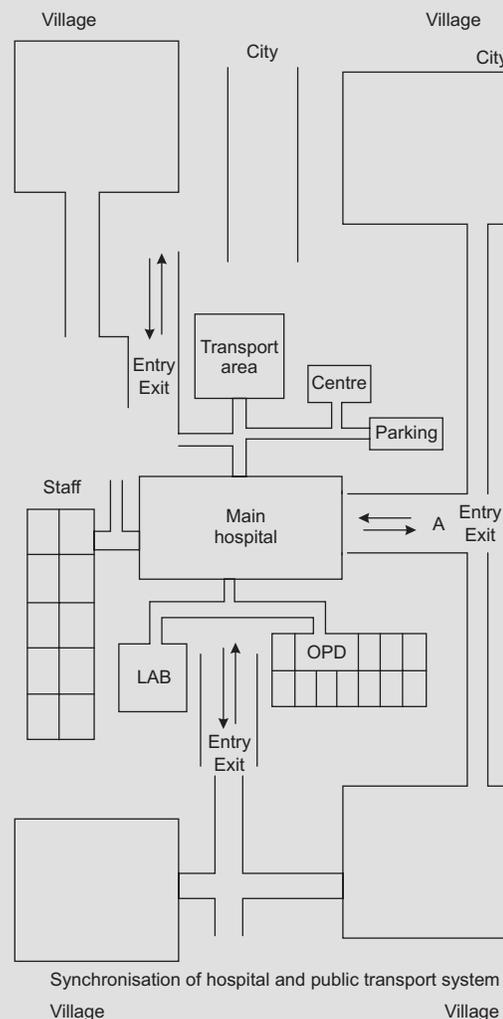


Figure 31.5 Plan for synchronisation of hospital and public transport system to avoid hassle in hospital premises.

The hospital transport services are often ignored during planning and implementation. It is one of the important areas for effective functioning of an institute.

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Medicolegal Services

Prof Dalbir Singh and Dr Satinder Pal Singh

“The corpse is a silent witness who never lies.”

—Anonymous

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- describe the principles of medicolegal practice in hospitals.
- get an overview of medicolegal problems faced by the hospital staff and the possible remedial measures to be taken for providing better patient care.

INTRODUCTION

Medicolegal examination of victims to ascertain the facts relating to an offence is an indispensable part of criminal justice system that falls under the domain of forensic medicine. In the present day scenario, it is imperative that the healthcare administrators are acquainted with problems faced by the hospitals so that better care can be provided to the patients. Over the past decade there have been significant developments in forensic field due to changes in trends of crime and its investigation, and also due to increasing awareness in public about their legal rights. Lack of adequate job opportunities, competition, limited financial resources and enhanced work pressure are some of the factors responsible to make people prone to frustration and depression, and increase their chances of getting involved in a scuffle. Sometimes a trivial-looking argument can lead to a brawl.

A medicolegal case is a medical case with legal implications (examples include murder, rape, assault, road accident cases, poisoning, hanging, strangulation, electrocution, dowry deaths, torture, etc.) and thus require intervention by the law enforcement agencies. In attending to such cases, the combined role of hospitals, police and judiciary is of outmost importance while the electronic and print media are responsible for making the general population aware of the unlawful activities taking place in the society and bringing into light the newer methods adopted by criminals for the committing crime.

Essentially, forensic medicine plays a pivotal role in protecting the freedom of people and ensuring that no

person is unduly condemned. For example, a woman may allege that she has been sexually assaulted and accuses a person who denies this allegation; only a medicolegal examination will establish whether the allegation was true or false. Similarly, a person may be driving under the influence of alcohol; thus endangering safety of himself and others. Medicolegal examination of such a person would reveal whether or not he was under the influence of alcohol.

As this work requires elaborate observations and investigations, the doctor concerned with the care of such a victim should be meticulous enough not to miss any significant finding that leads to adverse effect not only for patient's health but also in delivery of justice to him. The usefulness of diagnostic technologies cannot be undermined. For example, in a case of sexual offence, disputed paternity or in an unidentified dead body, DNA testing has become an important diagnostic tool. Such cases include misinterpretation of lacerated wound as incised wound, especially over the scalp or shin of a tibia, inadequate sample collection in a sexual assault case and mislabelling of samples, etc. Such lapses besides harming the victim in a number of ways also make the doctor liable to face the charge of negligence.

Medicolegal autopsies are conducted in all unnatural deaths and play a vital role in guiding the investigation agencies in the right direction. In custodial deaths, the autopsies have to be conducted according to guidelines of National Human Rights Commission (NHRC). The medicolegal autopsy not only gives the cause and approximate duration of death but also the manner in which the death occurred and the possible weapon(s) used, if any. In cases of unknown

bodies brought for autopsy, many times it helps in identification process also based on identification marks, congenital deformities or DNA profile, etc. If the doctor is not adequately trained, he/she is likely to miss some of the findings that could prove to be detrimental to crime investigation. So a proper training of doctors to keep them abreast with the latest knowledge is a vital link in this chain.

The medicolegal services in general have been neglected all over the world barring few exceptions. There is skeletonised dedicated staff working in pitiable conditions and with bare minimum facilities. A model medicolegal centre should be well equipped with amenities like radiological facilities, adequate instruments, uninterrupted power supply, a well-equipped laboratory and refrigeration system along with a qualified and committed staff.

Management of medicolegal services can be broadly discussed under the following headings.

MANAGEMENT OF MEDICOLEGAL CASE

The emergency department is usually the first place where a patient with a case history of medicolegal significance comes in contact with the healthcare workers. After providing initial care, the doctor prepares his medicolegal report which not only includes a detailed examination of the injuries but also the requisite history that led to the present condition of the patient. Following the preparation of report, it is sent to the concerned police station to start the investigation process. Some of the examples of medicolegal cases are victims with grievous injuries (even accidental), poisoning, road traffic injuries, sexual offences, burns, unconscious person with injury of any nature, hanging, strangulation, drowning, attempted abortion by unauthorised persons, people under police or judicial custody or patients brought to hospitals under suspicious circumstances, etc.

Steps for Medicolegal Examination

Primary care

The first and foremost duty of the treating doctor is to save the life of a patient and give the necessary urgent treatment. Police should be informed as early as possible, but the patient should not be allowed to suffer. For this, he must not wait for the arrival of police. Even if the patient is unable to pay fee at the time of presentation to the hospital, he must not be denied emergency care. Failure to provide such care may render the hospital liable to face legal action.

Timing

It is essential that the medicolegal examination should begin without any further delay so that the process of crime investigation can be initiated by the police as early as possible.

Examination

Consent: It is mandatory to take consent of the patient before examining him/her. It should be a voluntary, intelligent, written and informed consent. A person above 12 years of age can give consent for examination.¹ For a person below 12 years of age, consent of the guardian is required. In case of an alcoholic person, consent for examination and collection of blood, urine and breath samples are essential. If the patient is unconscious, the consent from the family or guardian is required. In cases where they refuse, it should be mentioned in the report that the consent could not be obtained citing reasons. When examining an accused person who has been arrested, consent is not required (u/s 53 and 53A Cr.P.C.) and a reasonable amount of force is allowed for the same after the receipt of request from a police officer not below the rank of subinspector. However an arrested person can request a medical officer to examine and detect evidence in his/her favour (u/s 54, Cr.P.C.).²

Preliminary data: This includes name of the hospital, medicolegal report number, name of attending doctor with designation. Note patient's name, age, gender, caste, address, occupation, site of incidence and brief history of the event. Name and signature of the accompanying persons should be taken. Exact time of arrival in hospital and examination should also be noted. In admitted cases, note the central registration number for future reference.³

Identification marks: It is mandatory to note two marks of identification on the body of the patient and mention these in the medicolegal report. The tattoo marks and moles as far as possible should be avoided and noted only if no scar marks are present on the body. In case where no identification mark is available, a thumb impression can serve the purpose. In males, the left thumb impression and in females, the right thumb impression are traditionally taken.⁴

Physical examination: Begin with a general physical examination and recording of the pulse, blood pressure, orientation to time, place and person, speech, gait, level of consciousness, smell of alcohol or any other intoxicant. Clothing should be checked for any tear or cuts, stains or foreign matter.

A detailed examination of all the injuries should be done to establish type, size, shape, location, direction, time and age of injury. Usually nature of injury is given on the spot in case of simple injury and kept for further observation in case of serious injuries. The examination should ideally be from head to toe on both the front and back aspects of the body.⁵

A medicolegal report cannot be produced twice unless specifically asked by the police or under court orders.

Collection of evidence: While collecting samples, care should be taken to avoid contamination and maintain asepsis.

The samples collected should be immediately preserved in appropriate preservative, labelled and sent for examination.⁶

Further medical investigations: After a detailed examination of the injuries, the necessary investigations required to ascertain the facts should be sought. These include X-rays, ultrasonography, CT scan/MRI, histopathology, DNA, fingerprinting, spectrophotometric examination of gunpowder, etc. depending upon case to case.

Examination of female victims in both medicolegal and nonmedicolegal cases: A female patient has to be examined either by or under the supervision of a female doctor or in the presence of a female relative/friend or woman hospital attendant if the doctor happens to be a male. This should be done to prevent any allegation of sexual assault against the male doctor.⁷ In a case of alleged rape, the victim has to be examined by a female doctor only.

Examination in poisoning cases: While examining such a case, gastric lavage should be preserved and sent for toxicological analysis. If no lavage sample is preserved, the doctor may be charged with negligence.⁸

Examination of victims/assailants in sexual offences: In a case of sexual assault, the general precautions while examining a female patient should be taken. In addition, swabs should be taken for seminal/blood stains. Any foreign matter such as hair, fibres mud stains, etc. should be preserved. Special attention should be given to prevent the spread of sexually transmitted diseases.⁹ There is, however, no gender bar for doctors to examine a male victim of sodomy.

Fee

All the cases brought by the police for medicolegal examination are exempted from fee, while in private cases a fee prescribed by the state government is charged.

Dying declaration

If there is likelihood that the patient will not survive as a result of injuries sustained by him/her, then the doctor should ask the police in writing to call a magistrate to record the statement of the patient. If that cannot be arranged quickly and the patient is likely to die in this time, then doctor should record his statement himself in the presence of two disinterested witnesses. This should be read over to him/her and signatures taken, if possible. No police personnel or relative/friend of the patient should be allowed to be present while it is being recorded. The doctor should issue another certificate stating that the patient was in sound mental health when the declaration was being made and remained so till its completion.¹⁰

Intimation to police

As soon as the report is prepared, it should be handed over to police to initiate the process of investigation. A receipt in

this regard should be obtained and maintained with the patient's record. This receipt contains the date and time of informing the police, and preliminary details of the patient.

Reports

After receipt of reports from concerned medical specialists, opinion regarding nature of injuries or other queries should be intimated to the police.

Chain of custody

It is ideal for the doctor to handover the medicolegal report and samples to the police himself. If other members of staff are included in the procedure, chain of custody should be maintained.

Preservation of clothing

Preservation of clothes is usually required in all cases of homicides, firearm injuries, stab injuries, sexual offence cases, burn injuries (if available), etc. When collected look for the type and colour of the cloth tears or cuts, gunpowder residue, presence of blood, semen or other foreign material or smell. The tears/cuts should be encircled and signed; clothes thus sealed should be handed over to police and receipt to this effect may be obtained. Before handing over the clothes to police, care should be taken that these are dried under shade and not sunlight.

Handling the recovered bullets/pellets

While providing care to a firearm victim, if bullets/pellets are recovered, they should be handled with hands or nontoothed forceps to preserve the original markings and avoiding adding any artifacts. They are then handed over to police after sealing and receipt is obtained.

Discharge

After intimating police regarding the pending discharge of a medicolegal case from hospital, doctor should wait for a reasonable period of time for the arrival of police personnel before actually discharging the patient.

Record keeping

As medicolegal record is confidential in nature and should not be disclosed except in court of law, it should be kept in a safe custody in the hospital for future reference. A photostat copy may be provided to police if desired. If the court asks for the original record, the same may be provided after numbering of all the pages and a photostat copy of the same may be maintained for future reference.

Brought dead cases

Sometimes a medicolegal case dies during transportation to the hospital. If such a situation arises, the doctor on duty should try to revive the victim; and if all resuscitation measures fail, send the dead body to mortuary for a

postmortem. In such cases, consent of the relatives is not required for autopsy as the law provides the same. No death certificate should be issued in such cases.

Estimation of age

People may come to hospital for estimation of age that are under trial in different courts for some offence, making of passes for public transport, recruitment purposes, etc. Such cases are usually examined by a board of doctors comprising of dental surgeon, radiologist and a forensic expert/orthopaedic surgeon/physician. All the necessary radiological tests aided by the general examination findings and stages of development of secondary sexual characters should be carried out to determine age within a reasonable limit in such cases.¹¹

MANAGEMENT OF MORTUARY SERVICES

The mortuary is the place where many dead bodies are kept together at the same time, leading to increased exposure of the hospital staff to resistant microorganisms posing a major health hazard. Hence, the healthcare professionals and other assistants should take precautionary care as the body is extensively mutilated, and chances of accidental spillage of blood and other body fluids are comparatively more.¹²

Steps of Postmortem Examination

Indication

Under Sections 174 and 176 Cr.P.C., a medicolegal autopsy is indicated in all unnatural deaths, which include homicides, deaths due to road traffic injuries, poisoning, fall from height, electrocution, hanging, strangulation, unknown bodies, deaths in police custody, etc.

Police inquest

Before the autopsy, police inquest papers containing all the relevant details of the case must be obtained. Without a request from police, postmortem cannot be carried out.

Timing

Postmortem is usually conducted during daytime, except when there is a foreseeable problem of law and order and police has specially requested to conduct postmortem in the evening/night or under orders of a district magistrate. In some western countries and even at a few places in India, now postmortems in the cases like deaths due to road traffic injuries, etc. are conducted round-the-clock to speed up the investigation process.

Medical records

It is desirable to go through the medical records of the deceased if he was treated in the hospital before his demise.

The purpose is to obtain useful information that is helpful to ascertain the cause of death, as some important health condition could otherwise be missed that has contributed to death of the person.

Autopsy

Before commencing the postmortem, examine the clothes and other belongings of the deceased as it sometimes gives information regarding the circumstances preceding death. For example, if there was a brawl before the murder, some mud stains indicating the site may be found on the clothes; in cases of drowning deaths, some weeds or other plants belonging to the site of incidence may be found adhering to the clothes.¹³

The autopsy includes the external examination of the entire body for the type, number, pattern and duration of injuries. External examination may also yield foreign material like ligature, blood stains, fibres, mud stains, saliva, seminal stains, etc., that can help in identification of the accused after cross matching. Development of rigor mortis also helps estimate time of death. Any injection-like marks may give a clue regarding the drug addiction or insect/snake bite that may sometimes be hidden in the hairy areas like axilla; so a careful examination of the site is an absolute necessity.¹⁴

Internal examination requires a general examination of all the body organs and focused attention on the organs of interest. A histopathological and chemical examination for more detailed study is desirable, especially in poisoning/suspected deaths.

In autopsies on unknown dead bodies, try to find any identification mark/scars/tattoo marks or any other personal belonging that helps in establishing its identity. A piece of bone having marrow/hairs with its bulbs or blood should be preserved for DNA fingerprinting.

For autopsy on human immunodeficiency virus (HIV)/hepatitis-positive dead bodies, more stringent protective measures (AIDS kit) are to be taken. In such cases used instruments and laundry material should be disposed of after proper treatment. HIV/hepatitis positive dead bodies after autopsy should be properly wrapped in double-layer plastic bag with their details mentioned over it and tagged as 'biologically hazardous'.

Occasion may arise when a postmortem has to be carried out on the dead body contaminated with radioactivity. If the radioactivity is more than 5 milli curies, thick rubber gloves, double plastic aprons with a lead sheet in between, double plastic shoe covers and spectacles along with long handled instruments should be used to carry out the postmortem in shifts and by multiple doctors to minimise the exposure. The organs showing maximum radioactivity should be removed and placed in separate lead jars.

Re-examination

Sometimes, in controversial cases, a second medicolegal/postmortem is required which is conducted on receipt of directions from court/police (investigation officer)/civil surgeon citing reasons for the same.

Handing over the dead body and postmortem report

At the time of handing over the body, the postmortem report should be handed over to police. If there is a delay in handing over the report, this fact should be brought in writing to the knowledge of police.

Chemical/histopathological examination

After the receipt of reports of chemical/histopathological analysis they are sent to the police along with the opinion regarding the final cause of death, which is invariably kept pending subjected to receipt of these reports.

Case Study 1: Alleged case of poisoning solved by medicolegal examination

Ms ABC was brought by her neighbours in emergency department with alleged history of poisoning by self-ingestion of wheat preservative. The victim (26-year-old female) was married back 3 years and had a 1-year-old daughter. In her dying declaration to the duty magistrate, the victim stated that she was being harassed by her husband and in-laws for not bringing enough dowry and also for giving birth to a female child.

Management: At the time of presentation in the emergency department, she was immediately offered medical aid. Gastric lavage was done and preserved, electrolyte infusion started and vitals maintained. As the victim was an illiterate lady, her thumb impression was taken on the medicolegal proforma under the column of consent for the preparation of medicolegal report after explaining her need for this legal formality. The gastric lavage sample was sealed and handed over to police for chemical analysis along with the medicolegal report for initiation of investigation of the case. The victim died after few hours and the postmortem was conducted. The viscera were sent for chemical examination. The report of the chemical examination showed the presence of aluminium phosphide both in gastric lavage and viscera, which was consistent with the history provided. These provided enough evidence and all the accused were booked under 306 IPC (abetment of suicide).

PROBLEMS FACED BY HEALTHCARE PROFESSIONALS AND THEIR SOLUTIONS

In Casualty Department

Casualty is the place where besides managing the medical emergencies, medicolegal examination of the victim is usually carried out. Medicolegal examiner may come across the situation where the victim or his relatives/friends are not in favour of and may even insist that the doctor should not inform the police or prepare a medicolegal report, especially if it is a road traffic injury/sudden death case. At times, there comes a case to casualty that gives a very vague and suspicious history. In such cases the doctor must inform the police despite facing opposition from the attendants.

Further, some patients present with 'self-suffered' or 'self-inflicted' injuries just to implicate the arrivals. Such injuries should be very carefully examined. They are usually superficial and present on the nonvital parts of the body. There will not be corresponding tears/cuts on the clothes. On taking the history carefully, inconsistencies will be found. Sometimes when a number of patients with injuries arrive at the hospital simultaneously, it is challenging to provide timely care to all. This undesirable situation frequently leads to quarrels between the hospital administrators and the relatives and friends of victims.

Case Study 2: Medicolegal report: Rescue for alleged assailant

Mr XYZ (28-year-old male) presented in the emergency department with alleged history of assault by a blunt weapon. The patient complained of two 'bruises' on the flexor surface of left forearm in its middle. On examination the area showed redness and inflammation with a few vesicles. No other part of the body was injured. A suspicion of artificial bruise arose. To confirm the diagnosis swab samples from the site of 'injury' were taken and handed over to police for chemical examination along with the medicolegal report for the initiation of investigation of the case. Later, the report of chemical examination confirmed the presence of calotropin and uscharin, which are the active agents found in calotropis juice are sometimes used for the production of self-suffered injuries. The alleged assailant was exonerated of the false charge and the so-called 'patient' was booked under various sections of IPC (Indian Penal Code).¹

Case Study 3: A case of sexual assault solved by medicolegal examination

Ms ABC (27-year-old female) was brought by the police in the emergency department in an unconscious state. She was found lying on the floor of an industry where she had recently joined as a worker.

Management: During the brief history by fellow colleagues in industry, the owner of the industry was found to be a known flirt. Besides providing medical care and preparing the medicolegal report of victim, vaginal swabs were also collected to rule out sexual assault. Swabs showed the presence of spermatozoa, which, however, did not match with that of owner of the industry. This lead was provided to the police and later it was found in police investigation that she had sexual intercourse with another man with whom she fled from her native place just before committing suicide by self-immolation because of the fear of getting caught and face humiliation at the hands of her relatives. With these findings in place, the owner of the industry was acquitted of a false charge.

In Ward Areas

The ward is a place where illness of a patient is treated in a cordial, congenial, safe and relaxing environment. This environment can be vitiated or turned into a brawl if two rival persons get admitted in the same ward/hospital, putting staff and other patients at unnecessary risk. There have been incidences when two opposite parties have opened fire on each other in the ward, creating a threatening situation for everyone. Occasionally, the admitted patient absconds and may carry the medicolegal file with him, in the process creating problems for the staff. There are also chances of tampering with records if medicolegal report or file is readily available to the patient/relative.

There is generally a tendency on the part of patients with simple injuries to make frequent request for a late discharge from the hospital as these patients are generally more concerned to fulfill the condition laid down in eighth clause of grievous injury than their health. Another type of request that is usually made by the patient to the doctor is that he may be allowed to go outside the hospital unofficially under some pretext. No such request should ever be entertained as he may get involved in some illegal activity while officially getting treatment in a hospital after admission. The doctors can land up in serious trouble if they ever gives such permission.

Sometimes patient with a medicolegal history repeatedly insists for unnecessary tests like CT scan/MRI just to give an impression to the interested party(s) that he is suffering from some serious injuries.

In the Mortuary

The autopsy surgeon and other staff in the mortuary have exposure to the infectious diseases like typhoid, hepatitis, cholera, influenza, meningitis, anthrax, HIV, etc. These diseases can be transmitted either by direct contact or through infected materials (e.g. vomit, blood, etc.) associated with the dead body. Preventive gears should be used to avoid the risk of transmission.¹⁵

Sometimes there is large number of dead bodies waiting for the conduction of postmortem. But the staff cannot cope up with this sudden demand in a short period of time, leading to an argument of relatives with the hospital staff for a speedy postmortem. If the police inquest papers of more than one case are simultaneously brought to the doctor on duty then there is a competition among these parties to get the postmortem done before the other party and doctors have tough time dealing with these situations.

At times, there arises a situation when the dead body lies in the mortuary over a long period of time and postmortem cannot be conducted because of unavailability of police papers or lapses on part of doctors of the ward to intimate the police in time regarding death of the patient. This makes the relatives and friends of the deceased lose their patience and they try to take away the dead body without postmortem. This creates ruckus for the hospital staff, including doctors involved with the autopsy services.

Another problem faced by the doctors is the request made by the relatives of the deceased to conduct postmortem at odd hours as they want to cremate the dead body as early as possible as many relatives and friends wait for the arrival of body at the cremation site. Sometimes even a polite refusal by the doctors makes them violent, especially if the deceased is an influential person.

There are deficient numbers of cold chambers in almost every hospital in India and it creates problems for the forensic team as the bodies kept outside tend to decay very fast and vital clues might be lost because of decomposition. Adding to the woes, even hospitals are not spared of electricity cuts. Emission of foul body odour from such decaying bodies makes it difficult to stand near it for the mortuary workers.

Shortage and Lack of Adequate Training of Staff

Many hospitals lack the adequate strength of staff including doctors, technical staff, attendants, etc., which leads to increased work load and consequent delays in providing healthcare services.

The problem of training particularly arises at state level where medical officers face difficulty in preparation of medicolegal and postmortem work due to inadequate training. Some of these doctors refer the patients or dead bodies

to higher centres for this reason only and not because of other valid reasons.

GOVERNMENT VERSUS PRIVATE HOSPITALS

A doctor working in government hospital is bound to inform the police of every case of poisoning, be it homicidal, suicidal or accidental; but a doctor in private practice is not bound to inform the police if he is sure that the case is of suicidal poisoning. However, he must report every case of homicidal poisoning to police.¹⁶ It is advisable that the private practitioners should inform the police of every case of poisoning to avoid legal trouble at a later stage, if any.

Though there is no law debarring, most of the private hospitals do not prepare medicolegal reports leading to long delays in the progression of the medicolegal cases. The patients have to then go to a government hospital for the same. Unless the underfunding and lack of staff are adequately addressed, the situation is likely to deteriorate in future leading to delays in delivery of justice and lawsuits against the private hospitals.

TRAINING AND RESEARCH IN MEDICOLEGAL ASPECTS: A LOW PRIORITY

The subject of forensic medicine is as old as the mankind itself. Because of the fear from the forces of nature, man started worshipping various deities and later framed a set of rules and regulations that led to the rise of medical jurisprudence. With passing time, the knowledge of medicine grew and became an important tool in the hands of law and judiciary. The subject of forensic medicine today has many aspects dealing with pathology, toxicology, odontology, anthropology and biology.

In the present scenario there is an acute shortage of forensic medicine specialists in India that has led to a situation where nonspecialists are involved in medicolegal services to a larger extent. As most of these doctors are not well versed with the medicolegal work, it frequently results in preparation of medicolegal and postmortem reports that are incomplete and vague. This is a huge blow to the legal system as justice may get carried away in the wrong direction. Therefore, adequate training of medical staff in dealing with such cases is the need of the hour.

Research in the medicolegal field has traditionally been limited to community forensic medicine. But research in fields like estimation of time since death from DNA degradation, body electrolytes and enzyme levels, and estimation of age from racemisation of aspartic acid and from telomere length are some of the new areas of interest. The government of India is now providing adequate funding for such projects that are likely to enhance our understanding of issues of medicolegal importance.

As per the directions of the court, many hospitals have started issuing computerised medicolegal and postmortem reports, which have addressed the problem of illegible handwriting to a larger extent. However, many hospitals are still issuing handwritten reports due to inadequate funding and consequently lack of computers and adequate staff.

Medicolegal services form an indispensable part of hospital services that not only assist in guiding the law enforcement agencies in right direction but also aid judiciary in delivery of justice. Every effort should be made for incorporating all the latest advancements in this field to provide a better service to the society.

A medicolegal case requires harmonious cooperation among the hospital, police and the judiciary. As far as the hospitals are concerned, casualty is first place that receives a medicolegal case and hence the doctors should skillfully handle it. After obtaining consent, two identification marks should be noted and medicolegal report needs to be prepared and sent to police without delay. Required samples should be obtained taking all precautions and are preserved in appropriate medium and handed over to police while maintaining a chain of custody. Before conducting postmortems, police or magistrate inquest papers should be obtained and identity of the body is established. Every precaution should be taken to avoid contracting infections from the patient/deceased.

As these legal matters require a scrupulous medical examination of the person in question—a general awareness of the medicolegal issues is crucial to provide leads to the investigation agencies involved in solving the case. A lack of adequate training on the part of hospital staff, in general, and doctors, in particular, in dealing with such matters along with inadequate infrastructure not only hampers the delivery of the justice to the victim but also invites lawsuits against the medical practitioners. It is, thus, the need of hour to address the various issues associated with medicolegal practice that have been highlighted in this chapter.

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Building Public Image of Hospitals

33

Dr Anmol Gupta and Dr Sonu Goel

“Public opinion is the only thermometer a monarch should constantly consult.”
—Napoleon Bonaparte

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- define the role of health administrator in building and maintaining good public image of hospital.
- enumerate operative and communicative methods of promoting good public image.
- describe the role of hospital functionaries in building image of hospital.

INTRODUCTION

The community's expectations from hospitals have been increasing day-by-day due to growing appreciation of human values coupled with improved socioeconomic conditions. A hospital is an integral part of our social system. On one hand, hospital has to deal with professionals (like doctors, nurses, technicians and other paramedical personnel), whereas on the other hand, it has to encounter with personnel that are a part of the management services (like dietary, laundry, supplies, housekeeping, accounts and so on). Most importantly, it also deals with the patients and try to satisfy them as their actual customers (which at most of times are assumed to be just the patients). However, apart from those who are attending as outpatients or are admitted as inpatients, the patients' relatives and visitors also need to be catered as they are the potential customers for future.¹

Public relations are more than a summation of individual relations. Public relations of hospital generally define the image of a hospital. The image (may be positive or negative) is a mix of:

- Impressions and experiences of the public.
- Attitudes of the people working for the hospital.
- Attitudes of people in hospital administration.

The intrinsic needs of each of the above differ. Patients not only want effective services but also satisfaction. The prime need of the staff of the hospital is recognition by their peers and general public along with good hospital

environment. The hospital administration wants efficiency of outputs and maximum satisfaction of staff as well as patients.

The patient along with his family and relatives has expectations, anxieties, hopes and fears while entering the hospital. While hospitals judge themselves on certain indicators like number of beds, specialists, equipment, size of budget and so on, the patients are least interested in such statistical aggregates. Once in a hospital, they need good care, satisfaction for their very special (patient) and addressing their private, psychological and emotional needs. Depending on its image, a hospital can be categorised as a crisis place, a curing place or a trauma place. As a place, Canter considers the nature of the hospital as a result of the interaction of three major influences and suggests that each of these should be constructively modified if we seek to humanise the hospital²:

- The physical setting.
- The activities that take place within.
- The conceptions held by users.

Even when the hospital is not dependent for its continued existence on the financial support of the community, it cannot properly fulfill its role unless it can win and maintain the confidence of the public it serves. It is the public for whom the hospitals exist. Hospital administration must ensure that the hospital is serving the purpose for which it has been created and is meeting the needs of those it serves. To meet this aim, all those concerned with the hospital have

to make a conscious effort to project the correct image of the hospital. This effort on the part of a hospital is nothing else but the essence of public relations in practice.¹

Public is becoming more and more conscious of their rights and privileges, and is expecting a higher standard of service. They cannot evaluate the professional quality of care, but they do evaluate the quality of the services being provided, i.e. food, linen, housekeeping services and behaviour of the staff. Therefore, public relations have to stem from the involvement of every single individual working for the hospital, as every action by every such person is an act towards public relations. There is a need to dispel the notion from the minds of the physicians working in a hospital that public relations are the task of the administrator alone. The image of the hospital reflects through the behaviour of every member of the staff. Therefore, an understanding of the consumer's needs and sympathetic services is the crux of public relations in a hospital.¹

Nevertheless, the extent of good public relations cannot be measured quantitatively. Yet, the extent can be elicited by asking users about their general impressions about a particular hospital. The impression that the community harbours about a hospital may be pleasant (positive), indifferent or unpleasant (negative). This impression is not just a question of chance alone. Creation of this impression has to be deliberately planned and actuated by conscious effort. It is one of the functions of public relations to continuously promote understanding and appreciation of the hospital by the community and to continuously monitor it. There are many reasons for bad public relations and poor image of the hospital resulting in complaints. The main complaints from the patients and the community are summarised in Table 33.1.

Table 33.1 General complaints relating to patients and community

Domain	Description
Indifferent care	Lack of 'human touch' and poor behaviour of staff
Low-quality care	Poor quality of linen, diet, equipment, facilities, cleanliness, etc.
Lack of information	About facilities and staff, but especially about the patients' disease condition and its treatment
Lack of guidance	Signage, posting, boards, oral information, treating chambers, basic amenities, etc.
Lack of basic amenities	Chairs, benches, drinking water, toilets, etc. at strategic locations
Lack of creature comforts	Running for practically anything, e.g. getting investigation, getting report, getting medications from chemist, lots of noise, heat/cold, etc.
Overcrowding and long queues leading to delays	Right from reception counter till discharge (in inpatient) or treatment initiation (in outpatients)

BASE OF A GOOD IMAGE OF HOSPITAL

The three things that project a positive image of hospital are (Fig. 33.1):

- Technically competent medical care.
- A mutual trust between hospital and its clientele.
- Goodwill and understanding between patients and hospital staff.



Figure 33.1 The image of the hospital stems from staff's interaction with others.

METHODS OF PROMOTING GOOD PUBLIC IMAGE IN A HOSPITAL

Broadly, there are two methods of promoting good public relation in a hospital. They are the operative method and the communicative method (Figure 33.1).

Operative Methods

Operative methods are essentially connected with almost every aspect of the hospital's operations, including those that are carried out by such workmen as inquiry office personnel, admission counter personnel, security officers to mention a few. All those coming in contact with patients as well as those operating behind the screen share the same burden.

The three fundamental ingredients of a hospital's operations are (i) cheerful and courteous behaviour, (ii) prompt and efficient treatment and (iii) clean surroundings and well-kept appearance of workers. However, one must always remember the following:

- A *high quality of patient care* is the sine qua non of good public relations. No amount of smiles and propaganda can compensate for poor professional care.

- *Adequate physical facilities* with a good functional layout such as adequate waiting areas, toilets, drinking water and refreshment facility in the outpatient department, etc. These facilities take care of the basic creature comforts of the patients, thus helping in creating a good image of hospital.

Case Study 1: Patient satisfied with amenities of hospital

In Indira Gandhi Medical College (IGMC), Shimla, every effort has been made to take care of the patient's physical needs. In a general opinion poll carried out on the patients and other visitors visiting this tertiary-care hospital regarding waiting area, patients were found to be highly satisfied with the amount of space available as waiting area in the hospital premises as well as OPDs. Ninety per cent of the total 115 people interviewed expressed their satisfaction on various issues like canteen, drinking water facilities, etc.

- To make others happy, one must be happy himself. *Good morale of workers* not only increases efficiency, but workers with high morale interact in a positive manner with one another and also with patients and the community. Frustrated doctors, nurses, technicians and paramedical personnel will bring the working of the hospital into disrepute. The least expensive way to improve public relations is to render the service with a smile and cheerful greeting.
- By placing more *emphasis on technology* in dealing with the diagnosis and treatment results in fewer delays and hence more satisfaction.
- *Effective coordination* among all clinical departments and other supportive services stems from good administration. Organisational structure, policies and procedures, authority and accountability should be clearly understood by each worker.
- *Hospital should focus on sensitive areas* like:
 - Many misunderstandings by patients and public originate in the outpatient department (OPD). Efforts should be made to reduce long waiting time of the patients in OPD. Lindell felt that the nature of the admission process plays a major part in determining the humanity of the hospital.² The procedure may be an administrative triumph but if it reduces our patient to barely a significant case or number who is an imposition on the high-technology medical shrine, the process is a failure.
 - Delay in receiving specimens at the laboratory counter and delay at the dispensary should be curtailed.

Case Study 2: Reduced waiting time of patient by multipronged strategies

A separate queue for senior citizens, below poverty line families, females, etc. at various registration counters at IGMC Shimla has been ensured so as to curtail waiting time of the patients. To further add to their convenience central registration under HIMS has been made functional in the institute. An opinion poll regarding this facility highlighted a very positive response from the respondents.

- Casualty department must be organised to deal with any type of casualty, at the same time causing least confusion when a number of relations accompany the patient.
- Importance of food served hot from the dietary department and of clean and well-pressed linen from the hospital laundry cannot be overemphasised.
- The hospital premises should be kept clean at all the times.

Case Study 3: Outsourcing sanitation services

The hospital authorities have taken resort to outsourcing sanitation services in order to ensure round-the-clock cleanliness in the hospital. After intervention, cleaning of the hospital was carried out three times in the morning, two times in the evening and two times during the night. A questionnaire administered to 234 visitors in various parts of hospital brought out the fact that nearly 85% of the respondents were highly satisfied with the general cleanliness of the hospital premises.

- Hospital visitors should be dealt with courteously—their visit to a hospital inpatient is of great emotional value to the patient. A member of nursing or medical staff should be available in the ward during visiting hours to answer their queries. Availability of medicosocial workers round-the-clock in a hospital is very beneficial, as patients have social problems more than medical problems.
- Voluntary services by people from the community help to provide emotional support to patients. Such services can run libraries for patients, write letters on behalf of disabled patients and help the nursing staff in carrying out unskilled nursing chores. Perhaps the greatest benefit is that they soon develop an insight into the limitations of the hospital and by discussing

the same with other members of the community cause a mutual understanding and goodwill between the hospital and the community.

Communicative Methods

These methods employ means of communication in all possible forms to enable the hospital to convey its message to the public. Some of these are also intermixed with the intramural functions of the hospital and operative methods. Some of these communicative methods are listed below:

- Making available appropriate information to the patients, their relatives and visitors at enquiry and registration, and also on patients discharge regarding health status and follow-up. A discharge interview with the attending physician can serve this purpose well.
- An open-house approach to the visitors without interfering in the routine medical care functions. Large number of visitors to patients cannot be avoided in our peculiar sociocultural ethos. The queries of the relatives and visitors can be satisfied if a doctor or senior nurse conversant with the ward is made available in the ward during the visiting hours for this purpose.
- Administrative rounds by hospital administrators at different levels should be as informal as possible.
- A provision to listen to verbal complaints instead of insisting on written ones in grievance redressal system of hospital. The suggestion box should be provided at an appropriate place. The prompt replies to questions in suggestion box should be there.
- Audiovisual communication like film shows, exhibitions, displaying information on working areas of the hospital, dedicated working staff, and also about seasonal communicable and noncommunicable diseases should be part of various OPD and inpatient department (IPD) areas.
- Hospital tours by groups such as school teachers and students, housewives and members of women's organisations, peoples' representatives and religious leaders also build public image of hospital.
- Holding of an annual 'hospital day' where public can be shown every aspect of the hospital's operations including some of the highly technical functions.
- Talks and interviews on radio and television should be routinely done.

In this discussion on the humanisation of the hospital, Lindell has advocated that firstly the misconceptions held by community towards the hospital should be dispelled by breaking down the 'trauma', 'crisis' and 'high-technology' associations, and by developing the health maintenance and community support images.¹ Secondly, the physical setting should be modified to respect the 'human' in the patient by helping them to feel significant. The hospital will be humanised if the 'human' in the patient is understood and respected.

INDICATORS FOR MEASURING PUBLIC RELATIONS

As previously discussed, the image of hospital cannot be quantitatively defined. There are plethora of methods suggested to measure public relation of hospitals. However, the following methods are widely accepted:

- Patients' satisfaction surveys.
- General opinion poll.
- Number of complaints received.
- Extent of voluntary efforts by community towards hospital.
- Turnover of medical staff.
- Consistency in attendance by patients.
- Donations.
- Letters to editors in local papers.
- Inpatients leaving against medical advice (LAMA).

ROLE OF PUBLIC RELATIONS OFFICER IN BUILDING PUBLIC IMAGE

Few hospital authorities have regarded public relations as a special function calling for the services of an expert. In smaller hospitals, the chief hospital administrator or his deputy usually assumes this responsibility in dealing with the external agencies, delegating certain functions to others at appropriate levels. However, larger hospital will require a full-time public relations officer.

COMMUNICATION TO THE PRESS

A prudent administration must get to know the local press. The local press can be the hospital's key helper in this regard, whereas a hostile press can do a lot of harm. If an editor understands the hospital's problems, he or she can help enormously. However, sensational reporting cannot always be prevented. In such cases, it may be worthwhile to hold a press conference and clarify the misconceptions. When something has seriously gone wrong and the consequences may be of legitimate public concern, to await questions and then provide patchy answers is to invite troubles. Legitimate information must be volunteered as early as possible to press.

Clearance of all material intended for release must be controlled by the chief public relations officer who would consult the concerned departmental head. The material should be put on a format and released in a manner calculated to benefit the hospital. Information regarding the condition of hospital patients, especially very important persons (VIPs) and very serious patients should be guarded and preferably governed by an approved code. Interviews of patients by the press or taking their photographs should only be permitted if the patient or their relatives give consent and if it is in the hospital's interest.

Case Study 4: Informing public about hospital help

In IGMC, Shimla, a daily press notification is issued by the Deputy Medical Superintendent in all the leading local newspapers in order to keep the public well-informed as to which specialists would be available in various OPDs on all the days of the week. This activity has been highly acclaimed by the local public as they are spared from visiting the hospital, especially for seeking such information, thus saving their precious time.

OTHER CONSIDERATIONS

Role of Physicians: Dissemination of Medical Information

Information concerning the medical staff and patients for release of public information, except medical papers for professional publications, is required to be cleared by public relations. Needless to say, such information and medical facts are within the ambit of medical ethics. No information regarding patients should be released without the consent of the patient (for which a consent form must be signed by the patient), and the consent should be an 'informed consent'. All questions about the hospital, its operations and its patients, which are likely to be publicly quoted or published, must be cleared and replied only by the Chief Public Relations.

Role of Nursing Services

Whatever may be the physical condition, the psychological needs or patients demand a strong sense of its recognition by nurses. The nursing staff must learn to assess the patients' needs. The hospital administrator on his part must determine the patient's commitments peculiar to his hospital; communicate with them effectively and through them to the nursing staff for creation of better team spirit. Problems identified through consumer critique should be analysed by managerial efforts, which involve nothing but thoughtfulness, concern for patients' needs, respect for human dignity than anything else (Ray, 1979).³

Role of Voluntary Organisations

There is considerable scope of voluntary organisations not only in improving public relations but also in easing some of the administrative burdens of the hospital. These organisations have been doing commendable work for many worthwhile causes, including healthcare; there are no reasons why

their services should not be utilised on a bigger scale in hospitals. In many western countries, many organisations give their dedicated time to voluntary hospital services. In USA, the service is formalised in the form of 'Women's Hospital Auxiliary'. The National Health Service (NHS) of England has demonstrated the effectiveness of community involvement, especially in long-stay hospitals and utilise the services of volunteers extensively.⁴ For the last 20 years, the NHS has shown its appreciation by appointing voluntary service coordinators (320 VSCs in 1986) to enhance the effectiveness of voluntary service contribution.

Voluntary effort by such organisations can be utilised in hospital wards, in the OPDs, at the reception and enquiry counter, in managing gift shop and in fund raising. They can play a key role in establishing community relations and educating the community. The volunteers should be made conversant with the general functioning of the hospital in order to make effective community contact.⁵

However, it should be made certain that such services do not attempt to exercise authority in the administration of the hospital and become a liability than an asset. Usually, they can be of inestimable value, provided working relationship between such organisations and hospital administration are laid down on mutual understanding.

In conclusion, it is necessary to provide high-quality services as well as to educate the public on the hospital's problems or limitations. The hospital being a part of the social system is bound to be influenced by the external and internal environment, which in turn influences the public. The warmth, concern, perception, sensitivity and compassion are integral to the art and business of healing, and building public relation and image of a hospital. It can never be replaced by technology. Nursing services have an extremely important role to play in this respect. The patients and the community have a legitimate right to enjoy reasonably satisfactory standard of services and the hospital has an obligation to meet it. In a nutshell, it can be safely concluded that public relations programme cannot be a sporadic activity, but has to be an ongoing process with a scope of refinement at every step.

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Public Relations in Hospitals

Ms Manju Wadwalker

“PR people are the story tellers. It’s our job to help find the authenticity at the core of our companies and clients, and tell those stories to the world in real words that will really be heard.”

—Fred Cook

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- explain the role of public relations (PR) in the image building of an organisation.
- analyse how public relation helps in realisation of many policies and programmes in a hospital.
- elucidate the role of PR personnel in crisis management.

INTRODUCTION

Here are a few definitions of public relations (PR) from around the world.

PR is an influencing behaviour to achieve objectives through the effective management of relationships and communications [British Institute of Public Relations (IPR), whose definition has also been adopted in a number of Commonwealth nations.]¹

‘Public relations practice is the art and social science of analysing trends, predicting their consequences, counselling organisation leaders and implementing planned programs of action that serve both the organization’s and the public’s interest.’ (A definition approved at the World Assembly of Public Relations in Mexico City in 1978 and endorsed by 34 national PR organisations.)¹

Hence, PR is the art of building relationships with employees, customers, financiers, people or the general public. Any organisation that has a stake in how it is perceived by the public engages in some sort of PR. Corporate communications is a general term used for building relations with different groups such as media, employees, investors, NGOs, labour unions, government and private companies.

PUBLIC RELATIONS AS A PROCESS

Public relations involves a continuous activity that brings about a change. It is a process. This process has four components of research, action, communication and evaluation.

RACE acronym for these four components was first identified by John Marston in his book *The Nature of Public Relations*.² PR activity consists of four important stages:

Research: Identifies the issue or a problem.

Action: How are we going to tackle the issue?

Communication: What will be the method of communication?

Evaluation: Was the plan successful and what is the feedback?

This process is a never-ending cycle in which six steps are linked with each other.

- *Step 1 Research and analysis:* To determine the gravity of a problem that includes public response, media reporting, research data and government regulations.
- *Step 2 Policy formulation:* Acting as advisers for the top management the PR personnel help in formulating the policies.
- *Step 3 Programme designing:* Communications programme is designed once the policy is framed.
- *Step 4 Communication:* Tools of communication like press releases, newsletters, Internet, web portals, special events, community outreach visits are used to execute the programme.
- *Step 5 Feedback:* The efforts are measured by the feedback.
- *Step 6 Assessment:* The success or failure of the programme is analysed and future policies are framed.

Public relation works at two levels. Firstly, it interacts with the external sources and gives input to the management. Secondly, it becomes a medium through which management reaches the public.

Public Opinion: Key to Building Public Relations

The objective of PR is the development of favourable public opinion for an institution. The process of public opinion formation and attitude change is basic to PR. Public opinion is a collection of beliefs, illusions and views expressing the attitudes of individuals who comprise the public.

Public opinion, according to many experts, works as the barometer of PR. It provides the psychological environment in which organisations work. With the increasing expectations of consumers, PR not only works towards creating a positive image of the organisation but also for realisation of its policies.

Public relation is the function of making the performance of an organisation and its image better and better by using various means of communication between the management and its public. In an organizational setup public relation (PR) signifies recognition of performance. **P** stands for performance and **R** for recognition. As per the textbook on Public Relations by Dennis L. Wilcox and Glen T. Cameron, 'It is not necessary, however, to memorise any particular definition of PR. The keywords used in most of the definitions of PR are¹:

Deliberate	Public relations personnel make an effort for a particular PR activity.
Planned	To organise a public relations activity lot of thought and planning is needed.
Performance	Effective PR is based on the quality of performance.
Public interest	Public's concern should be foremost.
Two-way communication	Dissemination of messages and feedback both are important.
Management function	Important decisions have to be taken by the management in all public relations activities.

Public relations is an ongoing process where research, action, communication and evaluation are the important components to keep the management abreast about the effects of its policies and actions on its public.

COMPONENTS OF HOSPITAL PUBLIC RELATIONS

There are two types of public that an organisation deals with—external and internal. Internal public of a hospital/medical institute constitutes doctors, nurses, paramedical staff, employees, teaching faculty, students, etc. External publics are patients, patient attendants, local residents,

media, community leaders, philanthropists, nongovernmental organisations (NGOs), government officials, politicians, etc.

Successful PR boosts employee morale, increase awareness of hospital services and programs, improves the hospitals' image, act as a buffer when negative news appear, builds confidence in people who avail the services and garner support from the government, NGOs and sponsors.

The Public Relations Society of America has included the following basic components of PR in a monograph⁴:

- *Counselling*: Advising the management on important issues and policies of the organization through effective communication.
- *Research*: Studying the attitudes of the stakeholders and plan PR programs is part of research. This helps in understanding and influencing the public.
- *Media relations*: Handling mass media for conveying messages to the public.
- *Publicity*: Using media to promote an organizations' interests through planned communication.
- *Employee relations*: Taking care of employees' interests and motivating them to work for the organization.
- *Community relations*: Interaction with the community helps the organization and its stakeholders.
- *Public affairs*: Public policies are framed through research and feedback to fulfill the needs of public.
- *Government affairs*: To be in constant touch with the government representatives and regulatory agencies on behalf of the organisation.
- *Issues management*: Highlighting issues that concern the public and the organization and working for them.
- *Financial relations*: Building good relations with the financial community.
- *Industry relations*: Being in touch with similar people in the industry and trade associations.
- *Development/fund-raising*: Encouraging donations from the public for the support of the patients in a hospital.
- *Multicultural relations/workplace diversity*: Accepting people from all communities and states.
- *Special events*: Organising events in the interest of internal and external public.

Communication Methods

Hospital professionals usually go about communicating with their public—both external and internal—using different tactics. The purpose always has to be good and effective communication. Communication should motivate and make the target audience respond in the way that you have planned.

Brochures/handouts may be used for education, direct mail to create awareness for programmes or services; direct mail packages are used by private practitioners and speciality mailings are appropriate for campaigns on health issues.

Communicating Information

It is important to send information through the right channel so that it reaches the target audience at the right time and in the right way. Some of the current methods are through mail, fax and e-mail. Each method has its own significance. Mail ensures that the communication has been received properly. Fax ensures that the document reaches the table of the recipient. E-mail gives ready material to the media for their news articles. Phone calls and face-to-face meetings give a personal touch. Websites, newsletters and video presentations are good for presenting hospital services, directories, graphics, data, etc.

MEDIA RELATIONS: HOW TO GET THE BEST RESULTS?

The PR personnels work towards improving and sustaining the positive image of the organisation on a day-to-day basis. The PR office keeps a tab on all premier newspapers and periodicals, and keeps the authorities informed on the news concerning the institute and different health issues through constant monitoring and collection of feedback. Press conferences and interviews with experts on important issues are organised to enhance the image of organisation. All productive activities in the organisation are given media coverage through newspapers, and official media like Doordarshan, All India Radio and private media channels. Press conferences are held and press releases are issued on various research projects, new research methods, opening of new centres, installation of new equipments, etc. Media are informed about the various awards won by the faculty and other staff. Queries from media are received on day-to-day basis and processed. Special interviews are conducted for national publications. To project the organisation's point of view, PR person (as official spokesperson) has to be in regular touch with the authorities and media persons. When a spokesperson is given the responsibility to interact with media, it is better that no other official does it. If a single channel of communication is created in a large organisation media, communication is organised better.

What Makes Good News?

Any good news or feature story will have some or all of the following elements:

News story: A good news story is current and fresh. It has not been published or talked about earlier. Any new happening in the hospital calls for a news story whether it is a service, treatment, equipment or joining of staff. All this is news for the community. The element of timeliness is important. If you want to highlight a particular department's achievements, combine it with some new service that has been started there or a new equipment that has been purchased. Even if you want to showcase research, etc. of the last few years, tag it with something that has benefited a patient tremendously.

The best stories are those that have human-interest angles and are connected with the community directly. For example, the poor patient stories where there is an appeal to the human heart are the most popular ones amongst the media and the people, as experienced in a premier hospital.

Anything different, unique or happening for the first time makes news. People are always curious to know about the unusual. The biggest, best, tallest, smallest creates lot of interest in the readers. For example, the first baby born in the New Year, the birth of quadruplets, a unique cardiac surgery that involves an innovative line of action, the smallest child (newly born) undergoing a complicated surgery, etc.

Rules for Good Media Relations

Best results in media relations are obtained by being responsive, honest, helpful, organised and articulate in good and bad times. During the crisis, strongest relationships are developed with the reporters. Always try to understand various angles of the story about which you have to respond or prepare a release. The message should be clear to the reporter and its importance has to be emphasised. When a third party endorses the message, it becomes more credible.

It is very important to understand how journalists think and what they're looking for in a story. Reporters have a responsibility to their readers and viewers to cover newsworthy information. They look for sources everywhere. They not only talk to people/public/the mediators but also to the authorities. Each source is important for them as they want to give all angles in the story, especially those that are important for their readers. They have a duty to report all the sides. Even with positive stories, reporters will be on the lookout for conflicting situations.

Reporters look for interesting, controversial and colourful stories. The PR person has to feed this desire by giving a variety of inputs like photographs, graphics, sound bites and other illustrations. Reporters always want an exclusive story or a scoop. They are always on the lookout for stories that their colleagues do not have.

Rule 1: Be direct, frank, fair and enjoy media's confidence through accuracy, integrity and performance. It is self-defeating and unwise to block media through evasion and censorship.

Rule 2: Give information useful to the public. Give interesting, timely stories, pictures that media want when they want and in the form in which they can readily use them. Respond to their urgent calls.

Some specific guidelines

- Talk from the viewpoint of the public's interest and not of the organisation's.
- Never say anything when you don't want to be quoted.
- The release should begin with the most important fact.

- Avoid getting into an argument with the reporter.
- Always be courteous and polite and never get caught by the reporter's mood.
- Give straight answers to direct questions.
- If the official spokesperson does not know the answer to a question, he/she should simply say 'I do not know, but I will find out for you'.
- Tell the truth, even if it hurts.
- Do not exaggerate the facts.
- Just remember, playing favourites may spoil the relationship with media persons.

When to Break News

Inform the reporters about a planned event at least 24 h in advance. For major events 48 h is a must.

For breaking news, notify reporters as soon as possible.

For day-to-day news, address a release to a specific reporter. For major events that make history for an organization, it should be addressed to the editors so that they are involved during its reportage.

PRESS RELEASES

A press release is the best way and a golden opportunity to communicate the news of your organisation through which the reporters are motivated to use it for the media.

- A press release should answer the five Ws and one H to display all the facts:
 - Who?
 - What?
 - When?
 - Where?
 - Why?
 - How?

For example, a blood donation camp held recently answers these questions of who held the camp, what led to the organisation of the camp, when it was held, where it was held, why it was held and how it was held. Here the place, the people, the purpose, the scale and the time are very important.

Guidelines for Press Release

Kindly note the following guidelines for a press release:

- Write in the inverted pyramid style. Put the most important and interesting news at the top, followed by important, less important and least important details in later paragraphs.
- Use simple, straightforward sentence structure.
- Keep it simple and short (KISS).
- Check the press release for spellings, accuracy and language. The headline should be catchy and subject interesting. Avoid adverbs, adjectives and qualifiers—such as 'very'—that do not add to the story.

- A press release should indicate the source from where reporter may clarify all the facts. Identify your organisation at the end of the press release.
- To be doubly sure about the authenticity of the press release, it should be endorsed by some other responsible officer in the organisation.

Components to Strengthen a Press Release

Covering Letters: A covering letter is an initial letter to create interest in a story idea. The letter should emphasise the importance of the idea. The letter should never exceed a single page.

Media Kits: The media kit is intended to save reporter's time in gathering background information. A good media kit may include:

- **Information handouts:** A one-page document with factual information about the hospital and its working
- **Backgrounders:** May include research information, statistics and may explain the importance of the subject.
- **Photographs:** One photograph is equal to 1000 words. Hence, photographs play an important role in telling the story. Identify names in photos with up to five people. Photos of more than five people can be described as a group.

Importance of clippings

For better recognition and greater impact, it is important to maintain a print and video clipping file and send it to important persons in the organisation. The management gets constant feedback through clippings of the media organised by the PR person.

PRESS CONFERENCES/PRESS INTERACTION

This form of communicating with the media should be done only in special cases where face-to-face interaction with the media is a must and the subject is better understood through interaction. Some hospital events that may require a press conference are crisis like natural disaster, tragic or unexpected death, employees' strike. Press interaction is required for community education, in case of rare surgeries, new equipment, new wing or new facility, patient-related stories where there is a need of multiple sources like patient, relatives of the patient, doctors, etc., for example in a case of organ transplant. At press interactions, reporters may be invited to a venue of an event where a number of expert interviews can be done and lectures on important issues are attended depending on their convenience.

If a crisis or significant event is attracting a lot of reporters, press conference is a way to deal with it; but when there is a doubt about an issue or controversy, it is better to avoid it. It is critical that all the correspondents hear the same message at the same time. Press conferences should not be

held too often. The reporters may not always consider an issue as important as the organisation.

To call a press conference, send a press note at least 24 h in advance. The time between 12.00 noon to 2 pm is usually fixed because morning meetings are over and reporters have time to cover assignments during that time. Always be sure of the number of reporters attending the conference. It is important to organise the conference at a convenient place. Facilities for using equipment like computers, laptops and television should be made available. A platform to address the correspondents should be there along with microphones, podium, etc. If the programme is held at the site of the event it becomes more interesting and relevant to the occasion. There should be a provision for parking, etc. Simple refreshments, like coffee and water, are a nice gesture.

HOLDING SPECIAL PUBLIC EVENTS

Special event in a hospital is a useful PR exercise for reaching out to many public—both external and internal—like patients, patient-attendants, faculty, students, staff, etc. on a personal level. The hallmark of most successful events is creativity and meticulous planning. Some of the examples in a medical institute are convocations, conferences, foundation days, special awareness days, national Independence and republic days. These provide opportunities to authorities/stakeholders to express directly before their audiences and make an impression. A careful planning, involving aims and objectives of the event, is a must. These events can bring about awareness about a certain issue or raise funds for charity or even encourage employees by giving them commendations.

Case Study 1: Golden jubilee events in PGIMER Chandigarh

Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh is completing 50 years of its existence and celebrating the Golden Jubilee Year from July 2012 to July 2013. It is a great opportunity to project achievements of the institute and make an impact once again about the institute's international standing and unique profile. Several meetings were held by the authorities to plan the activities. It was decided to showcase the best of PGIMER in the form of events where nearly all the departments would be involved.

To begin the Golden Jubilee year with aplomb, a major event was planned on the Foundation Day of the Institute, i.e. 7th July, 2012. Sh. Montek Singh Ahluwalia, Deputy Chairman, Planning Commission of the Government of India was the Chief Guest; Sh. Pawan Kumar Bansal, Minister of Parliamentary Affairs, Science and Technology and Earth Sciences, Government of India was the Guest of Honour;

and Sh. Gulam Nabi Azad, Minister of Health and Family Welfare, Government of India; and President of the Institute presided over the inaugural function of Golden Jubilee Celebrations. Before the function, press conference was held to apprise the media—both print and electronic—about the major events to be held during the Golden Jubilee year and also about the Foundation Day celebrations. Letters were written to the editors to become media partners during the Golden Jubilee Year of the Institute. Since the institute makes significant contribution to health-care in the region and has established its credibility over the years, the media readily contributed in further enhancing its image during the special year. On the foundation day, special supplements were published free-of-cost where the achievements of the institute were displayed. The Institute's alumni cell was created and former faculty was felicitated for the first time. National research day was celebrated for the first time. Symposia and seminars were held on front-line issues like next generation sequencing (Roche 454) in biology and medicine, advancements in forensic applications, economic evaluation in healthcare, medical equipment: safety and innovation, etc. Shri Pranab Mukherjee, the President of India was invited as Chief Guest for the Convocation of the Institute. Innumerable events were planned and held. Scores of continuing medical education programmes and workshops in various departments were organised. Some of them are **awareness programmes** like glaucoma awareness week, World Health Day, World No-Tobacco Day, World Retinoblastoma Awareness Week, World Physiotherapy Day, World Diabetes Day, World Heart Day, etc. **Public lectures** on cleft lip and palate awareness programme, organ donation, Breastfeeding, childhood asthma, epilepsy in children, common problems in newborn babies were organised. **Alumni meet** of the institute and various departments were held. **Sophisticated medical facilities** were added and expanded like closed-loop anaesthesia delivery system (CLADS), HIV testing and disease monitoring laboratory, MPLA-based genetic testing in neuroscience research laboratory (NRL), state-of-the-art facility of liquid-based cytology (LBC), stem cell research in patients with type-2 diabetes, two new state-of-the-art gamma cameras, etc. School of Public Health introduced Post Graduate Diploma in Public Health Management and online Health Economics course. An 'Asha Jyoti' Women's Healthcare Outreach Mobile Programme was inaugurated.

To highlight all these events during the Golden Jubilee year, more than 50 press conferences/interactions were organised. Approximately 200 press releases were sent to the media. Around 50 radio programmes (FM Life Line) on official radio broadcaster—All India Radio—were organised involving PGI experts. These events helped in showcasing various events of PGIMER, thus strengthening public image of institution.

Case Study 2: Organ and body donation programme at PGIMER

About 5-year back, the institute authorities decided to expand the organ and body donation programme in the hospital along with the discipline of organ transplantation. PGIMER in this region has been known for cornea and kidney transplantation for long. But the awareness regarding and motivation for body and organ donation from cadavers were lagging far behind. The Department of Transplant Surgery started awareness programmes for organ donation (kidney, liver, etc.) and body donation by holding events for the patients, attendants and the general public. The helplines for eye donation and body donation were started. A committee to look into brain-dead patients and organ donation was constituted. In the last 2–3 years, the programme got a boost with media highlighting every donation that was given to the hospital. Press conferences were held every time. Each body donated for hospital research was highlighted in the media. The relatives of body donors were made aware through media about its benefits. Memory lanes were created by installing portraits of the donors. Public lectures and radio talks were organised on this subject. Cadaver organ donation was highlighted simultaneously with the newly introduced liver transplantation programme. It got tremendous response from the public where following donations were received by the Institute in year 2012:

- Twenty-three bodies were donated for research purposes to Department of Anatomy.
- Three hundred and thirty-two eyes were donated to the Department of Ophthalmology.
- Eleven kidneys of six cadavers were transplanted to eleven patients in the Department of Renal Transplant Surgery.
- The Department of Hepatology in collaboration with the surgical team successfully performed three deceased donor liver transplants.

CRISIS COMMUNICATIONS

Kathleen Fearn-Banks,³ in her book *Crisis Communications: A Casebook Approach*, writes that “A crisis is a major occurrence with a potentially negative outcome affecting the organisation, company or industry, as well as its public, products, services or good name’.

Cutlip’ et al. have categorised crises in three classifications:

- *Immediate crises*: The most dreaded type that occurs suddenly and unexpectedly, when there is no time for research and planning, e.g. fires, accidents, earthquakes, medical errors, disease epidemics, unexpected deaths, etc.
- *Emerging crises*: Crises that allow time for research and planning, but many suddenly erupt after brewing for some time, e.g. closure of a facility, discontinuance of a service, retrenchment, pay package, etc.
- *Sustained crises*: The crises may persist for months and sometimes years before they precipitate suddenly, despite the efforts of management to tackle them. Misinformation may go on increasing till it snowballs into a major controversy.

Today, with the prevalence of Internet and mobile phones, negative information can spread rapidly. To manage response effectively, crises management plans should always be in place. Jaishri Jethwaney and NN Sarkar in their book ‘*Public Relations Management*’ have given the following points to follow in a crisis⁴:

- Develop a strategy based on worst case scenario.
- Appreciate the vital importance of preplanning.
- The initial critical few moments when a crisis breaks out are very important.
- Know the media and their mind, do journalist tracking.
- Isolate the crisis team from daily grind.
- Aim at containment and not suppression.

How to Communicate During a Crisis?

Many professionals offer useful checklists on what to do during a crisis. Here are some good suggestions from the book ‘*Public Relations Strategies and Tactics*’ by Dennis, et al.¹

- The public is most important.
- The organization should take responsibility and amicably manage the crisis.
- Honesty is the best policy. Give facts without hiding anything.
- Always explain what happened during the crisis to satisfy the public.
- Throughout the crisis one person should be made the spokesperson for credibility sake. Spokesperson must have the full confidence of the organisation and the news media.
- Setup a central information centre.
- Information should be given at short intervals to satisfy the stakeholders. Once the information is withheld, rumours take over.
- Respect the compulsions of media. They have their deadlines.
- Be available for queries.
- Keep a tab on news coverage and telephonic queries.
- Be open and answer questions from the public.

Immediate Steps to Be Taken

- Alert the security.
- Complete information with all the facts should be collected before preparing a press release.

- Be alert on graphics.
- Identify the spokesperson. The employees must be advised to refrain from speaking to outsiders.
- Announce a telephone number for public inquiries. A responsible person should attend to the calls.
- Feedback is important to assess how your audiences perceive your messages. This will help to make any changes, if necessary.

Corrective Measures

- The organisation should inform the media and public about the corrective measures taken once the disaster is over.
- Words of reassurance to different publics and the community should be released.
- Handling a crisis can actually be turned into an image-building opportunity.

Case Study 3: Handling of cases of cheating during an entrance test at PGIMER

A crisis situation occurred at a prestigious Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, when in an All India MD/MS entrance exam, 16 candidates were caught cheating using hi-tech gadgets. Since the Institute was tipped-off about the hi-tech cheating by an unknown e-mail, the police was informed and the Central Bureau of Investigation caught the cheaters red-handed. The cheating turned out to be part of a national racket.

PGIMER immediately decided to scrap the entrance test, a right step to avoid all controversies. It announced a date for the rescheduled exam. Press releases were sent to the media—both print and electronic. A notice was published in the national newspapers to inform the candidates. The information was posted on the website. The PR officer as spokesperson was available all the time for providing facts and making comments.

Tight security arrangements with modern gadgets were made at all the examination centres to make the premises foolproof. Through both electronic and print media, public was updated about every step. There were no doubts and uncertainties regarding the date, time, venue and security preparation for the rescheduled entrance test. The test was conducted peacefully and within 48 h results were declared and displayed.

Media reports about the cheating scam made the genuine candidates insecure about their future and the public doubtful of the Institute's credibility, but by taking right steps the institute won their trust once again. The crisis was managed by taking right decisions at the right time and being transparent in all the actions.

In a hospital the clinicians, administrators and PR personnel should work in coordination to ease the suffering of patients and their attendants. The doctors' job is to take care of patient, whereas department of PR help in building public image of hospital by coordinating with doctors and other staff in disseminating information correctly and timely. Public relation department should act as a buffer—during crisis and otherwise—so that doctor spent more time in patient care rather than handling media queries. In this way, public relation department in a hospital strengthens its image in the eyes of public, employees, government officials, politicians, etc. through smart communication strategies.

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Material and Equipment Management

Section VII

SECTION OUTLINE

Chapter 35 Materials Management

Chapter 36 Purchase and Procurement System



Materials Management

Dr Sitanshu Sekhar Kar, Dr Archana Ramalingam and Dr Sonu Goel

“Those who have knowledge, don’t predict. Those who predict, don’t have knowledge.”

—Lao Tzu

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- list the uses and needs for materials management in healthcare sector.
- describe various components of material-management cycle.
- list the techniques of inventory control.

INTRODUCTION

Modernisation and increased use of machines in healthcare delivery system demands scientific management of materials. Materials management is very well accepted as a quantitative technique of operations research and has been successfully employed in industry. Application of principles of materials management in health sector is not up to desired standards.

Materials management is the process by which an organisation is supplied with the goods and services that it needs to achieve its objectives of buying, storage and movement of materials. Materials management is related to planning, procuring, storing and providing the appropriate material of right quality, right quantity, at right place and in right time so as to coordinate and schedule the production activity in an integrative way for an industrial undertaking.¹ The principles of materials management are derived from military science.

In health system, materials amount to approximately 30–40% of total health budget. Materials usually mean drugs, vaccines, contraceptives, laboratory reagents and other consumables. Health administrators must give adequate importance to effective management of materials in their respective centres.

The four essential needs for materials management are:

1. To have materials at the time of need.
2. To have the same quality of materials at lowest cost.
3. To reduce or minimise inventory investment.
4. To operate efficiently.

MATERIALS MANAGEMENT CYCLE

Materials management is concerned with ‘planning, organising and controlling the flow of materials from their source through internal operations to service points.’² The elements in the cycle of materials management is shown in Figure 35.1.

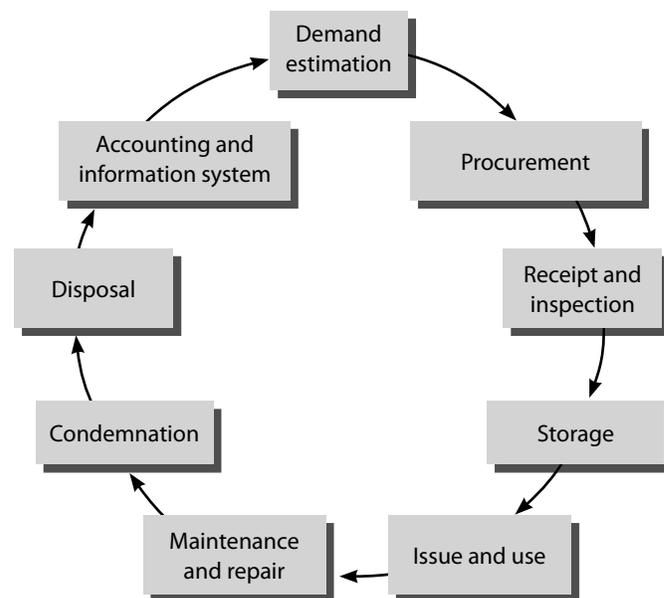


Figure 35.1 Materials management cycle.

As evident from Figure 35.1, materials management strives to ensure that the material cost component of the total product cost is to be the least. In order to achieve this, the control is exercised in the following fields:

1. Materials planning (demand estimation).
2. Purchasing (procurement).
3. Store keeping (receipt and inspection).
4. Inventory control (managing the flow of materials).
5. Value analysis, standardisation and variety reduction.
6. Materials handling and traffic.
7. Disposal of scrap and surplus, material preservation.

The materials planning division plans and estimates the required number of materials. This could be done based on the amount of materials consumed during the same quarter in the previous year and accounting for anticipated increase in requirements. Also, the budget allocated will be critically reviewed so that the materials management could be controlled in a better fashion.

The purchase section functions to purchase materials as per requisitions from the planning department. There are four basic purchasing activities. These are as follows³:

1. Selecting suppliers, negotiating prices and issuing purchase orders.
2. Speeding up delivery from suppliers.
3. Acting as liaison between suppliers and other company departments.
4. Looking for new products, materials and suppliers that can contribute to company objectiveness.

It is vital to purchase the adequate quantity at the appropriate time without compromising on quality of materials. The cost factor also needs to be taken into account, while deciding upon the purchases to be made. All these would increase the efficiency of the purchasing system and also provide benefit to the organisation.

The storage section is responsible for protecting the quality of the items and reducing wastage of materials due to improper storage.

The despatch section receives the materials, inspects them for quantity and quality, and despatches them to the respective departments.

Materials handling section is responsible for the transport of materials to various departments. There are four basic traffic activities.

1. Selecting appropriate carriers and routings for despatch.
2. Tracing inbound shipments of material in short supply, as requested by production control or purchasing.
3. Auditing invoices from carriers and filing claims for refunds of excess charges or for damaged shipments when required.
4. Developing techniques to reduce transportation cost. This may involve negotiation with competing shippers, special studies in selecting the most advantageous plant location for new products, analysis of tariffs and negotiation of any number of special arrangements for handling certain traffic. The activity includes packaging

of finished product, labelling and loading end products in the trades.

Finally, the disposal of scrap and surplus must be done periodically to release the capital locked in those items.³

Principles of Materials Management

The principles of materials management are summarised in Table 35.1.

Table 35.1 Principles of materials management

Principles	Management technique
Right item/Materials	<ul style="list-style-type: none"> • Value analysis • Standardisation • Codification
Right quantity	<ul style="list-style-type: none"> • Economic order quantity
Right price	<ul style="list-style-type: none"> • Cost analysis • Value analysis
Right source	<ul style="list-style-type: none"> • Market research • Purchasing techniques • Selection process
Right delivery time	<ul style="list-style-type: none"> • Procurement technique • Follow-up • Operations research
Right methods/systems	<ul style="list-style-type: none"> • Work study • System analysis • Management information system
Right people/attitude oriented towards innovations/improvements	<ul style="list-style-type: none"> • Organisational analysis • Behavioural science

Economics in Materials Management

Before proceeding further, two important terms namely 'inventory' and 'stock' need to be clarified. Inventory may be defined as 'usable but idle resource having an economic value'. It can also be described in financial terms as the sum total value of raw materials, semi-processed and finished goods at any given time. When we deal with tangible items such as materials, it is called 'stock'.

In a healthcare setup where more than 10,000 items are in its inventory listing, including pharmaceuticals, hospital supplies and equipments, surgical supplies, dressing materials, intravenous solutions, and laboratory supplies so on and so forth, it is not possible to control or monitor their availability in the system. Also, all inventory items do not require the same level of attention, i.e. monitoring.

Various techniques of monitoring these items are available. Only a few (about 10% by number) materials contribute to approximately 70% of cost commonly termed '*vital few*' and their availability is important for maintenance of the organisation. These '*vital few*' items can be segregated for the closer control to ensure productivity. Inventory control is concerned with achieving an optimum balance between two conflicting objectives. These objectives are:

- To minimise investment in inventory.
- To maximise the service levels.

Relevant costs

Basically there are four costs relevant for consideration in developing an inventory model. These are the costs incurred during the process of:

- Purchase cost.
- Ordering cost.
- Inventory carrying cost.
- Understocking and overstocking costs.

The cost of ordering and inventory-carrying cost are viewed as the supply side costs and help in the determination of the quantity to be ordered each time for replenishment. Understocking and overstocking costs are viewed as the demand side costs and help in the determination of the amount of variations in demand and the delay in supplies, which the inventory should withstand.

Purchase cost: This is the actual cost paid for the purchase of materials and stores, and the aim should be to reduce this as far as possible without compromising on the quality and quantity of items purchased.

Ordering cost: Every time an order is placed for stock replenishment, certain costs are involved; and for most practical purposes, it can be assumed that the cost per order is constant. The ordering cost may vary, depending upon the type of items ordered. This cost of ordering includes:

- Paper work costs, typing and despatching an order
- Follow up costs required to ensure timely supplies—includes the travel cost for purchase follow up, telephone, telex and postal bills
- Costs involved in receiving the order, inspection, checking and handling in the stores
- Any setup cost of machines if charged by the supplier, either directly indicated in quotations or assessed through quotations for various quantities
- The salaries and wages to the purchase department

Inventory carrying cost: This cost is measured as a percentage of the unit cost of the item. This measure gives a basis for estimating what it actually costs a firm to carry stock. This cost mainly includes:

- *Cost of borrowed money:* It is the interest paid to a financier or the interest lost that could have been earned, had a large amount of money not been used for purchasing the stock presently held as inventory.
- *Cost of space:* It needs to be hired for storage.
- *Cost of additional manpower:* By incurring additional expenditure on salaries, etc. of manpower required to manage the stocks.
- *Cost of obsolescence:* All materials, especially hospital supplies, become obsolete, leading to financial loss.
- *Cost of deterioration:* Supplies when stored for a very long time tend to deteriorate with time, especially crucial hospital supplies like injections, medicines and intravenous medicines, etc.

- *Cost of pilferage:* A large and unmanageable inventory is bound to lead to pilferage and loss to the organisation.

The inventory carrying cost varies from 25–30%. A major portion of this is accounted for by the interest or capital, which depends on the fiscal policies of the government. In the analysis and use of mathematical formula, only the variable costs should be considered, as the fixed costs will be constant irrespective of the number of orders placed or the inventory carried.

Understocking and overstocking cost: *Shortage costs* are the ‘direct’ and ‘indirect’ costs paid by an organisation for not having a particular item in ready stock. The impact of this shortage would depend on the criticality of that item and its importance for functioning of the organisation.

The direct cost of this shortage would be in the form of the expenditure incurred by the hospital in procuring these drugs urgently from the open market at a premium. The ‘indirect cost’ would be in the form of adverse publicity, suspended healthcare in the form of refusal of admissions and may be a few avoidable deaths due to shortage of those critical drugs.

CONCEPTS OF INVENTORY CONTROL

As we have seen previously, inventory may be defined as ‘usable but idle resource having an economic value’. It can also be described in financial terms as the sum total value of raw materials, semiprocessed and finished goods at any given time. When we deal with tangible items such as materials, it is called ‘stock’.

Every hospital deals with a stock of thousands of items, raising a series problem of keeping control or track of all these items; also, it may not be necessary to have the same closeness of control on each and every item. The basic issue involved in inventory management is to ensure that adequate amount of raw materials are available to meet the demand of the organisation, while at the same time ensuring that too much inventory is not accumulated and also that there are no ‘stock-outs’ in the organisation. A close perusal of the inventory will reveal that only a few of the inventories require close attention to achieve desired results and the remaining many may be trivial for the purpose.

Types of Inventory Control

Eyeballing technique

This is the crudest form of inventory control where the hospital manager tends to ‘eyeball’ or look at the available inventory and decide which one needs replenishment. This technique is nonscientific and not used in modern day hospital management.

Double-shelf method or A/B method

In this method of inventory control whenever a new supply of materials arrive, the hospital manager divides the stock

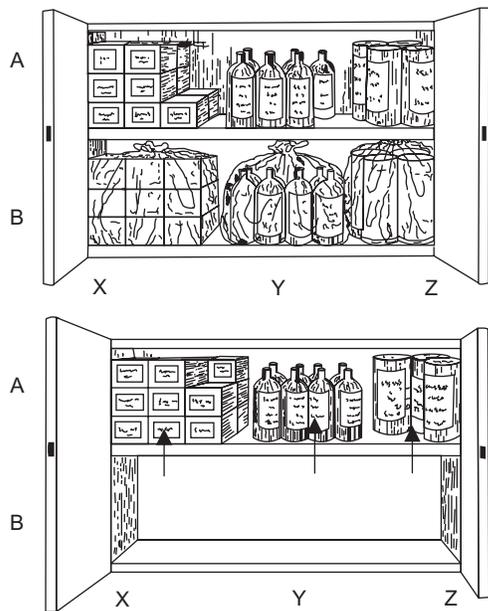


Figure 35.2 Double-shelf method.

into two halves and labels them as A and B. The part labelled A is placed on the top shelf of the storage area and the one labelled B is put inside a cover with a label saying 'Not to be used unless purchase order is sent' and is stored in the bottom shelf. Thus, as soon as part A gets over, a new purchase order is sent and then part B is used until the new stock arrives as shown in Figure 35.2. This way at any point of time half of the stock serves as a buffer so that stock-outs do not happen.

Modern techniques for inventory control

These modern analysis techniques of the inventory controls are based on a set of criterion that will help in selecting the 'vital few' and 'trivial many' in respect of achieving adequate control. The criteria for classification may be based on annual consumption cost, criticality of spare, weight, unit cost, etc. Different types of analyses, each having specific advantages and purposes, help in finding a practical solution to the control of inventory with minimum efforts. Some important analyses carried out are:

- *ABC analysis*: Based on annual consumption.
- *Vital, essential desirable (VED) analysis*: Criticality for production.
- *Scarce, difficult, easy (SDE) analysis*: Availability.
- *High, medium, low (HML) analysis*: Weight/cost permit.
- *Fast, slow moving and nonmoving (FSN) analysis*: Consumption rate.
- *GOLF system*: Based on the source of supply and include governmental sources (G), ordinary (O), local (L) and foreign (F).
- *SOS* is the classification of items based on seasonal (S) and off-seasonal (OS) availability.

- *ABC analysis*: ABC is said to connote 'always better control'. The basis of analysing the annual consumption cost (or usage cost) goes after the principle 'vital few-trivial many', and the criterion used here is the money spent and not the quantity consumed.

The steps of ABC analysis are as follows:

- Obtaining the list of drugs from the pharmacy and the cost per item form the purchase section.
- Calculation of annual consumption cost: Based on the annual usage and cost per item, the annual consumption cost for each item is first calculated.
- Calculation of cumulative cost: The annual consumption of all the items is arranged in descending order and the cumulative cost is calculated.
- Calculation of cumulative cost percentage: Then the cumulative cost-percentage is calculated.
- Categorisation of drugs (Table 35.2).

This categorisation is not water tight and sometimes A drugs could account from 60–80% of the cumulative cost and similarly categories B and C could account for 15–25% and 5–15%, respectively (Figure 35.3).

Table 35.2 Categorisation of drugs

Item	Percentage of item	Percentage of cumulative cost
A Items	10	70
B Items	20	20
C Items	70	10

Hence, we can see that adequate control of 10% of items will help the hospital managers to control 70% of total cost.

A-Items

- Tight controls
- Rigid estimates of requirements
- Strict and close watch
- Safety stocks should be low
- Management of items should be done at top management level

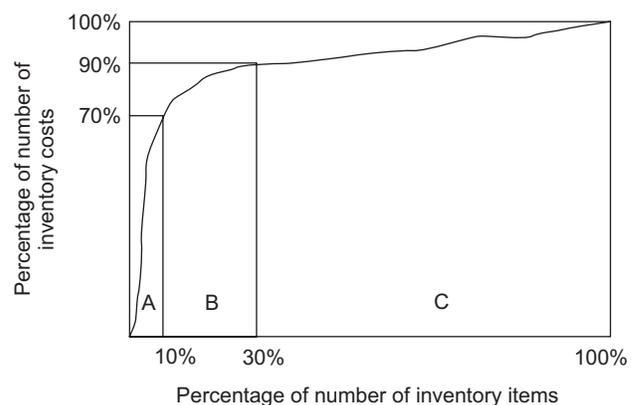


Figure 35.3 ABC analysis for inventory control.

B-Items

- Moderate control
- Purchase based on rigid requirements
- Reasonably strict watch and control
- Safety stocks moderate
- Management be done at middle level

C-Items

- Ordinary control measure
- Purchase based on usage estimates
- Controls exercised by storekeeper
- Safety stocks high
- Management be done at lower levels

The ABC analysis is discussed in Table 35.3, wherein the annual usage and cost of 10 items (unit cost) is given. Apply the principles of ABC analysis and summarise your results (Table 35.4).

Table 35.3 ABC analysis—usage in rupees

List of items	Unit cost (Rs)	Annual usage unit	Annual cost (Rs) [(2) × (3)]	Ranking
1	0.25	20,000	5000	4
2	0.20	30,000	6000	3
3	0.10	10,000	1000	6
4	0.30	500	150	9
5	0.20	50,000	10000	2
6	0.05	8000	400	8
7	0.40	60,000	24000	1
8	1.00	700	700	7
9	0.50	9000	4500	5
10	2.00	50	100	10
		Total	Rs 51850	

Table 35.4 ABC ranking

List of items	Annual usage unit	Annual cost (Rs)	Cumulative annual usage (Rs)	Cumulative percentage	Ranking	Category
7	60,000	24000	24000	46.28	1	A
5	50,000	10000	34000	65.57	2	A
2	30,000	6000	40000	77.14	3	B
1	20000	5000	45000	86.78	4	B
9	9000	4500	49500	95.47	5	C
3	10000	1000	50500	97.39	6	C
8	700	700	51200	98.14	7	C
6	8000	400	51600	99.51	8	C
4	500	150	51750	99.81	9	C
10	50	100	51850	100.00	10	C

Class	Item	Percentage of item	Rs (per group)	Cumulative percentage of cost (Rs)
A	7, 5	20	34,000	65.57
B	2, 1	20	11,000	21.21
C	9, 3, 4, 6, 8, 10	60	6,850	13.22

- **VED analysis:** This analysis specially pertains to the classification of inventory denoting the essentiality of materials according to their criticality.

V-Vital items when out of stock or when not readily available completely hinders the functioning of the hospital, e.g. oxygen supply.

E-Essential items without which moderate amount of disruption in hospital functioning occurs, e.g. IV fluids.

D-Desirable items—all other items that are necessary, but do not cause any major effect on functioning of hospitals, e.g. vitamin E.

The classification of items into Vital, Essential and Desirable should be done by the hospital manager/medical officer in-charge of Primary Health Centre; and it is specific to each setup like Primary Health Centre (PHC), Community Health Centre (CHC) or district hospital.

- **Combination of ABC and VED analysis:** A combination of ABC and VED analysis takes the best of both the methods and helps in efficient inventory control. This method categorises inventory into three groups (Table 35.5):

- Category I contains all the vital and costly items whose shortage may adversely affect the functioning of the hospital or overstocking/pilferage may lead to financial loss to the hospital. These items such as injection of Rabipur, anti-snake venom, or costly medicines and vaccines should be monitored by a senior manager himself.
- Category II items are essential but are less costly and can have lesser stringent controls.
- Category III items are the stores and medicines that are desirable but would not affect the functioning of the hospital.

- **SDE analysis:** This analysis is based on the availability of an item:

S-Scarce items, especially imported and those that are very much in short supply.

D-Difficult items that are procurable in market but are not easily available. For example, items that have to come from far-off cities or where there is not much competition in market or where good quality supplies are difficult to get or to be procured.

Table 35.5 Combination of ABC and VED analysis

	V	E	D		Item	Cost
A	AV	AE	AD	Category I	10	70%
B	BV	BE	BD	Category II	20	20%
C	CV	CE	CD	Category III	70	10%

Category I: Needs close monitoring and control
 Category II: Moderate control
 Category III: Minimal degree of control.

E—Refers to **easy** items that are easily available, mostly local items.

It is normally advantageous to consider **A**, **V** and **S** items for selective controls.

- **HML analysis:** The cost per item (per piece) is considered for this analysis. High-cost items (**H**), medium-cost items (**M**) and low-cost item (**L**) helps in bringing controls over consumption at the departmental level.
- **FSN analysis:** This analysis is to help control obsolescence and is based on the consumption pattern of the items. The items are analysed to be classified as fast moving (**F**), slow moving (**S**) and nonmoving (**N**) items. The nonmoving items (usually not consumed over a period of 2 years) are of great importance. Scrutiny of nonmoving items is to be made to determine whether they could be used or be disposed-off. The fast- and slow-moving classifications help in arrangement of stock in stores and their distribution and handling methods.

Inventory Replenishment

Inventory replenishment answers the two questions in order to maintain optimum levels of stocks and avoid stock-outs. When to order and how much to order? Determining when to order is often accomplished by establishing a 'reorder point'. When the inventory level for a particular item falls to the reorder point, it is the time to restock the item. A computerised inventory control system can be programmed to track the inventory level perpetually, as transactions are entered against existing stocks. It automatically indicates when it is the time to reorder, perhaps even generating a purchase requisition to do so. Before going to the details of the inventory replenishment, we must understand two important terms 'safety or buffer stock' and 'economic order quantity (EOQ)'.

Safety stocks or buffer stock

The safety stocks become necessary in order to avoid 'stock-outs' if the rate of consumption is increased and/or the lead time (time it takes for an order to arrive when an order is placed) gets extended from the values considered for the replenishing systems. A simple way of establishing the safety stock would be to find out the above two variations that could normally occur over a period of time in terms of additional quantity of stock to be maintained.

1. When consumption variation is very high
Safety stock = (Maximum rate of consumption – normal rate of consumption) × lead time.
2. When lead time variation is very high
Safety stock = Normal consumption rate × (Maximum lead time – normal lead time)

Economic order quantity

The original economic order quantity (EOQ) model is typically encountered in management science courses and is

concerned with minimising total ordering costs associated with inventory replenishment.

The following assumptions are kept in an EOQ model (Figure 35.4):

- Ordering cost is constant.
- Rate of demand is known and spreads evenly throughout the year.
- Lead time is fixed.
- Purchase price of the item is constant, i.e. no discount is available.
- Replenishment is made instantaneously; the whole batch is delivered at once.
- Only one product is involved.

Economic order quantity is calculated as (Figure 35.5).

Economic order quantity (EOQ)

$$Q^* = \sqrt{2 \cdot D \cdot S/H} = \text{EOQ}$$

- **Q** = Order quantity.
- **Q*** = Optimal order quantity.
- **D** = Annual demand, in units.
- **S** = Fixed cost per order (not per unit, typically cost of ordering and shipping and handling, and is not the cost of goods).
- **H** = Annual holding cost per unit (also known as carrying cost or storage cost). The warehouse space, refrigeration, insurance, etc., are usually not related to the unit cost.

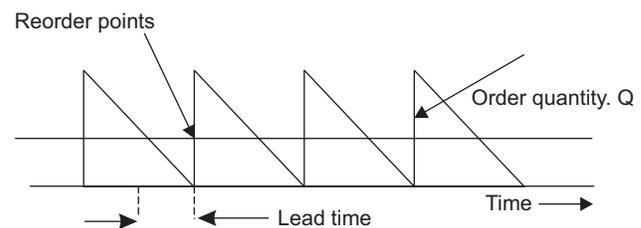


Figure 35.4 EOQ model showing reorder points.

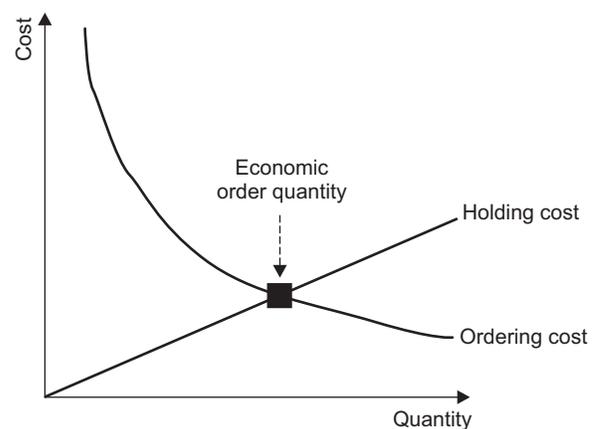


Figure 35.5 Economic order quantity.

Economic order quantity is discussed in the example given below:

A vital drug that costs Rs 180/bottle is required at an average rate of 60 bottles/month by different PHCs of a district. The cost to replenish the stock of the item and the cost of holding inventories are Rs 50/order and Rs 2.60/bottle, respectively.

What should be the EOQ of the drug?

- Q^* = Optimal order quantity
- D = Annual demand, in units = $60 \times 12 = 720$
- S = Fixed cost per order = Rs 50
- H = Annual holding cost per unit = Rs 2.60 per bottle
- P = Price per unit = 180

$$Q^* = \sqrt{2 \cdot D \cdot S / H} = \text{EOQ}$$

$$Q^* = \sqrt{2 \cdot 720 \cdot 50 / 2.60}$$

$$= 170 \text{ bottles}$$

Reorder limit (ROL) method

The orders are placed for a fixed quantity, usually the “economic order quantity” either as and when the stocks reach the reorder limit (ROL) or at the end of a predetermined review period if the stocks have fallen below the reorder limit.⁴

- The ordering quantity is fixed (the EOQ); it is checked whether the reorder limit is reached.

The ROL is determined by adding the lead time requirements to safety stock.

$$\text{ROL} = \text{Safety stock} + \text{lead time requirements.}$$

- The ordering quantity is fixed (the EOQ); it is checked whether at the periodic review the stocks have fallen below a reorder limit. If the stock is lower than the reorder limit, order is placed for EOQ. Otherwise, if it is above the reorder limit, no action needs to be taken till the next review point.

The reorder point, R , is calculated as follows:

$$R = \text{Safety stock} + \text{Rate of consumption} \cdot (\text{lead time} + \text{review period}/2)$$

INTEGRATED CONCEPT FOR MATERIALS MANAGEMENT

As we have seen, materials management involves a lot of processes like planning, purchasing, storing, inventory control, etc. Integrating all these processes under a single umbrella and assigning the overall responsibility to a materials manager would bridge the gaps in communication and help in quick transfer of essential data to the various sub-departments. This would solve problems and ensure proper balance, resulting in greater coordination and better control.

Advantages

Organisations that have gone in a big way for the integrated materials management usually enjoy the following advantages:

Accountability

The overall responsibility for materials management is vested to a single, centralised authority, thereby making the materials manager accountable for the smooth functioning of this department.

Coordination

As responsibility is vested with one department instead of many, the problems can be discussed in one forum and solutions can be found easily. Hence, there is better cooperation among the individuals responsible for the various processes in materials management. It also creates an atmosphere of trust for the user departments and avoids the unnecessary hassle of having to deal with multiple heads.

Better performance

Since all the processes are integrated under a single department, there is greater speed and accuracy. The need for materials, as estimated by the planning division is promptly communicated to the purchase section, and the stock is replenished and stored in the stores section. All these lead to lower costs and better performance of the department as whole.

Better information management

A single data processing system can be designed to facilitate collection and analysis of data about all the processes of materials management. This would lead to better decision making and economical management of data.

Miscellaneous advantages

Under a centralised materials manager, a team spirit is inculcated; and this results in better morale and cooperation. The opportunities and exposure available for the individuals for growth and development are better in an integrated setup.

Materials management is one of the key managerial components that a medical officer should practise. Materials management ensures to have materials at the time of need, have the same quality of materials at lowest cost, reduce or minimise inventory investment and operate efficiently. Various scientific methods like ABC, VED and SDE methods are available for inventory control. Economic order quantity and reorder limit methods can be used for inventory replenishment.

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Purchase and Procurement System

36

Dr Vipin Koushal, Dr Harvinder Singh and Dr Sonu Goel

“We need more transparency and accountability in government so that people know how their money is being spent.”

—Carly Fiorina

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- list the principles of sound purchase and procurement system.
- describe types of purchase systems along with their advantages and disadvantages.
- explain purchase procedures and steps of purchase and procurement system.

INTRODUCTION

Hospital is one of the most complex and dynamic institutions of the society.¹ The core function of the hospital is to provide care for sick and the injured. Purchase and procurement form an important support function, which helps in providing best possible care to the patients. Equipments, supplies and other services are a substantial part of the hospital budget, and efficient procurement process will help in reducing financial stress on the hospitals. Apart from tendering, hospital should look into addressing supply chain inefficiencies such as competitive prices for goods and services, inventory and distribution management, and reducing the transaction cost. If the procurement process is operating efficiently, it results in reducing the costs and optimal utilisation of financial resources and the personnel will be happier resulting in better care for the patient.

Purchase and procurement seems to be similar functions; but, in fact, these are two distinct entities. Purchasing is a part of procurement. Procurement involves the process of buying, purchasing, renting, leasing, or acquiring goods, works and services. Purchasing is the function responsible for acquiring goods and services to meet the requirements. Procurement includes all the aspects related to the activities associated with the providing of the equipments, products, supplies and services encompassing policy and strategy development and implementation, provisioning strategies and demand management, etc. whereas the purchase is the

procedural aspect related to competitive process and the methodology employed to actually purchase equipments, products, supply and services.

PRINCIPLES OF A SOUND PROCUREMENT SYSTEM²

The Following are the broad principles around which procurement system needs to be built:

- Transparency
- Accountability
- Efficiency

Transparency: Transparent procurement system will increase the confidence and faith of public, investors and suppliers. Strictly following of the written procedure shall promote transparency.

Accountability: Procedure shall have inbuilt accountability. Authority and accountability shall then go hand-in-hand. Authority without accountability will breed inefficiency.

Efficiency: Procedure shall ensure that the supplies meet the following standards:

- Right price.
- Right time.
- Right quantity.
- Right quality.
- Right source.
- Right place.

OBJECTIVES FOR GOOD PROCUREMENT

To realize the above principles, the following objectives can be framed:

- To buy quality goods, consumables, equipments and services in the cost-effective manner from reliable sources.³
- To ensure timely deliveries.
- To continuously appraise the supply sources.
- To continuously search for new supply sources and evaluate these for future supplies and promoting promote competition.
- To identify new reliable new sources through transparent tendering system.
- To search for new materials and equipment to keep the hospital updated.
- To scout the market for price trends.
- To buy or hire as per the policies of the hospital.
- To develop capacity for estimating the requirements for proper buffer stocks and optimum level of inventory.
- To participate in planning, coordinating and monitoring the procurement needs of the hospital.

GUIDELINES EMPHASISING THE ESSENTIALS OF PROCUREMENT PROCESS

To translate the principles and objectives into a sound procurement processes as under shall be adopted:

Parameters for decision to purchase or to hire: This is the most crucial decision. It is linked with decision of extent of capital investment available as that would act as a constraint. Important goods and services required will down other parameters. Goods and services which are life saving will necessarily be purchased as ensuring timely availability, quantity and quality becomes priority. This decision will follow the long-term strategic plan.

Framework for quantity, laying specifications for quality, scheduling of supplies and transparency: All organisations responsible for procurement whether they are public, private nonprofit or private for profit should procure the equipments, products, supplies or services according to the need, which is realistic and well-justified. It can be based on time series developed on the basis of past experience and and/or projected future demand. Economic order quantity (EOQ) can also be calculated. Care need to be taken to avoid purchasing stocks in excess of requirement to avoid inventory carrying cost.

Scheduling of the supplies can be resorted to, keeping in view the following:

- Storage capacity
- Shelf life
- Inventory cost

Specification in terms of quality, type and quantity to be procured should spell out the specific needs of the hospital. The specifications should be so framed as to meet the basic needs without including superfluous and nonessential features, as it would add avoidable cost. Specifications should be broad and not necessarily restrictive to promote competition. But at the same time should not be vague so as to avoid confusion and uncertainty.

Selection of bidding system⁴: There are the following three systems:

- Advertised tender enquiry.
- Limited tender enquiry.
- Single tender enquiry.

For the first two types of tenders, decision will depend on the value of the tender and also on the sources of supplies. If the value is large enough to justify the cost and sources of supplies are diverse or available globally, the tender may be given wide advertisement. However, if sources of supplies are known and value is not high, limited tender enquiry may be floated. For purchasing high-value plant, machinery, etc. of a complex and technical nature, bids may be obtained in two parts:

- Technical bid consisting of all technical details along with commercial terms and conditions; and
- Financial bid indicating itemwise price for the items mentioned in the technical bid.

This system is called '*two-bid system*'.

Proprietary items or spare parts to be compatible to with the existing machinery or equipment may be purchased through single enquiry. However, utmost care is to be taken to ensure fair prices. It will be advisable to cater to this aspect while tendering for the machinery/equipment.

Buyback offer: Modern hospitals need to install state-of-the-art latest equipment. This may require replacement of existing equipment, which still has productive life. In case of paucity of space, it may become more necessary to replace the equipment. The buy-back offer needs to be clubbed with buying of new equipment. Specifications of the old equipment shall be given and arrangement for inspection of such equipment by the bidders may be made so that right prices are obtained. For getting best offers, the tender may be decided by comparing the price of new equipment after deducting the price offered for the old equipment.

Turnkey projects: Heavy radiological/radiotherapy equipments may require specialised work execution. It becomes advisable to club the work of installation and commissioning with purchase of such equipment. Two-bids tenders may be floated for the purpose. Detailed drawings of the site, and specifications of the work involved will be necessary. Provision may be made for the inspection of the site by the bidders.

Sample-based procurement: There are items like furniture, linen, consumables for which it is difficult for the hospital to prepare detailed specification and there can be items for which it may not be cost effective to prepare detailed specifications. In such cases, bare minimum specifications may be prepared and bids may be evaluated on the basis of sample supplied along with the tender. In case of sample, there is a possibility of spoiling or destroying of the sample during evaluation, which may happen in the case of disposable and linen items, it will be advisable to obtain three-sealed samples. One sample may be used at the time of evaluation, the second at the time of receipt of goods, and third may be kept reserved for reference in the case of subsequent dispute.

Procurement of services: Specialised services like security, legal, sanitation, housekeeping, dietary, diagnostic facilities are sometimes required to be outsourced, depending upon the larger policies of the hospital. These special services can be performed by individual consultants and also consultancy agency. The procurement process for services is different in details. It is advisable to issue 'Expression of Interest' notice for shortlisting of consultant. After shortlisting of the consultant request for proposal (RFP) may be issued. The RFP follows two-bid system, i.e. technical proposal and financial proposal. Technical proposal is evaluated on the basis of predetermined, preannounced, criteria and sub-criteria need to be given grades as per the requirement of the services. Qualifying scores can be fixed for technically qualifying bidders. The financial bid in respect of qualified tenders is then opened. Bid with lowest cost is given the maximum scores and others are given proportionate scores. Depending upon the requirement, technically bid can have 70/80 scores and financial bid can have 30/20 scores. The bidder with highest scores is selected as a consultant.

e-tendering: With the advancement of web-based technology, e-tendering has brought revolution in the procurement process. e-Tendering tools have come up in the form of web-based platforms. The tender process, which is performed manually is transformed into e-processes and performed over internet. Such tender engine should have a security procedure in place. However, e-tendering can be used by using website internet facility to supplement and complement the traditional system. e-tendering is indeed a positive move for globalisation and breaking the national barriers with the use of internet.

Selection of reliable suppliers: The reliable suppliers must be selected through process of tendering. Hospitals can also maintain a list of such suppliers for limited tender enquiry and the local purchase. The list can be built by inviting applications through open advertisement. Even list of registered suppliers by reliable procurement organisation can be used. In India, such lists are maintained by the Director General of supplies and disposals.

Maintenance during warranty and after-wards: Maintenance shall form part of the procurement process. Period of warranty can be as per prevailing business practice or as per the requirement of the hospital. Warranty bears cost, as it may be loaded in the basic equipment cost. An informed view has to be taken. Warranty needs to be followed with maintenance period. It will be ideal to cover the entire life of the equipment. Maintenance can be comprehensive, which includes parts and labour or only for labour. In the case of robust and mechanical equipment, only commitment from the suppliers for maintenance may be necessary as such machines can be maintained on repair basis. Maximum downtime shall be fixed for warranty as well as maintenance period. Provisions for warranty, maintenance and downtime should advisably be included in 'tender'. The lowest bid may be based on the price of equipment, warranty and maintenance charges taken together so that competitive prices are received and monopoly is not created later on.

Ensuring timely delivery: The system must ensure timely delivery of appropriate quantities to the user department. Delivery period may be specifically given in the tender/contract. In case the supplies are required in instalments, the same may be prescribed. For this purpose, liquidated damages clause shall be added to the tender/contract.

Lowest possible total cost: The procurement of quality products/services at lowest possible total cost by way of competitive bidding shall be ensured.

Inspections and installation: When goods and machinery/equipment is received, it is required to be inspected to ensure their confirmation to specifications and assured quality. In case of machinery/equipment, successful installation and satisfactory working for reasonable period of time needs to be watched. Parts of payment, if not whole of payment, may be linked with successful installation and satisfactory working.

Payment terms: For goods, payment may be linked with receipt of goods in good condition, which include testing these for quality and specifications. For machinery/equipment, payment may preferably be made through letter of credit with 80% payment on shipment and balance 20% payment on successful installation and satisfactory working.

Earnest money and performance guarantee: Earnest money may be provided as 2% of the value of the tender may be provided as earnest money. Performance guarantee may be 5-10% of the value of the tender. Earnest money of the unsuccessful bidders may be returned on placement of order. However, earnest money of the successful bidder be returned only on furnishing of the performance guarantee for a period of warranty and 6-months' complaint period. Maintenance period should advisably be covered by performance guarantee of appropriate value.

Force majeure clause: Contingencies which that constitute force majeure need to be specifically mentioned. Procedure to be adopted for such cases shall also be incorporated in tender as well as contract.

Dispute resolution: In case of any dispute arising out of or in connection with the tender conditions/supply order/contract, the hospital and contractor/supplier shall address the dispute/differences for a mutual resolution, failing which the matter may be referred for arbitration to a sole arbitrator appointed by the hospital or board of arbitration consisting of three members — one each nominated by the parties and an empire/chairman appointed by consensus.

It should be specifically provided so that no court other than those having jurisdiction for the place of location of hospital shall have jurisdiction in the matters connected with contract/supply order.

Cancellation/termination of contract/supply order: Provisions may be incorporated in tender/contract for cancellation/termination of tender/contract, in whole or part, without prejudice to any other remedy for breach of contract or tender conditions:

- If the supplier fails to deliver any or all the goods within the time period(s) specified in the contract/supply order.
- If the supplier fails to perform any other obligation under the contract/supply order.

PURCHASE SYSTEM⁵

There are various systems of purchase. Each hospital has to adopt a system, depending upon its needs and requirements. Every system has its own advantages and disadvantages, and the best possible has to be chosen.

Centralised Purchasing

Advantages of centralized purchasing

The following are the main advantages of centralisation:

- Duplication of effort and haphazard purchasing practices are minimised.
- Quantity discounts are made possible by consolidating all hospital orders for the same and similar materials.
- Transportation savings are realised by the consolidation of orders and delivery schedules.
- More effective inventory control is possible.
- Centralisation develops purchasing specialists who inevitably buy more efficiently than less-skilled persons, who view purchasing as a secondary responsibility.
- Responsibility of the purchasing function is fixed with single department head, thereby facilitating effective management control.
- Vendors are liable to offer better prices and better services because their expenses are reduced.

- Record keeping is reduced and, at the same time, made significantly more effective.
- Fewer orders are processed.

Decentralised Purchasing

Decentralisation of purchasing exists when personnel from other functional areas of the hospital like pharmacy, dietary, radiology, laboratory, operation theatre decide on source of supply, prices and others aspects of purchasing system.

Disadvantages of decentralised purchasing

Under the decentralisation system, various members of the hospital have the authority to purchase. This system has many disadvantages against one advantage, i.e. the purchaser usually knows his/her needs and secures it. The disadvantages are:

- Two or more departments separately may order the same item at the same time, thereby depriving the hospital of the advantages of bulk buying.
- Department heads generally are not able to follow efficient inventory control. Therefore, they may be forced to rush orders, and thereby increasing ordering costs.
- Since there are many purchasers, personal interest may overcome institutional interest.
- Persons receiving goods may neglect to deliver the invoice and other documents to accounts department, with the result that scientific accounting is difficult.
- Inventory control becomes difficult.

Group Purchasing

In this system, a group of hospitals combine together and act as a single purchasing agency for the group. The items purchased under this plan are general usage items, all of which are usually utilised by the group. When the quantities used by this group are combined, the vendor may quote lesser prices.⁷

Independent group

These groups are not based within a system of an alliance or association, but are created by an entrepreneur who envisages opportunities to enhance programmes and services offered by groups.

System-based groups

Systems that own, lease, or manage hospitals generally provide group purchasing service under their stewardship. . Many of the system-based activities permit voluntary participation by hospitals, which are not controlled by the system. System-based purchasing operations include:

- For profit groups
- Nonprofit groups
- Government groups

PURCHASE PROCEDURE⁶⁻⁸

Committee System

In order to ensure the achievement of objectives of procurement, the hospitals should form a fool-proof system with experts from concerned fields, administration, finance, engineering and, if needed, the external experts. Two types of committees may be formed for ensuring the attainment of the objectives:

- Committees for recommendations.
- Committees for approvals.

Committees for recommendations

- *Core technical committee (for purchase of equipment):* The committee is recommendatory in nature for technical consideration of procurement cases. It prioritises the cases from the different departments/sections, and finalises the specifications and quantity. It also does the technical evaluation and recommends the cases for opening of price bids of those the tenders which that qualify. The members in this committee shall be within the hospital as well as from outside.
- *Committees for consumable and maintenance items:* These committees are for the consideration of technical specifications, sample evaluation and recommendation of bidders for the purchase of material/supplies for different stores. The committees shall have members from within the hospital. The separate committees shall be constituted for different stores as under:
 - Sanitation committee
 - Surgical committee
 - Chemical and glassware committee
 - Furniture committee
 - Stationary committee
 - Linen committee
 - Dietary committee
- *Committee for outsourcing of services:* The members are drawn from the concerned departments, finance department and administration. . These committees are responsible to access the need, prepare the specifications, terms and conditions, and evaluation of tenders for outsourcing of different services in the hospital.
- *Drug and dressing committee:* The members are from within the hospital. The committee accesses the need, projects the demands, prepares the specifications, and evaluates and recommends the drug and dressing materials.
- *Liquidated damages committee:* This committee works within the procurement department and levies late delivery charges, if the supplies/works are not completed in time.

Committees for approval

- *Standing purchase committee (SPC):* This is a high-power committee consisting of members drawn within and

outside the hospital. The committee considers procurement of high-valued goods/consumables/services.

- *Lower purchase committee:* This committee has members from within and outside the hospital and has power to approve the cases related to low-to-medium valued goods/consumables.
- *Standing finance committee:* This committee has members from within and outside the hospital, and gives financial approval to the various procurement cases.
- *Standing estate committee:* This committee has members from within and outside the hospital for the consideration of cases related to engineering works, rental and lease cases.

STEPS IN PURCHASE AND PROCUREMENT

Requirement/Demand

It will be generated from the concerned department.

A forecast is an estimate of demand expected in the future. Demands for materials, supplies, equipments, products could be certain or predictable, and uncertain or unpredictable. Certain and predictable demands are easy to forecast. It is the uncertain demands that pose the most problems.

The methods most suitable and simple to use in hospitals in forecasting of demands are *last period method, arithmetic average, and moving average*. The last period demand method simply forecasts for the next period period—the level of demand that occurred in the previous period. The arithmetic average simply takes the average of all past demand in arriving at forecast. The arithmetic average works well in a stable situation where the level of demand does not change. It will not adequately respond to trends in demand and it neglects seasonal fluctuations. The moving average method generates the next period's forecast by averaging the actual demand for the last 'n' time periods. The choice of the value of 'n' should be determined by experimentation. The objective of the moving average is to include a sufficient number of time periods so that random fluctuations are cancelled. This method gives more weight to the more current time periods. If the demand rate is steady, the moving average will respond with fairly constant forecasts.

Indent

The indent proforma is the most important document to initiate the procurement process. The indent should indicate the items, specifications, code, quantity, and time when required. It is raised by the department and to be signed by head of the department and depends upon the cost of the indent to be approved by the appropriate competent authority.

Technical Specification

These are to be prepared by the concerned department, which are to be approved by the appropriate committee depending upon the nature and cost of indent. The technical specifications shall be general in nature and these should generate competition.

Process in Procurement Department

After consideration and recommendations by the concerned committees, the procurement department shall process the cases according to, the nature and cost of indent by way of inviting tenders (NIT), notice inviting quotations (NIQ), repeat orders/rate contract or expression of interest (EOI).

Notice inviting tender (NIT)

It shall be ensured that the tender enquiries are widely advertised in print media and also uploaded on the hospital's website. The tender document shall furnish all the information necessary for a prospective bidder to prepare the bid. The information, as far as possible, shall be self-explanatory and should contain the instructions regarding the date and time for issue and submission of tender, date of opening of tender, general conditions of contract, special condition of contract, and also award criteria, quality control, payment terms, taxes and duties, completion certificate, warranty, direct liability, drawings, dispute redressal, arbitration and payment terms. All tenders received in time should be opened in front of the bidders or their representatives. The tenders received late should be returned unopened to the bidders. The opened tender documents should be signed and minutes prepared.

Quotations (NIQ)

The quotations' shall invariably be called through registered post and a period of 3 weeks shall generally be given to the firms for submission of 'quotations'. In case of urgency, this period may be reduced to 2 weeks after recording clear reasons for doing the same.

Rate contract

This is a contract for the supply of stores at specified rates during the period covered by the contract (usually one 1 year, but renewable). No quantities are mentioned, but the contractor is bound to accept any order that may be placed at the specified rates during the currency of the contract.

Running contract

This is a contract for the supply of an approximate quantity at a specified rate during a certain period covered by the contract (usually one 1 year, but renewable). The approximate quantities for the requirements of the period in question are calculated. The purchaser has the right to take a certain quantity (usually 25%) over or below the approximate

quantity mentioned in the contract. Withdrawals against this type of contract are carefully monitored and the guaranteed quantity (usually 75%) is made before the expiry of the period of contract.

Expression of interest (EOI)

'Expression of interest' (EOI) is issued to shortlist the consultants/consultancy agencies. The description of services with detailed selection criteria and subcriteria need to be incorporated in notice calling for 'expression of interest'. The criteria for shortlisting the consultants/consultancy agency should also be given in the notice. Request for proposals (RFP) is required to be floated for detailed technical and financial proposals. RFP is based on two-bid system. The RFP shall contain criteria and subcriteria determined on the basis of relevant importance of the services to shall be hired. The weightage shall be attached as per importance. The minimum qualifying score shall advisably be mentioned in the RFP. Financial bids shall be opened only for technically qualified bids. The relative scores to be given for technical and financial parts shall be finalised at the time of issue of RFP. The score between technical and financial bids may be fixed between 70:30 or and 80:20, keeping in view the technical quality and cost requirement.

Local purchases

It is constructed as 'acquisition to petty items required on emergent basis, and is arranged from local sources'.

The need of local purchase arises due to unforeseen and emergent situation, which cannot be fully eliminated. Through local purchases are attempted to be minimised, at times, it is difficult to avoid it due to various reasons. Basically, they are resorted to overcome:

- Failure of planned procurement.
- Delay in centralised buying.
- Operational emergencies, especially in healthcare institutions.
- Sudden arising of urgent/petty demand.

In case of local purchase, competitive quotations are also obtained from local traders by short-dated tender enquiry as the situation demands. The competent purchase officer, after satisfying about specifications, prices and delivery, issues the supply order for the same. The payment is normally made through imprest account. The payment and delivery of goods in case of local purchases are generally concurrent, except in few cases where the vendors insist for payment before delivery.

Technical Bid Evaluation

After ensuring that the bidding firms have provided all the requisite documents with the terms and conditions acceptable to bidders, the procurement department shall send the bids of the qualifying firms to the respective department for preparation of the comparative technical statement. The

comparative technical statements after getting the recommendations from appropriate technical committees are further processed for opening of price bids by the procurement department.

Opening of Price Bids

The price bids of technically qualified firms, as recommended by the appropriate committees, shall be opened.

Price-bid Evaluation

After opening the price bids, the procurement department shall send the cases to respective departments to prepare and send the draft price bid evaluation statements (duly signed by head of departments) to the procurement department again. The recommendation on the price-bid evaluation statement is also made by the concerned department, which is considered on the basis of lowest basis. If the user department feels that the price of the lowest bidder is on higher side and needs to be negotiated, it may also recommend the same. Reasonability of prices may be examined on the basis of last purchase price, estimated value and/or market price.

The cases shall again be sent to the appropriate committees, depending upon the nature of case and are sent to the lower purchase committee, standing purchase committee or to the concerned department, depending upon the cost of the case. The case may be approved or rejected by the committee.

Placing Supply Order

After approval from the lower purchase committee or standing purchase committee, the supply orders are to be placed to prospective bidders or firms.

In all press tender cases, an agreement has to be signed by the supplier and the competent authority of the concerned hospitals so, at the time of issue of supply order, the printed agreement shall be sent along with the supply order. The amount of performance bank guarantee required, if any, shall be clearly mentioned.

The draft supply order may be get vetted from the user department to eliminate the chances of any mistakes. It is important to incorporate in the supply order all the conditions of supply including times schedules in the supply order, and to seek an acknowledgement of the order from the vendor firm. Acknowledging the receipt of supply order legally binds the vendor firm legally. A complete and legally valid supply order should include the following:

- Purchaser's order reference number and date.
- Supplier's name and address.
- Tender/quotation reference.
- Description of materials
 - Specification
 - Brand name
 - Size

- Quantity
 - Number of units
 - Pack size/weight
- Packing—special packing, if any
- Price and total value based on approved quotation.
- Freight charges and dispatch instructions as per the approved bid.
- Provision for inspection
- Payment terms
- Warranty clause
- Annual maintenance contract/comprehensive maintenance contract, wherever applicable.
- Liquidated damages clause as per tender/contract conditions.
- Cancellation/termination clause as per tender/contract conditions.

The purchase department shall consistently keep the track of the progress of the supply order and ensure that the supplier adheres to the delivery. Such a follow-up that can prevent delays and bottlenecks, if any, at the supplier's end are also known and efforts shall be made to remove these.

Delivery

It is necessary to stipulate in the contract that the time is the essence of the contract. In the absence of such stipulation, the time for the delivery cannot be strictly enforced.

Delivery schedule in a contract is incorporated in two ways:

- Servable contract: indicating specific delivery dates for different instalments/ portions/quantities.
- Entire contract: when the delivery of the entire quantity is completed by a specified date without indicating deliveries for intermediate instalments.

In case of servable contacts, each portion of the contract with specified delivery dates in an individual contract and contract provisions for nonsupply/delayed supply could be enforced with respect to each such instalments. It should be ensured that all deliveries/supply of individual instalments are materialised.

Liquidated Damages

If the supplier fails to deliver the stores or any instalment thereof within the period fixed for such delivery, the purchaser has the right to claim penalties in case of delay in supplies, which will be up to 5–10% (depending upon importance of supplies) or part thereof for delays in supply. It is desirable that in individual cases, especially in cases of critical items, pre-estimated damages for delay in supplies should be decided and incorporated in the bidding documents and in the contract. Such pre-estimates damages are then generally recoverable.

The liquidated damages are recovered either at the time of making initial payment or at the time of making final payment, as per the provisions of the contract.

The purchaser accepting delayed supplies should communicate their intention to levy liquidated damages to the supplier their intention to levy liquidated damages. Further, the purchaser should not accept any increase in taxes and duties during the period of delay in supply and it should be specified in all amendments in delivery period.

Payment

After satisfactory supply of material and equipments installation and commissioning, the verified bills shall be processed for payment to the concerned party/vender/service provider as per the terms and conditions of the supply order.

Procurement Audit

It shall be ensured that for a transparent, efficient and accountable procurement system, a post audit of the contracts is conducted. All documents pertaining to procurement should be placed and kept systematically.

Complaint Redressal Mechanism

There should be an inbuilt mechanism to deal with the complaints regarding the procurement. All complaints on receipt should be maintained in a register. The action on the complaints should be initiated within 15 days and should be mentioned in the evaluation report. If a complaint is received after the award of the contract/tender, it should be discussed on the file and put up to notice of appropriate authority for decision.

All complaints should be handled at a level higher than that of the level of at which the procurement process is being undertaken. The allegations made in the complaint should be enquired into seriously. If allegations are found correct, appropriate remedial, measures should be taken by the hospital. Accountability may be ensured if complaint system provides feedback, which can be crucial for keeping the system updated and healthy.

The procurement functions and responsibilities (selection, quantification, product specification, preselection of suppliers and adjudication of tenders) should be proportionately divided among different offices in procurement department. They should be provided with appropriate training and expertise. The procurement process should be transparent, and formal written code and conducts should be there throughout the process. The criteria to award contract should be explicitly mentioned. The procurement performance should be monitored regularly, which should also include an annual external audit.

In order to ensure efficient and transparent procurement system, the following shall be practiced onboard:

- The procurement events shall be properly planned and an appropriate procurement methodology shall be selected.
- The procurement requests shall be submitted on time.

- Technical specifications, scope of work or terms of references shall be prepared well in time.
- Evaluation panels/committees shall be formed to ensure timely evaluation process.
- Reviewing and approving authorities shall complete the job in a given time.

Procurement system shall be part of the larger system encompassing the whole of the hospital, which, in turn, shall be integrated with the external environment. Seamless integration of sub systems namely stores, logistics, operations, finance etc., will increase the effectiveness. Clear communication lines, timely flow of documentation and continuous feedback will facilitate the procurement process. Procurement is the vertebra which keeps the system of hospital in place.

Case Study 1: Examining delay at various steps of procuring of ultrasound in a tertiary-care hospital

The process to procure whole-body ultrasound in one of the tertiary-care hospitals in North India was initiated in April 4, 2005. When the case was presented before the technical committee for approval of technical specifications, the committee did not approve the specifications and the concerned department was advised to prepare the specifications in more generalised manner so as to promote competition. The final approval by the technical committee was given in November 21, 2005 and tender was invited on March 8, 2006, which was to be opened on April 4, 2006, but as only one firm participated, so again tender was floated and opened on August 3, 2006. Three firms participated. After initial scrutiny in the procurement department, the case was sent to the concerned department for technical evaluation on September 15, 2006. The department submitted the report back to procurement department on January 15, 2007, with the recommendation to take the demonstration from the qualifying firms. The demonstration was given by the firms on March 12, 2007 and, the price bids were opened on August 14, 2007 and supply order was placed on January 25, 2008 to the L-1 firm. The supplier preferred to offer higher version of the equipment within the same price. The hospital accepted the new offer and issued amended supply order on August 14, 2007. Equipment was received on January 29, 2009. On inspection, printer component of the machine was found to be defective and company was asked to replace. After receipt of replacement, final satisfactory installation of equipment was completed on May 6, 2009.

Questions

1. What do you think about the procurement system adopted by the hospital?
2. Give suggestions to avoid the delay.

3. What do you think was the reason for offer of supply of higher version?

Intervention

The hospital reviewed the whole process. The delay has occurred at every stage. Administrative orders were issued, fixing the time period for every stage. Provision for latest model to be supplied by the supplier at the time of supply was added to the contract so that only upgraded latest version is supplied. Liquidated damage clause was to be enforced without fail in case of delays beyond the delivery period.

Case Study 2: Importance of turnkey project for installing high cost and extensive civil work

Dental surgery department in a large metropolitan city hospital was allocated a budget to procure the ten dental chairs of the latest model in April 2009. Department submitted the indent with technical specifications. The technical committee gave the approval to the technical specifications. The process to procure the dental chairs was started by the procurement department in the month of July 2009. The dental department also submitted the proposal for site preparation to the engineering department. The procurement process of the dental chairs was completed in month of January 2010 and supply order was issued. Chairs were received in the central store in the month of March 2010. The installation of dental chairs was not possible, as the site was not prepared as yet. While in audit inspection held in the month of August 2010, the observation was made for nonutilisation of dental chairs and blocking the public money. Procurement department asked the dental surgery department to get the process of installation of dental chairs expedited and replied to audit the observation of the noncompletion of engineering works to auditors as the reason. The installation of the dental chairs was done in May 2011 after the site preparation. The equipment till this time was lying unpacked in central stores and raised audit observation and brought bad image to the hospital.

Question

1. Do you think this was the case of turnkey project?
2. What steps you will you recommend for preparation of site for installation?
3. Who was responsible for the delay and what was the cause for confusion?

Intervention

It was decided by the hospital that for high-cost heavy equipment or equipment which that involves extensive

civil and electrical works for installation, it will be preferable to prepare a turnkey project for early, timely installation and commissioning. For minor civil/electrical works, the engineering department was asked to have a standing arrangements.

Case Study 3: Alertness inspection committee in procurement process helped PGIMER Chandigarh in receiving right supplies

A tender was called from procurement of cloth for patients' dresses, giving the specification of width of cloth 94 cm and also the prospective bidders to supply the bids with three samples. Eight firms participated. Technical committee evaluated the bids and samples, and recommended five firms. The price bids of the technically qualified firms were opened and supply order was issued to the L-I firm. The evaluated and qualified samples of L-I had width of 115 cm, i.e. higher specification. The supply order was issued mentioning the width 94 cm and supply as per sample. The firm supplied the cloth with 94 cm width, as mentioned in the supply order. The inspection committee rejected the supply, as it did not match with the sample supplied by the firm. The correspondence was made with the firm to supply the material as per samples and after 4 months of correspondence firm supplied the material as per sample, which was accepted by the inspection committee.

Questions

1. What were the infirmities in supply order?
2. Was technical evaluation committee was correct in approving the sample of higher specification?
3. Was inspection committee correct to reject the supply?
4. What are the lessons learnt?

Intervention

Instructions were issued to include as part of specification, whichever is higher between tendered specification and offered specification. Inspection committee was appreciated for alertness.

Case Study 4: A proper sanitation contract must before awarding contract

A sanitation contract in a multispecialty hospital was awarded on per square meter basis. The area under contract was mentioned in the tender. The service provider started the work and raised bills for payment on monthly basis, and, payments were accordingly made after deducting penalty for the cleaned areas cleaned.

After a period of 8 months, service provider raised an issue that the measurement of the area mentioned in the tender was much less than the actual area being cleaned. Lot of correspondence took place between hospital authorities and service provider, and finally the matter was referred to the engineering department to remeasure the hospital area under contract. The area was reassessed and the measurement came to the higher side than given in the award letter. Accordingly differential payment was made to the service provider. But the hospital authorities noticed later on that the penalty for uncleaned areas had not been deducted proportionally viz-a-viz increase in the area in reassessment. The service provider was directed to refund the money charged for uncleaned area back to the hospital.

Question

1. Why did the dispute over area arise?
2. What should have been the proper technical specification in such service contract?
3. How will you resolve the dispute of over payment?

Intervention

The hospital authorities constituted a high-power committee to resolve the dispute. Further, a standing committee was also constituted to go through the cleaning services tender document and give recommendations to be incorporated in the tender document so that such disputes do not arise.

Case Study 5: Better coordination between procurement department and other departments for efficient purchase

Various departments of a tertiary-care hospital wanted to purchase blood gas analysers for patient care. The need was processed by the departments separately at different point of time. The requirement of capacity and user requirement were different as per their expected patient load. Anticipated requirement of consumables spares and spares was also varying. The specifications were different. Tenders were floated at different point of time. Procurement department received another demand for two blood gas analysers. It was thought prudent to club the purchase of analysers with the earlier floated tenders to avoid a situation where different tenders floated by a hospital compete with one and another, and also benefit of bulk purchase was extracted. A committee was formed to look at the specifications given in each tender. It

transpired that specifications differ, especially with respect of to consumable, which includes chemical and consumable spares. It was considered to club the maintenance with purchase of equipment to avoid exploitation by the manufacturers in supplying consumables at exorbitant rates later on. Specifications were standardised and maintenance for 10 years, including rates for supply of all consumable, was included in comparison.

Questions

1. Was the system of raising of the demand correct?
2. Comment on the system of finalising the specification.
3. What was the status of coordination among the different departments?
4. Comment on the role of the procurement department?

Intervention

It was decided to setup committee for scrutinising the requirement of different departments. Specifications and maintenance issues were also to be finalised by such standing committee. It resulted in better coordination between procurement department and other departments.

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Quality and Safety Issues in Hospital

Section VIII

SECTION OUTLINE

- Chapter 37** Quality Management – I
- Chapter 38** Quality Management – II
- Chapter 39** Prevention of Hospital-acquired Infections
- Chapter 40** Safe Injection Environment
- Chapter 41** Biomedical Waste Management
- Chapter 42** Occupational Safety
- Chapter 43** Hospital Security



Quality Management – I

Dr Neha Pandey, Nishant Pandey, Dr Sanjeev Julka and Dr Sonu Goel

“Quality is never an accident; it is always the result of high intention, sincere effort, intelligent direction and skilful execution; it represents the wise choice of many alternatives.”

—William A. Foster

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the importance of quality assurance in hospitals.
- realise the intricacies involved in quality assurance in hospitals.
- enumerate the traits of a good quality assurance manager in hospitals.

INTRODUCTION

The Indian healthcare system has been largely influenced by the private healthcare providers ranging on one side from hospitals setup by large corporate houses or pharmaceutical companies to informal healthcare providers practicing the so-called traditional medicine, such as traditional bone setters, traditional birth attendants, etc. including somewhere in between 25–30-bedded small nursing homes and sole private practitioners, for profit and not for profit healthcare organisations in the urban setting. The public healthcare system of the country has three important tiers and spread throughout to cover even the rural areas, but is inept in meeting the complete burden of the healthcare. About 80–85% of the healthcare spending in our country by the people is out-of-pocket spending; and in the era of poor economic growth, it pinches the pocket of the people heavily. People have relied more on the private healthcare providers with a notion to get faster attention and better care. In such a scenario much stress needs to be laid upon the quality of healthcare imparted to the people in the hospitals.

WHAT DO WE UNDERSTAND FROM QUALITY MANAGEMENT IN HOSPITALS?

However intangible, yet being the desired level of excellence expected from a service or a product, quality is the inherent part of all activities and steps that bring that service/product into being.

The concept of total quality management includes quality planning, quality assurance, quality control and quality improvement (Figure 37.1). From introducing the concept of quality in the inception stages of planning for a service/product to monitoring its existence and then identifying the gaps where it does not meet the said requirements and then improving upon the assured quality of service or product delivery to the end user is the holistic picture of quality. Quality is more than just a concept to be understood; it is a mind-set that needs to be instilled in each and every member of the organisation till it becomes a driving force and the culture of an organisation. This is especially true for a service delivery system like healthcare where human lives are involved. In any hospital organisation, the assessment of

quality on a very basic level will come by gauging parameters such as the waiting time period before service delivery, the overall cleanliness and hygiene throughout the hospital, the outcomes of the medical and surgical interventions carried out, the average length of stay of the patient, and the timely discharge rate of the patients, the overall satisfaction of the patient with the hospital services, the competency level of the staff in accordance with their job profile, medications errors and other adverse events occurring in the hospital, etc.

Solutions to the gaps at the process level needs to be related with the structure of the service and then measured with its outcomes. This would entail integration and a proper coordination between the hospitals' services and departments. To target the improvements that are to be made, the real problems need to be addressed at the organisational level and not at the individual patient level. The structure–process–outcome model given by Donabedian serves as a good tool in the hands of managers to understand the flow of patients' problems through the various hospital services and the care they receive in the organisation.¹ Well-managed smooth process results in better outcomes for the patients, which is the goal of every quality manager. Well-run processes also decrease the overall chaos and errors in the delivery of care.

Case Study 1: Wait, wait and wait some more

Issue

Raghu Shukla was daily wages labourer. He had taken leave today from his job to bring his wife Sunita to get her third antenatal check-up for their first pregnancy at the government hospital. She used to get her check-ups done at the local dispensaries, but came to the big hospital for tests such as ultrasound and to meet the 'big' doctor. Her scheduled appointment was at 11 o'clock, but Raghu arrived an hour early just to stand in the queue. This was the only big government hospital in the city; and often the patients and their attendants would have to wait at least a couple of hours extra in the queue irrespective of the schedule to see the doctor. This would sometimes mean that the patient with an 11 o'clock appointment would come before the patient at 10:30. Being mostly from the struggling classes, the patients too would not let the latter one go before them to see the doctor resulting in daily confusions and fights.

However, at about 1 o'clock seeing that the queue was not moving forward at all, Raghu went to ask the receptionist the cause for the delay. Irritated at having to

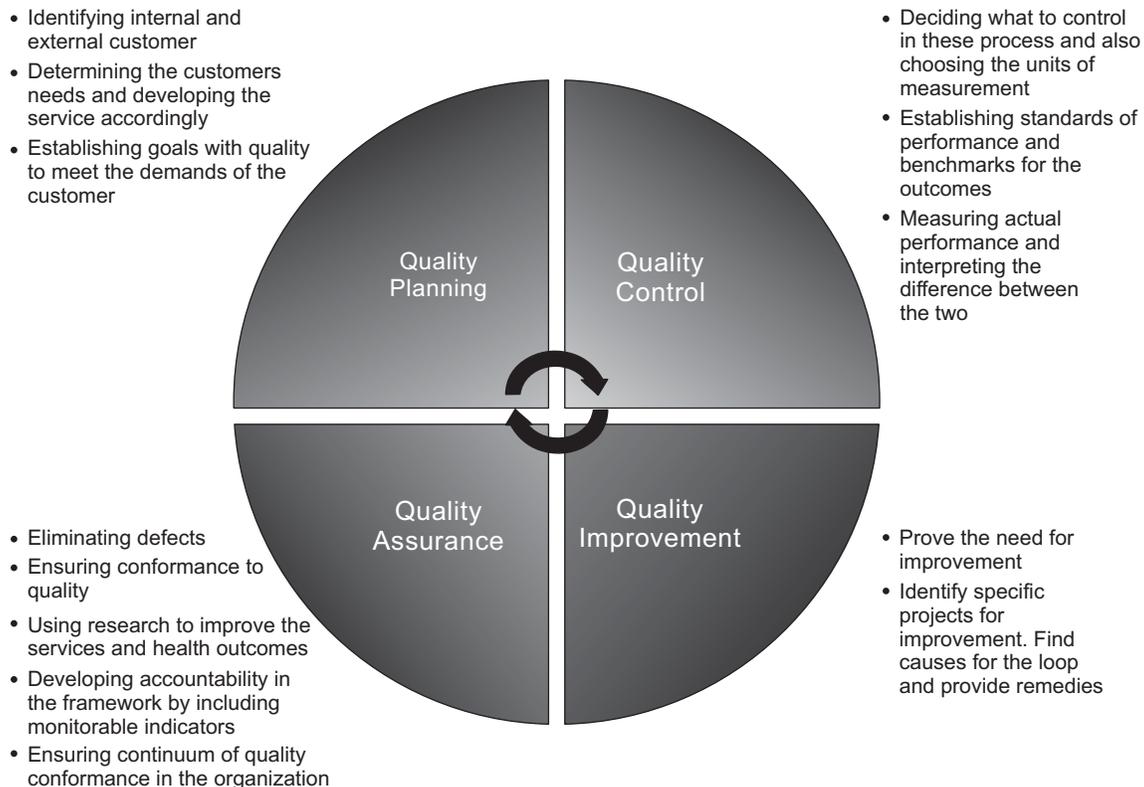


Figure 37.1 The concept of total quality management.

answer the same question several times yet understanding Raghu's plight, she replied, 'the doctor has gone to do an emergency case; but she will come in some time. If you cannot wait, come tomorrow. Anyway the outpatient department (OPD) will close at 2 o'clock'.

The information brought no respite to Raghu, seeing the long line of patients already ahead of them; he calculated that Sunita's turn would not come today. Disappointed at having to lose another day's wages, he went to discuss the situation with her finally. He got them registered for an appointment with the doctor the next day.

However, at the next appointment, the doctor did only the physical examination and ultrasound was not done. When asked, the doctor informed Raghu that the ultrasound machine had not been working for the past 2 weeks and there was no telling when it would be repaired. Since Sunita was due to deliver soon, the only option left with Raghu was to get it done from outside. After losing 2 days' wages, he was distraught at the extra expenditure. Question raised was, 'What do you think happened in this scenario that can be rectified from the management perspective'?

Interventions required

This was a failure in the delivery of health services at many levels. The organisation was facing a high case load versus the manpower employed. The chaos due to ineffective patient scheduling and queuing systems had ensued due to mismanagement of the waiting time and the patient actually getting some consultation with the doctor was an everyday problem faced by the organisation. The patients and their attendants came to a state-run health facility to lower the financial burden upon themselves; but, in turn, were facing high opportunity costs. The staff had communication issues with the patients, whereby they had failed to inform the patient about the broken ultrasound machine and also that they had poorly managed the crisis at the office. Both the plan of medical care to be given and the quality of patient care delivered at this particular department of the hospital should be keenly sorted and issues dealt with.

ROLE OF A QUALITY MANAGER

The quality manager should have an astute eye to amalgamate the three entities namely the patient, the clinician, and the healthcare organisation and their interrelationships in the triad of service delivery (Figure 37.2). Co-aligning the goals of these three entities to enhance the performance measures will result in resource stewardship and satisfaction cum support. Simply put, it means meeting the expressed standards of the consumer by the provider. Mostly this is

dealt with the value-based approach to any service or product. According to the value-based approach, the quality of any service would be defined by its cost or price. As Phillip Crosby said that the desired quality of a service or product is the one that provides performance at an acceptable price or conformance at an acceptable cost. Analysing what is the desired quality by the consumer and the quality that can be delivered by the healthcare organisation would be the first role of a quality manager.² His other roles would include:

- To identify and co-align the competing expectations and perceptions of all the stakeholders of the hospital. The three entities mentioned earlier will all have different values associated with different aspects of care. However, a common ground-level expectation should be set to satisfy all stakeholders. This can be done at both—senior level and middle manager level in the organisation, patient with his individual needs and the physician's judgement of what kind of care a patient needs. Though the physicians are always caught between cost containment and delivering high quality of care to the patient, clouding his own judgement at times; however, the needs of the patient should take precedence above and over all. The outcome of the delivered healthcare becomes the yardstick by which the goals and expectations of all these three entities are gauged, that is to say the outcomes finally decide the quality of care. Everyone should understand the concept of quality, feel accountable and responsible towards it, not just the quality manager. Quality in a healthcare organization is the result of a collective approach towards it by all the stakeholders.
- The task-at-hand of a quality manager includes establishing the processes for the quality management system in

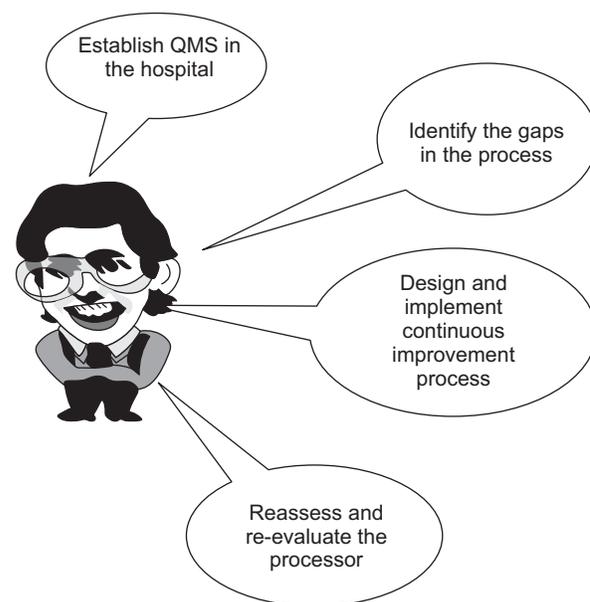


Figure 37.2 Role of quality manager.

any organisation, and ensuring thorough implementation and maintenance.

- To be able to reduce the gaps and conflicts between the physical deliverables, financial and nonfinancial variables where the quality of care is involved.
- Develop clear criteria for benchmarking of services delivered by the organisation.
- The internal audit programme should be clearly defined and implemented in the organisation. Develop clear supervision and monitoring clinical and nonclinical indicators for the organisation along with the routine reporting formats. For example, monitoring of ventilator-associated pneumonia, catheter-associated urinary tract infection (CAUTI), hospital-acquired infection rate (HAI rate), the costs of maintaining the medicines versus the costs of nonavailability of essential drugs, waiting time in the out-patient department (OPD), rate of complaints received from patients, etc. The formats need to be so designed to be understood by the staff of the criteria they are being gauged upon. Simple formats give clarity of evaluation and the expectations from the staff of the organisation. The quality manager also needs to bear in mind the turnover rate of the organisation since the newly recruited staff needs to be updated of the standards and protocols established by the healthcare organisation to achieve the set quality of the service delivery.
- The quality manager also forms a link between the desirables and the achievable. Among the many responsibilities of the quality manager, reporting to the top-level management regarding the ground reality in terms of equality of the service is one. A quality manager of a healthcare organisation also forms a link between the external certifying or accrediting bodies and the healthcare organisation for getting the final seal of approval.
- Last but not the least, the data should be collected on a regular and defined periods and analysed rigorously so that continual improvement measures can be planned and implemented within the organisation.³ A record of these continual improvement measures need to be documented and reviewed too. Any quality management system should ensure that continuous quality improvement measures are prioritised within the organisation.

HOW TO SUCCESSFULLY IMPLEMENT QUALITY MANAGEMENT IN HOSPITALS?

In order to successfully implement the concept of continuous quality improvement in any healthcare organisation, it is vital to understand the philosophies behind clinical quality improvement (CQI), which are Kaizen, lean thinking, Six Sigma, etc. It is also important to include all the stakeholders to be affected by it, especially the hospital staff at all hierarchical levels to be a part of organisation wide CQI implementation plan. Since the process itself is based upon

identifying the gaps and deficiencies and further improving them based upon evidence collected, this exercise can be done with utmost accuracy when the staff feels a part of it and not under the judging microscopic eyes of others. The teams need to be empowered to take the charge of the improvement process and include continuous learning in the long-term plans. All efforts should be made to modify the organisational culture to be receptive of the continuous change and improvement that will come along with the plans of CQI. Organisational culture becomes a pivotal link between implementation plans and the other factors at any organisation such as the participation of the physicians, the outcomes, resources, etc.⁴

Therefore, the significant question remains—how do we bring about a change in the organisational culture itself? Leadership at any organisation has an important role in implementing quality-based improvements.^{5,6} Most of the times, it is felt that the people cry lack of resources in order to deliver good quality. Henceforth, if this is the case, sufficient resources should be made available to them or the budgets should be increased for quality-based activities from time to time and not just one-time capital expenditure.

A self-sustainable mechanism for implementation of quality in the organisation can be done by designing policies in a manner that encourages the staff to come forward with their concerns and any deficiencies they might feel exist in the functioning of the organisation, if required be able to report anonymously and also through an open-door policy to the top-level management. The staff should be encouraged to have an organisation-wide platform to discuss any topics of concerns. The quality management programme should give importance to employee empowerment programs.⁵

After a mechanism has been established, it is important to empower the medical and nonmedical staff by formulation of teams and committees to monitor and evaluate the success of the steps taken above. The physicians and the nursing leaders should be involved in the formulation of teams and committees by using their areas of expertise in conjunction with their existing duties. This group of physicians and nursing leaders should be encouraged to take the lead in educating their peers and other staff about the new practices and protocols brought into effect with a view to enhance quality of patient care.

Coordination among teams and committees should also be established to improve upon the reporting of the findings and access to physician services for inpatients. Benchmarks and other industry performances should be used to identify the gaps and deficiencies to improve upon the service delivery and patient satisfaction. Above all, goals should be set to integrate quality in all functions and time-to-time monitoring should also be taken up to ascertain achievement levels. Just as the culture change is required at the organisational level so is change in the existing hospital policy or care

protocol. Reformation of the guidelines and clinical care maps catering to certain specific procedures should be done. Information brochures educating the patients about their rights and responsibilities for infection prevention and regarding the preventive measures from falls, etc. should be widely available throughout the hospital.

The staff should be given refresher trainings to reduce medication- and protocol-related errors and encouraged to report each and every sentinel event to improve data collection, etc. Infection control is an important aspect of nursing care of the patient, which should be frequently stressed upon along with the handwashing techniques, etc. A department-specific quality plan should be designed and brought into effect. The practice reform measures should clearly indicate the short-term and long-term goals, and monitor the progress of their achievements. Information technology has become an integral part of the care-giving process to the patients. Starting from admission to lab results to even the smallest of instructions given by the doctor can be handled by correct use of information technology aids. It greatly reduces the time lapsed as well as errors in implementation of prescription methodology and healthcare given to the patient.

Kaizen: Kaizen means ‘continuous improvement’. The origin of both the term and the philosophy is Japanese. As explained above on continuous improvement, the philosophy encourages to make small changes and improvements and on regular basis to improve the productivity, safety, effectiveness and decreasing the waste products. The philosophy tends to improve a process based on new ideas, even if the process does not have any visible flaws to eliminate the wastes. Surmounting challenges in the healthcare field in today’s scenario calls for acceptance of a philosophy that focuses on customer satisfaction and flow of work. Hospitals today are struggling with material costs, manpower crunch, increasing demand of quality of services and healthcare services as well, increased pressure on the staff to perform to their utmost and the increased risk of sentinel events occurring, increased expectations of the patients in terms of the services they receive and the financial constraints faced by the organisations. Implementing the philosophy of Kaizen is to create solutions and improvements within the existing infrastructure in the most cost-effective way possible (Figure 37.3).

When implementing Kaizen to a particular process of healthcare, the people involved in the process are asked first to identify the gaps they feel exist and recommend their solutions also. This approach ensures that the involvement of the staff, which is most well-versed with the process, has its say so that any opposition in implementing the new process is eliminated right from the start. This way, any change implemented by the way of Kaizen becomes sustainable for a long period of time.

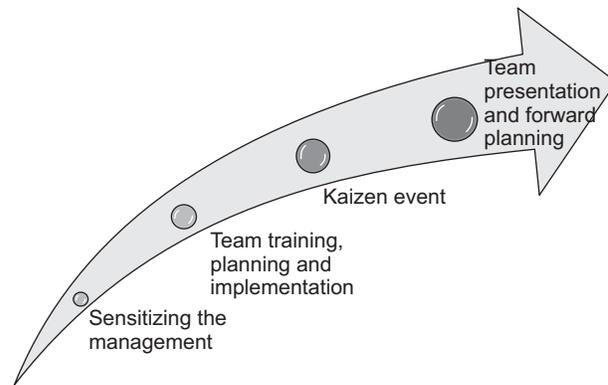


Figure 37.3 The Kaizen approach for quality management.

Lean thinking: The origins of the philosophy of lean thinking are from the Japanese business house of Toyota, where the errors generated in entire process of manufacturing system were taken up to study the costs incurred to the organisation along with the causes and ways to reduce them. Lean thinking has been defined as a journey the organisation willingly embarks upon to sort out its deficiencies, set them in order, standardise the protocols and finally sustain the results in the service delivery process. Lean thinking promotes the ideology to use fewer resources and achieve more. Lean thinking can be used to streamline processes in a healthcare organisation, reduce costs, and improve quality and timely delivery of products and services in the first go itself.⁷ A flow of work needs to be established with the engagement of both the staff, which identifies its own areas for improvement, and the management system that helps to sustain these improvements by providing the support system for them. This philosophy is based on studying the patients’ journey through the hospital and identifying the value in terms of patients’ expectations from the healthcare organisation. Lean thinking uses evidenced-based–best-practice methods to bring about the necessary changes in the current work practice of the organisation to reduce delays in work process, patient waiting times, request processing and reduce waste in terms of efforts of the staff and eliminate the errors.⁸ Lean thinking involves resolving the conflicts that may arise due to these wasted efforts and delays, and between the departmental objectives that are interlinked.

While using the philosophy of lean thinking in a hospital, one can begin with ascertaining the maximum demand that is generated from a few processes and standardise the care maps for these healthcare demands. This would help by saving a lot in terms of time and effort invested as well as maintaining records.

Six sigma—its role in healthcare: Six Sigma has been defined as the data-driven approach and methodology for eliminating defects. All healthcare organisations aim to have low-cost–high-quality deliverables for its end user—the patients. However, not only this ideology involves innovation

and customer insight to increase productivity and deliver high quality of healthcare. The Six Sigma philosophy can be applied to all hospital services, for example, bed-related inpatient services, outpatient-related services, diagnostic and treatment functions, administrative functions, supply chain of the hospital, etc. Customer requirements, design quality, metrics and measure, and employee involvement along with continuous quality improvement in the process are the main elements of a Six Sigma process.⁹

Six Sigma has two methodologies to approach—the process improvement and variation reduction in the organisation. DMAIC (define, measure, analyse, improve and control) is an improvement system that works best for existing process within the organisation. The second is DMADV (define, measure, analyse, design and verify) is an improvement system that is used to bring about innovations in services and processes within the organisation. The define component in this approach outlines the expectations of the customer from the organisation. Next, measuring the way it is being done by collection of data and validating the measurement system and constructing or designing a flow chart of the process. This is then analysed and root causes of any outlined variation is identified. The fourth step in the process pathway is to improve the process performance by prioritising improvement efforts of the root causes identified earlier. In this step, there is a scope to bring about innovation by implementing new solutions to the root causes. This improvement needs to be validated by means of collection of data. Finally, data needs to be collected again to demonstrate process gains and ensure that the solution is being sustained.

Case Study 2: Adopting lean thinking

Issue

The General Hospital was undergoing a makeover and the new Nursing Superintendent had heard about lean thinking philosophy in a national conference. She went and spoke to the Medical Superintendent (MS) about it, seeking permission to pilot test the philosophy in the general ward of the hospital. As she explained to the MS that the general wards of the hospital had many delays relating to services delivered by the nurses and longer stay-times of the patients. She explained her strategy of including the philosophy of lean thinking in this area of the hospital to see the results. After getting a go-ahead from the MS, she went on to plan her strategy.

Questions raised

What opportunities were present to include lean thinking in general wards?

Interventions done

Identifying the admission rates, average length of stay, average time consumed daily on each patient, and the reasons of delay—both during medical interventions and discharge, etc. was taken as the priority at the outset itself. Medical care plan and bed management was also included as a part of this exercise. Next, root cause analysis was done for each of the delays and variances to protocols were identified. While keeping in mind that the patient and his expectations were the most important objective to be achieved, opportunities were identified in terms of monetary gains or costs that could be saved to show concrete results to the management. This included identifying any excess equipment or furniture in the wards that was lying around without serving any adequate purpose. It was then checked if these excess equipments could serve some use in other wings of the hospital where the requirement had been generated or were to be condemned. The hub areas were taken up to identify any excess medicines or supplies lying around, including adequate storage for these as well. This would help in reducing any medication errors on the part of the nurses and decrease in the response time by reducing clutter at the hub. Items were then tagged at the hub and a staging area was identified by the floor manager. Only items that were required very frequently on an everyday basis was stored at the hub.

The same method was used to store items according to the frequency of their use and accessibility. Clear locations were marked for these items and this was displayed at the nurses' station. Broken and condemnable equipment and other stuff was identified and removed. It was also important to designate one person to be responsible for this stacking and shelving of items on an everyday basis and this person to be identified by one-and-all working at that hub so that everyone knew who was responsible. Guidelines and checklists were mandatorily displayed at the working station.

A reaudit was planned to assess the ongoing change and its results. The nurses themselves reported to having more time to document their daily activities and patient charts compared to before, since now they could find the same stuff in less than half the time! They also reported to having less missed information episodes through this period. Over the next 6 months, the number of medication errors is also reported as less. When the discharge times of the patients were compared, even they had gone down considerably. The waste of time invested by the nurses in searching for medications and the equipments, which should have been centrally located but were not due to extra furniture, etc. was greatly reduced by this exercise of adopting the lean philosophy in the general wards.

PRECEPTS INFLUENCING QMS IMPLEMENTATION IN HOSPITALS

From the above section we can readily gather that there exist certain factors that can be clearly categorised either as patient-related factors or organisation-related factors, and are widely responsible for the implementation of QMS in the hospitals.¹⁰

By measuring these criteria one cannot only assess how an organisation has adopted the principles of quality management but also identify what factors limit its ability to adopt them and the change brought about by continuous quality improvement.^{11,12}

These precepts or criteria are¹⁰:

- *Leadership and commitment*: If the senior management of the organisation gets involved in any quality implementation programme, not only does it provide a direction for the employees but also the ideas generated by the research and development team become quality centric too.
- *Policy and strategy*: Quality needs to be translated firmly into both—the long-term and short-term policies of the organisation.
- *Human resource management*: To include quality into the management of the workforce of the organisation, it is important to constantly look into projects to ensure the workers are well-versed with their fields or arrange continuous education programs so that they continue to grow at an individualistic level. This relates mostly to a feeling of job satisfaction in the staff.
- *Patient care services*: This criterion focuses on both the internal and the external customers of the organisation and putting their preferences first.¹³
- *Process management*: Quality processes guide the organisation in a manner where its standard operating procedures are clearly outlined along with the key performance indicators sought and measured by the organisation.¹⁴
- *Service culture*: The philosophy of quality states that the service culture of any organisation should impact the thinking of the employee in such a manner that they believe in doing things right the first time, and this would reduce the wastage. In healthcare, accountability is very important at all levels of management and services.
- *Service scapes*: The physical environment of the organisation has an important bearing on the minds of all its customers.
- *Administrative systems*: Through administrative systems an organisation does regular audits to ensure that all the documentation is complete in the organisation. This, in turn, helps the organisation in times of accreditation, certifications and medicolegal cases. Administrative system is subdivided into several special committees like the ethics committee, the hospital infection control committee, etc. to delegate the tasks of the administrative members.
- *Measurement, information and analysis*: The use of latest technology to standardise and integrate the information from all departments of the healthcare organisation helps in sharing of information in an expeditious way and provides for the practice of evidence-based medicine.¹⁵
- *Supplier quality management*: Timely management of the supply chain and paying special attention to the specifications and product quality helps in reducing errors, wastage and repetitions.
- *Customer focus and satisfaction*: The organisation needs to take keen initiatives to listen to the voice of its customers via feedbacks, grievance handling mechanisms and complaints monitoring systems, etc.
- *Key organisational results*: The progress of any organisation can be monitored in terms of outcomes of the organisation such as the increase in the number of the patients, the profits generated and employee satisfaction levels, etc. They also have a direct bearing on the strategy formulation of the organisation.
- *Social responsibility*: In the current times, there is no deniability of the responsibility of the hospitals towards the community. Especially in a country like India, where the needs of the population cannot be served by the public healthcare infrastructure alone, it is very important that private hospitals give quality care to the impoverished classes of the country.¹⁶

QUALITY ASSESSMENT AND MANAGEMENT TOOLS

Gurus of quality from both manufacturing and services sector have devised tools to assess quality in the healthcare sector. This helps in identifying and monitoring the demand of services and delivering equitable services at all times. Diagnostic and treatment processes demand to produce high customer satisfaction to develop a loyal customer pool.

Assessing the outcomes of the delivery of services and monitoring the key quality indicators are the foremost requirement for any organisation. For instance, among some of the mandatory indicators that need to be monitored and reported to the National Accreditation Board for Hospitals and Healthcare Providers (NABH) postaccreditation of a hospital are: the percentage of medication errors occurring in a hospital, incidence of needlestick injuries, percentage of transfusion reactions, CAUTI, CLABSI, VAP, SSI, incidences of falls and bedsores after prolonged hospital stays, bed occupancy rates and average length of stay, and so on. Quality indicators have been explained in detail in Chapter 38.

Patient Feedback Forms

One of the simplest assessment tools in the hands of quality managers for the assessment of service delivery is the patient feedback survey. Patient feedback forms also indicate the expectations of the sample population group from the healthcare organisation and its staff. They need to be

Sample Patient Feedback Form	
Are you male or female?	<input type="checkbox"/> Male <input type="checkbox"/> Female
Please tick the appropriate age range:	<input type="checkbox"/> <18 years <input type="checkbox"/> 18–25 years <input type="checkbox"/> 26–40 years <input type="checkbox"/> 41–55 years <input type="checkbox"/> >56 years
Length of stay of the patient at this hospital	<input type="checkbox"/> Less than 6 months <input type="checkbox"/> 6 months–1 year <input type="checkbox"/> 1–3 years <input type="checkbox"/> 3 years or more
How many departments have you visited in this hospital?	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 or more
Please rate the following questions on a scale of 1–5 with 1 being the lowest score and 5 being the highest score of what you feel about this hospital:	
How do you feel about the general ambience of this hospital?	
Waiting period before each appointment, especially for OPD (1 for very long and 5 for the short)	
Were you able to locate the concerned doctor's office easily in the hospital?	
Did your doctor discuss the treatment plan in detail with you for your understanding?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Were you adequately informed about the treatment costs, investigation costs and costs of other procedures prior to any of these procedures being carried out?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Would you recommend this facility to anyone you knew?	<input type="checkbox"/> Yes <input type="checkbox"/> No

Figure 37.4 Sample of patient feedback form.

evaluated at regular intervals to ensure the record of any change in the perceptions of the patient towards the care required and received at the healthcare organisation. Factors such as consistency in services, response time of the staff, the average length of the waiting period prior to any checkups and reviews, ambience of the hospital and general attitude of the staff are just some of the variables that effect the perceptions of the patient towards a healthcare organisation.

Organisational performances in terms of financial and market outcomes along with the human resource turnover are important for any organisation if it is to ascertain the useful deployment and rate of return on its resources. Among the other key results described earlier, the ones that need focus are organisational effectiveness outcomes, leadership and social responsibility outcomes (Figure 37.4).

Clinical Audit

Clinical audit is a method to identify and improve the quality processes in a hospital. Clinical audit has been

defined as a quality improvement process that seeks to improve the patient care and outcomes through a systematic review of care against explicit criteria and implementation of change (Figure 37.5).^{17,18}

In other words, it is a critical analysis of the quality of medical care given to the patient starting from the diagnosis to the final discharge process, the use of various organisational resources of manpower, equipment medicines, etc., the outcomes of medical interventions done at the organisational level and the quality of life of the patient receiving care.⁸

The current practices are observed and documented and then compared with the set of benchmarks of the healthcare sector with the aim to improve the existing delivery of healthcare to the patient. The approach to clinical audit begins with the identification of the areas of improvement; already set standards become the yardstick for the comparison of the current status and data collection. Next, the areas of improvement are highlighted whereby the necessary changes are brought about by the process of redesign but the clinical audit is not completed yet. Another audit is performed to adjudge whether the necessary changes in the processes have brought about the desired changes in the outcomes by sustaining the improvements made. **This is termed the process of audit cycle.**¹⁹

Preparation phase

The preparation phase for the clinical audit begins with the selection of a suitable area of a service delivered to the patient. This area of the service delivery should be reviewed for the description and measurement of present performance. The guidance for the selection of the area of the service deliverable to be audited depends upon factors such as the high cost incurred by the patient or the hospital, frequency of utilisation of the service or the risk associated with it, the potential for improvement, organisational priority, area of clinical care where essential services may show signs of deficiencies or missed diagnosis.²⁰

The objective of doing a clinical audit should be to improve the deliverable, enhance the scope of service delivery, increase the output, eliminate any missed cases and ensure that high quality continuous care is being given in the organisation to each and every patient.

Audit requires planning the entire process in a manner whereby all the concerned people are available and involved throughout the audit process. This helps in accessing all the evidence and identifying all the gaps and potential areas of improvement. The next step is to develop a methodology for the audit process and do a pilot study with a representative sample. After the auditor's report is collated, any due action can be planned and is implemented. After the newly implemented process has been properly vetted, a reaudit is conducted, now choosing the entire sample, if possible, to ensure that there are no further gaps in the service delivery and the change has been uniformly implemented.^{9,10}

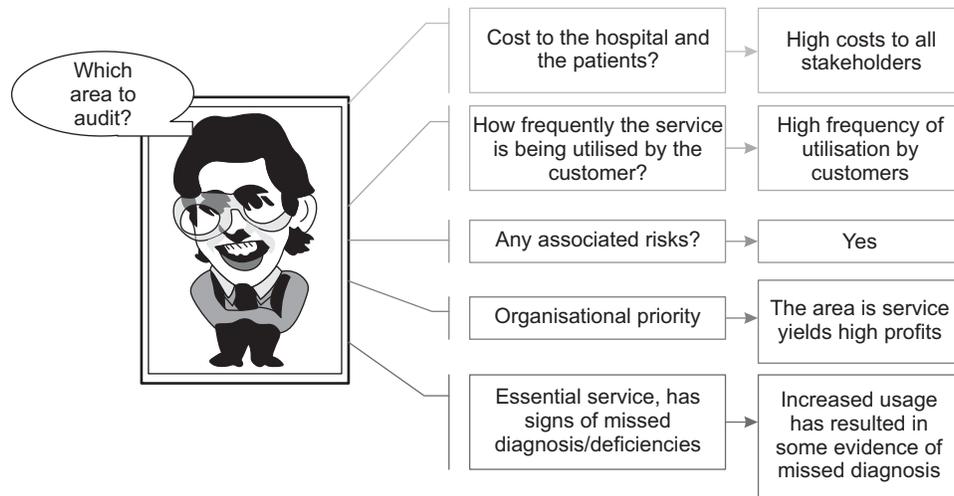


Figure 37.5 Areas of clinical audit.

A clinical audit is a very important activity especially in an institutional setting in a sector such as healthcare. Data collection in a clinical audit can be done by various sources such as HMIS (hospital management information system), case notes, medical records, conducting surveys and interviews, questionnaires and checklists, prospective recording of specific data, etc.

The data needs to be then analysed to differentiate between the rectifiable gaps and shortfalls of the delivery of care and identifying the pre-existing barriers in the way of rectifying these shortfalls.²¹

Barriers to conduct regular clinical audit can arise from any quarter and could exist in the form of fear of change or lack of knowledge and understanding of the newer technologies and medical protocols, lack of infrastructure or organisational culture to bring about any change or any financial considerations, etc.¹⁰

To overcome these barriers, the approach should include all those who shall be affected by the change to decide upon and design an action plan. The role of every staff member should be clearly defined when implementing any change. A plan should also be formulated to monitor the progress of the implemented action plan and should be put into effect. A formal report should be prepared containing all the findings followed by a review to analyse the same. Sharing these findings helps in further identification of any gaps that may be required to be rectified. Finally, the success stories emerge out of all the previous attempts to improve upon the processes in the form of a smoother function.

After the above activity is complete, a reaudit should be planned on regular intervals to sustain the improvements resulting from the changes in long term. At this stage it is important to monitor and evaluate the changes in practice and record the sustained outcome. Any further changes can be planned after the sustenance of the previous change is recorded and the cyclic process is continued with a reaudit.⁹

Case Study 3: Nutrition

Problem

The 500-bedded general multispecialty hospital had a single dietician to plan out the meals of all the patients and this resulted in many patients not getting the prescribed meal plans by their doctors. Also, it was noted by some of the doctors that there were no notes existing in the discharge summaries of the patients from the nutritionist or the dietician. This raised red flags among most of the surgeons.

Criteria

All patients should have a customised diet plan during their hospital and home recovery periods, which should be prescribed by the doctor and stringently brought into effect by the dietician.

Standard

The current food services of the hospital should work in accordance with the prescribed food plan of the doctor and the dietician should see that the food and beverage (F and B) department of the hospital does the needful. This helps in speedy recovery of the patients. Whether it is cholesterol-free diet, low-salt–low-sugar diet regime, pureed food plan for the intubated patients, diet with lactose or other carbohydrate restrictions, etc. should be made available without any changes. Also the patient should have clear instructions, both verbally and detailed, in the discharge summary regarding the dietary regime to follow.

Method

The medical superintendent constituted a three-member team to survey if the patients were getting their own custom-prescribed diet plans and also review the discharge summaries if the notes regarding special meal plans to be followed were being mentioned in all the patients.

Review

The committee surveyed the different departments of the entire hospital for the inpatients and found out that to overcome the case load the dietician was actually putting 93% of the patients on a generic food plan and only 7% of the intensive care unit (ICU) patients were receiving any special diet as prescribed by their doctor. The dietician was first quizzed about the existing standards regarding the diet to be served to the patient according to the accreditation guidelines. The dietician was asked to explain this deficiency in the meal plan. It was also found that the dietician did not mention any special diet to be given to the patient and neither was any counselling given to the patient at the time to the discharge. The findings of the survey revealed that due to shortage of manpower the dietician was neither able to make a different plan for all the patients nor could arrange for a special counselling session at the time of the discharge.

Change

The dietician was instructed to plan for manpower, which would include at least one assistant dietician, one counsellor and one computer assistant to look after the diet plan of the patient as well as mention special notes for dietary plan of the patient to be followed at home during recovery period. Also, a review of the same was advised during the patients' follow-up visits.

Reaudit

During the reaudit, it was found that almost 83% of the patients now had a custom diet plan according to their needs and the prescription of the doctor. And almost 100% of the patients were getting counselling about the diet they had to follow postdischarge, as mentioned on their discharge summaries. A similar percentage of patients were also seen at the follow-up by the dietician.

Future audit plans

The MS instructed the committee to review and monitor the meal plans of all the patients on a monthly basis along with an audit of the discharge summaries to ensure that the new protocol in place was being followed.

Nursing Audit

Quality of nursing care has come under grave scrutiny in current times. Nursing audit is also a part of clinical audit in which the quality of nursing care is reviewed and evaluated based on clinical records by qualified professionals to identify, examine or verify the performance of certain specified aspects of nursing care based on established criteria.²²

In a nursing audit the information is collected on the basis of reports and other documents to assess the quality of

nursing care given to the patient. According to Goster Walfer, the nursing audit serves to find out if best nursing practices are being followed.

Nursing audit has been defined as a part of cycle of quality assurance, which incorporates the systematic and critical analysis by nurses, midwives and other health visitors in conjunction with other staff of the planning, delivery and evaluation of nursing care in terms of their use of resources and outcomes for patients/clients and introduces appropriate change in response to that analysis.

Two methods of conducting a nursing audit are:

- *Retrospective nursing audit:* An in-depth assessment of quality of nursing care given to the patient is done after the patient has been discharged from the hospital using his/her records as an aid. The analysis is based upon the patient data and how nursing care was designed to be given to the patient. It is important to judge if the nurses document each-and-every information of the patient, the instructions of the doctors and the way these instructions were followed.
- *Concurrent nursing audit:* In a concurrent nursing audit, the evaluation is conducted on the quality of nursing care of the patients who are still in hospital undergoing care. Assessment is done of the patient at bedside with the pre-determined criteria and interviewing the staff delivering the care. A review of the care plan followed by the nursing staff is also done.

Steps in a nursing audit

Nursing audit can be conducted both internally within the organisation as well as an independent appraisal by an external auditor (Figure 37.6).

Three components reviewed in the nursing audit are:

1. *The quality of structure:* Assuring that there is a direct relationship between the quality of patient care delivered and the appropriate structure, structure audit evaluates the structure or the setting in which care is being given to the patient. It reviews the finances, medical records and environment along with the nursing service.²²
2. *The quality of process:* The quality of process during an audit is used to measure the entire protocol of patient care and how it was carried out. It is assumed that a relationship exists between the quality of the knowledge and skill of the nurse and the quality of care provided. This audit focuses on the task according to the standards of care.
3. *The quality of the outcomes:* When auditing the quality of the outcomes of care, the results of intervention of nursing care on the outcome or the health of the patient is taken as the criteria. The outcomes are judged accurately and is directly linked to the quality of nursing care provided to the patient. The variables used in an outcome audit are mortality, morbidity and the length of hospital stay, etc.

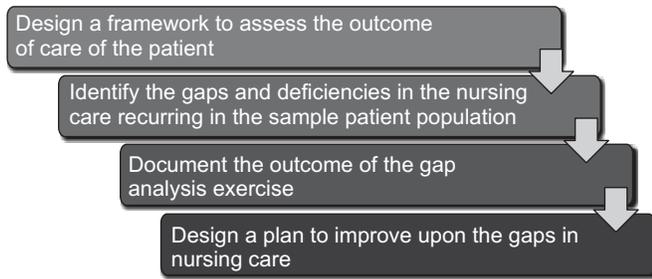


Figure 37.6 Steps in nursing audit.

It is important to collect the patient-related data in a methodical way, which includes a detailed medical history and other prehospital patient routine, severity of the illness for which the patient has been admitted, a comprehensive reporting on the lab tests conducted and monitored vital signs. The nurses' diagnosis and orders are collected on basis of which immediate short-term and long-term plans are made. The plans that need to be implemented are the plans for health teaching to the paramedical staff; and students should be included along with an evaluation of the plan of care at the nurse's level.

The audit itself should be designed to include feasibility practicality and a case of understanding by keeping the scoring sample.

Medical Equipment Audit

A medical equipment audit looks acutely into the efficiency and effectiveness of the regular and periodic management, maintenance, repair and replacement of medical equipment.²³ Since the current condition and life expectancy of the medical equipment is directly related to the quality of service deliverables at the healthcare organisation and the potential harm as well as the opportunity cost incurred due to frequent breakdowns to the patients or the staff at the healthcare organisation, henceforth regular annual maintenance contracts and equipment calibrations, etc. need to be done. A comprehensive assessment of the cost of continued usage of the asset and care vs. cost of replacement is an integral part of quality management of the medical equipments under the asset management plan.

The **asset management plan**²⁴ will include the basic information for all equipments such as the age of the equipment, the utilisation levels, the maintenance practice, technological change, availability of replacement parts, changes in clinical practice, etc.

Equipments placed in the critical areas of the hospitals such as those in the cardiac or trauma centre or for chest pain, hip replacement, etc. should be regularly assessed for their performance and current condition. The performance of the equipment should be judged on all functional parameters and its compliance with the relevant health and safety protocols be documented. The assessment is carried out in comparison with the life expectancy benchmarks.

The asset management plan provides the procurement needs for the future medical equipments by the healthcare organisation based on the identified needs and should be regularly updated. The hospital benefits from this activity by generating a justifiable and timely basis for the procurement of the equipment, the maintenance programme and its costs, records of testing and utilisation of the equipment, and reducing the safety risks to minimum.

A dedicated medical equipment audit at the HCO requires constituting a biomedical engineering department to regularly calibrate and maintain the sophisticated modern medical equipments widely in use at the hospitals in alliance with the vendor to provide services of the equipment. The quality of maintenance can be greatly enhanced with the adherence to the established standards by the accreditation agencies. Accreditation, in turn, ensures the quality assurance of the maintenance process by regular audits, and proper documentation and comprehensive records.

In the least to say, the medical audit of the hospital equipment also ensures that best practices are in place while utilising funds for procurement and maintenance of equipments.

Role of Internal Audits at the Facility Level

Once the internal audit of a hospital is done and opportunities for improvement have been identified in any process, the quality manager should brainstorm with the team of experts from within the hospital to find out what is wrong in the process and who would best know about the gaps in that process the best.²⁵ This is called **quality improvement process**. A better illustration could be achieved by use of Ishikawa's cause-and-effect diagram and other tools as described for explaining to the entire team or staff the problem areas (Figure 37.7).

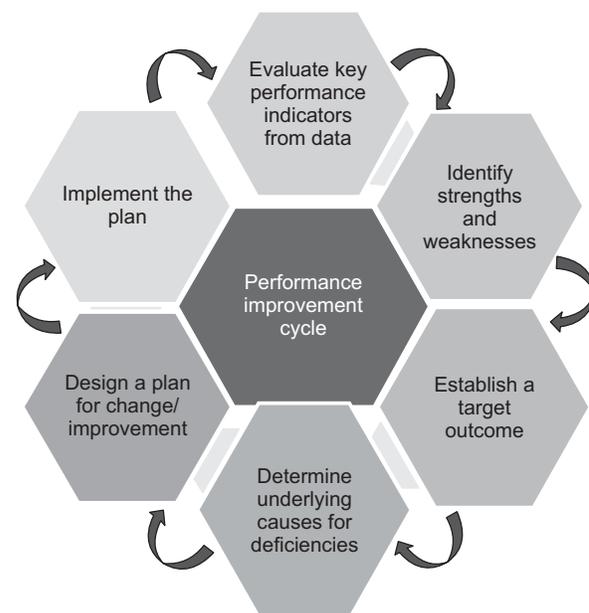


Figure 37.7 Performance improvement cycle.

This would help to identify the source of variation in the process from that what is desired or expected in terms of outcomes. Next, select the best way or method to bring about the change to improve the process. Once the improvement process is planned, it should be discussed thoroughly with the people concerned or the stakeholders from within the process to ascertain that they understand the change that is desired.²⁶ Post the planning phase is the implementation phase. Implementation would also include monitoring of the process now followed by the data collection. The data should then be analysed by checking and studying the results. This should be done at regular intervals to make sure that data is consistent. Methods such as key performance indicators and critical success factors can be used to check if the experimental changes introduced are achieving the desired outcomes. In case the desired outcome is not achieved, one should go back to the planning stage and brainstorm for new ideas to resolve the gaps in the process.

Once the desired outcome is achieved, continuous improvement should be initiated to make sure that the process runs smoothly. In case over time any other gaps are identified, one should go back to the first step and identify the cause, effect and plan the improvement process again.

Next the standardisation of the process would include blending these changes into the processes to be implemented on a larger scale and on a long-term applicability. This entire

process is what is called the plan–do–check–act cycle given by EW Demming (Figure 37.8).

QUALITY IMPROVEMENT

Identifying the problem is the first step to any quality improvement step taken organisation wide. Since the need for improvement will be justified by the identification, specific projects can be undertaken to improve the identified gaps in the services for both internal and external customers. The objective of these projects is to discover the causes for these gaps and establish why they have occurred. Perhaps we can better understand this by taking a clinical analogy of a situation where a patient presents his or her symptoms of a disease to the doctor. The doctor's first step is to identify the presence of those symptoms in his body. This is followed by identifying the cause of the symptoms and making a provisional diagnosis.

The Ishikawa's Cause-and-Effect

The Ishikawa's Cause-and-Effect or *fishbone* diagrams help in identifying the root cause of the problem and the effect it has on the organisation (Figure 37.9). This is especially important from a quality manager's perspective since it leads to a systematic generation of the ideas and the causative factors of the problems how-so-ever intangible the problem might be.

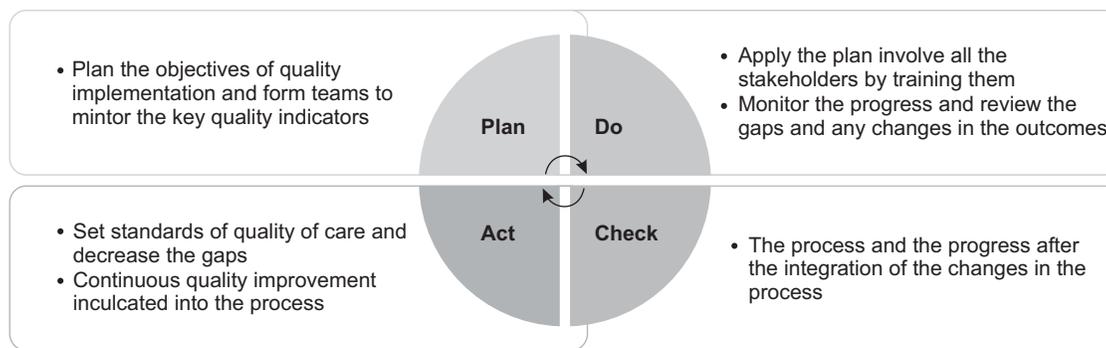


Figure 37.8 Demming's plan-do-check-act cycle.

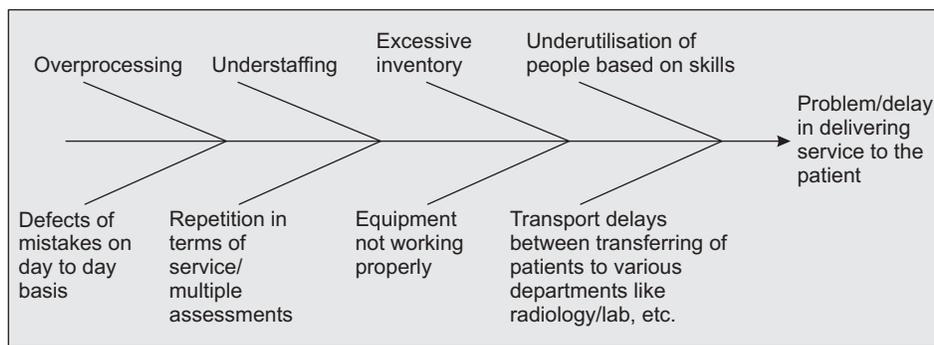


Figure 37.9 The Ishikawa diagram illustrating the relationship between cause and effect.

Next, the quality manager needs to provide with the remedial measures much like the physicians prescription. But alas, his job does not end there. The quality manager also needs to show by way of evidence like real-time data from the organisation that the remedial measures are actually effective.

Pareto Analysis

Based on Pareto law of vital few for trivial many or the 80:20 rule as it is also known. Pareto analysis is based on Pareto charts where bars are made graphically in descending order of height from left to right. The tallest of bars are placed on the left and the smallest on the right implying the significance. This breakup of a problem into smaller divisions illustrates a clear picture as to where one should focus their attention when trying to solve the problem in order to gain maximum. These charts can be used to illustrate data such as needs of the patients, skills of the employees, any type of errors, improvement efforts and their results, etc. However, strictly speaking not all problems can be divided into a clear 80:20 rule. A manager trying to use this rule where it does not fit may face problems such as misrepresentation of the data or incorrect plotting of the data. Henceforth, the result would be inappropriate depiction of the measurements. But even in the circumstances that do not strictly adhere to the 80:20 rule, one can ascertain by a Pareto chart those areas that need critical attention. Henceforth Pareto chart can

serve to be a very useful tool, especially in CQI efforts of the organisation.

Checklists and Regular Facility-based Inspections

Checklists are designed to include all the things that need to be followed or are done stringently with a small checkbox at the left hand side to be filled once the task is complete.²⁷ It can be implemented anywhere in the hospital, whether it is to show adherence to a protocol or to ensure that a certain set of duties are being completed daily like the cleaning activities, etc. These prepared checklists can also be distributed to the patients and their attendants for what they might need to bring to the hospital during a procedure or their stay. A checklist serves as a reminder to ensure that safety steps are being followed. When implementing checklists for the first time, it would be prudent to pilot test it in a small section or area of the hospital and look for ways to improve it. If the checklist has been imported from an outside source, every effort should be made to customise it according to the needs of the organisation. The importance of hospital-wide implementation of checklists and inspection sheets cannot be stressed enough. They serve as mechanism for the strict adherence to protocol in any high-strung and dynamic environment. With hospital procedures becoming complex furthermore and infections increasing at a higher pace, the checklist is the easiest-to-follow mechanism to keep a check on conformance to all procedures and protocols being

 WORLD HEALTH ORGANIZATION			SURGICAL SAFETY CHECKLIST (FIRST EDITION)		
Before induction of anaesthesia >>>>		Before skin incision >>>>>>>>>>>>		Before patient leaves operating room	
SIGN IN		TIME OUT		SIGN OUT	
<input type="checkbox"/> PATIENT HAS CONFIRMED <input type="checkbox"/> IDENTITY <input type="checkbox"/> SITE <input type="checkbox"/> PROCEDURE <input type="checkbox"/> CONSENT <input type="checkbox"/> SITE MARKED/NOT APPLICABLE <input type="checkbox"/> ANAESTHESIA SAFETY CHECK COMPLETED <input type="checkbox"/> PULSE OXIMETER ON PATIENT AND FUNCTIONING <input type="checkbox"/> DOES PATIENT HAVE A: KNOWN ALLERGY? <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> DIFFICULT AIRWAY/ASPIRATION RISK? <input type="checkbox"/> NO <input type="checkbox"/> YES, AND EQUIPMENT/ASSISTANCE AVAILABLE <input type="checkbox"/> RISK OF > 500 ML BLOOD LOSS (7ML/KG IN CHILDREN)? <input type="checkbox"/> NO <input type="checkbox"/> YES, AND ADEQUATE INTRAVENOUS ACCESS AND FLUIDS PLANNED		<input type="checkbox"/> CONFIRM ALL TEAM MEMBERS HAVE INTRODUCED THEMSELVES BY NAME AND ROLE <input type="checkbox"/> SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE VERBALLY CONFIRM <input type="checkbox"/> PATIENT <input type="checkbox"/> SITE <input type="checkbox"/> PROCEDURE <input type="checkbox"/> ANTICIPATED CRITICAL EVENTS <input type="checkbox"/> SURGEON REVIEWS: WHAT ARE THE CRITICAL OR UNEXPECTED STEPS, OPERATIVE DURATION, ANTICIPATED BLOOD LOSS? <input type="checkbox"/> ANAESTHESIA TEAM REVIEWS: ARE THERE ANY PATIENT SPECIFIC CONCERNS? <input type="checkbox"/> NURSING TEAM REVIEWS: HAS STERILITY (INCLUDING INDICATOR RESULTS) BEEN CONFIRMED? ARE THERE EQUIPMENT ISSUES OR ANY CONCERNS? <input type="checkbox"/> HAS ANTIBIOTIC PROPHYLAXIS BEEN GIVEN WITHIN THE LAST 60 MINUTES? <input type="checkbox"/> YES <input type="checkbox"/> NOT APPLICABLE <input type="checkbox"/> IS ESSENTIAL IMAGING DISPLAYED? <input type="checkbox"/> YES <input type="checkbox"/> NOT APPLICABLE		<input type="checkbox"/> NURSE VERBALLY CONFIRMS WITH THE TEAM <input type="checkbox"/> THE NAME OF THE PROCEDURE RECORDED <input type="checkbox"/> THAT INSTRUMENT, SPONGE AND NEEDLE COUNTS ARE CORRECT (OR NOT APPLICABLE) <input type="checkbox"/> HOW THE SPECIMEN IS LABELLED (INCLUDING PATIENT NAME) <input type="checkbox"/> WHETHER THERE ARE ANY EQUIPMENT PROBLEMS TO BE ADDRESSED <input type="checkbox"/> SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE REVIEW THE KEY CONCERNS FOR RECOVERY AND MANAGEMENT OF THIS PATIENT	

Figure 37.10 WHO surgical safety checklist. (Source: The WHO website.)

followed. The WHO safe surgery save lives programme indicated the implementation of surgical safety checklists to be associated with a substantial reduction in morbidity and mortality, postsurgical complications, etc. (Figure 37.10). The effectiveness of checklists in reducing complications have been stressed in many significant studies. It is aptly said that checklists provide a thorough mechanism for evaluation of compliance with the standards of evidenced-based care and helps to promote good communication among care givers. Checklists not only promote accountability but also teamwork among the employees of any organisation.

Benchmarking

The American Productivity and Quality Centre has described benchmarking as the process of identifying, understanding and adapting outstanding practices and processes from organisations anywhere in the world to help your organisation improve its processes. It is an ongoing outreach activity.

Using industry wide-set benchmarks help to visualise achievable targets and challenge any operational complacency. It converts targets into figures for the employees to visualise, as the change they need to make to achieve those figures. Benchmarking has been proved to be an efficient and effective way to make improvements and help managers in transmitting the desired change for bring in improvements to the rest of the employees. It helps to speed up the ability of the employees to make improvements since the goals seem to be effectively laid down before them now. Benchmarking could be internal, i.e. within the organisation for its own operations; external or competitive, i.e. with its competitors with the same kind of service deliverables, industry, i.e. with other suppliers in the same industry; and process benchmarking, i.e. which focuses on the work processes rather than only on the business practice as above.

The process of benchmarking basically involves the identification of a process to be benchmarked and selection of a team to conduct this activity. Further the team decides on the methodology of data collection and information collection, and collects the same. These are then analysed and compared with the inhouse data of the organisation. This team then analyses the occurrences of gaps and establishes the targets and approach to achieve these targets. Process-wide implementation of the approach is then done. Finally a reassessment is done to see if the benchmarks are achieved.

Affinity Diagrams

In any organisation, brainstorming is credited with being the way to come up to solutions to the many day-to-day operational issues. The data in the form of ideas and opinions is collected and grouped under various heads based upon the commonality in their natural existence. This helps the scattered and disorganised issues in becoming organised and graphically representable to encourage the flow of more ideas and gain a better and clearer perspective of thoughts.

Failure Mode and Effects Analysis

Failure Modes and Effects Analysis (FMEA) is defined as a systematic, proactive method for evaluating a process to identify where and how it might fail and to assess the relative impact of different failures in order to identify the parts of the process that are most in need of change.²⁸

Graphical Representation

Often a quality manager needs to illustrate the outcomes of the organisation in various ways. Studies have shown that graphical representation in terms of scatter plots, control charts, etc. are the most comprehensible by any audience. These are explained briefly below:

- Run and control charts:** Both these tools are used to monitor the process variation over time and understand the cause behind these variations (Figure 37.11).
- Scatter diagram:** Scatter diagrams are used to show relationship between two variables. This graphical tool is used to illustrate if a direct, indirect or little correlation exists between two variables.
- Histograms:** Histograms are also bar charts of a kind and are used to measure the distribution of data that is grouped together in ranges. The usual impact of histograms gives clarity to distribution of data and patterns of variation (Figure 37.12).

However all forms of graphical representations can be used to illustrate the impact of any strategy or intervention in the organisation.

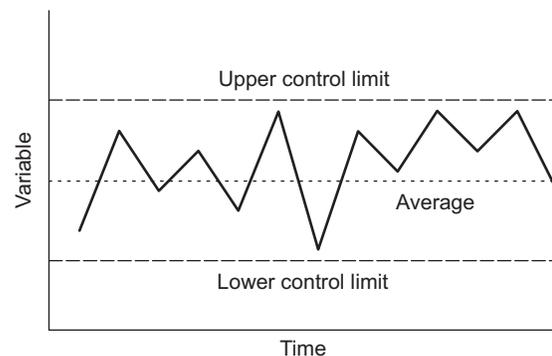


Figure 37.11 Run and control charts.

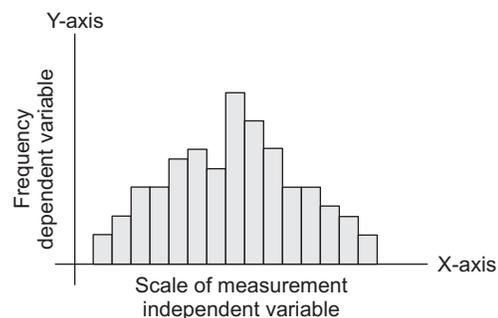


Figure 37.12 Histograms.

TRIGGERS OF QUALITY IMPROVEMENT STRATEGY IN A HOSPITAL

How does a management start taking initiative to improve the quality of its health services? Is there any difference between the public and private sector organisations, what act as a trigger to encourage the top-level management at any organisation to emphasise a change in practice and make best practices as its goal? Many-a-times bad media publicity due to negligence, errors, etc. provokes the management to take stringent action to include quality in the services. Any change in the top-level leadership with a long-term vision inclusive of better patient service and quality of deliverable drop in the existing market position and share value may lead to discouragement among the staff and dissatisfaction among patients, noticeable increase in the length of stay or frequent readmissions due to consistent reasons, etc. may all act as catalysts in order to bring a change and accept improvement in quality as a viable solution to the above problems.²⁹

Quality can be understood as the desired level of excellence in a product or service. It more than just a concept, as it needs to be a mind-set especially for practitioners in a healthcare organisation and needs to be included in long term vision and short term goals. The process of total quality management includes quality planning, quality assurance, quality control and quality improvement and is a collective approach by all stakeholders not just the quality manager.

Quality Planning: Identifying internal and external stakeholders and determining their needs. Establishing clear organisational quality goals to meet the patient needs.

Quality Control: Choosing the right metrics (and units) for benchmarking performance that are monitorable with the right controls to measure these accurately.

Quality Improvement: Identify gaps and ways to solve these in continuous process of improvement.

Quality Assurance: Ensuring quality continuum in the organisation by developing accountability on measurable indicators and conformance to quality.

Organisational culture is often the pivotal link of success of total quality implementation and is driven by encouraging and empowering all staff stakeholders to take ownership and improving coordination between teams. Better staff training and IT aids are other key means to reduce various patient and healthcare organisation related errors.

Kaizen and Six Sigma are basic tenets and processes in lean thinking that helps us in understanding and better implementation of quality management. The Kaizen approach has an important lesson in stakeholder alignment through upfront sensitisation and training along with following up with forward planning. The two key methodologies used in Six Sigma are DMAIC (Define, Measure, Analyse, Improve and Control) and DMADV (Design, Measure, Analyse, Design and Verify).

Continuous quality assessment through Patient Feedback Forms and Clinical Audits in addition to regular monitoring should lead to a quality improvement cycle through expert brainstorming.

The surging demand for better quality of healthcare and cost effective rates along with stiff market dynamics of perfect competition has led the healthcare organisations prioritise the needs of their customers and have highly structured healthcare delivery systems for cost containment that can be leverage to ensure quality management.

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Quality Management – II

Dr Neha Pandey, Mr Nishant Pandey, Dr Sanjeev Julka and Dr Sonu Goel

“Quality is the result of a carefully constructed cultural environment. It has to be the fabric of the organization, not part of the fabric.”

—Phil Crosby

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- independently evaluate the quality of services of any hospital.
- understand the accreditation procedures for hospitals.

QUALITY INDICATORS OF A HOSPITAL

Quality indicators (QI) are measures of the level of quality of healthcare being delivered by any healthcare organisation. These quality indicators make use of readily available inpatient administrative data to highlight the performance in various areas of the organisation, identify the areas for improvement and also track the progress of any change made over time to improve the service delivery.¹

The Agency for Healthcare Research and Quality has classified four quality indicator modules to represent various aspects of quality in a hospital. These are given in Table 38.1.

Table 38.1 Quality indicators (AHRQ)

Quality indicator	Quality aspect monitored
Prevention quality indicators	A set of measures used to identify the quality of ambulatory care that can potentially prevent the need for hospitalisation or for which an early intervention can prevent complications or more severe disease. These indicators act as a relatively inexpensive screening tool to assess the quality of service in primary healthcare facilities and can be used to prevent hospitalisation for certain conditions by providing high quality of outpatient services.

Inpatient quality indicators	Using the inpatient QI one can infer on the quality of care being provided within the hospital and relate to the morbidity and mortality rates, volume indicators for clinical procedures, etc. The inpatient QI monitors mainly four groups of indicators: volume indicators (oesophageal resection, coronary artery bypass graft surgery (CABG), percutaneous transluminal coronary angioplasty (PTCA), etc.), mortality rates for inpatient procedures and conditions (AMI, CHF, acute stroke, etc.) and utilisation rates (C-sections, vaginal births, etc.).
Patient safety indicators	These are a set of indicators that reflect upon the complications and adverse events occurring within the hospital following surgeries, clinical procedures and interventions, etc.
Paediatric quality indicators	This set of QI is specially designed to monitor the quality of paediatric healthcare. These monitor both the preventable quality indicators in paediatric population and safety indicators in children. Since this age group has a differential epidemiology of healthcare, dependency, demographics and development, simply applying the adult indicators has been proven to be insufficient; henceforth modifications and redesign are both required.

Below is a sample listing of the QI most commonly measured by the organisations with a view to improve service delivery outcomes:

- Point of first contact or the registration area: Here the time for initial assessment of outpatients, emergency patients and inpatients is assessed.
- Waiting time, reporting errors, correlation of the reports of investigations with the provisional clinical diagnosis, repetition of investigations and adherence to protocols are all measured for all diagnostic services.
- Percentage of patients in which care plan is documented along with the expected outcome.
- Percentage of patients in which nursing care plan is documented.
- In the operation theatre: The number of redo's, readmissions and rescheduling, re-exploration, etc. Anaesthesia-related errors and percentage of adverse drug reactions.
- Hospital infection rates: **Central line-associated bloodstream infection(s)** (CLABSI), upper respiratory tract infection (URTI), surgical site infection (SSI), urinary tract infection (UTI), intravascular device infection rate, etc.
- Human resource-related indicators such as employee satisfaction rate, turnover rate, absenteeism rate, etc.
- Patient related: Incidences of falls, bedsores, etc.

Case Study 1: Civil hospital's quest for quality

The Civil Hospital was a 600-bedded renowned hospital. Dealing with a huge case load over an extended period of time, it had earned a fair degree of autonomy from the State Health Services, which had helped it to become one of the well-equipped government hospitals in the state, both in terms of manpower and technology.

The new Medical Superintendent (MS) of the hospital Dr S Sinha took over in December 2010. He was ambitious to take the hospital to further acclaim and had a keen interest in monitoring all the clinical indicators of the hospital very acutely. During interactions with the other medical superintendents in one of the interstate meetings, he came to know about National Accreditation Board for Hospitals and Healthcare Providers (NABH) and how the other state-run hospitals throughout the country were taking it up. He was initially at a loss in this discussion and could not comprehend the entire process of accreditation. But a detailed dialogue with the other MS's helped him gain clarity in the subject. Next, he invited a consulting agency to get a briefing about the accreditation process.

Once back from this meeting he voiced his inclination to the health secretary of the state for NABH accreditation of the Civil Hospital giving clear examples of the other hospitals in neighbouring states, which had gone for the same. His perusal of the cause helped him gain the full support of the state health committee and the health

secretary. But the journey of achieving accreditation was not as easy as Dr Sinha had perceived.

His first task at hand was to formulate a hospital quality assurance committee (QAC), as none existed. He himself decided to head the committee and appointed three consultants for the implementation of the demands of accreditation process. The only bright light that gave more strength to his resolve was the steps his predecessor had already taken in the hospital to start Diplomate of the National Board of Medical Examiners (DNB) course in the hospital. Some infrastructural changes like the new OPD block were already in place, which had improved both the look and services of the hospital.

But more than just infrastructural changes were required to prepare for the accreditation of the hospital. Quality of care was a mindset. The doctors who had been employed in the hospital for long periods initially made fun and passed off the idea as a whim. The other medical staff was hostile towards what they thought was increased workload and then there were those who were simply nonagreeable and sarcastic.

To complete the herculean task of making his staff understand the importance of NABH accreditation and the entire process involved. Dr Sinha got in touch with the quality consultants from the agency again. They organised a sensitisation workshop. In this workshop the quality consultants assured the attending doctors that it was not an unattainable goal. It definitely would involve better documentation procedure, but that would only help the doctors in the long run to cover all their bases in case any legal issue arose.

The consultants also appreciated the existing infrastructure and praised the way the healthcare facility was being maintained. This motivated the entire staff and a positive word was spread regarding the accreditation process.

The team also apprised the staff that the first step after a Memorandum of Understanding (MoU) was signed between the agency and the hospital would be a gap assessment of the hospital where all the services and delivery points will be assessed. But this was not to scare anyone; any red flag would simply mean that one process required improvement. Anyone with any concern regarding how to improve their process could contact the team for advice and help. The aim of it all was to provide the best care to the patient and delivers utmost quality of services.

This served as a great motivation for the entire hospital staff who felt empowered and proud about what their efforts were going to achieve.

At each point of the case, it is evident that the general idea regarding the accreditation process is that it involves added burden of work that no one wants, specially the

overworked and underpaid government hospital employees. But, it is also clear that behavioural change in any organisation can be achieved for any activity by right amount of motivation through communication and complete information being presented to the employees in the right way.

ACCREDITATION

Accreditation is a part of the quality assurance of a hospital. In this process, an impartial regulatory organisation reviews the processes of the healthcare organisation thoroughly to ensure that the service delivery by the hospital is at par or in conformance with the set standards of the regulatory organisation. This format of quality assurance process advocates a comprehensive approach towards accountability of services between the healthcare provider and the healthcare receiver. Areas such as the professional competence of the medical and paramedical staff employed by the hospital, the conduct of the employees, the access to healthcare in the facility, community benefits given by the organisation, health-promoting activities taken up by the organisation, the rights of the patients, the laboratory services, etc. are all judged for accountability by the accrediting bodies. But the accrediting bodies' do not consider the patients as the only customers of the healthcare facility. The employees are also considered as the internal customers, and their rights and responsibilities are also taken in view during the assessment for accreditation of any healthcare organisation.

Some examples of the regulatory organisations are ISQUA, ASQUA, JCI, etc. JCAHO has incorporated TQM/continuous quality improvement (CQI) approach to management within its accreditation process and standards. Different countries have quality awards like the Malcolm Baldrige National Quality Awards for healthcare organisations, the American Hospital Association – McKesson Quest for Quality Prize, the Cheers Award to commemorate the dedication of hospitals and other healthcare organisation to delivering high quality of care. The quality assurance process has been fruitful in improving the quality of healthcare services, which are deemed more patient centric, especially in the developing countries that have been proactive in adopting these accreditation programs.

Accreditation, licensures and certification are all means of evaluating the quality of a healthcare organisation; however, licensures focuses on fulfilment of basic requirements of a service with a focus on patient safety, the accreditation focuses on the achievement of maximum standard of quality achievable for that service with continuous improvement in quality of that particular service. Resources do not

define the quality assurance of a service in a healthcare facility in an accreditation programme. An accreditation programme motivates its professionals to seek continuous improvement in quality and ensures that the service delivered has high compliance with quality along with optimal efficiency and effectiveness. Regular evaluation is required to monitor the care delivered and other organisational processes by means of feedback surveys, reviews, interviews, observations and inspections, etc. These can be done both as planned and surprise inspections to evaluate the compliance with the standards.

JCI: Introduction and Its Standards

JCI is the international arm of The Joint Commission (USA), with the mission to improve the quality and safety of healthcare of the international community.² The purpose is to ensure that the organisation commits itself to a set of standards for its patients, and continuous and sustained improvement of its processes. JCI standards exists for healthcare organisation, ambulatory care, clinical laboratories, primary care centres, the care continuum, medical transport organisations and the clinical care programs.

JCI defines accreditation in which an entity separate and distinct from the healthcare organisation usually nongovernmental assesses the healthcare organisation to determine if it meets a set of requirements (standards) designed to improve the safety and quality of care. Standards are usually optimal and achievable.

Joint Commission International and its standards (<http://www.jointcommissioninternational.org>) are designed to respond to the demands of quality-based healthcare globally for hospital-based care, delivery of patient care services and the efforts taken by the organisation to improve its quality and efficiency of the patient care services. Any healthcare organisation that is operational and licensed as a healthcare organisation in its country and willing to assume responsibility for improving the quality of its healthcare and services, and willing to conform to the JCI standards is eligible for the survey by the JCI for the grant of accreditation.

Once the accreditation survey begins, the JCI evaluated the organisation's compliance to its standards based on onsite observations, review of its documentations, interviews with the staff and customers, and the results of self-assessments, etc. The JCI accreditation is valid for a period of 3 years after which it should be reevaluated for renewal of accreditation.

In India larger private healthcare organisations such as Fortis hospitals, Apollo Group of hospitals, Artemis Health Institute, Aditya Birla Health services, Moolchand Hospital New Delhi, Narayana Hrudayalaya Bangalore are just few names of hospitals who have received this accreditation from JCI.

The JCI standards are divided into patient-centred standards and healthcare organisation-based standards.³

Patient care-based standards

The patient care-based standards are the following:

The patient-centred standards are based upon the International Patient Safety Goals (IPSG), which are designed to promote specific improvements in patient safety. The goals are listed below:

- *To identify the patients correctly:* Patients should be identified correctly using at least two patient identifiers before any surgery or medical intervention, administration of any medicines, blood/blood products or any form of clinical testing and policies for the same should be developed and implemented.
- *Improve effective communication:* Any verbal or telephonic order should be written down by the receiver and should be read back to the giver of the order for verification of the same. There should be policies and procedures both developed and implemented within the healthcare organisation to verify the accuracy of these orders.
- *Improve the safety of high-alert medication:* Clear policies/procedures are developed and implemented for the identification, location, labelling and storage of high-alert medication and concentrated electrolytes should not be stored in a patient storage unit. If at all it is stored in a patient-care unit, all stock stored should be clearly labelled and stored in a restricted manner.
- *Ensure correct site, correct procedure and correct patient surgery:* A preoperative verification to ensure the correct site, procedure, and patient for the procedure is present, and that all the relevant documents pertaining to the patient are available. Policies and procedure regarding this should be developed and implemented.
- *Reduce the risk of healthcare-associated infections:* Hand hygiene has been considered as the most important and the guidelines to maintain it are available from WHO, US CDC, etc. The organisation should adopt any of the currently published and accepted hand hygiene guidelines to continue its efforts to reduce the healthcare-associated infections.
- *Reduce the risk of patient harm resulting from falls:* Falls have been identified for a significant portion of the injuries among the hospital patients. Therefore, the healthcare organisation should establish a fall risk reduction programme based on the policies or procedures after assessing the initial risks of patients to falls, etc.

Functions: A sample of the summary of the standards from the JCI guidelines for accreditation has been given here. For a detailed reading please refer to the '4th Edition of the *Joint Commission International Accreditation Standards for*

Hospitals'. The following has been taken from the guidelines directly for maintaining the authenticity:³

Access to care and continuity of care (ACC)

ACC.1: Patients are admitted to receive inpatient care or are registered for outpatient services based on their identified healthcare needs and the organisation's mission and resources.

ACC.2: The organisation designs and carries out processes to provide continuity of patient-care services in the organisation and coordination among healthcare practitioners.

ACC.3: There is a policy guiding the referral or discharge of patients.

ACC.4: Patients are transferred to other organisations based on status and the need to meet their continuing care needs.

ACC.5: The process for referring, transferring or discharging patients, both inpatients and outpatients, includes planning to meet the patient's transportation needs.

Patient and family rights (PFR)

PFR.1: The organisation is responsible for providing processes that support patients' and families' rights during care.

PFR.2: The organisation supports patients' and families' rights to participate in the care process.

PFR.3: The organisation informs patients and families about its process to receive and to act on complaints, conflicts, and differences of opinion about patient care and the patient's right to participate in these processes.

PFR.4: Staff members are educated about their roles in identifying patients' values and beliefs, and protecting patients' rights.

PFR.5: All patients are informed about their rights and responsibilities in a manner and language that they can understand.

PFR.6: Patient-informed consent is obtained through a process defined by the organisation and carried out by trained staff in a language the patient can understand.

PFR.7: The organisation informs patients and families about how to gain access to clinical research, clinical investigation or clinical trials involving human subjects.

PFR.8: Informed consent is obtained before a patient participates in clinical research, clinical investigation and clinical trials.

PFR.9: The organisation has a committee or another way to oversee all research in the organisation involving human subjects.

PFR.10: The organisation informs patients and families about how to choose to donate organs and other tissues.

PFR.11: The organisation provides oversight of the harvesting and transplantation of organs and tissues.

The other functions are mentioned below. For the related standards and their explanation please refer the 4th edition of the guidelines for JCI accreditation.

- *Assessment of patients (AOP)*
- *Care of patients (COP)*
- *Anaesthesia and surgical care (ASC)*
- *Medication management and use (MMU)*
- *Patient and family education (PFE)*

Healthcare Organisation-based Management Standards

- *Quality improvement and patient safety (QPS)*
- *Prevention and control of infections (PCI)*
- *Governance, leadership and direction (GLD)*
- *Facility management and safety (FMS)*
- *Staff qualifications and education (SQE)*
- *Management of communication and information (MCI)*

National Accreditation Board for Hospitals and Healthcare Providers⁴

Established by the Quality Council of India in the year 2006, the National Accreditation Board for Hospitals and Healthcare providers (NABH) operate the accreditation programme in India. It is an autonomous body, which is also the Institutional and Board Member of the International Society for Quality in Healthcare and also on the Board of Asian Society for Quality in Healthcare.

NABH defines accreditation as a public recognition of the achievement of accreditation standards by a healthcare organisation, demonstrated through an independent external peer assessment of that organisation's level of performance in relation to the standards. All the standards of NABH clearly outline that the care of a patient in a hospital setting is always multidisciplinary in its approach and henceforth the implementation of any change within the organisation should be based on this approach.

In our country both public and private sector hospitals have taken the initiative to prepare them for accreditation. Among the few hospitals that have received accreditation from NABH are Fortis Hospitals, Max Superspeciality Hospitals, Moolchand Hospital, New Delhi; Sir Ganga Ram Hospital, New Delhi; Amrita Institute of Medical Sciences, Kerala; Wockhardt Hospital Ltd., Nagpur; General Hospital, District Ernakulum; Government Head Quarters Hospital, Namakkal; LV Prasad Eye Institute, Hyderabad; Government Hospital, Sholingur; etc. Approximately 163 hospitals in India have been accredited by NABH. The NABH also has an international wing, operational with an

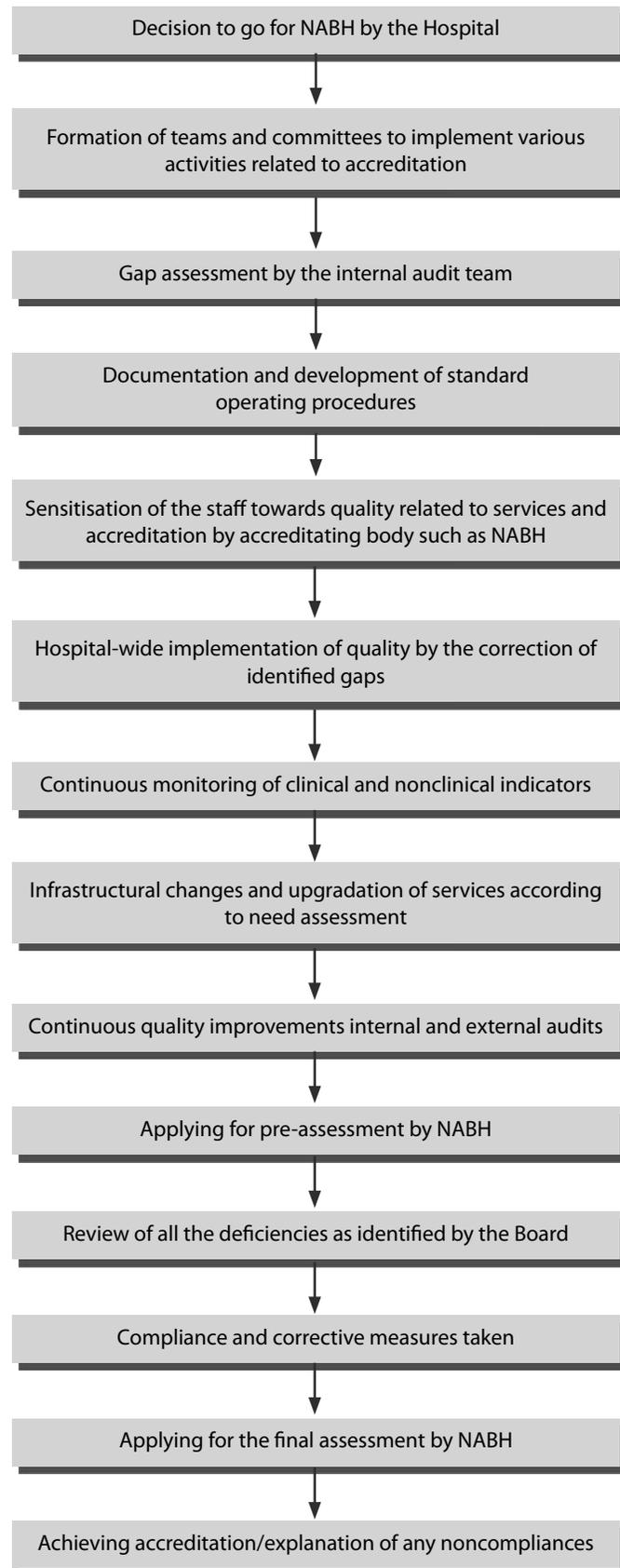
objective to enhance health systems and promoting continuous quality improvement and patient safety at international level.

The standards as laid down by the NABH are simply requirements giving the healthcare organisations enough leeway to come up with their own systems and processes including the modes for measuring the key performance indicators to show the compliance with the requirements of the standards. According to NABH, there are 10 chapters, 102 standards and 636 objective elements, which deal with the key issues related to all the stakeholders catered by any healthcare organisation namely the patients, the employees, legal, statutory and regulatory requirements, and the organisational policies. A brief summary of each of the chapter with the intent statement is given in Table 38.2.⁵ The steps followed for accreditation based on NABH guidelines are provided in Flowchart 38.1.

Table 38.2 Ten elements of NABH for accreditation of healthcare organisations

Chapter	Intent of the chapter
Access, assessment and continuity of care (ACC)	In this chapter, a special emphasis has been laid down to make the end user of the healthcare services well informed about the services provided by the organisation. Admission is done based only on the services rendered by the organisation and the emergency, life-stabilising care that it should give to the patient. For all other services the patient is referred to a hospital catering to that service. When the assessment is done a comprehensive evaluation including the imaging, laboratory and referral protocols are done.
Care of patients (COP)	The standards in this chapter are aimed at providing uniformity of care delivery throughout the hospital setting while following the regulations and laws, as and where applicable. Policies and procedures should be documented and are inclusive of the applicable laws and regulations regarding the patients in the intensive care units, high dependency units, vulnerable and high-risk groups and end of life care.
Management of medications (MOM)	Medicines are widely stored and dispensed in the hospitals. Keeping this in mind the standards in this chapter are designed to ensure safe and organised medication process. The policies should be documented and implemented to guide the availability, safe storage, prescription, dispensing and administration of medication. All the storage of medications should have a regular and stringent audit process. The availability of the emergency medication in line with the protocols is stressed upon. Patients who have been given any form of medication should be monitored at all times.

Chapter	Intent of the chapter
Patient rights and education (PRE)	Patients visiting a hospital have certain rights, e.g. to know adequately about their disease and treatment options available for them, to be a part of the decision-making process, etc. However, they also have certain responsibilities to fulfil while visiting a hospital, e.g. adhering to the visiting hours and other such protocols set by the hospital, paying for the hospital care and services, being respectful of the other patients in the hospital, etc., the rights and responsibilities of the patient needs to be documented and clearly displayed as well.
Hospital infection control (HIC)	A hospital is responsible for the implementation of an effective infection-control programme. The documented protocols need to be monitored and evaluated to reduce the incidence of hospital-associated infection. The documentation should include the action plan for the outbreak of infection, sterilisation protocols, biomedical waste management, etc.
Continuous quality improvement (CQI)	The standards encourage the implementation of a quality programme within the organisation, with a special focus on collection and analysis of data for gaps in the delivery of healthcare. They also promote the reporting and analysis of sentinel events and sustenance of any steps taken for improvement of services within the organisation.
Responsibilities of management (ROM)	The responsibilities of the management should be clearly documented to ensure patient safety and other risk management issues. The management should comprise of individuals with suitable qualifications responsible to oversee the functioning of the organisation in an ethical manner.
Facility management and safety (FMS)	The organisation should ensure the provision of a safe and secure environment for all the stakeholders, with a documented protocol for emergencies occurring within the organisation. Special attention should be paid to hazardous materials in the organisation and all healthcare organisations should be no-smoking areas.
Human resource management (HRM)	These standards acknowledge that since the human resource of any organisation is its most vital resource, all healthcare organisations should employ and retain adequately qualified people with respect to their positions, in adequate numbers also to fulfil the needs of the organisation as it serves the community. The organisation should keep its employees motivated by training, development and other opportunities to fulfil their professional and personal goals.
Information management system (IMS)	Information has been considered to be the resource for delivery of healthcare and its continual improvement. Henceforth this chapter stresses on the importance of gathering of data, its storage and appropriate utilisation. Evidence-based medicine has been given credit in the current times. The importance of effective communication at inter-staff level and the patients and their families have been shown. Though the use of modern technology in gathering and storage of data has been promoted; but the use of manual systems or paper based, if found effective, have been equally appreciated.



Flowchart 38.1 Flowchart of how a hospital goes for accreditation by NABH.

Case Study 2: Achieving quality in the hospital: the case of civil hospital continues

When looking from the perspective of accreditation from the NABH, the quality consultants found many gaps in the Civil Hospital, which at one point was depressing for the staff involved. But the continuous motivation from the same consultants, who pointed out their errors/gaps, helped the employees stay focused.

Some of the main gaps that consultants highlighted existing in the hospital were lack of teamwork and coordination, absence of any standard operating procedures and proper documentation, unhygienic environment and few infrastructural constraints. Manpower crunch and rational deployment of staff, lack of training and mainly financial constraints.

In the next brainstorming session the Quality Assurance (QA) committee of the hospital took up the ways it could overcome these challenges.

Analysing the gaps that were identified, the QA committee met to strategise the next steps. It was important to delegate the tasks by formation of teams and committees and promote team building. Teamwork and coordination was an important necessity for the accreditation process and required formation of various committees. The key committees that were needed: housekeeping committee, infection control committee, internal audit committee, medical record audit committee, biomedical equipment management, safety committee, blood bank committee, clinical risk management, condemnation committee, diet committee, disaster management committee, drugs formulary, ethics committee, office management committee, purchase committee, safety committee, staff welfare committee.

The Medical Superintendent Dr Sinha headed all the committees to monitor the organisation-wide progress. The rest of the staff in the committee were assigned role in accordance with their existing job pattern. For example, the Head of Department (HOD) pathology and I/C blood bank were both part of the Infection Control Committee (ICC). The committee met once every week to review the progress.

As identified, SOPs and documentation needed to be strengthened. Due to the high case load of the hospital, the attitude of the doctors towards paperwork was that these were just bunch of papers. No one paid much attention to the paperwork. To improve on the documentation, the case sheets were changed to one file form with all the relevant forms including initial examination report, laboratory investigations required to the final discharge summaries. The file also included a checklist of all documentation that was required for each patient. To motivate the doctors to fill up the documents and formats, regular persuasion was required. With the repeated motivation, the doctors started filling the formats legibly and

completely. They started putting their signatures, date and time after each entity of follow-up notes. To improve this process, Medical Records Department (MRD) was also formed where each and every case sheet was scrutinised. If any case sheet was found to be incompletely filled, it was sent back to the concerned doctor.

Doctors and other hospital staff were also sensitized regarding the management information system and the concerned people were given hands on skill-based training for the same. Software was custom designed according to the needs of the hospital and installed in all the departments. Data entry operators were appointed to strengthen the management information system (MIS) of the hospital and make proper patient-related entries into the system.

All patients got unique numbers assigned to them and a bar coded hand tag system based on radiofrequency identification (RFID) technology was also initiated. It was decided that regular audits were required to be conducted in the areas of internal audit, clinical audit, medical record audit, death audit and referral audit. Audit reports served as evidence-based approach towards achieving accreditation.

Keeping in view all this it was decided that just one sensitisation workshop in the beginning was not enough. The staff needed continuous reminder of the goals ahead of them and also be motivated time and again. Continuous sensitisation of the staff will also help in developing a thorough review process within the organisation itself to set a high bar of the demands of quality.

Next, it was decided that quality and safety practices should take precedence above all. The Housekeeping and Infection Control Committee would work together by making checklist and daily rounds of the hospitals. Skills training would be imparted to the hospital employees to upgrade the hygiene of the hospital. The nurses, the *safai karamcharies*, etc. were sensitised towards the upkeep of cleanliness and proper biomedical waste management. This category of hospital staff was the hardest to change in terms of mindset. They stuck to their work pattern despite rigorous motivation from the administration. Henceforth a difficult yet necessary decision of outsourcing was taken. This also led to some undercurrents between the management and the regular staff. However, a work pattern was formed wherein the regular staff was assigned a particular slot and the outsourced staff was assigned another slot. This resulted in only some resolution to the problem; however, a continuous system of cleaning and waste disposal was established in the hospital. The hospital infection control committee also decided to implement a checklist for hospital cleaning procedures and undertake pest control activities, biogas plant formulation, revise general waste disposal and constitute a sewage treatment plant.

For the accreditation, it was also concluded that various indicators should be monitored, like at the CSSD of the hospital with high-vacuum steriliser on a daily or weekly basis such as a validation of sterilisation by indicators and spore test, colour change indicator tests such as the Bowie Dick test in the autoclave and in the general hospital the monitoring of surgical site infection (SSI), UTI, phlebitis, needlestick injuries, blood stream infections, adverse events following immunisation (AEFI), etc. in the ICU ventilators-associated pneumonia (VAP), catheter-associated urinary tract infections (CAUTI), **central line-associated bloodstream infection(s)** (CLABSI), etc.

The lab services had mandatory internal checks done twice a day and external quality checks for biochemistry, microbiology and haematology, whereby samples were validated and checked for accuracy and precision.

Documentation of all of the above along with policies, SOPs, calibration and AMC of lab equipments, monitoring of lab turnaround time and display of the same was done.

The operation theatres that had earlier lacked central air conditioning, air curtains and zoning were renovated to include all these.

Planning for infrastructural changes like establishing a biogas plant for solid waste disposal, segregation system for biomedical waste management, repair of old furnishing of the old hospital, and roofs and flooring, etc. was taken up. As per the mandatory requirement of access to care, signages were displayed in three languages—English, Hindi and the local language. This was an added challenge due to financial constraints. More wards and rooms were required to accommodate extra beds, keeping in mind the spacing protocols of NABH.

However, since finances had to be arranged, the state health society took the matter in its own hands. After much contemplation, it was decided that some state funds will be reappropriated for accreditation to get the process rolling. However, since a huge amount of funds were required for this herculean task, the state would propose it in the upcoming programme implementation plan for the state. Till then financial help for developing dedicated wings could also be sought by means of sponsorship from various agencies like nongovernmental organisations (NGOs), corporate organisations, banks, etc.

The gain of sponsors to develop these new and dedicated wings along with repair of the old ones helped increase the confidence of the management in the project. Next, they looked acutely into the manpower deficiencies in the hospital. The organogram of the hospital had been last updated nearly five decades ago. The staffing for nurses was done nearly two decades ago. Some of them had since then left the institution or were posted elsewhere. This needed major review. New recruitments were planned by the HR department. Also, the committee instructed the HR department to look into any and all

trainings arranged for the staff and the rational deployment of the staff after gaining the knowledge and skills. Another training was planned in two batches for the staff to cover all the standards and objective elements of the NABH accreditation.

Disaster management committee organised special trainings as well as mock drills for emergency preparedness and disaster management along with identification of triage areas.

Some of the other trainings organised for existing staff included interpersonal communication training, protocols and reporting of needlestick injuries, handwashing training, etc. And reduction training plan and manual was designed for any new entrant to the hospital, which could also be attended by any hospital staff with prior permission of their supervisors.

The general wards of the hospital were given a new look with clear display of patient charter, general information about the services provided by the hospital in three languages, better organised and manned nursing boys with mandatory facilities, a diet counselling unit, patient's wheel chairs and access ramps, crash carts and essential medicine trolleys, and unique identification number (UID) bands for the patients, etc.

A 24 × 7 ambulance services with basic life support (BLS) and advanced life support (ALS) facilities, manned with nurses with clear display of information related to organisation along with and equipped with medication and other paraphernalia were initiated by the hospital.

After all, the above activities were set in motion and carried out efficiently for 3 months; the hospital filed an application for preassessment by the NABH.

ISO 9000 Certification

As defined, the International Organisation For Standardisation (ISO) 9000 are a set of quality management standards that help an organisation to meet the needs of its customers, while conforming to the statutory and regulatory requirements of that product. ISO 9000 can be understood as a structural framework and methodology to evaluate whether the operations of the organisation and its performance have been optimised up to the satisfaction levels of its customers. The pathway of the ISO 9000 defines the use of its organisational resources in an effective and efficient way, integrated and synchronised to produce high quality of deliverables. It paves way between the regulatory process of a hospital and achievement of its accreditation by helping the process of continuous quality improvement.⁶

The comprehensivity of the ISO 9000 standards adds to the competitive advantage of the organisation by creating a more efficient and effective operation, decreasing audits, enhancing well-executed marketing and international trade. It also

increases the profits by including strategies for reduction of waste and increase of productivity. It focuses on increasing employee morale, awareness, employee motivation and is considered as a common tool for standardisation. The final benefit achieved by the organisation is in terms of increase in customer satisfaction and retention.⁷ However, some authors feel that ISO 9001 has greater applicability to services since these have been based more on the process-based approach rather than the systems-based approach in the earlier version, which has more applicability to manufacturing sector.^{8,9}

ISO 14000

ISO 14000 are also a set of standards related to the environmental management. The core idea behind these standards is to reduce the negative impact of the organisation towards the environment in any kind of organisation, whether private or public healthcare organisation.¹⁰ In a hospital setting where biomedical waste is generated in many forms, the ISO 14000 and its principles holds a deep meaning for implementation. Tertiary-care hospitals such as PGIMER Chandigarh have self-evaluated their organisation versus the criteria of these ISO 14000 standards, acknowledging the importance of environmental auditing outlined in these standards with a view of mitigating the detrimental impact that a healthcare organisation can have on the society.

A QUALITATIVE APPROACH TO PATIENT SAFETY AND REDUCING MEDICATION ERRORS IN HOSPITALS

Errors and failures can have a catastrophic result in the healthcare industry. Though it would be humanely impossible to completely eliminate these; however, the policies and strategies of the hospitals can strive to reduce them to a bare minimum. This approach can save lives and disabilities and decrease the undesired costs incurred. To directly deal with the financial costs, insurance companies have covered several kinds of incidences arising from errors and accidents occurring in the hospitals. Apart from the financial costs, these errors result in high-opportunity costs like costs to repeat the tests or cover for the adverse event, loss of trust of the patient on the organisation's ability to provide care. Physical and psychological discomfort faced by the patient and his family due to the longer duration of the stay in the hospital to deal with the adverse event.

Hospitals need to look into reducing these medication errors. That is why all accrediting bodies have included it in their standards for stringent adherence.

A **medication error** has been defined by the FDA (Food and Drug Administration) as 'any preventable error that may cause or lead to inappropriate medication use or patient harm.' The Stanford University's evidenced-based practice centre defines the **patient safety** as a 'type of process or structure whose application reduces the probability of adverse events resulting from exposure to the healthcare

system across a range of diseases and procedures.' An **adverse event** has been defined as 'any untoward medical occurrence that may present during treatment with a pharmaceutical product, but which does not necessarily have a causal relationship with this product.'¹¹

Types of errors

Below is a list given of the kinds of medical errors that can occur in a hospital scenario. Most of these would be in the preventable risk category:

- Hypersensitivity reaction to a drug, allergy to which had not been documented in the history of the patient.
- Patient getting the wrong kind of drug, wrong dosage of the medication, expired medication, etc.
- Wrong patient being operated for the wrong kind of surgery due to overlooking of the patients charts.
- Mishandled surgeries such as wrong body part being operated upon.
- Misdiagnosis due to mix-up of diagnostic test, incorrect choice of therapy, misinterpretation of test results by the doctor and failure of the operator to act on abnormal reported result.
- Failure of equipments due to lack of timely calibrations.

OUTCOMES OF CHANGE

Evaluating the outcomes of implemented change is analogous to getting the report card for the year-long study and hard work. Examples of better outcomes at the hospital level include¹²:

- Reduction in the mortality rates, morbidity rates and complications during medical interventions.
- Less/decreased lag time between appointments, receiving lab results, length of stay and discharge time.
- Increase in the market share and confidence of the patients in the healthcare delivered by the organisation, and the staff satisfaction and morale.
- Reduction in the readmission rates, rates of the hospital-acquired infection, patient falls and other complications.
- Efficiency in the interdepartmental sharing of data and recording of incidences.
- Reinforcement of quality through a motivated staff and improvement of market position due to positive status in the local community.

REAUDIT AND CONTINUOUS QUALITY IMPROVEMENT CYCLE

- Once the quality initiative has been taken up by the hospital and it has started to monitor the changes in the process that have been made, a reaudit should be done. The reaudit actually marks the beginning of a fresh audit cycle. This cyclic process continues over time to make the system more comprehensive by isolating any and all

variables that hinder the highest quality of service from being delivered. The change in the process yields only two types of results. If they yield beneficial results, the strategy should be adopted for long term, if not then the strategy should be discarded.¹³

- Continuous quality improvement is a step ahead than the quality improvement philosophy we spoke about earlier in the chapter; yet basically the cycle remains the same. If one area yields beneficial results from certain actions or changes made then those changes are adopted till they can be completely sustained and integrated in the mainstream of activities of the organisation. Once this has been achieved, a new area can be taken up and the entire cyclic activity repeated. Though this is a long-term project, yet quality control has been proven to provide long-term results also in terms of improving outcomes and lowering costs dramatically. In no other industry other than the healthcare industry the benefits of continuous quality improvement so worthy the cause and the lack thereof has such a high overall cost.
- Through continuous quality improvement small incremental changes using scientific methods can achieve success and go over and beyond meeting the customers' needs and expectations.
- The adoption of continuous quality improvement as a natural part of everyday work increases the efficiency and effectiveness. The idea was founded by Dr Walter Shewart in 1920s. He developed the concept of control with regard to variation. This idea of CQI was further developed by Dr Edward Demming. The use of control charts was made popular by the above scientists to clearly and graphically demonstrate how the process is performing and how the process and capabilities are affected by the changes to the process. So basically the control charts determine the capability of the process and can help to identify the causes for factors that hinder the best performance.
- Therefore, we can say that the control charts serve as essential tools for continuous quality control. Control charts differentiate between the processes that are in control and those processes that are out of control. In control, processes can be predicted to some extent of how they would vary in the future by analysing their past performances. In case of out of control processes, this prediction is a little difficult to make since the variance falls out of predictable limits. For an out of control process, one has to look for assignable causes or special causes followed by the reasons as to why the phenomenon has occurred as is. The next step is to eliminate those reasons and investigate if the changes are working. In case, the variance is positive and the results are better than expected in an out of control process, again the reasons are sought and sustenance of those reasons become the next tasks. Both the in control and out of control processes can be investigated for measurement of data with a bell curve distribution.

CHALLENGES AND SOLUTIONS TO IMPLEMENTATION OF QUALITY IN HOSPITALS

Is change easily welcomed in any organisation? This is very hard to say since the people view change differently. Some look forward to gradual change over time, some welcome it, however, most resist change. The small-scale and large-scale hospitals face different challenges with respect to the implementation of quality within their organisation owing to the tune of services delivered by them.

Challenges Faced by the Small-scale Hospitals

- Small healthcare organisation do have the advantage of easy implementation of quality within their organisation, as there are always fewer number of people to motivate to take it up seriously and adopt it organisation-wide; fewer obstacles, fewer work processes and checkpoints to tackle and fewer levels of management so the vertical filtration of the philosophy becomes easy. However, the smaller the organisation, financial constraints, fund raising for new innovative projects and latest technology to upgrade the healthcare services, monitoring of key performance indicators with industry benchmarks, etc. become more difficult. Infrastructural deficiencies, inadequate training of the staff towards critical care, biomedical waste management, risk management, etc. along with lack of adequate licences for having certain services such as radiology, etc. are just some of the problems to begin with.^{13,14} High turnover rate of the staff of a small organisation is also a major challenge. Phasic or stepwise approach can be a more result-driven approach compared to segmental approach that work in a larger healthcare organisation, since there may not be many departments to pilot test and then implement the quality protocols in the organisation. Making a transition from the traditional management practice to a more decentralised or a scientific-driven practice can be a key step towards implementation of a quality management system within the organisation. Some services such as laboratory testing of the samples can be outsourced. However, this must be done with caution since the licensing and certification of the laboratory to which outsourcing is being done should be checked beforehand.¹⁵

Challenges Faced by the Large-scale Hospitals

- The major constraint of a large-scale healthcare organisation is its volume. Higher the number of staff working in the organisation means more people to motivate, greater management levels and more funds required to carry out the same activity. The mindset of the leadership of the organisation also needs to embrace the concept of implementation of quality in the organisation and then the other staff members follow. The involvement of senior leadership is of utmost importance, since it is the senior

leadership that translates the vision and the mission of the organisation to the lower rungs of employees. Any change brought about by inculcating quality into the organisational culture will have an organisation-wide impact with the support from senior leadership.¹⁶ When the senior leadership is not involved, it becomes difficult to find solution to the problems like financial constraints and the overall involvement of the entire employee body.

- Most of the studies point to the resistance shown by the physicians and nurses to any change being implemented in the organisation.¹⁷ It was also noted that the staff generally felt judged when quality monitoring was implemented. Nurses generally complained about the increase in the paperwork, which further consumed their time. These are some of the legitimate concerns and could be resolved at an 'open' platform or staff meetings to express any displeasure felt by them.¹⁸
- The process needs re-engineering or redesigning in a way that integrates quality into work practice itself and does not increase the workload.¹⁹ To integrate quality with the attitude of the staff, nurturing leaders from among themselves should be encouraged. Using experience of the staff members to find solutions to the gaps and deficiencies will encourage them to work towards a common goal.
- The goals should be clearly distinguished for short-term and long-term spans. The staff will be able to appreciate the vision behind implementation of quality throughout the organisation, once the results of the short-term goals start coming in. Small but meaningful rewards for their achievements in the form of appreciation parties or prizes or other forms of laurels is a good way to keep the staff motivated.
- Over the long term, the improvement in the numbers of key performance indicators (KPI) and market share of the organisation along with the growth in the financial performance will keep the management motivated.
- In most of the cases where infrastructural changes are required to be made, finances become a constraint variable. New equipment, computers, softwares, etc. may have to be purchased; human resources may be required to be hired, which requires financial investments that may be difficult to be done all at once and maintain profits in a slow market. The management may be forced to transfer these added expenditures to the costs borne by the end user. These may shoot up the medical costs and final out-of-pocket expenditure by the patient. When the costs on the patient increase, it is difficult to get the return on investments in a short term. Financial constraints can make it challenging to adopt quality implementation in a large organisation-wide scale on a regular basis. Henceforth, unrelenting and patient-oriented approach is required after a concrete decision is taken to implement quality in the organisation. The entire process takes time to implement and bring about results. Financial

investments can be balanced over short- and long-term service goals.

- Understanding the goals of quality and its practical relevance is hard work, but is achievable once the leadership believes in the long-term vision. Key performance indicators and customer satisfaction levels are parameters that clearly reflect on any intervention based on quality. Traditional healthcare organisations while changing their culture to a more modern approach or flexible approach need to educate their employees of the new philosophy. The top-level management at traditionally run organisations fear the loss of the autonomy and continuous attrition of staff, which deters them to invest in the training of their employees for quality improvement projects. Their own perception that adding quality assurance projects may encourage the employees to ask for salary hikes may also deter the management to foray into quality initiatives. All these fears and more can be addressed by holistic information regarding quality management system, its core concepts and values, and changing the perspective of the management to a more prospector approach of running the organisation.

A hospital's commitment to quality starts at the first step with measurement and benchmarking performance through quality indicators.¹² The key quality indicators to represent various attributes of quality in a hospital are categorised into prevention, inpatient, patient safety and paediatric modules.

The need for uniformity in quality across all the health services given to the patient calls for adherence to standards set by a certifying or accrediting body like Joint Commission International (JCI) or National Accreditation Board for Hospitals (NABH) which has setup clear goals and standards that are patient centred and healthcare organisation based.¹⁵

Key challenges: The accreditation process is challenging as it requires additional bandwidth and higher financial commitment. It meets further resistance as it identifies gaps and requires behaviour modification on its path to strengthening processes, improving communication, documentation and monitoring.

Key solutions: The entire process needs to be driven with the right motivation, often starting with the setting up of a hospital quality assurance (QA) committee. The entire process needs to be redesigned in a way that integrates quality into work practice and does not impact the bandwidth.

Using experience of staff would encourage them to make this a common goal. Holistic training for employees on quality management systems is a key step in solution of quality management. Incentive alignment for the management and employees for achieving key performance indicators drives quality management as well as financial performance of the larger organisation. Technology must be leveraged to achieve faster, better and accurate ways of doing processes including monitoring.

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Prevention of Hospital-acquired Infections

39

Dr Sonu Goel, Dr Mahesh Devnani, Prof Anil Kumar Gupta and Dr Amarjeet Singh

“Save live: Clean your hands.”

—WHO Global Annual Campaign, 2013

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the importance of hand hygiene and personal protective equipments (PPE) in prevention of hospital-acquired infections.
- understand the different modes of disease transmission.
- comprehend organisational structure for infection control in hospitals.
- understand the role of various hospital personnel in infection control.

INTRODUCTION

Hospital-acquired infections (HAI) are acquired by the patient in the hospital. These infections usually manifest after 48 hours of hospital contact.¹ The source of the infection is usually due to cross-infection from either staff or the other patients. The mode of transmission is mostly through contact—occasionally by air or droplet.²⁻³ Studies have reported HAI rates from 6 to 27%.⁴⁻⁶ As per the hospital infection society of India, the incidence of HAI in India ranges from 5 to 30%.⁷

There are many strategies that may be applied to prevent/control transmission of infections in healthcare facilities. Basic infection control and precautions that must be applied to all patients at all times regardless of diagnosis or infectious status. In addition, there are some precautions specific to modes of transmission (airborne, droplet and contact). The risk of acquiring infections from patients and infecting other patients can be decreased by observing standard precautions. For example, washing of hands by healthcare personnel every time before and after patient and specimen contact, considering all blood and body fluids of patients as potentially infectious and wearing gloves for any contact with blood and body fluids, placing used syringes immediately in nearby impermeable container, recapping of used needles should not be done, wearing protective eyewear and mask if splashing of blood or body fluids is expected, handling all linen soiled with blood and/or body fluids as

infectious and processing all laboratory specimens as potentially infectious.

HAND HYGIENE—SINGLE-MOST IMPORTANT THING TO PREVENT HOSPITAL-ACQUIRED INFECTIONS⁸⁻¹⁰

Appropriate hand hygiene can minimise microorganisms acquired on the hands during daily activities and whenever there is contact with blood, body fluids, secretions, excretions, or known/unknown contaminated equipment or surfaces. Hands must be washed and decontaminated using a plain soap and antimicrobial agent, such as an alcoholic hand rub or waterless antiseptic agent. The five moments for hand hygiene approach¹¹ [World Health Organisation (WHO) guidelines on hand hygiene in healthcare] recommends healthcare workers to clean their hands:

- before touching a patient,
- before cleaning/aseptic procedures,
- after body fluid exposure/risk,
- after touching a patient, and
- after touching patient surroundings.

Though the healthcare organisations continue to strive for 100% adherence to hand hygiene standards, studies have repeatedly shown that the compliance to hand hygiene among healthcare personnel is far from satisfactory. At Postgraduate Institute of Medical Education and Research

(PGIMER), Chandigarh, regular training courses, seminars, live demonstrations and continued on-job training is given to all categories of healthcare staff for appropriate hand hygiene. Apart from hospital infection-control nurse, a dedicated nurse and a sanitation inspector have been assigned this task who take daily rounds of various areas of hospital and reinforce proper hand hygiene practices. A booklet on hand hygiene has also been prepared and distributed among healthcare staff of the institution.

USE OF PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) provides a physical barrier between harmful organisms and healthcare personnel. It also prevents cross-transmission of microorganisms. Personal protective equipment includes gloves, protective eyewear, mask, apron, gown, cap/hair cover, boots/shoe covers, etc.

These should be used by:

- Healthcare workers who come in direct contact to patients and/or work in situations where they may have contact with blood, body fluids, excretions or secretions.
- Support staff including medical aids, cleaners and laundry staff in situations where they may have contact with blood, body fluids, secretions and excretions.
- Laboratory staff, who handles patient specimens.
- Family members, who provide care to patients and are in a situation where they may have contact with blood, body fluids, secretions and excretions.

At PGIMER Chandigarh, storage, quality assurance and distribution of PPE is centralised under the Office of Medical Superintendent. Regular monitoring and training for proper use of PPE is done by nursing administrators, mainly Deputy Nursing Superintendents (DNS) and Assistant Nursing Superintendents (ANS). Despite huge rush of patients, especially during outbreaks like the recent influenza A (H1N1) pandemic, there was hardly any incident of stock out of PPE in PGIMER.

VACCINATION OF HEALTHCARE WORKERS

Vaccines are available to protect healthcare workers against certain illnesses, viz. hepatitis B, influenza, measles, mumps and rubella, tetanus, diphtheria, pertussis, neisseria meningitidis and varicella. In western countries, hospitals require their employees to periodically get influenza vaccination, which is usually provided free by the hospital. PGIMER Chandigarh, provides vaccination to its employees for all the necessary vaccinations under WHO schedule.

ADDITIONAL (TRANSMISSION BASED) PRECAUTIONS

In certain situations, standard precautions alone are not sufficient. So additional precautions are recommended for

specific patients known, or suspected to be, infected or colonised with microorganisms that cause such infections by the following means:

- *Air-borne transmissions:* This includes:
 - Implementing standard precautions.
 - Placing patients in single rooms having negative air-flow pressure.
 - Anyone who enters the room must wear a special, high-filtration, particulate respirator (e.g. N-95) mask. N-95 masks were provided by PGIMER to the healthcare staff, patients [of severe acute respiratory syndrome (SARS)] and their attendants during the SARS outbreak in 2003.
 - Restricting the movement and transport of the patient from the room for essential purposes only.
- *Droplet transmissions:* Droplets are usually generated from the infected persons during coughing, sneezing, talking or during procedures such as tracheal suction. The following precautions are required to be taken for preventing droplet transmission:
 - Implement standard precautions.
 - Only one patient per room.
 - Wear a surgical mask when coming in contact within 1–2 m of the patient.
 - Place a surgical mask on the patient during transportation.
- *Contact transmissions:* The following precautions should be taken to prevent contact transmission:
 - Implement standard precautions.
 - Place patient in a single room. Consider the epidemiology of the disease and the patient population when determining patient placement.
 - Wear gloves during handling of patient.
 - Wear a gown when entering the room if substantial contact with the patient, environmental surfaces or items in the patient's room is anticipated.
 - Limit the movement and transport of the patient from the room for essential purposes only. Use precautions to minimise the risk of transmission during transportation.

PGIMER Chandigarh, has an isolation facility known as communicable disease (CD) ward, separate from indoor area. The ward has a capacity of 13 beds, out of which four are dedicated for tetanus. Each room has separate facility for hand-washing and biomedical waste management. The additional precautions are strictly followed and the staff is given regular training.

ORGANISATIONAL STRUCTURE FOR INFECTION CONTROL

Infection Control Committee

The infection control committee of PGIMER Chandigarh, comprises of representatives from hospital administration,

clinical departments, nurses, paramedical workers, clinical microbiology, pharmacy, sterile supply, maintenance, house-keeping and training services. It provides a forum for multi-disciplinary inputs and cooperation, and information sharing. The committee has a reporting relationship directly to administration to promote programme visibility and effectiveness. The committee has following main tasks:

- To review epidemiological surveillance data and identify areas for intervention.
- To review and approve a yearly programme of activities for surveillance and prevention.
- To assess and promote improved infection control practices at all levels of the health facility.
- To ensure appropriate staff training in infection-control and safety.
- To review and provide input into investigation of epidemics.
- To communicate and cooperate with other committees of the hospital with common interests.

Infection-Control Team

It is responsible for:

- Organising epidemiological surveillance programme for nosocomial infections.
- Checking the efficacy of the methods of disinfection and sterilisation, and the efficacy of systems developed to improve hospital cleanliness.
- Participating in development and implementation of training programmes.
- Providing advice and analysis in outbreak investigation and control.
- Participating with pharmacy in developing a programme for supervising the use of antimicrobial drugs.

Infection-control manual

A nosocomial infection prevention manual, compiling recommended instructions and practices for patient care is an important tool. The manual should be developed and updated by the infection control committee after taking inputs from all stakeholders. PGIMER Chandigarh has developed its own '*Hospital Infection Control Manual*', which is distributed to all the departments.¹²

Role of the physicians

Physicians at PGIMER are mainly responsible for following infection-control activities:

- Providing leadership and guidance in infection-control activities.
- Complying with the practices approved by the infection control committee.
- Obtaining appropriate microbiological specimens for further evaluation and reporting when an infection is present or suspected.

- Advising patients, visitors and staff on techniques to prevent the transmission of infection.
- Instituting appropriate treatment for any infections.

Role of the microbiologists

The microbiologists at PGIMER are mainly responsible for following infection-control activities:

- Providing leadership and guidance in infection-control activities.
- Ensuring laboratory practices meet appropriate standards.
- Ensuring safe laboratory practice to prevent infections in staff.
- Performing antimicrobial susceptibility testing following internationally recognised methods and providing summary reports of prevalence of resistance.
- Monitoring sterilisation and disinfection activities.
- Timely communication of various laboratory results along with recommendations to the infection control committee.
- Epidemiological typing of hospital microorganisms, where necessary.

Role of the nursing staff

The senior nursing administrator of PGIMER is mainly responsible for following infection-control activities:

- Active participation in the infection control committee.
- The development and improvement of nursing services, and ongoing review of aseptic nursing policies, with approval of the infection control committee.
- Developing training programs for the nursing staff.
- Supervising the implementation of recommendations for the prevention of infections.

The nurse in-charge of a ward is responsible for:

- Maintaining hygiene, consistent with hospital policies and good nursing practice on the ward.
- Limiting patient exposure to infections from visitors, hospital staff, other patients, or equipment used for diagnosis or treatment.
- Monitoring aseptic techniques, including hand-washing.
- Reporting promptly to the attending physician, any evidence of infection in patients under the nurse's care.
- Initiating patient isolation and ordering culture specimens from any patient showing signs of a communicable disease, when the physician is not immediately available.
- Maintaining a safe and adequate supply of ward equipment, drugs and patient-care supplies.

Besides this, Integrated Disease Surveillance programme of the Ministry of health and Family Welfare also operates through the surveillance committee of the institute. School of Public Health coordinates its activities. Internal medicine, microbiology, virology departments, etc. are also its members.

The health-promotion programme of any hospital would remain incomplete without incorporating the infection-control practices. Sound infection-control practices not only

reduce the overall burden of diseases by prevention and early recovery—thus benefiting patients—but also create a healthy environment for healthcare workers. An infection-free and healthy hospital environment is a collective responsibility of all. It is $24 \times 7 \times 365$ kind of work since ‘*First Do No Harm*’ is the prime responsibility of all doctors and healthcare staff, i.e. no harm should come to patients, their relatives, doctors and other staff by being in the hospital.

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Safe Injection Environment

Dr Om Prakash Kansal

“One Syringe, One Patient and One Needle.”

—Theme of CDC Injection Safety Campaign

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- define safe injection environment.
- understand the commonly observed wrong practices and to be followed best practices.
- understand the best practice models from across India.
- take an informed action to practice and promote best injection practices.

INTRODUCTION

Injections are the most frequent medical procedure performed throughout the world.¹ Firstly, the Hippocratic oath says, ‘do no harm’. However, by way of unsafe injection practices, the healthcare practitioners are violating the oath everyday. There has been documented evidence of transmission of Hepatitis B, Hepatitis C and HIV in recipients and service providers, and in general community due to reuse of syringes and needles (Flowchart 40.1).²

Secondly, the need for injections cuts across all specialties; be it outreach interventions for immunisation; outpatient procedures; indoor simple or intensive procedures, etc. Thirdly, adherence to safe injection practices is a stepping stone to strengthened infection control of the given healthcare setting. In the times to come, presence of

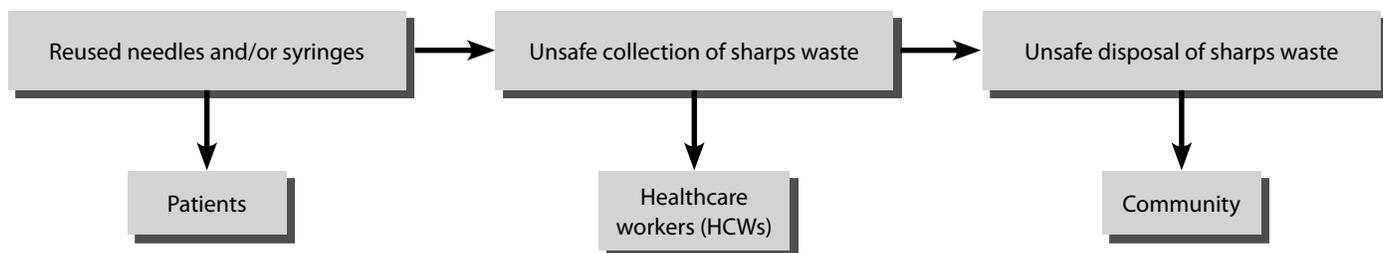
infection-control mechanisms in hospitals and outpatient clinics would help them significantly to earn accreditation from NABH or ISO or any other relevant agency.

WHAT IS SAFE INJECTION AND SAFE INJECTION ENVIRONMENT?

Safe injection, as per WHO is the one that

- Does not harm the recipient
- Does not expose the provider to any avoidable risks
- Does not result in waste that is dangerous for the community.

Safe injection environment is a set of conditions which is made available to ensure safe injections in any healthcare setting.



Flowchart 40.1 Harm caused by unsafe injections to patients, HCW and community.

PRESENT SCENARIO—GLOBALLY AND NATIONALLY

Various levels of injection use have been reported worldwide, ranging from 1.7 in Brazil to 13 injections/person/year in Mongolia. All injections administered for whatsoever reason should be safe. Of all the injections, 5% injections are administered for immunisation (preventive care), while the rest 95% injections are meant for curative care.^{1,3}

In India, India Clinical Epidemiological Network (INCLIN) undertook a nationwide assessment on injection practices from 2002 to 2004.⁴ The findings, released in 2004, revealed a high use of injections for even simple ailments like fever, cough and diarrhoea. Of all the injections, 63% were unsafe and 23% of these were due to reuse of syringes and needles. The injections administered are as follows:

Injections administered/year	Characteristics of unsafe injections (%)	
Globally	22 billion	
In developing countries	16 billion	
In India	6 billion	
	Total unsafe	62.9%
	Wrong habits of injection givers	54%
	Questionable sterility	20%
	Reuse of syringes and needles	22%

The incidence of transmission of blood-borne pathogens, including hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV), all of which can lead to more severe consequences such as disability and death in the years following contamination, is presented in Figure 40.1.^{2,5}

The silent epidemic of unsafe injections has plagued many healthcare systems, yet evidence has generally underestimated reality. The reasons for this are that infections are invisible on equipment, and also, since initially these viruses present no symptoms, the majority of cases go unreported.

Unsafe injections leading to outbreaks have been a global phenomenon. In India, there has been two major reported outbreaks due to reuse of needles and syringes: (i) In 2009, an outbreak of hepatitis B with high mortality was observed in Modasa block of Sabarkantha district, Gujarat with 456

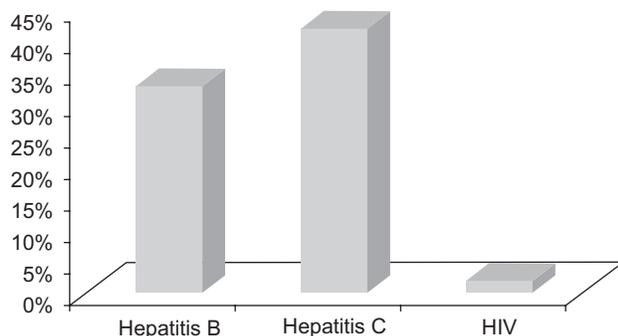


Figure 40.1 Annual number of infections attributed to unsafe injections.

cases and 89 deaths⁶; (ii) In 2012, an outbreak of hepatitis C was observed in Ratia town of Hissar district in Haryana with 1600 confirmed cases.

Some of the incorrect practices that lead to transmission of pathogens:

- Not following the One Syringe–One Needle–One Patient principle.
- Recapping of needles.
- Using the same syringe to access the bag for flushing a patient's intravenous (IV) or catheter.
- Using the same syringe for aspirating dose from a multi-dose vials and using in multiple patients.
- Disposing off hazardous waste in an uncontrolled manner.

The best practices for safe injections would include⁷:

- Using sterile injection equipment.
- Avoiding contamination of injection equipment and medication by not touching the needle after opening its cap.
- Taking precautions to ensure prevention of needlestick injuries to the provider.
- Prevent access to used syringes and needles—intentional and downstream reuse.
- Other practice issues include:
 - Safety-engineered medical devices—reuse prevention syringes, safety syringes and needles
 - Adhering to hand hygiene
 - Checking that skin of the provider does not have any injury or bruises
 - Using gloves whenever possible
 - Always swabbing vial tops or ampoules
 - Preparing skin of patient

Ongoing Best Practices in Policy and Practices in India for Safe Injection Environment

National: Following the INCLIN report findings; the Government of India adopted the World Health Organisation (WHO)/The United Nations Children's Fund (UNICEF)/United Nations Population Fund (UNFPA) joint resolution⁸ on using auto-disable syringes in immunisation. Thus, since 2005, AD syringes are being used in all government sector immunisation programs across India.

State level: The concern about unsafe injections has been understood at state level in many states. Some of the initiatives are described as:

- Kerala has established a Centre of Excellence on Safe Injections in partnership with Becton Dickinson India, in General Hospital, Kochi. The two essential components are (i) model injection room (Figure 40.2) and (ii) training room (Figure 40.3). This centre adheres to all laid down protocols on safe injection practices and is training the existing government and private doctors and nurses in batches on safe injection practices.

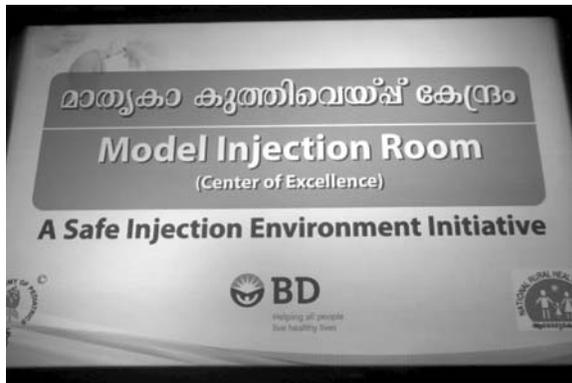


Figure 40.2 Model injection room.



Figure 40.3 Training room.

- Madhya Pradesh: The state had launched a safe injection environment campaign in May 2012. They have drafted injection safety guidelines for strengthening practices in all types of healthcare establishments.
- Punjab: The State AIDS Control Society has circulated guidelines to all their officials to strictly monitor that there is no reuse of needles and syringes.⁹ They have also outlines maintaining the supplies of all essential consumables to facilitate safe injection environment.

Professional/technical organisations

- *Indian Academy of Pediatrics (IAP)*: This august professional body has been championing the cause for safer injections since 2004. IAP has recently released the Third Edition of its guidebook on safe injection practices (Figure 40.4).¹⁰ IAP is undertaking sensitisation workshops on injection safety across the country for their members.
- *Forum for Injection Techniques, India (FIT)*: This forum has recently developed recommendations for best practice in insulin injection technique for all involved in diabetes care.¹¹
- *NABH-BD*: The National Accreditation Board of Hospitals (NABH) in partnership with Becton Dickinson

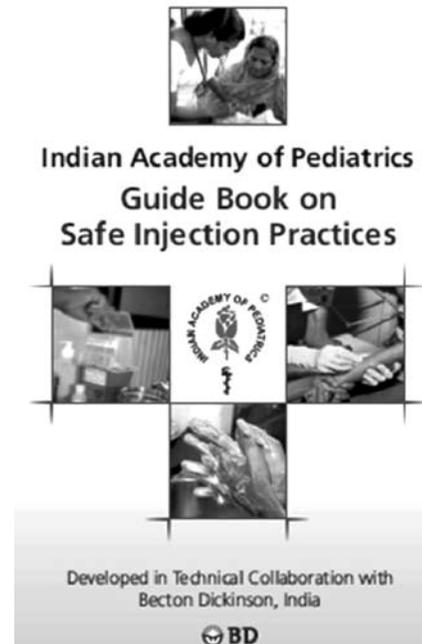


Figure 40.4 Cover page of IAP Guide Book.

India (BD) has come up an accreditation programme known as Safe I^{TSM}, aimed at strengthening and maintaining infection-control standards including safe injection practices.¹² The Safe I^{TSM} means a healthcare facility that is (i) safe for the patients (ii) follows all such protocols that strengthen safety for the healthcare professionals and workers, and (iii) has adequate waste disposal mechanisms so that the nearby community is safe.

Case Study 1: A young girl harbouring hepatitis B virus, unknowingly

Neha, a 17-year-old girl from Patiala, Punjab had a shock of her life when she was found to be seropositive for hepatitis B in September 2011. This was recommended to her by her dentist as a routine checkup before a minor surgical procedure. Little did she know that a couple of injections taken about 2 years ago for cough and fever would land her in the current stage. She was undertaken through a series of more diagnostic tests and was advised to visit a specialist every 6 months for follow-up. Her parents were worried about any possible disruption in her academic and marital prospects. The gastroenterologist put her up on a costly pill on a precautionary basis for 4 months. Her last test, taken in March 2013, showed her seropositivity on lower side.

While Neha was at least lucky enough to be identified as a carrier and her parents are resourceful enough to monitor and manage any likely complication, majority of cases/carriers of hepatitis go undetected and may transmit the infection through various routes, including unsafe injection practices.

Case Study 2: Mother's preventable illness due to hepatitis B shatters a student's dream

Shanthma, a 38-year-old lady working as a cleaner in a tertiary hospital in Chennai Tamil Nadu had been suffering from weakness and malaise for many days. She was a daily wage worker and ignored her illness to continue managing her and hospital duties. Her husband had died a few years ago and her 11-year-old daughter Nandini was preparing for a debate competition in her school.

One day, while working in the hospital, Shanthma fainted. She was investigated upon and was found to be seropositive for hepatitis B. She had features of jaundice as well. The medical specialist asked to her recollect any possible history of injections or blood transfusions. While she had not taken any such intervention at least in the last 5 years, she did remember getting pricked by a needle about a fortnight back while collecting the garbage from the ward dustbin. She had just washed her hands and carried on with her work, despite severe pain and minor bleeding.

Shanthma was diagnosed with acute hepatitis B. In the meanwhile, her daughter had won the debate competition and was selected to visit national level debate competition. But on knowing her mother's illness and understanding the fact that there is no one else to take care of her mother from an unwanted illness, she abandoned her dream of participating in the national debate competition.

Such avoidable events of family suffering happen quite frequently with many healthcare workers in India.

INJECTION WASTE DISPOSAL

Of the total waste generated in any hospital, about 20% constitute biomedical waste, which is hazardous and needs to be properly disposed. The common challenges in proper injection waste disposal include:

- Wrong perception: Used but apparently clean syringe pose no harm.

Table 40.1 Dos and Don'ts on safe injections–infection prevention and control practices⁸

Dos	Don'ts
• Maintain hand hygiene (use soap and water or alcohol rub)	• Don't forget to clean your hands
• Use alcohol swab to clean the site for injections and plain sterile swab for vaccinations, only if visibly dirty	• Don't presoak cotton wool in a container
• Use a single-use device for blood sampling and drawing	• Don't reuse a syringe, needle or lancet
• Disinfect the venipuncture site	• Don't use a single loaded syringe to administer medication to several patients
• After giving injection, if using re-use prevention syringe, break the plunger and contain the needle through hub cutter	• Don't touch the puncture site after cleaning
• Where recapping of a needle is unavoidable, use the one-hand scoop technique	• Don't leave an unprotected needle lying outside the sharps container
• Seal the sharps container with a tamper-proof lid	• Don't recap a needle using both hands
• Ensure one needle–one syringe–one patient	• Don't overfill or decant a sharps container
• Take post-exposure prophylaxis in case of needlestick injuries and blood/body fluid splash	• Don't delay PEP beyond 72 h; PEP is NOT effective

- Poor surveillance on needlestick injuries with actual picture not being captured.
- Access and availability to all safe disposal mechanisms is limited to a small percentage of all health facilities.

Best practices for injection waste disposal are as follows, which would help prevent needlestick injuries and prevent access to used needles by anyone.

- Do not recap the needles.
- Immediately contain the needle in blue-/white-coloured sharp container or hub cutter.
- Reuse prevention technology, wherein a syringe gets locked after single use (Table 40.1).

Newer Technologies for Safe Injection Practices

Technology helps the healthcare professionals immensely in their endeavour to achieve the desired standards of health-care. In the syringe and needle category, there have been many innovations in the last decade or so, which are worth knowing and practicing as and when they are available in your settings.

Auto-disable and reuse prevention syringes: These syringes imbibe the basic mechanism of getting locked after their single intended use. There are two types of mechanisms:

- *Active mechanism:* In this, the plunger is to be pushed actively by the user for locking the syringe.
- *Passive mechanism:* Here the plunger locks automatically after it is bottomed out, after pushing the intended medicine.

Prefilled injection devices: These are the syringes having prefilled medication in the exact dose that is required to be given to a patient. After administration, the syringe gets locked. Thus, a sterile dose is delivered safely without posing risk to the provider as well.

Safety syringes: The needle in these syringes is locked through a Luer lock mechanism. Thus, accidental spillage of medication or the needle is avoided.

Vacuum-based technology for drawing blood: Instead of normal syringes, this is a better, safe and sterile technology for drawing the blood from the patients. The blood is collected directly into small tubes as per need for a particular investigation through a small plastic chamber.

Safety needles and cannulas: These needles have a plastic sheath used for covering the needle immediately after use. Similarly, in the cannulas, the plastic sheath covers the stellate automatically after the cannula is inserted into vein and stellate is removed. Additionally, there are blunt needles available for reconstitution of the powder form of vaccines and medications. The tip of such needle is blunt, thus, reducing possibility of accidental prick to the healthcare workers while undertaking the procedure.

Surveillance Mechanisms to Strengthen Safe Injection Practices

Surveillance is data collection for action. The data is used as a basis for planning, implementing and evaluating the event or disease prevention and control activities. In the context of safe injections, the following minimal information is required (Table 40.2).

Table 40.2 Information required for surveillance of safe injection

Level	Information
No harm to patient	Abscess at injection site
No harm to provider	Did the provider wash his/her hands or wear gloves; did the provider recap the needle after use; Is there any needlestick injury? What is the percentage of needlestick injury over a period of time in the hospital?
No harm to community	Has the plunger of the syringe been broken? How has the needle been destroyed?

Why Should Hospitals Propagate Safe Injection Environment?

In the times to come, when there is a huge influx of health-care services in government and private sector, the quality of care would be a differentiating factor for all. To ensure sustainable growth, the hospitals shall have to adopt standardised care and treatment protocols, and secure accreditation from one or the other reputed organisations of the trade. One of the basic requisites for infection control that is monitored by accreditation agency like NABH is the adherence to safe injection environment—stated policy, trainings, message propagation through posters, tracking of needlestick injuries, focal point to provide post-exposure prophylaxis (PEP) round-the-clock, and safe disposal of plastics and sharps.

How Should Hospitals Propagate Safe Injection Environment?

A few actionable tasks for every hospital management are:

- Ensure that all staff—medical, paramedical and administrative working in the hospital has been well-protected against hepatitis B through preventive immunisation. Hepatitis B is the only infection against which primary prevention through vaccination is available.
- Display Dos and Don'ts related to injection safety at all strategic points in the hospital.
- Ensure segregation of waste at every point of waste generation itself.
- Make Hub cutters for sharp containment at all such locations where injections are likely to be administered. The sharps need to be contained immediately after their intended use is over.
- Use technology that helps prevent access to used needles and syringes. Auto-disable syringes for preventive immunisation and reuse prevention syringes for therapeutic care offer highest level of safety in a country/geography with high disease burden due to unsafe injections.
- Organise sensitisation sessions of about 2 h on safe injection practices and case studies of all staff, at least every 6 months. Do not miss grade 3 and 4 employees.
- Undertake patient/public awareness drives as well through various modes.

Relevance of Hospital Infection Control Committee (HICC) in Providing Safer Injections

The presence of an active hospital infection control committee (HICC) is helpful for any healthcare setting in tracking the unsafe injection practices and taking on-the-spot corrective measures. The HICC members could also encourage needlestick injury cases, and offer prompt medical and psychosocial management to the victims. A sample proforma to record NSIs is as follows:

Agency: Employer:

Location: Title:

Date of injury: Time: am pm

- Describe clearly and in detail, what happened/how you were injured?
 - What were you doing at the time of the incident/injury?
 - Part(s) of the body that were injured (be specific—such as left hand or right thumb):
 - Who did you report the incident/injury to?
 - When did you report the incident/injury (give date and time and explain any delay in reporting)?
 - Name all witnesses:
- Employee signature: Date:

Unsafe injections are a public health hazard, which could be avoided to a great extent. As we grow in our wisdom on hospital management, making all injections safer would be the key area of focus for any hospital management team.

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Biomedical Waste Management

41

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“The very first requirement in a hospital is that it should do the sick no harm.”

—Florence Nightingale

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- elicit the hazards associated with biomedical waste (BMW).
- know correct methods of safe disposal of different types of biomedical wastes.
- learn national and international regulations and legal provisions for management of BMW in hospitals.
- identify common problems and undertake operational solutions in day-to-day management of BMW in a hospital.

INTRODUCTION

The rise in population and the development activities to meet the needs of mankind have caused immense stress on the natural environment. This indiscriminate increase in population, urbanisation and industrialisation since 1974 has led to an increase in number of patients, which is directly linked to the development of medical infrastructure facility. In fact, India's population of 1.08 billion is expected to reach 1.53 billion by 2050, making it the most populated country in the world. Therefore, adequate management of waste assumes tremendous importance in a country like India whose economy forces the poverty stricken and ignorant 'rag pickers' to sift and sort through dumped waste material, in order to eke out a living. Time-and-again, the audiovisual and print media has highlighted the desperation and pathetic conditions of these people; but the apathy of the people at decision level is that they have managed to give this problem less importance than what it deserves. So much that unscrupulous element has moved in and 'recirculation' of waste has become one of the 'leading' industries in the unorganised sector.¹ A number of documentaries have been made and reports have been compiled regarding improper waste management in the majority of healthcare institutions. But in most cases the lack of significant steps in this regard is due to apathy at the levels of decision making.

As reported by the committee on Urban Solid Waste Management in India constituted in 1994, there are no reliable epidemiological data from developing countries on the health impacts of poor hospital waste management.² Some of the problems identified are:

- Injuries from sharps to all categories of hospital personnel and waste handlers.
- Nosocomial infections in patients from poor infection control practices and poor waste management policies.
- Risks of infection outside hospitals for waste handlers and scavengers and, at times, general public.
- Risks associated with hazardous chemicals, drugs being handled by persons handling wastes at all levels.
- 'Disposables' being repacked and sold by unscrupulous elements, without even being washed.
- Drugs that have been disposed, being repacked and sold off to unsuspecting buyers.

Due consideration must be given to the impact on environment, especially to risk of pollution of water, air and soil, besides aesthetics of the biomedical waste (BMW) generated in the hospital. In order to minimise these environmental problems, action should be taken to deal with pollution at source, i.e. waste should be segregated and concentrated within healthcare institutions, and whenever possible it should be disposed-off safely.

CURRENT SCENARIO OF BIOMEDICAL WASTE MANAGEMENT IN INDIA³

Presently, the hospitals and other healthcare institutions have just gradually started to implement proper waste management principles; there are a number of healthcare institutions that dump their wastes in the municipal garbage dumps without any segregation whatsoever. In fact, it is common place to find large heaps of 'Biomedical' wastes in the vicinity of a number of hospitals containing human tissues, blood-soaked items, excreta, drugs, swabs, disposables syringes and needles, bandages, etc.

Types and Composition of Biomedical Waste

It has been found from studies that the amount and composition of hospital waste normally generated in a hospital is as follows:

- **Hazardous/nonhazardous^{4,5}**
 - Hazardous 15%
 - Hazardous but noninfective 5%
 - Hazardous and infective 10%
 - Nonhazardous 85%
- **Composition**
 - By weight
 - Plastic 14%
 - Combustible
 - Dry cellulosic solid 45%
 - Wet cellulosic solid 18%
 - Noncombustible 20%

The approximate chemical composition of general healthcare waste is usually as follows:

- 50% Carbon
- 20% Oxygen
- 6% Hydrogen
- Numerous other elements

Components of Biomedical Waste⁶

Biomedical waste (BMW) generally consists of:

- Soiled bandages, linen and other infectious waste (30–35%)
- Plastics (7–10%)
- Disposable syringes (0.3–0.5%)
- Glass (3–5%)
- General uninfected waste including leftover food (40–45%)

It has been found that in India the generation rate varies between 0.5 and 2.0 kg/bed/day and total generation is more than 0.33 million tonnes/year.

Health Hazards and Risks^{7,8}

In developing countries, medical-related waste is disposed off illegally into the garbage and into the sewers. Even in developed countries, infectious and hazardous wastes are dumped in the municipal bin, where used syringes with or

without blood and needles, used intravenous bottles, tubes, soiled cotton, medicine vials, urine bags, mattresses are picked up by rag pickers and junk dealer (kabari). The used cotton is further sold to people after washing with water. The blood is drained out of syringes at the time of sorting and emptied into the drain outside of the residential premises. Bags, syringes and other wastes materials are reused and recycled in large quantity after picking up from the incinerator and autoclave sites. These all activities are associated with risk of transmission of human immunodeficiency virus (HIV), hepatitis B and C infections. Rubbish collectors and scavengers are aware of this activity and some had needle-stick injuries. At many places, authorities are failing to install appropriate systems due to nonavailability of technologies, inadequate financial resources and absence of professional training on waste management. In addition, the awareness is poor among various categories of health workers about environment health including BMW management.

All BMW is hazardous. In hospital, it comprises of 15% of total hospital waste. In a nutshell, healthcare waste includes all the waste generated by healthcare establishments, research facilities and laboratories. In addition, it includes the waste originating from 'negligible' or 'scattered' sources, such as that produced in the course of healthcare undertaken in the home (dialysis, insulin injections, etc.).

Between 75 and 90% of the waste produced by healthcare providers is of nonrisk or is 'general' healthcare waste, comparable to domestic waste. It comes mostly from the administrative and housekeeping functions of healthcare establishments and may also include waste generated during maintenance of healthcare premises. The remaining 10–25% of healthcare waste is regarded as hazardous and may create a variety of health risks.^{9–11}

Infections are the most common health hazard associated with poor hospital waste management. This has been magnified with the advent of AIDS, Hepatitis 'B' virus infection and the increase in the prevalence of these diseases in healthcare workers working in hospitals and other healthcare institutions. Among all hospital wastes, the 'sharps', i.e. the needles, scalpels, blades, etc. are the most common culprits, mainly because of their propensity to cause accidental pricks or cuts, thereby providing direct entry of pathogenic organisms into blood stream. Used needles are very good reservoirs of infection in which pathogens remain for a long time. Studies in USA reveal that of all workers who come in contact with medical waste, those in sanitary services report highest 'on-the-job injuries'. The annual injury rates varied from 10 to 20/1000 workers, in other categories, compared to 180–200/1000 workers in sanitation department (refuse collectors). Although there are no exhaustive well-documented studies on health hazards associated with poor hospital waste management, some indicators like progressive increase in hospital infection rate, increasing resistance of organisms to wide variety of antibiotics are pointers to the way in which poor hospital

waste management can contribute to the ill health plaguing the healthcare institutions. The modes/routes of transmission of infection are:

- Through a 'break' on skin surface, i.e. either by pre-existing cuts or raw areas or by cuts or puncture of skin.
- Through mucous membranes, such as splashing into eyes.
- Through inhalation of dust particles containing microorganisms.
- Through ingestion of food/water by contaminated hands or consumption of contaminated food/water.

The following categories of persons are exposed to the risk of infection from potentially infectious wastes, if they are not properly managed:

- Patients attending the healthcare institution who are at special risk from infectious and other complications resulting from exposure to microbial pathogens and sharps that may arise from breaks in waste disposal system chain are:
 - Immunosuppressed patients whose host defence mechanisms are otherwise altered (e.g. patients with AIDS).
 - Patients with bleeding/clotting disorders.
 - Patients on dialysis.
 - Intravenous drug abusers/addicts.
 - Patients who have chronic debilitating diseases.
- Medical and paramedical persons, who are providers of medical care.
- Sanitation staff, who are involved in collection, segregation, transportation and final disposal of waste.
- Staff working in support service areas like laundry or central sterile supply department.

Another risk associated with BMW is environmental degradation. The present day hospitals and healthcare institutions including research centres use a wide variety of drugs including antibiotics, cytotoxics, and corrosive chemicals, radioactive substances, which ultimately become part of hospital waste. The advent of 'disposable' in the hospitals has brought in its wake, attendant ills, i.e. inappropriate recycling, unauthorised and illegal reuse, and increase in the quantum of waste. All round technological progress has led to increased availability of health-related consumer goods, which have the propensity for production of increased wastes.

During the last couple of decades, the public has also become increasingly aware of one of the major consequences of development, i.e. the quantity and diversity of hazardous waste that is generated. While some countries have made great efforts to develop effective technologies and standard protocol for administrative procedures; in most, it is in its infancy and clear cut answers to several questions are still unanswered. National solutions to the problem differ according to the constitution and legislative system of the country concerned and are a reflection of the level of industrialisation, population density, geological

and climatological conditions within individual countries. Moreover, because of overcrowding and increasing population density of cities, hospitals are now located in the (or near) residential areas, further increasing the chances of hazards linked with BMW.

INITIATIVES FOR SYSTEMATIC BIOMEDICAL WASTE DISPOSAL¹²

To bring the issue of hospital waste management to the attention of the decision makers, the Environment Health Unit of South East Asia Regional Office (SEARO) carried out a questionnaire survey during June–September 1994 to assess the status of hospital waste management in the countries and to identify the area needing improvement. This focused only on the wastes from hospitals and the aim was to identify issues, which require intervention rather than undertaking a detailed review of hospital waste management practices.

Case Study 1: Evolution of BMW in India—The trigger

The issue of improper hospital waste management in India was first highlighted in a writ petition filed by Dr BL Wadhwa against the Union of India in the Hon'ble Supreme Court in 1994. The writ petition related to the dumping of hospital waste and garbage of Safdarjung Hospital at Bhalswa Dump by the civic authorities; as the incinerator installed there had not been working for more than a week and the repairs were likely to continue for several more days. Furthermore, the incinerator had been suffering from breakdowns and there was no stand-by arrangement for disposal of hospital waste. The dumping of hospital waste was stated to be extremely harmful, as the same could contaminate the waters of river Yamuna during the rainy season. The contention was that this dumping of hospital waste at Bhalswa should be stopped henceforth and measures be initiated for stand-by incinerator facility, for proper disposal of hospital waste.¹³

The Supreme Court of India, after hearing the aforementioned case in connection with safe disposal of hospital wastes ordered that:

- All hospitals with 50 beds and above should install incinerators or any other effective alternate method under their own administrative control before 30 November 1996.
- The incinerators or alternative methods should be fitted with necessary pollution control mechanism, approved by and conforming to the standards laid down by Central Pollution Control Board (CPCB).
- The CPCB and Delhi Pollution Committee should regularly send its inspection teams in different areas of Delhi/

New Delhi to ascertain that the collection, transportation and disposal of garbage/waste is carried out satisfactorily, and file reports accordingly.¹⁴

During the same period, a High Power Committee was constituted to look into various aspects of solid waste management in India and suggested suitable models for the development of cost-effective and environment-friendly approaches to promote sanitary methods of collection, transportation and disposal of solid wastes in cities and towns, including hospital wastes and the associated risks.

Pursuant to the directives of the Hon'ble Supreme Court, the Ministry of Environment and Forests, Government of India issued certain draft rules called BMW (management and handling). Rules 1995 vide extraordinary gazette notification on 25 April 1995 to invite suggestions, comments or objections from parties/persons concerned; and had also incorporated some suggestions on 30 August 1995.¹⁵ Subsequently, a round-table discussion on the topic was organised by several NGOs, which are actively involved in this area on 13 December 1997, and they came up with certain recommendations, which were forwarded to appropriate authorities. After duly considering suggestions/objections and making some modifications the final notification was issued on 20 July 1998 and gazetted on 27 July 1998.¹⁶ These rules have been framed in exercise of the powers conferred by sections 6, 8 and 25 of Environment (Protection) Act 1986 (29 of 1986); and shall apply to every hospital, nursing home, veterinary institutions, animal houses or slaughter houses, which generate BMW in a time-bound manner. These rules have been further amended in 2002 and 2003. It shall also be applicable to clinics, dispensaries, laboratories providing treatment or diagnostic facility to not less than 1000 patients/month. The Ministry of Environment and Forest has categorised and notified medical wastes in the BMW Handling and Management rules. Each category needs a separate disposal treatment. But this is not done in most hospitals. The whole lot is dumped with waste from other sources, infecting the latter also. Scavengers are the potential carriers of infections.

Case Study 2: Scenario of biomedical disposal in Maharashtra

The Times of India, Bombay (dated 17 August 2004) has reported an interesting case regarding scenario of biomedical disposal in Maharashtra. The report says:

'The thick nose masks do nothing to block the putrid smell, but the workers seem oblivious to it. Bags stuffed with medical waste are being shoved into an autoclave where the waste is sterilised and then shredded. Gloves coated with muck are discarded on the floor after every round of loading and slipped on again for the next round. Welcome to the centralised biomedical waste (BMW) treatment facility at Sewree, the only BMC-run facility in

the city that treats the infectious waste of around 1500 hospitals and nursing homes in Mumbai. The numerous problems dogging the issue of BMW in Mumbai and in other cities in the state show up all the players in poor light—hospitals, treatment facilities, the BMC and the Maharashtra Pollution Control Board (MPCB). The problem starts at source—in the way the waste is segregated. Infectious waste is of two types: Anatomical tissues, which should be packed in yellow bags and sent for incineration, and other waste (plastics, needles, etc.), which should be packed in red bags and autoclaved. But at Sewree, several yellow bags go in for autoclaving along with the red ones. The attendant explains, "Since many hospitals do not observe the colour coding, we assume the heavier bags contain anatomical parts and send them to an incinerator at Taloja while the lighter ones go into the autoclave." (The Taloja incinerator is used because the one at Sewree has been shut since last November after local residents complained of air pollution.) Not only do many hospitals fail to segregate correctly, their waste often remains uncollected by the BMC contractor for up to 4 days.

A survey conducted by the CPCB in 66 major hospitals of Delhi in 1998 stated that proper segregation of waste was not being practiced, except in a few hospitals. Rag pickers were playing a key role in segregation of waste for materials, which have some resale values. It was suggested that health-care waste should be transported by the quickest possible route, which should be planned before the journey begins. After departure from the waste production point, every effort should be made to avoid further handling. If handling cannot be avoided, it should be prearranged and should take place in adequately designed and authorised premises. Handling requirements can be specified in the contract established between the waste producer and the carrier.

Case Study 3: Assessing biomedical waste in PGIMER Chandigarh

Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, India, is a referral centre for several northern Indian states. It is one of the most prestigious medical institutes of national importance. PGIMER Chandigarh has its own biomedical waste management (BMW) programme comprising own incinerators, autoclaves, shredder and well-trained staff to handle different types of wastes. Its BMW incineration facility is also shared by other local nursery homes, hospitals and institutes. The BMW generated in the institute is classified into various categories as per the BMW (management and handling) rules 1998 framed by the Ministry of Environment and Forests, India under the Environment (Protection) Act,

1986, which are applicable to all healthcare institutions generating BMWs.

A short study was undertaken in the institute to assess BMW management. It was found that the colour-coded bins as specified by the Chandigarh Pollution Control Committee were placed in all wards (private and general) for throwing hospital waste. This BMW is then collected and transported in trolleys to the garbage bin centre by the contractual sanitation staff of the Institute. The stages/activities for BMW management included:^{17,18}

Generation: Various areas of the hospital and the institute generate BMW, which is classified under different categories of the waste. The segregation of the waste is done at the sources of generation.

Collection: It is collected regularly from the areas of generation and transported to a common refuse point in the colour-coded bags. The team for collection is earmarked and wears a special uniform with all protective gears. Sharp waste, though already sterilised with 1% sodium hypochlorite solution, are carried in labelled bags to avoid any cut injury to the collection team while collecting and transporting it to the refuse point.

Reception: The waste generated and collected in various areas other than the one that goes for incineration are received at the hospital refuse point. At the incineration plant there is an adequate space for receiving and storing the hospital waste to be incinerated.

Storage: At hospital refuse point, bags with proper tags/levels are received and stored only for a period of 2–4 h when a refuse van (belonging to PGI only) comes and carries this waste to dumping area earmarked by Chandigarh administration for land filling. In the incinerator, plant storage is done in the storeroom provided for the same. It is never stored for more than 24 hours, except on sundays and holidays.

Transportation: The waste, which is to be disposed-off by land filling, is carried by refuse van of the PGI to the land-filling areas in the Dadu Majra.

Treatment: Solid (plastic) waste is treated with 1% sodium hypochlorite solution for minimum 30 min at the source of generation and then shredded in the shredder and again treated with 1% sodium hypochlorite solution for minimum 30 min and sold after sterility report is obtained from microbiology department. The infectious waste is incinerated. The disposal of radioactive waste is done as per the regulations of RPPAI, BARC, Mumbai.

However, the role of incinerators in BMW disposal is being debated nowadays. All the developed countries and even some of the developing countries have banned the use of incinerators in their countries because of the toxic emissions from incinerators.

Foreign environmental groups in Korea warned about it way back in 1999 that it was in danger of becoming a dump-

ing ground for obsolete incinerator technologies that could lead to the increase of dioxin levels in the air. As incinerators are losing its ground in industrialised nations, incinerator companies are targeting overseas markets where people are not aware of the serious health problems associated with incinerators. The Washington-based environmental group multinationals resources centre (MRC) used Korea as an example of countries that have contracted with the US-based company 'AMCO' to supply and install incinerator technology. In particular, the contract mentioned refers to an incineration project in Taejon, according to the letter sent to the Citizens' Alliance for Consumer Protection of Korea (CACPA). The MRC also claimed in the letter that 'the building of municipal waste incinerators in Asia is a clear case of double standards in which the health of Americans is protected more than the health of Asians'. In the US, municipal and medical waste incineration has been identified as among the top sources of dioxin—the most toxic man-made chemical known—the MRC claimed.

Healthcare without harm, a coalition of 433 organisations in 52 countries working to reduce the environmental impact of healthcare has supported the resolution to phase out the use of incineration as a waste treatment method as it is an outdated, polluting and expensive technology. In Illinois, many hospital incinerators have been already closed since incineration is unpopular and obsolete. The reason for this is clear—medical waste incinerators harm people. They pollute the air we breathe and the environment in which we live, posing serious health risks. Incinerators release dioxin, mercury, and other toxic pollutants, and expose workers and communities to these poisonous chemicals. Making it even less popular, incineration also costs significantly more than cleaner, less dangerous waste treatment technologies.

However, India has yet to launch a wholehearted campaign against it.

Lately, India too has become aware of it. Recently, all the hospitals in Chandigarh including PGIMER have agreed for the common BMW disposal facility.

As per the Central Pollution Control Board evaluation report (2010), 50–55% of BMWs in India is collected, segregated and treated as per the BMW rules. Rest is dumped with municipal solid wastes. Each day, more than 4.2 lakh kg of BMW is generated in the country, but there are only 157 facilities qualified to treat it. As a result, only 2.4 lakh Kg BMW is actually treated. In institutional terms, an inventory showed that of the 84,809 hospitals and healthcare facilities in India, only 48,183 are using either common BMW treatment facilities or have engaged private agencies to treat their waste. The report says that 14,959 defaulting hospitals that have been issued show cause notices.

But in most cases the lack of significant steps in this regard is due to apathy at the levels of decision making. Therefore, the hospital administrators should owe the responsibility and should be fully accountable for any lapse in this direction.

Case Study 4: Biomedical waste management scenario in Delhi: Stepping towards systematic waste management⁹

In Delhi there are about 72 hospitals and 936 dispensaries under government sector, and 550 registered nursing homes; about 40,000 hospital beds are available in the public and private sector.

Delhi is generating approximately 7000 metric tons of waste, out of which 70 ton is BMW. The government hospitals and major private hospitals have their own arrangement for treatment of BMW; however, smaller hospitals are finding it difficult to dispose BMW. Keeping in view the difficulties faced by smaller nursing homes/clinics/blood banks/diagnostic laboratories, etc. government has taken initiative to establish centralised waste treatment facilities. The government of NCT of Delhi (GNCTD) had been allotted land by Delhi Development Authority (DDA) for establishment of centralised BMW treatment facilities of 1000 m² each at Okhla and Gazipur in Delhi.

There are 31 hospitals under Delhi Government, out of which only four hospitals have incinerators and nine hospitals are having autoclaves and shredders for scientific management of BMW. Biomedical waste from hospitals, where such facilities are not available, are segregated and transported in special van to hospitals where such facilities exist. However, proper coordination between government hospitals, nursing homes and centralised BMW treatment facility is still needed. Periodic inspection should be carried out to keep a proper check on BMW activities.

Case Study 5: Study of bacterial flora of different types in hospital waste: evaluation of waste treatment at AIIMS hospital, New Delhi

A case study of assessment of bacterial flora of different types of hospital waste was undertaken at AIIMS hospital, New Delhi. Samples were collected from different types of waste at the hospital, at different time intervals, for microbiological evaluation. The results reveal that the microbial flora isolated from infectious waste and general waste from the hospital is similar. The samples from general waste in this study reveal many types of pathogens. The bacteria present in the waste initially were low in quantity, but they replicated rapidly over time so that significant numbers were detected in 24 h, due to environmental factors that were favourable for growth during this period. This study strongly suggested that waste should be removed from the hospital within 24 h of its generation to prevent environmental contamination caused by any accidental spillage of waste. It also

suggested that general waste generated in the hospital should be treated similar to infectious waste, as it could be equally hazardous.²⁰

Case Study 6: Biomedical waste management practices at Balrampur hospital, Lucknow, India: Glaring disparity in guidelines and practice

A study undertaken at Balrampur, a premier healthcare establishment in Lucknow, showed that infectious and noninfectious wastes were dumped together within the hospital premises, resulting in a mixing of the two, which were then disposed with general municipal waste at the dumping sites in the city. For disposal of this waste the hospital depends on the generosity of the Lucknow Municipal Corporation, whose employees generally collect it every 2 or 3 days. The hospital does not have any treatment facility for infectious waste. The laboratory waste materials are also disposed-off directly into the municipal sewer without proper disinfection of pathogens, ultimately reaching the Gomti river. The open dumping of the waste makes it freely accessible to rag pickers who become exposed to serious health hazards due to injuries from sharps, needles and other types of material used when giving injections. The results of the study demonstrate the need for strict enforcement of legal provisions and a better environmental management system for the disposal of BMW in the Balrampur Hospital, as well as other healthcare establishments in Lucknow in 2003.²¹

Case Study 7: Management of biomedical waste: awareness and practices in a district of Gujarat

A cross-sectional study conducted in 30 hospitals of Gujarat highlighted that doctors were aware of risk of HIV and Hepatitis B and C, whereas auxiliary staff (ward boys, ayabens and sweepers) had very poor knowledge about it. There was no effective waste segregation, collection, transportation and disposal system at any hospital in the district. It was concluded that there is an immediate and urgent need to train and educate all doctors and the staff to adopt an effective waste management practices.²²

Case Study 8: A scoring system to improve biomedical waste management system

The department of hospital administration of a tertiary-care hospital designated a senior nursing sister grade 1

for surveillance in the clinical areas and research blocks, and to generate awareness among all hospital staff regarding BMW management. She visits the areas of the hospital everyday according to her schedule of visits. The full compliance of the schedule ensures that every area of the hospital is at least visited once a month. She submits daily surveillance report to Nursing Superintendent, Assistant Professor of Department of Hospital Administration (who is incharge of BMW management and sanitation) and to the senior administrative officer (hospital).

The daily surveillance record chart containing a scoring system of ten points (format attached as Annexure-1) was devised lately. A signature is taken on the score sheet from the incharge of the ward or area. This scoring system had helped the hospital administrator to issue letters of warning to the departments that scored lesser points. The Additional Nursing Superintendent (ANS) of the area receives the letter and makes an effort to improve the condition of the ward regarding segregation and destruction of waste at the point of generation. The same applies to the labs, outpatient departments, blood bank and research blocks as well.

Case Study 9: BMW management during strike of contractual employees in a tertiary-care hospital

The contractual class IV workers of a tertiary-care hospital struck work for a period of 5 days. The department of hospital administration anticipated that there would be no cleaning, dusting, shifting of patients for investigations, taking specimens to the labs, bringing medicines and equipment from the stores, refilling of oxygen cylinders. The toilets would be in very bad shape and there would be heaps of waste collected in the sluice rooms. There would be high chances of hospital-acquired infections (HAI) due to accumulation of infectious waste.

Taking immediate action, the Department of Hospital Administration shifted permanent class IV workers from the research blocks (relatively less key area from patient care perspective) to all the direct patient-care unit so that there was no hindrance in the work. Besides this, a control room was established by department for any complaint/additional requirements from the wards. The existing staffs were shuffled accordingly. The sanitation supervisor monitored situation in their area and informed additional Medical Superintendent about the same. The department also hired workers from the labour office and daily wagers from outside market.

As the hired workers had little knowledge of BMW management therefore so a joint team of one hospital

employee (Class IV) and one worker (hired worker) were posted in the wards. The nursing sister deputed to look after the BMW management in hospital took the help of all ANS, Deputy Nursing Superintendent (DNS) and senior staff to educate and teach the workers about the ongoing practices of BMW management laid out by the centre. They also educate patients in their respective wards to minimise throwing of waste outside the BMW collection bags.

In the ward, a designated place for the purpose of BMW (where all the four colour-coded bins with the same colour-coded bags are kept) is there, which was informed to them. A needle destroyer is kept there in order to dispose of the sharps as soon it is possible, for which doctors/nurses were told to dispose syringes in them.

The procedure room and the dressing room in each area too contain all the four bins with colour-coded bags, so that it is convenient for the waste generator to dispose off the waste in the required manner while performing dressing of the patient or during a procedure of a patient. The principle of 'No work-No pay' was immediately implemented and widely circulated in media. The security staff was strengthened so that the contractual staff may not bully/threaten permanent staff.

Result: The intrasectoral coordination and teamwork helped in maintaining the overall cleanliness in hospital without major disruption of work in OPD, OT and ward areas. The union of contractual workers called off the strike and work continued normally.

Case Study 10: Standards of clinical waste management in UK hospitals: gaps in compliance

In a study conducted in 26 hospitals in London and elsewhere across south and south-east England, the arrangements for bulk clinical waste handling were observed. Twenty-six hospitals providing almost 7000 beds were included in the study.

It was found that all hospitals used 1100 or 800-L-capacity wheeled and lidded carts (Eurocarts) for the storage of clinical waste. Four hospitals had additional smaller capacity carts in use, although these numbered less than 20 in total. There was approximately one clinical waste cart for every 10 beds, with little variation between acute and community hospitals.

All hospitals had a central cart storage area, with additional satellite storage areas in all acute hospitals. Satellite cart stores were sited both outside and inside hospital buildings, often close to stairwells or lifts, in corridors or on external walkways. Not all waste carts appeared to

comply with the provisions of UN3291, which requires containers intended for the transport of clinical waste (regulated medical waste) to be rigid, puncture and break resistant, leak resistant and impervious to moisture, tightly lidded, and marked with a biohazard symbol. Waste carts at 21 of 26 hospitals were manufactured from yellow, heavy-duty, high-density polyethylene (HDPE). In two-thirds of waste carts, colour coding was reinforced by overprinted and embossed wording 'clinical waste only', and these carts also generally carried a biohazard symbol with additional 'biohazard' wording. Approximately 5% of carts had no visible hazard warnings.

At two city centre locations, several filled clinical waste sacks and sharps bins were lying on the ground in unsecured outdoor areas on public walkways, fully accessible to passersby. It was also common to observe clinical waste sacks piled in corridors, often close to ward entrances. Overfilled waste carts with gaping lids and protruding sacks were common—both at the main cart stores and at satellite locations within hospital buildings. It was concluded that emphasis should be placed on the safe handling, secure storage, correct segregation and disposal of waste from clinical areas, and waste carts should be well-maintained.²³

Case Study 11: Hospital waste management in the teaching hospitals of Karachi

A cross-sectional survey was conducted in eight teaching hospitals of Karachi in 2005 using convenient sampling technique to evaluate the current practices of segregation approaches, storage arrangements, collection and disposal systems.

Out of eight hospitals visited two (25%) were segregating sharps, pathological waste, chemical, infectious, pharmaceutical and pressurized containers at source. For handling potentially dangerous waste, two (25%) hospitals provided essential protective gears to its waste handlers. Only one (12.5%) hospital arranged training sessions for its waste-handling staff regularly. Five (62.5%) hospitals had storage areas, but mostly it was not protected from access of scavengers. Five (62.5%) hospitals disposed-off their hazardous waste by burning in incinerators, two (25%) disposed-off by municipal landfills and one (12.5%) was burning waste in open air without any specific treatment. No record of waste was generally maintained. Only two (25%) hospitals had well-documented guidelines for waste management and a proper waste management team. It was concluded that there should be proper training and management regarding awareness and practices of waste disposal.²⁴

Case Study 12: Waste management in the hospitals of Mauritius: An evidence of hospital waste causing water and environmental pollution

This study was initiated by Department of Chemical and Sugar Engineering, Faculty of Engineering, University of Mauritius, Reduit, Mauritius to characterise solid and liquid wastes generated in healthcare institutions and to provide a framework for the safe management of these wastes. The project was carried at three major medical institutions. A waste audit carried out at these sites revealed that approximately 10% of solid wastes were hazardous in nature, consisting mainly of infectious, pathological and chemical wastes. The average amount of hazardous wastes/patient/day was found to be 0.072 kg at Jeetoo hospital, 0.091 kg at SSRN hospital and 0.179 kg at the clinic. The amount of hazardous wastes generated as a function of the number of occupied beds was found to follow a relationship of type $y = 0.0006x - 0.19$, where y was the amount of hazardous wastes generated/bed/day and x was the number of occupied beds. The waste-quantifying process also revealed that at SSRN hospital, 0.654 m³ of water was being consumed/patient/day and the amount of waste water produced was 500 m³/day. Further analysis revealed that the waste water had above permissible limits of chemical oxygen demand (COD), biological oxygen demand (BOD), total suspended solids (TSS) and coliform content. It was concluded that emphasis should be given for segregation of waste at site of generation.²⁵

Case Study 13: Management of medical waste in Tanzanian hospitals: A picture of poor waste management

A survey was conducted to study the existing medical waste management (MWM) systems in Tanzanian hospitals during a nationwide healthcare waste management training programme conducted from 2003 to 2005. During the training sessions, a questionnaire was prepared and circulated to collect information on the MWM practices existing in hospitals in eight regions of the Tanzania. A large proportion (71%) of the hospitals used dust bins for transporting waste from generation points to incinerator without plastic bags. Most hospitals had low incineration capacity, with few of them having fire brick incinerators. Most of the respondents preferred on-site versus off-site waste incineration. Some hospitals were using untrained casual labourers in medical waste management and general cleanliness. The knowledge level in MWM issues was low among the health workers. The analysis showed that increased population and poor MWM systems as well as expanded use of disposables were the main reasons for increased medical wastes in hospitals.²⁶

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ANNEXURE

Schedule I (See Rule 5)

Table 41.1 Categories of biomedical waste

Waste category no.	Waste category type	Treatment and disposal option ⁺
Category No. 1	Human anatomical waste (human tissues, organs, body parts)	Incineration@/deep burial ^e
Category No. 2	Animal waste (animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals, colleges, discharge from hospitals, animal houses)	Incineration@/deep burial ^e
Category No. 3	Microbiology and biotechnology waste (wastes from laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)	Local autoclaving/microwaving/incineration ^d
Category No. 4	Waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)	Disinfection (chemical treatment ^{d/d} autoclaving/microwaving and mutilation/shredding)
Category No. 5	Discarded medicines and cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)	Incineration ^{d/d} destruction and drugs disposal in secured landfills
Category No. 6	Soiled waste (items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood)	Incineration ^d autoclaving/microwaving
Category No. 7	Solid waste (wastes generated from disposable items other than the waste sharps such as tubings, catheters, intravenous sets, etc.)	Disinfection by chemical treatment ^b autoclaving/microwaving and mutilation/shredding ^c
Category No. 8	Liquid waste (waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities)	Disinfection by chemical treatment ^b and discharge into drains.
Category No. 9	Incineration ash (ash from incineration of any biomedical waste)	Disposal in municipal landfill
Category No. 10	Chemical waste (chemicals used in production of biologicals, chemicals used in disinfection, as insecticides, etc.)	Chemical treatment ^b and discharge into drains for liquids and secured landfill for solids

^a Options given above are based on available technologies. Occupier/operator wishing to use other state-of-the-art technologies shall approach the Central Pollution Control Board to get the standards laid down to enable the prescribed authority to consider grant of authorisation.

^b Chemicals treatment using at least 1% hypochlorite solution or any other equivalent chemical reagent. It must be ensured that chemical treatment ensures disinfection.

^c Mutilation/shredding must be such so as to prevent unauthorised reuse.

^d There will be no chemical pretreatment before incineration. Chlorinated plastics shall not be incinerated.

^e Deep burial shall be an option available only in towns with population less than 5 lakhs and in rural areas.

Schedule II (See Rule 6)

Table 41.2 Colour coding and type of container for disposal of biomedical wastes

Colour coding	Type of container -I waste category	Treatment options as per schedule I
Yellow	Plastic bag Cat. 1, Cat. 2, and Cat. 3, Cat. 6.	Incineration/deep burial
Red	Disinfected container/plastic bag Cat. 3, Cat. 6, Cat.7.	Autoclaving/microwaving/chemical treatment
Blue/white translucent	Plastic bag/puncture proof Cat. 4, Cat. 7. Container	Autoclaving/microwaving/chemical treatment and destruction/shredding
Black	Plastic bag Cat. 5 and Cat. 9 and Cat. 10. (solid)	Disposal in secured landfill

Notes:

1. Colour coding of waste categories with multiple treatment options, as defined in schedule I, shall be selected depending on treatment option chosen, which shall be as specified in schedule I.
2. Waste collection bags for waste types needing incineration shall not be made of chlorinated plastics.
3. Categories 8 and 10 (liquid) do not require containers/bags.
4. Category 3 if disinfected locally need not be put in containers/bags.

Occupational Safety

Dr (Col) Ashok K Jindal and Dr (Maj) Ayon Gupta

“Look to your health; and if you have it, praise God, and value it next to a good conscience; for health is the second blessing that we mortals are capable of; a blessing that money cannot buy.”

— Izaak Walton

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- get an overview about occupational safety issues for healthcare sector.
- ingrain general principles on how to address the occupational safety issues affecting healthcare workers.
- learn best practices in occupational safety in the healthcare sector.

INTRODUCTION

Healthcare is involved, directly or indirectly, with the provision of health services to individuals. These services can occur in a variety of work settings, including hospitals, nursing homes, private clinics, dental offices, OPDs, maternity homes, emergency medical care and pharmacy dressing rooms.³ The WHO defines healthcare workers (HCWs) as ‘all people primarily engaged in actions with the primary intent of enhancing health’.⁴ It includes family caregivers, patient-provider partners, part-time workers (especially women), health volunteers and community workers. Healthcare workers may also be defined as all paid and unpaid persons working in healthcare settings who have the potential for exposure to patients and/or to infectious materials, including body substances, contaminated medical supplies and equipment, contaminated environmental surfaces or contaminated air.⁵

The healthcare sector is burdened by the historical and entrenched belief that patient-care issues supersede the personal safety and health of workers and that it is acceptable for healthcare workers to have less than optimal protections against the risks of hazardous exposures or injuries. Nowhere is this scenario truer than in the developing world. The 2006 World Health Report, ‘Working Together for Health’ on human resources reported on a global shortage of health personnel that had reached crisis level in 57 countries.

India’s abysmally low doctor–patient ratio—one doctor for 1953 people or a density of 0.5 doctors/1000 population coupled with acute shortage of nurses and health delivery personnel is a case in point.¹ This manpower shortage results in overstressed doctors, nurses and paramedics, who constitute a danger not only to patients but also to themselves and society at large. Society has an obligation to protect the health of workers engaged in diverse occupations. Healthcare workers (HCWs) need protection from workplace hazards just as much as do mining or construction workers. Yet, because their job is to care for the sick and injured, HCWs are often viewed as ‘immune’ to injury or illness. Patients and healthcare providers share the healthcare environment; therefore, efforts to protect patients and providers can be complementary or even synergistic, when pursued through a comprehensive and integrated approach.

In 1950, the Joint ILO/WHO Committee on Occupational Health stated that ‘occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations;² the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities’. In summary, ‘the adaptation of work to man and of each man to his job’.

HEALTH AND SAFETY ISSUES UNIQUE TO HEALTHCARE SECTOR

Major hazards in the healthcare sector are listed in Table 42.1.

Table 42.1 Major hazards of healthcare sector

- Biological hazards, such as TB, hepatitis, HIV/AIDS H1N1 influenza
- Chemical hazards, such as glutaraldehyde and ethylene oxide
- Physical hazards, such as noise, radiation, slips trips and falls
- Ergonomic hazards, such as heavy lifting and repetitive strain injury (RSI)
- Psychosocial hazards, such as shiftwork, violence and stress
- Fire and explosion hazards
- Electrical hazards, such as frayed electrical cords

Protecting the occupational health of HCWs is critical to having an adequate workforce of trained and healthy health personnel. The WHO global plan of action on workers' health calls on all member states to develop national programmes for HCWs' occupational health. World Health Organisation (Figure 42.1) also promotes and supports national campaigns for immunising HCWs against hepatitis B. Among HCWs infected with hepatitis B, the WHO global burden of disease from sharps' injuries to HCWs showed that 37% of the hepatitis B among HCWs was the result of occupational exposure.⁶ Infection with the hepatitis B virus is 95% preventable with immunisation, but less than 20% of HCWs in some regions of the world receives all three doses of the vaccine needed for immunity. Less than 10% of the human immunodeficiency virus (HIV) among HCWs is the result of an exposure at work. However needlestick injuries, the cause of 95% of the HIV occupational seroconversions, are preventable with practical, low-cost measures and have the cobenefit of preventing exposure to other blood-borne viruses and bacteria.⁶

EPIDEMIOLOGY

There is a paucity of data available on occupational health and safety of HCWs in India or indeed from anywhere in the developing world. The greatest body of literature regarding disease patterns in this sector comes from European and American researchers. As per statistics released by the US Bureau of Labor Statistics (BLS).⁷ In 2007, there were 670,600 injuries and illnesses in the healthcare and social-assistance industry, with an injury and illness rate of 5.6/100 full-time workers compared with 4.2 for all of private industry.⁷ According to the National Institute for Occupational Safety and Health (NIOSH), hospitals led the list of industries that reported 100,000 or more occupational injury and illness cases over the 4-year period from 2003 to 2006.⁷ The most common nature of injury suffered in the healthcare sector were sprains, strains and tears, which accounted for 86,060 injuries in

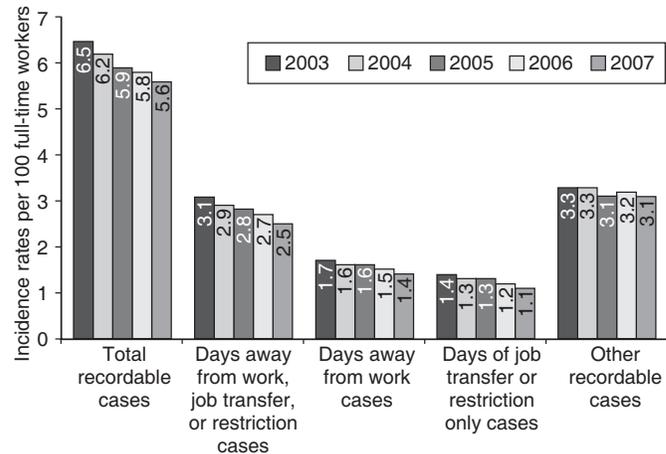


Figure 42.1 Nonfatal occupational injury and illness incidence rates by case type, health care and social assistance, private industry, 2003-07.

Reproduced from: Janocha Jill A, Smith Ryan T. *Workplace Safety and Health in the Health Care and Social Assistance Industry, 2003-07*. Bureau of Labor Statistics. U.S. Department of Labor. As per the authors and NIOSH, 'This document is in the public domain and may be freely copied or reprinted.'

2007. In 2001, the American Nurses Association conducted a survey of 4826 nurses from across the United States.⁵ Eighty-eight per cent of nurses participating in the survey reported that health and safety concerns influenced their decision to remain in nursing and the kind of nursing work they chose to perform. More than 70% said the acute and chronic effects of stress and overwork was one of their top three health concerns. More than two-thirds reported being required to work mandatory overtime every month. Disabling back injury and fear of contracting HIV or hepatitis infection from a needlestick injury were also among the top three health concerns.⁵ Given the critical shortage in trained health manpower in large parts of the developing world, extrapolation of these statistics to the healthcare sector in these parts would seem to suggest a huge burden on an already overstressed healthcare system.

ECONOMIC BENEFIT AND VALUE OF OCCUPATIONAL HEALTH AND SAFETY

Improvement of health and safety at work is important not only in human terms to reduce workers' pain and suffering but also as a way of ensuring that hospitals and healthcare financial services (HCFS) are successful and sustainable in the long term.⁸ European data shows that about 150 million days are lost each year due to accidents at work and 350 million due to other health problems caused by work in the European Union.⁹ Work-related accidents were estimated to have caused costs of 55 billion € in the European prioritisation in 2000.¹⁰ These are only the costs specified by the companies, and most of them (88%) were due to lost working time. The costs relating to the victims are not

included.¹⁰ Studies by Chapman in the United States of America showed that workplace health-promotion measures result in an average reduction in the illness costs of 26.1%.¹¹ Illness-related absenteeism was found to be reduced by an average of 26.8%.

COMPREHENSIVE INTEGRATED APPROACH TO IMPROVE PATIENT/WORKER SAFETY

Promoting a culture of safety in the healthcare workplace benefits workers, patients, family members and all who enter these facilities. The potential hazards that exist in healthcare settings affect both patients and workers. Thus, safety programmes should not discriminate between patients and workers. Rather, they should promote comprehensive 'systems of safety' in these organisations and promote 'cultures of safety' that address all known hazards and are supported by all stakeholders.

ROLES AND RESPONSIBILITIES

Occupational health and safety is a management task! Employers are obliged to take all measures necessary for the health and safety of workers. The overall responsibility for determining and assessing risks at the workplace lies with employers, in this case the hospital administration. They must ensure that these activities are properly implemented. An employer may obtain expert advice internally through occupational health and safety specialists and occupational physicians or through an external audit. Workers have a responsibility to maintain the safety culture by following set protocols, and giving appropriate feedback and cooperating with the hospital administration in all matters related to establishment of a 'culture of safety'.

STEPS OF RISK ASSESSMENT⁸

- Step 1: Identifying hazards and those at risk
- Step 2: Evaluating and prioritising risks
- Step 3: Deciding on preventive action — T-O-P
- Step 4: Taking action
- Step 5: Documentation, monitoring and review

Step 1: Identifying Hazards and those at Risk

Well-known occupational risks and hazards in the healthcare sector include biological, musculoskeletal, psychosocial and chemical risks. Specific risks that should be addressed are, for example:

- The handling of blood and blood products, including the handling of needles and other sharp objects.
- Exposure to airborne biological agents transmitted through inhalation.
- Exposure to chemical agents/hazardous gases and substances, including cleaning agents and disinfectants.

- Time pressure, high workload and interpersonal conflicts.
- Psychosocial stress of shift, weekend and night work.
- Manual patient handling, lifting, pushing and pulling of weights.
- Ergonomic design of workplaces.

Step 2: Evaluating and Prioritising Risks

Not all of the identified risks and hazards will have the same importance nor can they all be addressed at the same time. It is recommended to prioritise within the risks and hazards and to decide which ones should be tackled first.

Step 3: Deciding on Preventive Action — T-O-P

If possible, a risk should be avoided rather than being reduced, e.g. a dangerous chemical substance should be replaced by a less dangerous one. Additionally, the following hierarchy should be considered regarding preventive measures: first Technical solutions should be considered, followed by Organisational and finally Personal/Individual measures.

How to Carry Out a Risk Assessment?⁸

It is better to provide employees with height-adjustable tables than to train them to relax back muscles which are cramped from sitting all day at a desk which is too high or low.



Technical measures

If possible, risks should be reduced with technical appliances, technical aids or construction measures.

Organisational measures

A good work organisation and written organisational agreements on working sequences can avoid or reduce risks.

Personal/Individual measures

Individual instructions as well as training and most importantly retraining measures are necessary for sustainable effects on workers' health and safety.

Reproduced from: European Union. Occupational health and safety risks in the healthcare sector. Guide to prevention and good practice. Luxembourg; 2011.

Step 4: Taking Action

The preventive and protective measures must be implemented according to the prioritisation plan. Employees have to be informed about the results of the risk assessment and the planned improvements. The long-term implementation of measures depends greatly on the participation of the workers and their acceptance of the measures.

Step 5: Documentation, Monitoring and Review

Documentation

The risk assessment has to be documented. The documentation should include the results of the risk analysis, the improvements implemented and the results of the evaluation of the improvements.

Monitoring

The preventive measures taken have to be monitored and evaluated. Additional modifications might be necessary if the measures do not produce the expected results. The implemented measures must also be monitored and reviewed to ensure that they are effective and do not create additional risks, e.g. on the one hand, the use of disinfectants protects the workers from biological risks such as bacteria, but on the other hand it increases the risk of skin problems. So additional measures will be necessary to take, e.g. appropriate skin protection.

Review

The assessment should be reviewed at regular intervals. The review process should determine whether the chosen preventive measures have been implemented as planned; the chosen preventive measures are being used and being used correctly; the preventive measures are being accepted by workers and included in their daily work; the assessed risks have been eliminated or reduced by the measures; the preventive measures have resulted in any new problems or have any new problems occurred. The above-mentioned risk assessment plan can be adapted to use in any of the specific scenarios enumerated later in this chapter and serve as a tool in formulating preventive interventions.

PREVENTION OF HAZARDS SPECIFIC TO HEALTH SECTOR

Biological

In the context of the health sector, three modes of transmission are of relevance⁸:

- Blood-borne infections
- Other infectious diseases
 - Contact infections
 - Air-borne infections

Faecal-oral infections also present a risk, but can be prevented in the same manner as contact infections. Risk analysis and assessment procedures should be developed separately for each of the defined modes of transmission and the protective measures should be stipulated, respectively.⁸

Blood-borne pathogens

Healthcare workers are exposed to blood and other body fluids in the course of their work. Consequently, they are at

risk of infection with blood-borne viruses, including HIV, hepatitis B virus (HBV) and hepatitis C virus (HCV). The risk of infection for HCWs depends on the prevalence of disease in the patient population and the nature and frequency of exposures. Occupational exposure to blood can result from percutaneous injury (needlestick or other sharps' injury), mucocutaneous injury (splash of blood or other body fluids into the eyes, nose or mouth) or blood contact with nonintact skin. The most common form of occupational exposure to blood and the most likely to result in infection is needlestick injury.^{4,8,12} The most common causes of needlestick injury are two-handed recapping, and the unsafe collection and disposal of sharps' waste.⁴

Most blood exposures in health settings are preventable. Strategies to protect health workers include implementation of universal precautions, immunisation against hepatitis B, provision of personal, protective equipment and the management of exposures. Successful implementation of these strategies requires an effective infection control committee with support from the health administration.

Other infectious diseases

In addition to blood-borne pathogens, HCWs are also at risk for a number of other occupationally acquired infectious diseases. Health sector personnel face an increased risk of contracting an infection, for which numerous and to some extent quite disparate pathogens play a significant role. Depending on the specific pathogen, transmission can occur via direct contact with patients and contaminated surfaces or air-borne bioaerosols, generated mainly by sneezing and coughing. The potential threats associated with new and emerging infectious diseases have caused much concern; these threats include SARS, avian influenza, pandemic influenza and multidrug-resistant pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA) and extensively drug-resistant tuberculosis (XDR-TB). In most cases, however, simple interventions prevent transmission. Hand-washing, vaccination, and rapid recognition and appropriate isolation of potentially contagious patients are especially important interventions.

A risk assessment is crucial to the prevention of infection. Any assessment of risk potential must take account the natural virulence of the pathogen, its capacity to survive in the environment, the severity of the disease and the dose or exposure level necessary to cause illness or infection. The mode of transmission and other epidemiological factors will also inform the choice of preventive measures.

Sharps injury

Percutaneous injuries caused by needlesticks (puncturing of the skin by a needle or similar sharp object) are a serious concern for the HCW population. According to the Centres for Disease Control and Prevention (CDC), approximately 384,000 percutaneous injuries occur annually in US hospitals,

with about 236,000 of these resulting from needlesticks involving hollow-bore needles.^{5,7,12} World Health Organisation made a special risk analysis of hepatitis B, hepatitis C and HIV infections among healthcare workers caused by contaminated sharps, such as syringe needles, scalpels and broken glass.¹³ World Health Organisation found that, among the 35 million HCWs worldwide, there were 3 million percutaneous exposures to blood-borne pathogens in 2000.¹²⁻¹⁴ WHO also found that between 1 and 12% of HIV infections in HCWs was caused by sharps injuries.^{12,13} Proper needle handling and waste management, substitutions for sharps and adequate worker training has the potential to drastically reduce the risk of percutaneous injury.

Chemical

Chemicals found in hospitals can be in the form of dusts, vapours, gases or liquids. There are three main routes of entry of potentially harmful chemicals.

- Inhalation (disinfectant, cleaning fluid, embalming fluid vapours, laser plumes from cauteries)
- Cutaneous contact (splashes, chemical burns)
- Oral ingestion (accidental, oral pipetting, etc.)

Many chemicals can cause serious illness and, in some cases, death. Often the effects are not immediately evident but may give rise to pathologies that may manifest years later in the form of several types of cancer,¹⁵⁻¹⁸ adverse reproductive outcomes such as spontaneous abortion and congenital malformations¹⁹ and the three major forms of work-related asthma (occupational, irritant and work-exacerbated).^{20,21} Increased rates of cancer have been documented in HCWs, particularly nurses. These include breast, ovarian and other cancers. While some chemicals (e.g. ethylene oxide) have been implicated in these studies, much more epidemiological work needs to be done to understand the underlying causative factors.

As in other industrial sectors, the industrial hygiene prevention hierarchy of elimination, substitution, engineering controls, administrative controls and warnings, and personal protective equipment (PPE) applies equally to the healthcare sector. Substitution is an extremely important issue in the sector because of its potential to eliminate hazards from the workplace. An example of substitution could be the use of peroxyacetic acid/hydrogen peroxide gas plasma as a substitute cold sterilant in place of ethylene oxide, which has been implicated in the etiopathogenesis of various cancers.

Physical

Work-related musculoskeletal disorders (MSD) are defined as an injury of the muscles, tendons, ligaments, nerves, joints, cartilage, bones or blood vessels in the extremities or back that is caused or aggravated by manual-handling work

tasks such as lifting, pushing and pulling, and carrying; as well as working in awkward postures with very repetitive or static forceful exertions. Work-related MSD such as low back and shoulder pain, rotator cuff tendinitis, epicondylitis (tennis elbow) and carpal tunnel syndrome are common in HCWs. Nursing staff have high rates of back and shoulder injuries. In 2007, more than 20,000 recordable cases of back and other pain, carpal tunnel syndrome and tendonitis were reported in the healthcare and social assistance (HCSA) sector by the US Bureau of Labor Statistics (BLS).^{5,7} The single greatest risk factor for MSD in HCWs is the manual moving and repositioning of patients; although MSD risks are also found in housekeeping, food service and other areas where workers manually handle heavy, awkward loads or do repetitive, forceful hand work. Cognitively impaired patients can be unpredictable and may suddenly become combative, resist the caregiver, or go limp during a transfer, creating a sudden unexpected load on the caregiver and resulting in excessively high forces that can injure the spinal muscles.^{22,23}

Various mechanical lifting and transferring devices have been recommended to reduce physical loads on caregivers. Equipment such as adjustable beds, raised toilet seats, shower chairs, grab bars, etc. are also helpful for reducing musculoskeletal risk factors in the home setting. Workers must be made aware of the advantages of using the right equipment and having the appropriate training (e.g. saving time and avoiding injuries).^{22,23}

Case Study 1: Back pain

A model intervention study, '*evaluation of a best practices back injury prevention programme in nursing homes*',²⁶ was carried out by a large nonprofit US healthcare system that owns nursing homes; manufacturers of patient-lifting equipment; researchers at Washington University, West Virginia University, and U.S. National Institute for Occupational Safety and Health (NIOSH) and HCWs. The prevention programme combined measures to reduce back injury by identifying the movements and postures that put nursing assistants at risk of back strain, stress and injury in lifting and moving residents. Mechanical-lifting devices for reducing those stresses and strains were evaluated in the laboratory and then in the nursing homes. A best practice training and lifting programme was put in place on the basis of researcher and employee input, and rates for key measures of success were recorded for 3 years before the intervention and for 3 years after the intervention. The successful project reduced the frequency of back injuries in six nursing homes by 57%, lowered injury rates by 58%, and decreased workers' compensation expenses by 71%.²⁶

Ergonomic

Occupational slip, trip and fall (STF) incidents are a significant source of workers' injuries in the healthcare sector. Courtney et al. found that STFs are a leading cause of occupational injury resulting in an annual average of 52 deaths and 220,000 nonfatal injuries in the United States.²⁷ Hazard assessments must be carried out to identify environmental conditions that might increase the risk of slip, trip and fall incidents. Specific hazardous conditions to be assessed include the condition of walkway surfaces, objects and contaminants on the floor, protruding objects, cords, lighting, handrails and drains. Measures that could be taken to reduce the risk of STF injuries are:

- Keeping floors clean and dry.
- Use of slip-resistant shoes (for nursing, housekeeping staff).
- Good housekeeping (adequate lighting, keeping corridors and aisles clean and clear of clutter, securing any loose cords or wires, covering/taping cords placed on the floor, etc.)

Specific work environments within the healthcare sector also present with their unique set of ergonomic issues. For example, a tall surgeon may develop chronic low back pain from stooping for long hours while performing surgeries. A simple intervention like raising the operation theatre (OT) table to an optimum height while the surgeon's shorter assistants use steps that would mitigate the risk manifold. Hospital administrators must perform an ergonomic risk assessment in collaboration with the workers in a variety of settings within the hospital to develop effective interventions.

Psychosocial

Occupational stress has been a long-standing concern of the healthcare industry. Studies indicate that healthcare workers have higher rates of substance abuse and suicide than other professions, and elevated rates of depression and anxiety linked to job stress.²⁸ In addition to psychological distress, other outcomes of job stress include burnout, absenteeism, employee intent to leave, reduced patient satisfaction, and diagnosis and treatment errors.^{29,30}

The daily occupational stress faced by the HCWs may manifest in the following types of reactions:

- Psychological (irritability, job dissatisfaction, depression).
- Behavioural (sleep problems, absenteeism).
- Physical (headache, upset stomach, fatigue, blood pressure changes).

An acute traumatic event could also cause post-traumatic stress disorder (PTSD).

The most effective way of reducing occupational stress is to eliminate the stressors by redesigning jobs or making organisational changes. In practice, a combination of these methods

is seen to work best in reducing job stress.³¹ The most commonly implemented organisational interventions in healthcare settings include team processes, multidisciplinary healthcare teams and multicomponent interventions.⁸

Team process or worker participatory methods give workers opportunities to participate in decisions and actions affecting their jobs. Team-based approaches to redesign patient-care delivery systems or to provide care (e.g. team nursing) have been successful in improving job satisfaction and reducing turnover, absenteeism and job stress.^{30,31}

Multidisciplinary healthcare teams (e.g. composed of doctors, nurses, managers, pharmacists, psychologists, etc.) have become increasingly common in acute, long-term and primary-care settings. Teams allow services to be delivered efficiently, without sacrificing quality. They save time (a team can perform activities concurrently) and promote innovation by exchanging ideas.

Multicomponent interventions are broad-based and may include risk assessment, intervention techniques and education on stress-busting techniques and coping strategies.³²

Miscellaneous

Fire

Healthcare facilities routinely store and use various inflammable substances like explosive gases, volatile liquids, large quantities of cotton dressing materials, bed linen and patient clothing. They also operate a plethora of electrical devices on a massive scale. In hospital laboratories, lab staff often works with a naked flame in close proximity to volatile substances. Fire is therefore an ever-present hazard in a healthcare setting and must be given high priority in any risk assessment plan. The threat of fire in a healthcare setting is magnified by the fact that a majority of persons in a hospital at any given time are patients, some of whom might be bedridden or unable to independently evacuate in case of a fire. Evacuation plans in all hospitals must take this into account and allow for redundancy. Large, modern, tertiary healthcare facilities tend to be centrally air-conditioned. Although this helps maintain better internal air quality and alleviates heat stress for both patients and HCWs, the threat of smoke inhalation by spread through the AC ducts, in case of a fire, is magnified. Plate glass windows that cannot be opened limit avenues of alternative evacuation. All such hospitals should consider installation of shutdown devices in the AC duct system to limit the spread of smoke. Fire escapes should be wide, provided with a railing and should be easily accessible through wide swing doors. Patient-exit ramps should be provided in ICUs, acute wards and orthopaedic units that are likely to have a large number of lying cases. It should be kept in mind that elevators are unlikely to function during a fire. Fire exit doors should not be fitted with locks or latches to prevent accidental locking. Basements and parking lots should never be used as warehouses to store

hospital waste, surplus bedding, dressing materials or gas cylinders. Standard operating procedures (SOPs) on fire hazard prevention should be drawn up and every worker should be adequately trained specific role in the event of a fire. Firefighting equipment should always be maintained in good repair and their efficacy should be reviewed periodically. The location of firefighting equipment and the fire evacuation plan should be prominently displayed in all common areas. The regular conduct of fire drills is mandatory.

Case Study 2: Fire safety

A major fire broke out on the morning of 9 December, 2011 at the AMRI hospital—a tertiary healthcare facility in Kolkata, India. The fire was allegedly caused by the negligence of the hospital conservancy staff who had stocked flammable substances in the basement of the building, which ignited due to electrical short circuiting. It is reported that 91 people, including members of the staff, died due to asphyxiation. Six board members of the hospital were arrested on the charges of culpable homicide. The license of the hospital was revoked after the incident. The local administration instituted a probe into the incident. The probe committee led by Assistant Director General (ADG) Fire Services, Kolkata submitted a report a month after the incident. The report implicated the stocking of bales of cotton linen meant for use as dressing materials in the hospital basement as the origin of the fire. Inaction and delay in informing the Kolkata Fire Brigade on the part of the hospital staff led to the situation spiraling out of control. The probe found that there was no specific plan to evacuate patients in the ICU and acute wards who were unable to move themselves. They therefore suffocated to death in their beds.²⁸ Based on their findings the probe committee recommended the following:

- Incorporating a shutdown provision in AC ducts to stop the spread of smoke through the AC duct in large, centrally air-conditioned buildings.
- Making mock fire drills mandatory once in every 3 months.
- Floor number and fire arrangement to be displayed prominently on each and every floor.
- Electrical wiring to be concealed or should pass through covered shaft only.
- Basement not to be used as a warehouse.
- Appointment of a fire safety officer in every hospital to be mandatory.
- All hospitals and other establishments to have elevators as well as a ramp for easy and faster movement of patients.
- Elevators as well as the patient wards to have stand-alone alternative emergency power backup.²⁸

Electrocution

Healthcare staff routinely operates a plethora of electrical devices meant for monitoring, investigation or treatment purposes. Many of these devices use high-voltage DC and can cause electrocution if handled improperly. Healthcare workers should be sensitised to the proper use of such equipment. Improper usage or inappropriate usage for unlicensed tasks should be strictly discouraged. In no event should HCWs attempt to repair malfunctioning equipment on their own without recourse to proper service staff.

Radiation

Many sources of radiation, such as X-ray machines, CT scans, linear accelerators and radionuclides are routinely used in clinical and research applications. No level of radiation exposure is free of some associated risk. Thus, the principle of radiation safety is to keep the level of exposure as low as reasonably achievable (ALARA).³³

In general, the basic means of reducing exposure to radiation and keeping the exposure ALARA regardless of the specific source of radiation are as follows³³:

- Keep the time of exposure to a minimum.
- Maintain distance from source.
- Where appropriate, place shielding between human body and the radioactive source.
- Protect against radioactive contamination.

All healthcare facilities operating radiation oncology units are mandated by law to constitute a Radiation Safety Committee, which is empowered to take actions to keep the level of radiation ALARA. In addition, such facilities must employ a Radiation Safety Officer (RSO) and be certified by the Atomic Energy Regulatory Board (AERB).^{33,34}

Healthcare workers working in X-ray and fluoroscopy units should be trained in the proper use of lead aprons, thyroid collars and leaded eye protection where mandated, depending on the total annual radiation dose. Thermoluminescent dosimeters (TLD), film badges, fast neutron monitors and direct-reading dosimeters can be employed to measure external radiation dose on personnel. The AERB recommends a limit to the effective dose of **20 mSv (millisieverts)/year** averaged over 5 years (100 mSv dose in 5 years) with the further provision that the effective dose limit should not cross 30 mSv above background radiation in any single year.³⁴ Enhanced safety and security measures must be put in place to restrict unauthorised access to radiation source.

SAFETY PRACTICES FOR HEALTHCARE PERSONNEL AND WASTE WORKERS

Universal Precautions

Universal precautions are a simple set of effective practices designed to protect HCWs and patients from infection with

a range of pathogens including blood-borne viruses. These practices are used when caring for all patients regardless of diagnosis. They are applied universally. It is not feasible, effective or cost-effective to test all patients for all pathogens prior to giving care, in order to identify those who are infected and take precautions only with them. Thus, decisions regarding the level of precautions to use are based on the nature of the procedure and not on the actual or assumed serological status of the patient. In practice, implementation of universal precautions includes the following interventions³⁵:

- Hand-washing after any direct contact with patients.
- Safe collection and disposal of needles (hypodermic and suture) and sharps (scalpel blades, lancets, razors, scissors), with required puncture- and liquid-proof safety boxes in each patient-care area.
- Wearing gloves for contact with body fluids, nonintact skin and mucous membranes.
- Wearing a mask, eye protection and a gown (and sometimes a plastic apron) if blood or other body fluids might splash.
- Covering all cuts and abrasions with a waterproof dressing.
- Promptly and carefully cleaning up spills of blood and other body fluids.
- Using a safe system for hospital waste management and disposal.

Hygienic Hand Disinfection

If there is an actual or even possible microbial contamination of the hands, hygienic hand disinfection is essential. Use of a reliable bactericidal, fungicidal and virucidal preparation is mandated, provided valid test results are available for it. Hygienic hand disinfection must be carried out in such a way that the contamination flora still on the hands is largely killed off.

The alcoholic preparation is rubbed in over all the areas of the dry hands, paying special attention to the inner and outer surfaces including the wrists, the areas between the fingers, the finger tips, the nail folds and thumbs; and these are to be kept moist for the entire exposure time (Figure 42.2).

Hygienic hand disinfection is necessary⁸:

- Before the individual concerned enters the clean side of operating departments, sterilisation departments and other clean room areas.
- Prior to invasive measures, even if gloves (sterilised or unsterilised) are worn (e.g. installing a vein or bladder catheter, before angiography, bronchoscopy, endoscopy, administering injections, etc.).
- Prior to contact with patients who are subject to a particularly high degree to the risk of infection (e.g.



Figure 42.2 A Deliberate and thorough handwashing is a sine qua non in any healthcare setting.



Figure 42.2 B All healthcare workers must have easy access to alcohol-based disinfectants/hand sanitisers for routine hand disinfection and hygiene.

leukaemia patients, polytrauma patients, patients who have been exposed to radiation or are otherwise seriously ill, patients with burns).

- Prior to activities involving a risk of contamination (e.g. provision of infusions).
- Before and after any contact with wounds.
- After contact with potentially or definitively infectious material (blood, secretion or excrement) or infected areas of the body.
- After contact with potentially contaminated objects, liquids or surfaces (urine, respirators, respiration masks, tracheal tubes, indwelling catheters, surgical drains, etc.)
- After contact with patients who may be a source of infections or who carry pathogens that are of special significance in terms of hospital hygiene [e.g. methicillin-resistant *Staphylococcus aureus* (MRSA), XDR-TB].
- After removing protective gloves where there has been or probably has been pathogen contact or major soiling.
- Before aseptic measures (e.g. when dealing with patients with burns)

Hand disinfection has priority over hand-washing. Hands should only be washed first and then disinfected if they are visibly dirty. This is because disinfection is more effective in reducing germs and too-frequent hand-washing damages

the skin barrier.⁸ Hospitals should endeavour to provide all workers with access to hand-washing stations with hot and cold running water, hand disinfectant dispensers, appropriate skin protection and skincare products and disposable towels. In high-infection-risk work areas, hand basins should be fitted with taps that do not require hand contact to be operated.

Immunisation

Hepatitis B vaccine (HBV) is the most infectious blood-borne virus. Hepatitis B vaccine is effective, cost-effective, relatively inexpensive and widely available. Routine immunisation of HCWs against infection with HBV is an effective way to protect them. HCWs should be immunised early in their career. Prevacination serological testing is unnecessary, but may save resources if feasible and if prevalence of immunity is high like in countries that have introduced Hepatitis B vaccination as part of routine childhood immunisation programmes. A 0-, 1- and 6-month schedule of three injections is currently recommended by the WHO.^{5,35} Protection is lifelong and booster doses are not required. Healthcare workers (HCWs) are also at risk for exposure to (and possible transmission of) many other vaccine-preventable diseases. Vaccination programmes are therefore an essential part of infection prevention and control for HCWs. Healthcare workers should therefore maintain a copy of their vaccination records. Accurate vaccination records can help to rapidly identify susceptible healthcare personnel (HCP) (i.e., those with no history of vaccination or lack of documentation of immunity) during an outbreak situation and can help reduce costs and disruptions to healthcare operations.^{8,36} A comprehensive recommendation on immunisation of HCWs has been formulated by CDC, Atlanta.³⁶ The report of the Advisory Committee on Immunisation Practices/Healthcare Infection Control Practices Advisory Committee for immunisation of healthcare personnel is freely available on the CDC website, at <http://www.cdc.gov/vaccines/pubs/acip-list.htm>. Conscientious administrators are urged to consult the recommendations when formulating an immunisation strategy for their healthcare staff.

Personal Protective Equipment

Personal protective equipment includes gloves, goggles or glasses, masks, gowns and plastic aprons. Adequate supplies should be ensured in all areas. The staff should be involved in the selection of personal protective equipment, as equipment that is of poor quality or uncomfortable to wear will not be used. All staff must be trained in the correct use of the equipments. Staff must also be motivated to consistently use the protective equipment in the appropriate manner at all times. The use of influential senior staff as role models to

promote personal protective equipment is often seen to be an effective management strategy. Compliance and inappropriate use must be monitored. Inappropriate glove use wastes resources and compliance eye protection often requires additional effort. Large hospitals should institute 'glove plans', which lay down the types of protective gloves to be used by the wearer in a variety of settings depending on the assessed risk of exposure to microbial contamination. This would mean that some low-risk settings like caterers or nursing assistants could make use of disposable polyurethane gloves, while waste workers who are at increased risk of percutaneous injury use heavy-duty industrial gloves. A surgeon who is not only at increased risk of exposure but whose work also involves retention of a high degree of tactile stimulus is best served by sterilised latex gloves, which though more expensive afford adequate protection while also providing freedom of function. Used personal protective equipment must be disposed-off safely.

Sharps Management

The most common causes of needlestick injury are two-handed recapping and the unsafe collection and disposal of sharps waste.^{5,12,13} It is estimated that about 69,000 needlestick injuries in hospitals can be prevented in 1 year through the use of needles with safety features.⁵ However, the use of needles with safety features alone is insufficient. Hospitals need to put in place a holistic sharps management plan, which would include a gamut of interventions, including one-time-use syringes, needle destroyer devices and an effective sharps disposal plan in tune with the overall waste management policy (Figure 42.3).



Figure 42.3 Needle destroyers reduce risk of needlestick injury and injection reuse.

Case Study 3: Safe injection practices

The WHO initiated *Project Focus: Ensuring Immunisation Safety in Burkina Faso* in July 2002 as a pilot project to use WHO materials in a focused effort to address all issues related to injection and immunisation safety: Availability of equipment and supplies (autodisposable syringes, safety boxes, incinerators); safe injection practices; safe vaccine delivery; and safe waste management.¹⁴ Dramatic reductions were found in needle recapping, needlestick injuries and misuse of safety boxes after a year of implementation of the pilot project. This project could serve as a model intervention implementable in a variety of health-care settings after appropriate local modifications.

Postexposure Management

The risk of infection following a needlestick injury with needle from an infected source patient is ~0.3% for HIV, 3% for hepatitis C and 6–30% for hepatitis B.^{35,37} An effective response to occupational exposure to blood or other body fluids involves the following:

- Development of guidelines outlining the first aid required, reporting mechanism and procedure to be followed for postexposure prophylaxis and follow-up testing.
- Dissemination of guidelines and ongoing information, education and communication (IEC) campaign.
- Provision of support and counselling.
- Where possible and indicated, provision of postexposure prophylactic medication.
- Analysis of reported cases of exposure to improve practices.

Safe Handling of Biomedical Waste

The production, segregation, transportation, treatment and disposal of healthcare waste involves the handling of potentially hazardous material. Protection against personal injury is therefore essential for all workers who are at risk. Healthcare waste management policies or plans should include provision for the continuous monitoring of workers' health and safety to ensure that correct handling, treatment, storage and disposal procedures are being followed.

Workers at risk include healthcare providers, hospital cleaners, maintenance workers, operators of waste treatment equipment and all operators involved in waste handling and disposal within and outside healthcare establishments. A comprehensive risk assessment of all activities involved in healthcare waste management, as outlined earlier in this chapter, should be carried out during preparation of the waste management plan to allow the identification of necessary protection measures. These measures should be designed to prevent exposure to hazardous materials or other risks, or



Figure 42.4 Segregation of waste at the point of generation.



Figure 42.5 Trolleys with bins demarcated clearly as per waste category.

at least to keep exposure within safe limits. Once the assessment is completed, personnel should receive suitable training. The practice of segregating biomedical waste at the point of generation is to be encouraged (Figure 42.4).

Hospital managers may prefer to use metal or plastic bins for waste as per prevailing local guidelines. The use of colour-coded-trolley-mounted bins for transport of biomedical waste reduces the risk of accidental exposure to toxic materials and/or accidental injury from sharps involved in manual carriage (Figure 42.5).

In India, the Ministry of Environment and Forests (MoEF), Government of India has notified the new draft Biomedical Waste (Management and Handling) Rules, 2011, which govern the segregation at source, collection, storage, transport and final disposal of biomedical waste by all healthcare facilities generating such waste.³⁸

The type of protective clothing and equipment (PPE) used will depend to an extent upon the risk associated with the healthcare waste; but the following should be made available to personnel who collect or handle healthcare waste.^{8,38}

- Helmets—with or without visors—depending on the operation.
- Face masks—depending on operation.
- Eye protectors (safety goggles)—depending on operation.
- Overalls (coveralls)—obligatory.
- Industrial aprons—obligatory.
- Leg protectors and/or industrial boots—obligatory.
- Disposable gloves (medical staff) or heavy-duty gloves (waste workers)—obligatory.

Response to Injury and Exposure

A programme of response should be established that prescribes the actions to be taken in the event of injury or exposure to a hazardous substance. All staff who handles healthcare waste should be trained to deal with injuries and exposures. The programme should include the following elements:

- Immediate first-aid measures, such as cleansing of wounds and skin, and irrigation (splashing) of eyes with clean water.
- An immediate report of the incident to a designated responsible person.
- Retention, if possible, of the item involved in the incident with details of its source for identification of possible infection.
- Appropriate medical attention in an accident and emergency or occupational health department, as soon as possible.
- Investigation of the incident, and identification and implementation of remedial action to prevent similar incidents in the future.^{5,8,35}

The purpose of incident reporting should not be seen as punitive. Active support by managers should encourage prompt and accurate reporting.

The healthcare sector is burdened by the inappropriate, but entrenched belief that patient-care issues supersede personal safety and that to achieve better patient outcomes healthcare workers must accept the risks of hazardous exposures or injuries. There is the stress of dealing with the highly charged healthcare environment, exacerbated by long work hours, rotating shifts and understaffing. Other hazards unique to healthcare setting include risks associated with patient handling, exposures to hazardous drugs administered to patients, and sharps injuries with their associated risk of blood-borne pathogen transmission. Healthcare workers must also face the unknown, as they are routinely on the front line in caring for those with emerging infectious diseases, whether naturally occurring [severe acute respiratory syndrome (SARS), avian influenza, pandemic influenza, ebola] or the result of bioterrorism (anthrax, smallpox).

The occupational safety and health of healthcare workers impacts not only workers but also their patients and clients

and others entering the healthcare work setting, such as families and visitors. A healthcare worker who is healthy, well-rested, and focused is able to provide better care and improved patient outcomes. Appropriate equipment for safe patient handling and protection from hazardous chemicals and infectious hazards in the healthcare work setting protects not only healthcare workers but also the patients and everyone else in the work setting.

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Hospital Security

Mr PC Sharma and Dr Sonu Goel

“The safety and happiness of society are the objects at which all political institutions aim, and to which all such institutions must be sacrificed.”

— James Madison

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- define the role of hospital security in functioning of a hospital.
- elaborate upon need and utility of hospital security.
- describe the role and responsibility of a security system to meet the day-to-day challenges.

INTRODUCTION

Hospital security is a very essential element in facilitating the smooth functioning of medical and paramedical staff as well as in safeguarding the patients, their attendants/relatives, employees and the property of the hospital. The security services in a hospital are not only restricted to provide the safety and security to men and materials, but it also plays a pivotal role to maintain law and order situation with the help of local police and also helps in maintaining cleanliness and other services in the hospital. Safety from fire angle is also a prime role of security. To channelise the human as well as vehicular traffic is one of the most important and difficult task of a security system of any hospital as a large number of floating population of various categories of the society from far-away places visit a hospital for medical care, who may not be versed with rules and regulations. The role of security services in a hospital becomes even more important in unusual situations like strikes, gharoes, dharnas, protests, etc. Security also played an active role during VIP/VVIP visits and special functions of a healthcare institute. Thus, hospital security efforts must be evaluated constantly and should remain flexible to meet new and expanding challenges which are occurring with great frequency in the modern healthcare system.

HOSPITAL SECURITY VERSUS LAW ENFORCEMENT AGENCIES

The term security in context to hospital refers to protection of healthcare resources. It may be simply defined as a system

of safeguarding or protecting the property of hospital and also to achieve relative safety for all those persons who interact within the organisation and its environment. The security functions are wrongly interpreted as law enforcement functions. Though there are some common functions of security and law enforcement agencies but most of their activities are totally different. Security is an internal protection (within the hospital) concept whereas law enforcement is an external concept which attempt to uphold the law for the whole of the society. Security is a preventive and proactive general service which is defined by an organisation to protect the property and persons of the organisation. However, law enforcement agency is a statutory defined body to react, investigate, apprehend, prosecute and protect the people and property of the society and government.

PHYSICAL SECURITY: AN IMPORTANT SECURITY DOMAIN

The main types of security are physical security, public security, economic security, health security and environmental security, however, the physical security is most common concern of a health administrator.

Physical security describe the measures which are designed to deny access to unauthorised persons from physical accessibility of building, facility, resources or store information and guidance on how to design structure to resist potentially hostile acts. Physical security cannot be as simple as ‘lock door’ or ‘multiplying layer of barriers’. Good

physical security is concept of layer defense in appropriate combinations, e.g. alarms, fences, locks and keys, closed-circuit television (CCTV), lighting, etc. which assist security personnel in effective functioning. The purpose of these various physical controls varies according to their objectives. Some are for traffic controls, some are for surveillance and others may be for controlling access to a facility or area. **Fundamentally good physical security is a combination of defensive principle designed to deter, delay, detect and respond.**¹

The first two actions, i.e. **deter** and **delays** are considered passive defense whereas the remaining two, i.e. **detect** and **respond** are active in nature. Modern measures for physical security of any building, office, hospital, facility are security wall, fencing, security lights, external barriers, locks and keys, frisking and searching by deploying security guards, access control, biometric system, CCTV, smart card, swipe card, security gates, I-card, visitor register, photo pass system, uniform and visitor/attendant pass system among many.

Since an organisation like hospital deals with the floating population and that too in a large number, it is very much essential to differentiate between the employees and the visitors/attendants as well as between the attendants/visitors and the patients. To ensure the same, it should be made mandatory for each and every employee to wear the prescribed uniform and display their ID-cards. Similarly, the patient's uniform should also be prescribed while their stay in the hospital. Each and every attendant/visitor should bear the attendant/visitor pass while entering in any area of the hospital. Though, by deploying the security guards on entry/exist points of all the areas of a hospital and ensuring the above measures with strictness, effective security services can be provided; but installing CCTV cameras at the sensitive places not only adds to the security but also provides tools and clinching evidences to an hospital administrator for identification of the culprits. It is also admissible evidence before the court of law beyond any iota of doubt. Existence of CCTV in any organisation itself puts control on some crimes as it creates psychological fear in the mind of antisocial elements/culprits/criminals that they are under surveillance. Moreover, keeping in view of the recent terrorist activities that took place in the country, especially in sensitive and overcrowded areas like hospitals, a constant surveillance in hospitals is need of the hour in the interest of safety and security of patients, their attendants/relatives, employees and property of the hospital.

HUMAN BEHAVIOUR: BEING POLITE WITH PATIENTS

Every security system of a hospital must be sensitive, polite and respectful to patients and their attendants. The points that put the patients in perspective in hospital are that a patient makes it possible to pay our salary; a patient deserves for most courteous and attentive treatment which we can

give; a patient is a human being with feelings and emotions like us; patient is not an interruption of our work but he is purpose of our work; and patient is a person who brings us his wants, it is our job to fulfill those wants. At the same point of time, the hospital security system should be able to maintain law and order situation in the hospital by pacifying bereaved patients and their attendants.

Security staff is probably the first one with whom a patient had an encounter, be it at the entry point of the institute or at the parking or entry of any building/emergency/wards, etc. Besides being polite with them, the security staff should ensure the safety and security of patients and their valuables. Though security personnel cannot be substituted with personnel providing medical care, but they form the essential link to build a rapport of hospital. The polite and courteous behaviour of the security staff not only reduces the agony of the patient, but also develops his confidence in the system and builds the image of the hospital.

SECURITY MANAGEMENT PROGRAMME

A hospital is committed for providing a safe and secure environment for its patients, their attendants, relatives, visitors, employees, faculty and students. A hospital functions 24 hours a day, 7 days a week and 365 days a year. As services in the hospital cannot be shut down, the hospital may not work for even a moment without a sound security system. Because of its size, the complexity of care provided, the location and patients/visitors population, a hospital confront many issues related to security which are not faced by any other organisations/facilities.

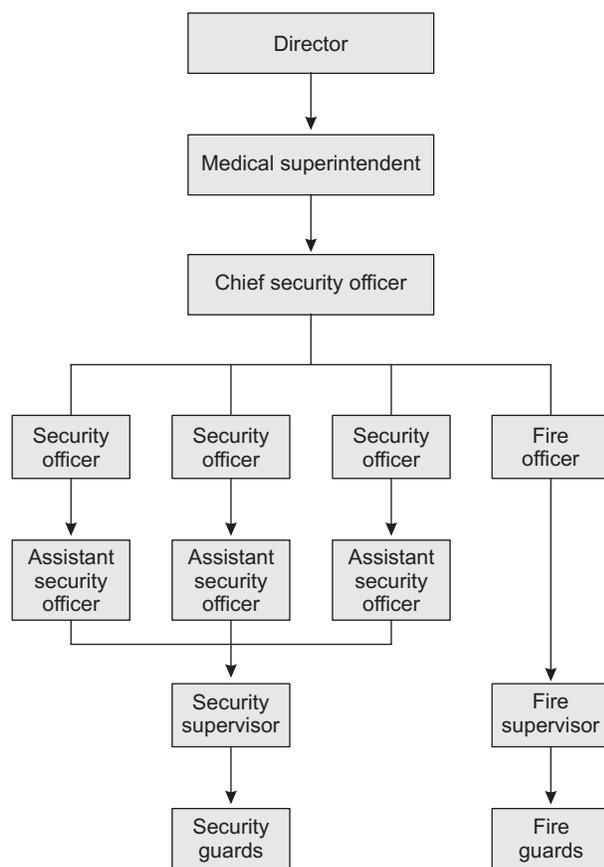
Through a security management programme, the hospital seeks to safeguard the hospital property; respond to emergencies/crises; ensure safety of patients, their attendants/relatives, employees and their belongings within the campus; ensure safety and security of buildings and facilities; control of vehicular as well as human traffic; liaison with police for monitoring and maintaining law and order within the campus; response to special events in the hospital; ensure preventive fire/safety measures; information regarding trade unions activities; incident reporting and investigation/enquiries and preventive maintenance of fire safety and security equipments.

The first step of security management programme is conducting security survey which bears questions and checklists for guiding the survey team during surveys/inspections of any building or a hospital. A security survey shows the general information about the concerned building/hospital, including its geographic characteristics as well as physical layout of the facilities. It also evaluates schedules of security deployment, operational needs, capability of security equipments and incidents having impact on the hospital security. The general security measures includes assessment of patients management, attendants/visitors management, security personnel deployment, policies and

procedures related to security, emergencies management/ standard operating procedures (SOPs), human resources, materials movement management and security of VVIPs during their visit to hospital. Building security measure includes assessment of perimeter barriers, controls gate security, vehicle control and perimeter entry point access, clear zones and signage, access control, lock and key control, outdoor and indoor lighting, closed circuit television (CCTV) and no entry zones/areas. Parking security includes assessment of designated space as per requirement, access control/electronic traffic barriers, adequate and trained parking staff, lighting arrangements, physical security measures, demarcation of no parking, vehicle-free zones/ areas, one-way, etc., segregation of staff and public parking, proper signage and proper footpaths along the roads.

ORGANISATIONAL CHART OF SECURITY WING

Generally, a security wing of a hospital work under the administrative control of medical superintendent. The security officer (or chief security officer) is incharge of the security wing, with assistant security officers and fire officers under his control. The size of wing depends on the type and size of hospital. The organisational chart of a tertiary care hospital is depicted in Flowchart 43.1.



Flowchart 43.1 Organisational chart of PGIMER Chandigarh security wing.

BASIC HOSPITAL SECURITY VULNERABILITIES

All the hospitals regardless of its size, location and services provided, faces some of the basic security vulnerabilities. However, the degree of magnitude of those vulnerabilities varies from hospital to hospital. The following basic vulnerabilities/significant problems are faced by almost every hospital.

Assaults

This problem exists both within the hospital building as well as outside the building. It involves employees, visitors, patients and their attendants/relatives. Such types of problems need immediate security as well as administrative attentions. Some reasons of assaults are delay in treatment; lack of proper attention by medical/paramedical staff; misbehaviour by any staff member; mental state of attendants/relatives of the patients; tussle between employees of different trade unions; strict enforcement of hospital rules and regulations, policies system, etc.; lack of adequate facilities and lack of communication, etc.

This problem is very common, especially, by the patients/relatives of the very sick patients and in case of the death of a patient as their mental state is very poor and under great agony. Under such circumstances, the incidents of assault or attempt to assault on the employees, i.e. doctors, nurses, and technicians, etc. are very common. Sometimes due to lack of proper communication/information to the attendants/relatives also leads to such type of problem which may further lead to legal proceedings/implications. Standing for a long time in long queues for making cards, etc., depositing fee and waiting outside the doctor's room in outpatient department (OPD) some time compel to a sick person or their attendant to loose his/her temper. It is therefore utmost essential that this outburst of abnormal human behaviour should be well tackled by security staff, for which they should be well trained in any protection programme.

Since there are large number of female patients, attendants and employees in any hospital, sexual assault needs most serious attention within the hospital. There are few areas where females work alone at night and are quite unprotected to which the security patrols are necessary to provide a reasonable degree of safety. The incidents of assaults can occur between patients and staff, between staff and visitors/attendants, between staff and staff, between visitors/attendants and attendants/visitors.

Preventive measures

Keeping in view the above noted reasons of assault, the preventive measures are essential which includes availability of adequate staff and space for emergency patients; timely attention by the medical and paramedical staff; proper

communication between doctors and relatives/attendants of the patients; availability of sufficient lifesaving drugs/equipments, especially, the ventilators; medical/paramedical staff should be well versed with the local language; to make the emergency free from patients' attendants by deploying hospital staff/attendants with the patients; installing of CCTV surveillance system; providing proper information to the relatives at the reception counter; prompt release of dead body and completing discharge formalities; and quick communication and coordination among various departments of treating doctors.

Case Study 1: PGIMER emergency

Emergency area of any hospital is one of the most vulnerable areas where such types of assaults usually happen. PGIMER Chandigarh emergency has a capacity of 110 patients whereas on an average more than 300 patients are being treated at a given point of time. Most of them are brought in a very deteriorating/sick/serious condition. Due to large number of the patients, most of the patients are treated on trolleys that too in an overcrowded area making the patient management a very difficult task for the security staff. In the recent past, few incidents are reported where either the relatives/attendants of very sick patients who died in emergency during treatment assaulted or tried to assault or sometime misbehaved, abused the medical as well as paramedical staff including security staff. In most of the cases, it was alleged by the relatives/attendants that timely/proper treatment and attention was not given to their patients despite their repeated requests. Inquires into the issues reveals that:

- In most of the cases, patient's attendants/relatives were more demanding even after knowing the end result.
- There was a lack of communication or a communication gap/language problem among the attendants/relatives of the patients and the medical/paramedical staff.
- In some cases, there was delay in treatment or lack of proper treatment due to overcrowding of patients; less number of medical/paramedical staff; lack of life saving drugs/equipments especially, ventilators; overcrowding in intensive care units (ICUs); lack of coordination among various clinical departments; delay in discharge formalities/release of dead body; pressure of doctors for post-mortem of nonmedicolegal (non-MLC) cases; inadequate availability of resources in comparison to requirement/demand; penetration of media; disgruntled/ vested interest of employees; sentiments/attachment of a family member; mental agony of the family due to irrecoverable loss; and lack of confidence of the society in the system.

Theft

The theft/pilferage of medicines/drugs, equipments, linen, foods supplies, maintenance parts and material, toilet fixtures, hospital waste, personal property of patients, their attendants/relatives/employees of the hospital is a major problem in all healthcare organisations. The most common thefts are mobile phones, purses, shoes [(from changing room/outside (OT)] operation theatre and medicines. Some of the common reasons of thefts by employees are problems of addiction, low wages, lack of proper handing and taking over, habitual nature of some employees, etc. The problem faced by security staff is difficulty in checking each and every employee/visitor, lack of surveillance system, carelessness by the custodian, nonkeeping of things in proper lock and key, easy access due to public place, lack of authority with security staff, casual attitude of security staff, relative darkness in patient area, increase in overall crime rate in the society, etc.

It is extremely difficult to develop a programme of theft control unless one can measure the type and extent of the problem. Various studies reveal that only 10–20% of the losses are reported to security department of a hospital, rest remains unreported because of busy schedule of staff and unawareness of patients/attendants. Although, the value of losses of patient property may not be high but it adversely affects the image of the hospital leaving patients and their attendants/relatives upset. It is also a fact that many belongings which are reportedly stolen, when verified/investigated, have already been taken to home by the friends/relatives of the patients.

Preventive measures

Preventive measures are installation of CCTV system; awareness among the staff as well as patients, their attendants/visitors to keep their belongings under lock and key; each and every employee must wear prescribed uniform as well as display their I-cards for proper identification; proper handing over/taking over of hospital property by custodian/user; all the areas should be well-lit/well-illuminated; regular security checks as well as patrol should be conducted; strict vigil on the habitual thief should be made; addict employee should be identified and special attention should be given to them; all the buildings/rooms should be locked when not in use; shifting of equipment from one place to another should be in black and white; the custodian should be held accountable; special checks need to be conducted by the security; entry/exit point should be minimum and manned properly; proper handing/taking over of keys; burglar alarm system for costly equipments be installed; proper storage of unused items/equipments and installation of plastic fixtures at public places.

Disaster Management

Disaster means a mishappening, calamity or a grave occurrence in any area arising due to natural (epidemics, earthquake, floods and storms and cyclones) or man-made (fire, explosion, building collapse, industrial accidents, terrorist's activities/attacks, train accidents, road traffic accidents, plane accidents and war) causes or the accident or negligence, which results in substantial loss of life or damage and destruction of property or damage or degradation of environment and is of such a nature or magnitude that it has to be beyond the capacity of the community of the affected area.

To meet any of the above-noted disasters, the security services of a hospital has to follow Disaster Management Plan of the hospital, which inturn will be prepared based on National Disaster Management Guidelines issued by National Disaster Management Authority, Government of India.² Some of the steps include cordoning off the emergency/effected area; crowd control inside/outside emergency/disaster management area; traffic control around public disaster management area; manage the media with the help of concerned officials; close liasoning with local police and helping them in medicolegal formalities; ensuring the safe custody of belongings of unidentified patients/deceased; extending all possible help to medical/paramedical staff; management of visitors visiting hospital to see the affected patients including responding to their queries; deployment of extra security staff; control of unnecessary movement of the unwanted staff/public, etc.

Civil Disturbances

Civil disturbances mostly occur due to communal riots. The SOPs (standard operating procedures) should be prepared in advance to meet such exigencies. The security services during civil disturbances are managed as for disaster management like focusing on visitors, patients, valuables, external vehicular traffic, external pedestrian traffic, special security coverage to the treatment area and the area designated for dissemination of information concerning injured/causalities, media, etc.

Strike

Strike occurs when a group of the hospital employees (generally represented by one or more trade unions) protest and halt a service of hospital. The primary purpose of strike is to create hardship for the hospital, weaken its bargaining position and bring the decision in favour of employee union. This hardship includes disruption of traffic, intimidation of staff, loss of revenue, damage to property, negative community reaction to the institution, media pressure, political pressure, social pressure, peer groups pressure, law

and order problem, antimanagement posters, slogans, etc., provocative speeches and ghareo of senior officials and officers, besides hardships for patients and their attendants.

The security system of a hospital is encountered with the problems during the strike period, some of which are, disruption of external services such as delivery of supplies, etc.; alteration between prounion and antiunion employees; malicious disruption of hospital property as well as employees' personal property; intimidation or assault on promanagement employees; disruption of water, electricity and communication supply and force withdrawal of the employees who want to work.

The preventive measures can be implementation of prohibitory orders declaring the strike illegal; negotiation/bargaining through a mediator, i.e. labour officer or the officials of labour department; prompt reaction to strike notices; special security cover to be provided to the costly equipments/stores; security cover to water, electricity and communication for maintaining their smooth functioning; regular checks on disgruntled/vested interest employees; informing local civil/police authorities; timely listening to employees grievances and accepting reasonable/genuine demands; regular deliberations on the problems/demands of the employees; extra police/security personnel should be deployed during strike to avoid untoward incident; and the employee who wants to work during strike should be given special protection/security cover and motivation as well as appreciation.

Control of Visitors' Rush

Hospital is a place where a large number of visitors visit for one or the other reasons. The main visitors in any healthcare institution are patients; their attendants; friends and relatives of the patients; suppliers for supplying different facilities to the institute; VIP/VVIP's along with their team; off-duty employees and ex-employees; medical representatives; information seekers; other public offices and educational institutes, etc. In case of VVIP, or death of a patient, the number of attendants multiplies.

It is a hard fact that the attendants are a dire necessity for patients to look after them, for procuring medicine, liasoning with medical and paramedical support, shifting of patients and overall moral support. Critical or serious patients need more than two attendants, as most hospitals may not provide requisite attendants because of staff crunch. Despite checking by the security staff at the entry points, majority of the patients' attendants/relatives are seen moving around for various reasons, i.e. delivering samples, collecting reports, purchasing medicines/surgical items, refreshment/food, depositing fee, doing discharge formalities, shifting of patients for various tests/investigations, providing care, etc.

Case Study 2: Control of patient's attendants rush – Nehru hospital (PGIMER)

Nehru Hospital is the oldest building of the Institute designed in 1963. The rush of attendants was not a serious problem at that time because of less population. Over the last about 50 years, the number of patients has increased manifold but the size of the building has remained the same. More importantly, this aspect was never kept in mind while designing the building leaving too many entry/exit points and accommodating most frequently approached areas in it. Additionally, Chandigarh is a small city inhabited mostly by influential people who (or their known to's) visit the institute on one or the other pretext and are very difficult to be stopped in the absence of any authority in this regard. It is also a hard fact that an attendant is a dire necessity to look after the patient for procuring medicines, meal, collecting reports, liaisoning with medical and paramedical staff, shifting of patients and over and above as a moral support. Critical or more serious patients need more than one attendant as the services of a patient's attendant/relative cannot be substituted by the institute due to limited resources and shortage of men and materials.

Most Frequented Areas

Nehru Hospital is one of the most frequently visited buildings of the institute as it houses 20 general wards, 5 private wards (No. of rooms 99), radiodiagnosis and imaging department, laboratories of various departments, operation theatres, emergency ward, blood bank, labour room, bone marrow transplant (BMT), intensive care unit (ICU), respiratory intensive care unit (RICU), transplant ICU, neurosurgery ICU, various offices, departments, chemist shops, STD shop, waiting halls, emergency complex and advance trauma centre, radiotherapy OPD, faculty offices, central store, main fee counters, main reception counters, procurement wing, and administrative and establishment offices of hospital administration, nursing wing, security wing, etc.

Causes of Rush of Attendants/Visitors

- There are 10 access points at ground level and 21 access points at the first level to the Nehru Hospital.
- There are about 1900 beds in the Nehru Hospital and two attendant's passes are issued for one patient which leads to 3800 attendants in hospital all the times.
- The patients in private wards/ICU/RICU/CCU/neurosurgery ICU/transplant ICU/paediatric ICU have more than two attendants which enhances this figure to more than 4200.

The numbers are further increased by those coming to see/attendants of labour room patients; visiting various offices at Nehru Hospital; friends/relatives of staff members coming to meet them; coming to meet doctors for one or the other reason; coming from OPD (patients as well as attendants) for various tests/reports to laboratories/radiodiagnosis department/dressing/minor procedure, etc.; coming for delivering food and other articles to the patients; coming for a social visit (friends and relatives) to extend moral support to the patients; if any VIP or VVIP patient is there, the number of visitors/attendants increases manifold; in case of very sick patients or death cases, the number of attendants also multiplies; off duty staff and suppliers/service providers.

Ongoing Measures to Control the Rush of Visitors

- Manual visitors/attendants pass system is present.
- Intensive checking of passes at all the entry/exit point, wards and floor.
- Staff members strictly told to wear prescribed uniform along with ID-cards.
- Surprise rounds being taken by security officer, chief security officer, resident doctors of department of hospital administration and manager of security services.
- An one week inhouse training session for security guards at least once in three months.
- Security guards also deployed in the lifts to ensure strict access control.
- Regular interaction with sister-in-charge of wards and other ward staff. They have also been requested for cooperation in minimising the number of attendants.

Proposed Suggestions to Reduce Number of Visitors

- Though the security has been given the responsibility of keeping the rush of visitors under control but there is no defined authority for the same. As responsibility has very little meaning without authority so the only option left with the security is to persuade visitors/attendants to be present in minimum number in the hospital. Moreover, this responsibility should be jointly shared by other staff (like doctors, nurses and paramedical staff) along with security staff to have a long lasting impact.
- There should be a computerised pass issue system at the time of making of file (similar to railway tickets) and it should be issued against some security (say Rs. 500/-) for a period of one week only to avoid its misuse.
- An information centre with bare-minimum facilities, e.g. phones, toilets, sitting arrangement, etc. should be made operational outside main reception and emergency.

- The number of entry points to the hospital should be reduced. There should be separate entry for staff members, for emergency and for general public.
- All lift entries should be manned. Screening of people for passes and of staff for ID-cards should also be done by the lift staff posted in various lifts.
- More waiting halls should be constructed to accommodate attendants and visitors.
- Medical package system should be introduced for treatment of patients admitted in (Nehru) Hospital. It will reduce visitor rush.
- Staff members should not be allowed to meet friends, relatives, business executives, etc. during working hours.
- CCTV may be installed in ward corridors and other key areas.
- Computerised networking of all wards, laboratories, reception/fee section/security control room should be done. This will help in minimising the traffic of attendants.
- An electronic display system in all waiting halls giving status of the patients.
- There should be public address system in the waiting halls (connected with wards).
- Issuing slips for various medicines repeatedly should be discouraged.
- Medical/paramedical staff must develop confidence in the patient that in the absence of attendant, the patient will be looked after properly.
- Arrangements to keep the patient's belongings (especially valuables) in every patient area.
- Do's and don't chart (in local language) should be provided to each patient/attendant at the time of admission.
- Designated places for refreshments should be made for the attendants/relatives.
- Offices should be segregated from the hospital buildings.
- All the employees should wear prescribed uniform and also display ID-card while on duty.

Control of Vehicular Traffic and Parking Management

People come in almost every vehicle within the hospital. Due to increasing number of patients and the vehicles (number and size), parking management is becoming more difficult for the security wing of the healthcare institutes.

Case Study 3: Vehicular traffic and security management in PGIMER

Presently, about 5000 cars and 4500 two-wheelers of staff and about 4000 cars and 2500 two-wheelers of public are accommodated in various parking areas of the Institute at different times of the day. Every day, all the existing parking areas get occupied to the capacity and people are forced to park their vehicles on the road sides. The visit of VVIPs adds on to this problem. The problem of parking areas in the Institute has been solved to some extent by implementing "one-way traffic system", construction of multilevel parking near new OPD along with many decentralised parking in various advance centres, separate parking facility for staff at various places, installing of speed limit boards and no parking boards at appropriate places; a hydraulic crane to remove the vehicle in no parking areas; and shuttle services to various centres is working in the campus. All the public parking have been auctioned to the contractor who is providing manpower and effecting proper functioning besides fetching money to institute. (The institute is earning more than Rs. 32 lakhs per annum from the auction.) The institute is thinking towards more measures like limiting the external traffic to only few types of vehicles, proper footpath along the roads, proper lane marking on the roads, widening of roads, segregating campus (residential area) from patient care areas by installing gates, proper halting space for rickshaws and auto rickshaws be made near the entry gates, deployment of traffic staff to deal with the violations within the Institute; battery operated shuttle service within the campus, patrolling vehicle, i.e jeep/gypsy be made available to security wing, and restricting vehicles of residents within the campus, etc.

Fire Safety and Prevention

Fire is a chemical reaction which takes place in the presence of heat, fuel, air. Fire always results in huge loss of life and property. It also causes dislocation of work, unemployment and human suffering. As per Delhi Fire Service Act 2007, there should be adequate arrangements for prevention of fire as well as for first aid fire fighting in all buildings including hospitals. Apart from a significant role of security/fire staff of a hospital, it needs contribution of each and every individual, working in a hospital. It is, therefore, very important that every employee must know how to prevent fires and deal with small fires that may come to his notice during the course of his duties.

Fire-prone areas in the hospital are electrical gadgets, electrical ducts, electrical risers and substation, pantry and

kitchen, pharmacy store and general store, laboratories, laundry plant, boiler room and records room. Most of the fires are the result of human carelessness and can be prevented. All fires have small beginnings and can be tackled at initial stage without any major expense or loss. Major fires have, of course, to be tackled with the help of fire professional, fully manned and well-equipped fire service.

Do in case of fire

- Immediately call Fire and Security Control Room.
- Break the glass of manual call point nearest to scene of fire.
- Please give clear and correct info related to location of the fire (site, ward/room, floor and building).
- Try to extinguish fire by available first aid fire equipments (fire extinguisher available near the scene of the fire).
- In case of electric fire switch/cut off the electrical supply.
- Evacuate all persons from the area of fire through fire-exit routes.
- In case of dense smoke, escape from the area by crawling.
- Give all possible help to the fire personnel.
- In case of major fire seek help from local fire service.

Do not do in case of fire

- Don't shout/spread panic as it may lead to confusion and stampede.
- Never neglect patients, physically challenged, sleeping persons, aged people and children while evacuating the area.
- Never open the door suddenly, if you suspect fire on other side.
- Never throw water on electrical fire.
- Never join in a major firefighting unless the fire fighters request your help.

Preventive measures required for fire safety are automatic fire detection and alarm system/manual operated call system, covering all the area as per the code practice; fire extinguishers and sand buckets covering all areas depending upon the risk of fire as per code practice; means of access with illuminated exit way marking signs; wet riser down-comer system; fire riser, hydrants and first-aid hose reels; public addressing system; underground/over head water static tank; fire pump house where jockey pump, main electrical pump, sprinkler pump, diesel pump are installed; sprinkler system; fire tenders and fire safety control room.

A large number of fire incidents happened due to carelessness/negligence of the employees. Such incidents generally happened in the hostels rooms, offices, etc. Most of the fire incidents occurred in the building happened due to electrical short circuiting due to naked wire/loose wires, leakage/seepage on the electrical wire, use of faulty electrical equipments, overloading and old wiring. In order to secure a hospital from fire incidents, the general preventive

measures should be undertaken regularly which includes that all the building should have proper fire safety arrangements connected with a centralised fire control room which should be monitored by the trained fire staff; availability of fire extinguishers in sufficient numbers; all the escape routes should be cleared all the time to meet any exigency; faulty equipments should not be used; overloading should be avoided; carelessness should be avoided and due care be taken; all the staff should be imparted with basic knowledge to use fire safety equipments; since most of the fire incidents happened due to electrical short circuit, the concerned must ensure regular electrical wiring/equipment, load, etc.; smoking should be strictly prohibited; regular maintenance of electrical fittings/equipments be done; regular checking/maintenance of fire safety equipment; and regular firefighting drill must be undertaken.

INCIDENT INVESTIGATION

In a hospital large number of incidents such as theft, fraud, brawl, inducement, encroachment, damage to government property, impersonation, etc. happens as large number of floating population used to visit. To minimise such incidents, investigation and action is must. Each and every incident has two phases of investigation:

Preliminary Investigation

Preliminary investigations includes:

- Visit to scene of crime/incident with safety equipments.
- To assist the injured.
- Efforts to arrest the perpetrator.
- To identify the witnesses.
- To examine complaint and witnesses.
- To maintain scene of crime/incident.
- To protect the evidence.
- To detain and interrogate the suspects.
- To note down the positions, events and remarks.
- To collect the evidence
- To prepare the incident report accurately and elaborately.

To the scene of crime/incident as quickly as possible and maintained the same is one of the most important consideration of preliminary investigation. Promptness in arrival at the scene of crime/incident help in ensuring that evidence will not be contaminated or destroyed. Moreover, presence of witnesses will also be there. The follow up investigation may be started immediately after the preliminary investigation ends. The preliminary as well as follow up investigation also assures the patients/public that the hospital authorities are concerned with their problems and the matter has not been ignored. After conducting incident investigation a detailed report in this regard should be prepared by the security wing, which includes details of the complainant, background of the incident, causes and place of the incident,

propose action and suggestion with regard to preventive measures.

OUTSOURCING OF SECURITY SERVICES

Keeping in view the increasing need of security services to meet the day-to-day security related issues, most of the government/private organisations including the hospitals are outsourcing the security services through the service provider. Though the outsourcing concept has made tangible improvement in the field of security services but has some negative impact too.

The merits and demerits of outsourcing of security services in a hospital are as under:

Merits

- Cost effective.
- Easy availability of service providers in the open market.
- No recruitment process as required.
- Easy to remove in case of poor services.
- Less liabilities than regular employees.
- Easy replacement of workers.
- Better performance if supervised properly.
- Unorganised from trade union's point of view.

Demerits

- Lack of reliability.
- Lack of confidentiality.
- Lack of accountability.
- Lack of perfection due to heavy change over.
- Lack of commitment.
- Lack of loyalty towards the organisations.
- Exploitation by the service providers.

However, despite above-mentioned demerits, the system of outsourcing of security services is running successfully in almost each and every government/private organisations.

RECRUITMENT OF SECURITY AGENCIES

To overcome the above-mentioned demerits of outsourcing, the Government of India has passed and implemented Private Security (Regulation) Act, 2005, along with the Private Security Agencies Central Model Rules.⁴ As per this Act, it has been made mandatory that the service providers provide trained persons to the institute. Every service provider has to impart training and relative skills as prescribed in this Act. As per this Act, they have to give preference to the persons having service experience in Army, Navy, Air, Force and other Armed Forces of India including State Police and Home Guard. The training includes public dealing, wearing of uniform, physical fitness, physical secu-

urity, security of the assets/building/apartment, crowd control, firefighting, personnel and household security, etc. They should be able to read and write English alphabets and Arabic numerical and be trained regarding disaster management, crisis responses, handling of weapons, knowledge of IPC, etc. They should also be aware about the badges of ranks in military and police forces, use of security equipments and devices and the desired knowledge of arms. This Act has also specify the physical standard which is as under:

- Height: Minimum 160 cm for male and 150 cm for female, chest 80 cm with an expansion of 4 cm (no minimum requirement for female).
- Eye sight: Far sight vision 6/6, near vision 0.6/0.6. No colour blindness and able to read and understand English alphabets and Arabic numerals.
- Free from flat foot and knock knee and run one kilometer in six minutes.
- Hearing: Should be able to hear and respond to voice and free from defect.
- Should be able to perform searches, handle objects and use force to restrain an individual in case of need.
- Should be free from any infectious disease.
- He should undergoes a medical examination after every twelve months to ensure his continued maintenance of physical standard.

This Act is not only helpful in improving the quality of outsourced workers but also made a check on the mushrooming of such service providers who were earlier doing this business without following any rules and regulations and were providing untrained persons for these services.

It is therefore concluded that security department plays a crucial role in effectiveness of patient care services. It is not only the first contact with patients, but also happens to be the most contacted department by patients/their relatives. Functioning effectively, it can provide a healing and sympathiser role to patients besides disseminating essential information to them.

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Hospital Staff Management

Section IX

SECTION OUTLINE

- Chapter 44** Human Resource Management
- Chapter 45** Problem Solving Among the Hospital Staff
- Chapter 46** Patient Satisfaction
- Chapter 47** Nursing Management



Human Resource Management

Prof S Vivek Adhish, Dr Sangeeta Gopal Saxena and Dr Sonu Goel

*“If you want to reap benefits for a year, sow rice
If you want to reap benefits for twenty five years, sow trees
If you want to reap benefits for a hundred years, sow men”*

—A Chinese Proverb

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- describe human resource management, its relevance and functioning in a hospital.
- plan for the manpower needs of the hospital and be able to recruit them.
- make a plan for the training and development of the employees.
- chalk out a system of personal development and performance planning and appraisal benefiting the employees and the hospital.

INTRODUCTION

Hospitals around the world a couple of centuries ago were individually owned generally by the doctor himself, who managed the hospital and provided the clinical care to the out as well as the inpatients. With increasing clinical workload the doctor appointed a clerk for multifarious managerial activities like keeping an inventory, maintaining a register for receipts and expenditure, and looking for staff like nurses, orderlies, etc. whom the doctor would interview for selection whenever a position fell vacant. With the increasing size of the hospital and the complexities of treatment, managers were appointed to run the hospital, accountants for maintaining the accounts, and clerks to look after the selection, interview and recruitment of the staff as well as salaries and annual increments, welfare and discipline of the staff. This clerical work slowly graduated as the ‘Personnel Department’. The manager has now become the ‘CEO’, accountant – the ‘Director Finance’ and the Personnel Department – the powerful ‘HR’ with its chief reporting directly to the CEO.

HUMAN RESOURCE DEVELOPMENT

The human resource management, generally referred to as HRM or the more fashionable HR, department is a very important cog in management and deals with all the aspects

of personnel—selection of staff, their salaries, training, performance review, increments, promotions, welfare measures, retention of staff and disciplinary actions against them, dealing with labour unions and court cases.

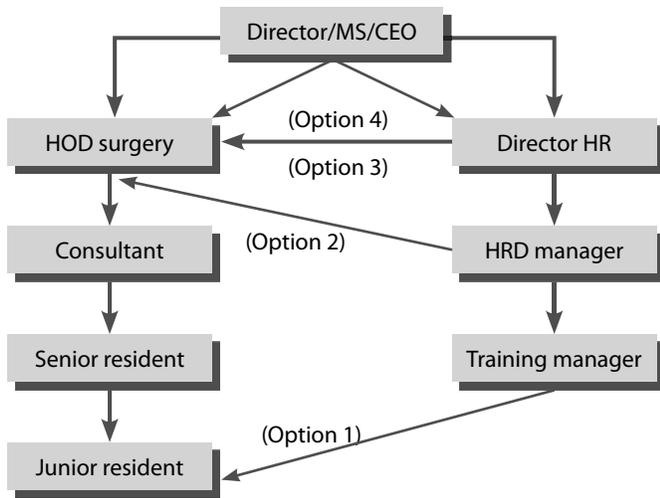
Hospitals being a service sector and HR being responsible for virtually all the activities related to personnel working in it, the relevance of HR need not be overemphasised.

It is no wonder that the Director HR reports directly to the CEO and works with the Board of Directors in chalking out the succession plan of the outgoing CEO. The challenge lies in ‘using’ the close association with the powerful prudently and unlimited powers with ‘restraint’ in the development of the organisation and harnessing the full potential of the human capital in the development of the hospital. Further, knowledge and application of most aspects of HR are needed by managers and supervisors (whether in HR or not) in efficient performance of their activities (Flowchart 44.1).

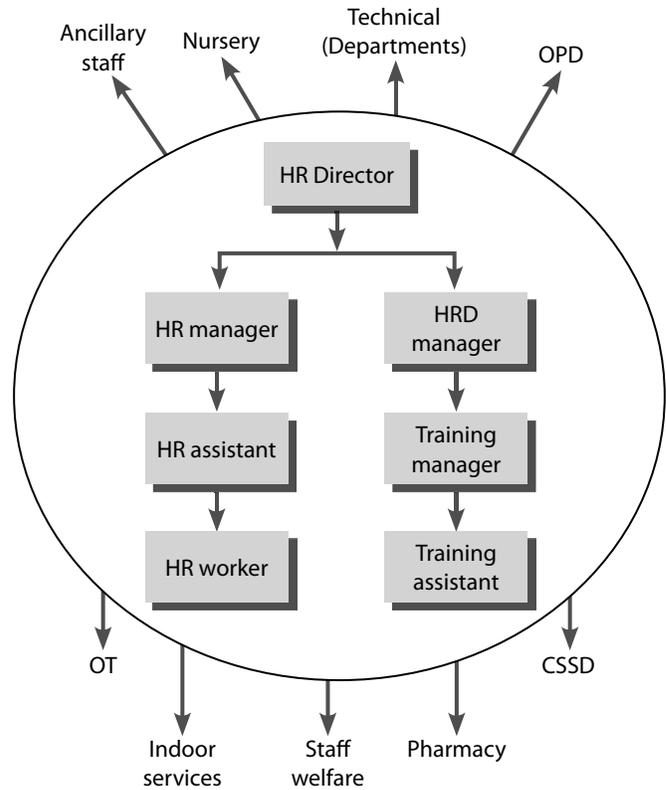
The HR also has all the functions of managing human resource, viz. strategic leadership, motivation and supervision of the employees, team building, etc.^{1-5,7}

Functioning of HR

A surgeon operates a patient and instructs the senior resident assisting her/him to observe the patient in the recovery and, if stable, transfer him to the ward after 6 hours. She/he



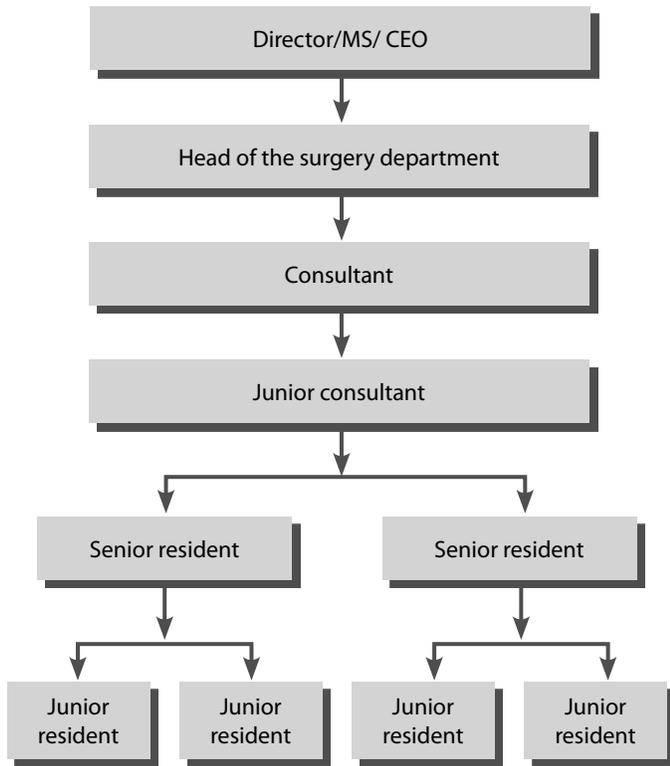
Flowchart 44.1 HR practices: **Option 1:** Training manager orders junior resident for attending training on CPA: poor HR practice. **Option 2:** Training manager requests HOD surgery to nominate the junior resident for training on CPA: good HR practice. **Option 3:** Director HR orders HOD surgery to initiate structural changes in the department: poor HR practice. **Option 4:** Director HR requests CEO who orders HOD surgery to initiate structural changes in the department: good HR practice.



Flowchart 44.3 Within the circle, the HR is line function. Outside the circle, with all the department/sections HR is a staff function and has an advisory and support role.

Certain departments, though very important as far as the functioning of the hospital, are concerned (like stores) to have a supportive and advisory function. The stores officer will work with the clinical departments for getting the best possible air mattress, which the surgeon needs for his patients, extend every possible advice and suggestion, and provide best possible support, but will not interfere in the functioning of the department. If at all she/he thinks it to be necessary to interfere in functioning, she/he will go through the head of the department and doesn't interact directly with the staff. This is known as the 'staff function' (Flowchart 44.3).

HR is a 'staff function' and its prime role is to provide support and advisory role. At no stage HR Director interferes in the functioning of the departments. It has little authority over the employees of other departments and has virtually no powers of enforcement. Yes, within the HR department it may have a line function, i.e. can directly instruct the Human Resource Development (HRD) manager. Similarly, if the HR is running the canteen in the hospital, it becomes a line function and can directly instruct the canteen supervisor. The HR Director cannot interfere in the functioning of the cardiology department and instruct the senior resident to do something (even though the senior resident is junior to the HR Director). If needed, the advice/suggestion should be routed through the head of the department.^{3,4}



Flowchart 44.2 Line function.

then instructs the junior resident to examine the patient every 2 hours and inform SOS. There is a direct line of command called a 'line function' (Flowchart 44.2).

They may counsel, negotiate or suggest, but should never order. This creates controversies and upsets the apple cart. An authoritative HR Director results in conflicts and demotivated staff, thus adversely affecting the functioning of the hospital. The net outcome is human resource destruction instead of human resource development and is an indication of poor human resource management. Inefficient and bureaucratic HR Director again adversely affects the functioning of the hospital (though there may be few conflicts) and reduces the HR to a clerical level or in other words going back in time to the clerical personnel management days.

HR in the Government Sector

In bigger hospitals of government sector, the administration is a separate entity looking after all the aspects of HR along with accounts function. It has sectional heads and accounts officer/s, all of them under an administrator, generally a Deputy Director Administration (DDA). She/he may be a Class I officer and even be a senior IAS officer in bigger hospitals like All India Institute of Medical Sciences, New Delhi. The DDA is the Director HR and Director Finance in one who reports directly to the Director or Medical Superintendent of the hospital (the counterpart of the CEO in the private sector).

The principles of management remain the same whether in the private or the government sector. The HR and finance are staff functions, and the role remains supportive and advisory only. The medical superintendent should not permit the DDA to misuse this closeness, and interfere in the departmental functioning and issue commands. This happens more often than not resulting in conflicts and ego clashes. The hospital's functioning and the morale of the staff takes a beating as the DDA is junior to the heads and more often she/he is functioning with the covert/overt support of the medical superintendent.

RECRUITMENT³⁻⁵

The interview committee was getting disgusted for not getting even an average candidate, leave alone a good one. The interview was for an important supervisory post of an officer grade with a decent salary, where the incumbent was responsible for the maintenance and upkeep of around 300 computers in the organisation. The vacancy for the last 1 year was adding to the never-ending woes. The majority of the users, middle-aged doctors and nurses, and professors engaged in teaching, with limited computer literacy did not help either. The incumbent was also to help the staff, some of them very senior doctors and professors with tall egos and little knowledge about computers, who called for instant help for trivial issues like saving the files downloaded from the internet, scanning documents and at times taking a printout in the desired format! In the last 4 years three young, competent and ambitious computer engineers had joined, having been selected through campus interviews in reputed computer engineering colleges, and all of them left within a few months of their joining. They blamed the atmosphere of the

organisation, the behaviour of the staff, and lack of job satisfaction and career prospects in their exit interviews. The staff on the other hand complained continually about the noncooperative and high-handed approach of all the three engineers. The decision before the committee was whether to select a below-average candidate for that crucial post or go through the long process of recruitment once again hoping to find 'Ms/Mr Right' and till then live with the never-ending problems.

Just to help you in deciding, the organisation is a subsidiary of the state government. Please answer the following questions:

- What do you think was the decision of the committee?
- What are your suggestions as an HR expert?

You will recall that the personnel department started with the clerical work of appointing the staff when the doctor who owned the hospital did not have the time to select the needed staff. This personnel department was transformed into HR department over time. What was the reason? Should the selection of the right candidate be a problem? Seemingly no, especially with the supply being much in excess of the demand. But is that the ground reality? Why is it that we do not get the right person easily? Even before we start the process of looking for the right candidate or 'head hunting' we should be crystal clear as to what kind of a person are we looking for. This is the only way for avoiding the selection of square pegs for round holes.

Suppose we want to appoint a surgeon. Doesn't everybody know what she/he is supposed to do—operate of course? The hospital appoints residents, senior residents, junior consultants, senior consultants, and chair or head of the department. Do they perform the same role? No. Will then a good consultant be a good resident and vice versa? In all probability neither of them can step in the other's shoes. So look for a person for the job she/he has to perform. We all think this is seemingly easy as we think we know what she/he has to do. After all we have been running the hospital for years. This is the first hindrance.

Do we really know the job a person has to perform or is it written anywhere? Most likely this is not the case. The first step should be trying to **analyse the job** of the person to be appointed and put it on paper. It is only when we get down to write if we realize it is not so simple. The best method for the HR manager and the immediate supervisor would be to interview few (2-4) good workers. Checklists may be used to know the details of the activities to be performed and the level of expertise needed. Yes, the worker would definitely exaggerate a bit, but we will at least get a holistic view of the work to be performed by the worker.

Once the job is analysed, the next step is to write the **job description** of the work expected of the incumbent. This will include activities to be conducted, the expected behaviour, the personality needed, and the desired standard or the quality of work. The required skills and the level of competency should be clearly written in unambiguous terms like 'endotracheal intubation' or 'starting an intravenous line

in a newborn. 'Any other work assigned by the head' is added generally to safeguard the organisation. This seemingly boring and unimportant paperwork is actually very useful—for both the applicants and the selectors.

If this job description was given at the time of the campus interview, do you think that those bright engineers would have applied?

Definitely not—and it would have helped them as well as the organisation.

The next step is to match the specifications of the individuals who are likely to do this job. These **specifications** are in terms of age, qualifications and grades, experience, behaviour and personality, etc. The specifications are generally mentioned as essential, i.e. every body must possess and desire. This means, it will be appreciated if they have them.

The salary, perks, leaves and the likely promotional channels should also be given. The candidates will now have a very clear picture of what they are in for (Flowchart 44.4).

So, what do you think tempted the computer engineers join the organisation? Yes you are right—the incomplete job specifications in the advertisement without the job description and the good salary and official status tempting them. The result—poor working in the organisation and poor take-off in the careers of the three bright engineers along with frustration; though they must be much richer in experience now.



Flowchart 44.4 HR recruitment process.

Inviting applications from the desired candidates is the next step. Visualise the jobs or places they may be in and then plan the strategy to reach them. We should visualise if they are likely to be in academic institutions, service hospitals, or students or residents. This helps us in reaching them. All the media, especially the print and the internet should be extensively and appropriately used.

Screening these applications then follows and may be a Herculean task if the number of applications is large. Going backwards, normally six times the number of vacancies is called for interviews—though there is no hard and fast rule. The supervisor, HR official and an expert should sift these applications generally in two stages. In the first stage, the ineligible candidates (those not fulfilling essential criteria) are weeded out and in the next round those likely to fit the bill are selected. The government organisations need to follow the government rules and a list of all the candidates is prepared mentioning their qualifications along with other important details. A screening committee then examines and sifts those with the essential and desirable qualifications. Meeting the essential qualifications is non-negotiable. References are generally asked for. If the number of candidates meeting the essential qualifications is very large, a screening test may have to be conducted. A skill test may also be conducted before the interview. The candidates should be informed about the weight, age or both (screening and skill test) to ensure transparency. The certificate of the candidates should be checked before the interview to confirm their eligibility. The verification of the original certificates of the selected candidates will be done again at the time of joining.

Conducting the interview is the vital cog in the selection process. Setting a good question paper requires a lot of home work and serious commitment on the part of the teacher, and an interview is no different. Conducting a good interview is not only an art but also a serious business. The objectives and methodology should be discussed amongst the members in advance after the officer/herd from the concerned department has briefed the group about the knowledge, skills, behaviour and personality of the required incumbent. The hospital is a service department and the ability to function in a team is vital. The technical skills are very important; but during the interview, the emphasis should be on values, diligence, integrity and concern for the patients as well as the staff. The personal goals and the organisational goals should be overlapping and congruent rather than divergent.

The group should question in a coordinated manner after making the candidate comfortable. Ample opportunity should be given for the candidate to express himself rather than the interviewers themselves doing most of the talking. Decorum need to be maintained, and personal and irrelevant questions should not be asked. The emphasis should be on finding out what the candidate 'knows' rather than 'not knows' during the interview. The decision has to be

taken after the interview; however, during the interview the candidate should be helped in giving the best performance.

Competency-based Interviews

The training has become competency based over a period wherein we assess the competency achieved by the trainee at the end of training, unlike the past where we limited ourselves to the knowledge gained. Similarly the trend these days is for competency-based interviews. In the process of competency-based interview, the candidate is asked to look back at the place of work and think of a problem her/his team faced and describe the efforts for solving them. Yes, the candidate may not be prepared for such a question and so should be made comfortable by giving time to think, say a minute, and supplying tea/coffee, etc.

The response of the candidate is then patiently but carefully listened to. The emphasis should be on the candidate's description of the problem and its analysis, finding the reason and deciding on the solutions thereof. Throughout this endeavour, the role of the candidate and the involvement of the team in the problem solving should be assessed. The candidate may be smart (remember that the candidate might have undergone managerial training) and say that we did this, we did that, etc. The interviewers may then probe the candidate by asking the role specifically performed by her/him and the carry home message taken.

Active listening by the interviewers will help them learn about aspects like problem identification and analysis, finding the solution and its implementation along with the importance given to teamwork. Remember the emphasis should be on the values, skills and taking the team along in goal achievement rather than technical knowledge.

Needless to say such interviews take a long time—generally an hour each and the candidates are informed accordingly with the timings of interview staggered for the candidates. The interviewers should discuss about the candidate before calling the next candidate. The discussion should focus on the academic excellence and the candidate's performance as a team player. The very good and the very poor ones hardly need a discussion. It is the mediocre ones that take time; or if there is a difference of opinion amongst the board members, it should be discussed and not rushed. The immediate grading is very helpful at the end when some of these mediocre ones have to be selected.

Head Hunting

The corporate hospitals these days have become high tech and the clients (patients) come to the hospitals drawn by high flying big names, not only within the country but from abroad. The top management should decide in which field such doctors are needed or at times even the doctors by name. It may require negotiations and at times employment agencies may have to be hired. One of the best methods is

what Mario Puzo wrote 'Reason with him. Make an offer he cannot refuse.'

Words of Caution

Giving much emphasis on objectivity and fairness like marks in school and college and the written tests conducted gets the best candidate as far as knowledge is concerned, but as an employee she/he turns out to be mediocre. The reason is that for a good employee though knowledge is very important but values, temperament, personality, attitude towards work, will to succeed and desire to perform are equally important. These cannot be judged through exams. These can be found only through an interview or observing while working (which is not possible). Relying only on an interview though may get the best candidate, puts a question mark on the fairness of selection, especially when corruption is rampant in our country. The government has made a mix of both, like in the civil services, to get the best of both the worlds.

In the current scenario we have enough applicants to choose from and, in fact, are spoilt for choices. With the development of our country and an era of scarce supply and increased demand, the unemployment is going to go down and selections may have to be made without these luxuries. The HR system should start gearing up and plan for future selections in the more realistic scenarios. This will need regular review of and by the HR.

Contentious Issues in Selection

Lateral entry

The single-most cause of bad blood amongst employees after favouritism is the lateral entry of employees from other organisations. Whenever an outsider is appointed ignoring the employee working for years or even decades at times, is generally not taken in the spirit the management would like. People start looking outside the organisation and the morale goes downhill. Frequent lateral entries generally result in the majority of the efficient workers moving out, leaving behind the grumbling and inefficient mediocre or below-average ones. On the flip side, fresh blood is needed to bring in new ideas and working styles in an organisation and removes stagnation. No right or wrong answers, but a balanced view with the full involvement of the staff is perhaps the right answer. Good manpower planning may eliminate the heart burning. High attrition rate is a sign of employee dissatisfaction. HR managers should discuss the issues with the employee leaving out of an organisation and help resolve the same.

Rehiring of old employees

Rehiring or re-employing an old employee on a post senior to the employee's peers in the organisation should be

weighed before deciding. The other employees should not get the impression that the best way to go up the ladder in the organisation is by moving out and then coming back after a few years.

Psychometric testing

Psychometric tests have been validated and used frequently, but are said to have doubtful efficacy in multicultural and multilingual setting. The organisation can take a call on the issue consulting the experts and the particular issue under consideration. No right or wrong answers.

Employee retention strategy

This is always a challenge in the era of cut-throat competition and aggressive head hunting. There are no clear cut solutions to this problem, but an active HR doing its homework well can manage to retain the majority, if not, all the staff. Retaining all the staffs is a dream in today's scenario.

Staff Turnover and Workforce Stability

Staff turnover is the percentage of the total staff that left the organisation in a year. The majority of the persons who leave an organisation do so in the first year of the job. The proportion of the staff with more than 1-year experience to the staff appointed in the last one year expressed as a percentage is an indicator of the workforce stability. Both the indicators should be calculated department wise and for the hospital as a whole. The exit interviews of the employees resigning gives crucial insight to the reasons of dissatisfaction of the staff and should always be looked into seriously.

Pay scale at parity with the other hospitals is very important for retention of staff. A slightly higher salary goes in favour of the hospital. However, the better salary is not the only reason why people hop jobs. A personal development plan of every employee should be prepared by the HR along with the employee. Appropriate training and right placement is crucial. Motivation and due recognition goes a long way in employee retention. Counselling session should be held regularly and whenever needed.

Constant dialogue between the organisation and the employees to know not only their unrealistic demands but also their ever-changing needs is a way out. Material benefits, though important, are not the end. Recognition and job satisfaction needs due attention. Strangely, the employees are not very unreasonable and would not like to change if they are made comfortable and feel wanted. Communication is the key to success.

Challenges in the Government Sector

The appointments are generally made by the Union Public Service Commission (UPSC) or the Staff Selection Boards. The process may take years, at times, and vacancies at senior management levels adversely affect the functioning of the

hospitals. A tendency to reappoint retired persons or appoint persons on contract has been initiated to tide over the crisis. This hardly serves the purpose as it is generally not possible to get senior staff on contract; reappointments are seen as geriatric rehabilitation with the retired persons reluctant to take 'orders' from juniors and the fresh contract employees hardly take it as a career opportunity due to poor remuneration and future prospects. Further changing the job requirements is a long-drawn process resulting in appointment of a person with little knowledge of the current job requirements.

So what is your judgement about the case study? Well, we should never select an incompetent person as she/he will be a liability for the organisation—and in a governmental one, perhaps life-long liability. The question that follows is that what should then be done. The job analysis will show that we need a supervisor who oversees maintenance, but the critical job is providing timely help to the egoist staff. What is needed is a trainer with a lot of patience. As it may not be possible to hold training courses on computers for the big bosses, this person should provide need based on the job training of short duration, say 15 minutes at regular intervals, whenever she/he is called and the complaints will stop. The job description and the job specifications should change accordingly.

HOSPITAL STAFF SKILL DEVELOPMENT

The medical superintendent of a large hospital circulated a copy of the note sent by the hospital epidemiologist to the heads of all the departments, including the HR. It read 'it has been observed that in the past few years the hospital-acquired infection rate in the nursery, urinary tract infections and wound abscesses in the surgical wards are showing a seasonal rise in summers. In winters the infections in the nursery are stable, but urinary tract infections and wound abscesses in the surgical wards again show a rising trend. The medication errors are showing a seasonal rise in summer months and are stable thereafter.' The hospital has a policy of hiring resident doctors on a contract from 1–3 years in the month of May and nursing vacancies are also filled annually in the month of May. The HR manager was thinking as to why a copy was marked to her by the MS and was wondering if the old lady is going nuts. Was not this the problem of the epidemiologist and the HOD microbiology, chairing the hospital-acquired-infection control committee, supposed to solve?

Question: What is your opinion?

A hospital is a human resource intensive setup and good services provided by the staffs are determined by their talent, temperament, attitude, values and morale. The HR has the maximum say in the selection of the staff. Does their responsibility end there or do they have a say in delivery of the services too?

The HR is a staff function, i.e. supportive and advisory, and this role is continuous. In fact, HRD is their prime responsibility and every big hospital should have an HRD unit in the HR Department. It should be headed by a

professional trainer and need-based training should be an ongoing activity in a planned manner. The surest way to demotivate a new employee and hamper the functioning of the hospital is by leaving her/him in the hospital and let her/him fend for her/himself. Learning will be there by trial and error; but that is the worst-possible method of learning for an individual and the hospital has to pay dearly for it.

Induction Process

The HR goes through the routine formalities of verifying the certificates, references and the medical reports before issuing the appointment letter. The incumbent then joins the hospital on the due date and reports to the HR. The HR official (at least one rank senior to him) should welcome her/him, accompany to the concerned department and introduce to the immediate supervisor. The supervisor should then introduce the newcomer in the department family (that is how the new employee should feel), i.e. each and every one in the department and then take her/him for a guided tour of the hospital. Introducing all the staff is neither possible nor desired, but should be done for the key persons with whom the interaction of the employee is likely. The routes should be made familiar (especially the ones that are open throughout the day) along with the timings of the ones that are closed. The cafeteria, its timings and specialities along with seemingly unimportant issues like the parking lots, bus and metro stations also be shown. The idea is to make the incumbent comfortable and feel at home.

A checklist should be given to the newcomer giving the names (and telephone numbers) of the key persons that she/he is likely to interact with and meetings should be arranged with them in the first fortnight with a departmental staff accompanying her/him.

Induction Training

An individual can give her/his best only when it is made crystal clear at the outset what is expected of her/him. The job responsibilities help in knowing what is expected out of him/her during the job and explanation by one of the superior/supervisor will help in clarifying things further. Each and every newcomer needs induction training, the duration and methodology may vary. Though advisable, long and thorough induction training like in the civil services or defence is generally not feasible in the hospitals. Innovative induction training is the need of the day.

The training need of each employee should be assessed. This is the difference between the knowledge, skills and attitudes of the individual at the time of joining and those needed for the optimum performance of the job. The HR should make an induction training plan for each category of personnel in collaboration with the departments concerned. She/he should list out the skills and activities that are vital or essential for the individual to be trained in. The plan in

which the supervisor will train and raise the competence to the desired level (to be measured by a checklist) before leaving her/him to work independently is the second step. Once these vital or essential skills have been attained, the training plan for the desired skills be chalked out and implemented.

For instance, the induction training of the urology chair appointed may be in the form of a half-an-hour discussion with the Director/Medical Superintendent over a cup of tea or over dinner, if the time needed is more. The residents may be given half-day training about the general rules of the hospital and the policies regarding outpatients, investigations, admissions, discharges, etc. The further training should continue in the departments.

I guess, you must have found out the reason for the epidemic of infections and medication errors in the summer months—no or poor induction training. Any guess for the epidemic of infections in the winters without the corresponding increase of infections in the nursery?

Inservice Training

Hospitals have a lot of similarity with the hospitality sector. Both are service sectors and labour intensive. Quality of services along with client satisfaction is of paramount importance. We tend to visit the hotels where the food is nutritious and tasty (quality), and the service and the behaviour of the staff is pleasant (client satisfaction). All the good hotel chains have a good HR and give a lot of importance to trainings in interpersonal communication skills—both verbal and nonverbal. Do the hospitals have such a programme? HR should regularly study the level of client satisfaction, the reasons for satisfaction as well as dissatisfaction and conduct courses regularly in small batches for every level of employees.

There should be regular courses for supervisors in supervisory skills, motivation and leadership. Along with it, imparting on-the-job training to the employees should also be a regular feature. It is the responsibility of the supervisor to make the employee perform at the desired level of competence through training, motivation and continuous monitoring. If an employee is not performing to the desired competency level, it should be found who is responsible—the employee (for not performing job), the HR (for improper training plan) or the supervisor (for inadequate training)? The employee may not always be at fault. In fact she/he is generally not at fault and is often made the scapegoat.

Promotional Training

In the job analysis we saw that the jobs of the residents and consultants were quite different, resulting in two different job descriptions being prepared by HR. The junior resident being promoted to a senior consultant may have the requisite job specifications; but for effective functioning should be

treated as a new employment and therefore induction training is needed. This may seem too bureaucratic, but she/he should definitely undergo a promotional in-service training. This is a regular feature in the defence and civil services. In fact, for the promotion to the rank of Brigadier or Joint Secretary, it is mandatory for the employee to undergo senior officer's training, failing which the promotion is deferred till that is completed. It may not be possible for the hospital to conduct such specialised management training. The HR can look for institutes conducting such courses and nominate the employees for these trainings. In fact, the HR should sign an MOU with such an institute explaining their requirements and nominate the staff accordingly. If a large number of employees, say nurses, numbering around ten have to be promoted in around 6 months, then a special tailor-made course may be organised for them by a professional organisation.

Specialised Technical Training

In the era of fast-changing technology, a hospital can maintain its cutting edge by keeping the staff trained in the latest technology. It is a costly proposition as the majority of them will be abroad. The HR along with the top management and the heads should come out with a realistic plan based on their appointment systems. Many successful hospitals, like many industries, fade away for not implementing timely modernisation and well-defined training plan for employees.

Self-development

The staffs also develop areas of interest in which they want to excel. The hospital should encourage them. After all, if the staffs do well the hospital also does well. Fame to a doctor brings fame to the hospital too. To quote Bill Gates 'If my employees become millionaires, I automatically become a billionaire.'

One of the methods is by giving them some paid academic leave per year wherein they can go to trainings, courses, conferences, etc. of their choice.

Skill Audit

Like other audits, the skills of the sections and departments of the hospital need to be audited. The desired level of the skills is decided by the top management in consultation with the departmental heads, HR and outside experts. Then the skills present in the employee are measured based on present criteria. The gap that is found is filled up—which may be by training or, at times, technology upgradation. The skills deficit in the finance department may need computerisation or introduction of new software along with the commensurate training of the staff. The skill audit in the gastroenterology

department may suggest just training of the senior residents or may be purchasing the latest endoscope or both.

Yes, HRD is a costly proposition. It may consume 1–2% of the hospital budget; but if well-planned and executed, it is a worthwhile investment. The return on investment is excellent and has many intangibles like client satisfaction and improved quality of treatment. The parallel of HRD is the investment on advertisement in sales and marketing. The investment is huge, but is generally rated as money well-spent.

Before ending the section on human resource development (HRD) let's get back to the last question on the increase in UTI and wound abscesses in winters. The reason was slightly strange. The staffs were washing hands less frequently and not well enough, as the water was very cold and hot-water facilities were not available in the wards. The operation theatres and the nurseries had a supply of running hot water as they had a hand-washing/scrubbing protocol. Training cannot solve this problem. It is a nontraining intervention. Regular hot-water supply or alcohol-based disinfectants being made available is the solution.

So it should always be remembered that training is not the panacea for all problems. Managerial issues will need managerial solutions.

HR Planning

Manpower planning

The hospital will retain its reputation and position as long as its staff retain a cutting edge in technology and management. To reiterate, this will happen as long as the training of the staff is commensurate with the required skills. A good HR manager will make the plans for training and development, not only for the present but also for the future. The United States eased the visa restrictions for nurses after a projection that they were likely to face a severe shortage of nurses in the coming decades. UK eased the restrictions for paediatricians two decades back and psychiatrists a decade back based on similar projections. The availability of surplus qualified human resource is going to get scarce and the hospitals would not have the luxury of relaxing visa restrictions. The hospitals therefore not only need to have to plan for the future but also come out with pragmatic solutions to avoid the scarcity. They just cannot function with manpower shortage.

Superannuation

The likely dates of superannuation of the senior technical staff, viz. doctors, nurses and technicians should be charted. Their replacements should be planned and trained so that they step into their shoes the moment they superannuate. Vacant positions—especially senior position—reflect inefficient HR. Likely vacancies should be forecasted and timely process for their recruitment initiated.

Planning for expansion and technological upgradation

There is a very popular 200-bedded general hospital in a B-grade city with a population of around three million. It is doing a very good business and commands the respect of the community for providing quality services at reasonable cost. The Medical Superintendent has the future planning of the hospital as follows:

- **Immediate future:** Establishing a retina clinic with fluorescein angiography and laser treatment, MRI scan, cardiology clinic with CT angiography, and stress thallium and a dialysis unit.
- **Medium term:** In vitro fertilisation (IVF), coronary artery bypass graft (CABG) and renal transplant facilities.
- **Long term:** Liver and knee transplant facilities.

How will you proceed as an HR Manager? Let's start with a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis.

Strengths: Well-established hospital with a good reputation. The patient will be benefited by expansion as they may not have to go to metro cities.

Weaknesses: Not enough qualified doctors, nurses and technicians, and their need will multiply with the expansion. Qualified staff from the metros is not willing to shift to the smaller city and the problem may actually worsen with the falling unemployment rates. Only mediocre ones are willing to shift. They too do not bring their families and are going home often. They leave the job the moment they get an equally paid or, at times, even slightly lower-paid jobs in the metros.

Opportunities: Stable efficient staff at present fulfilling the current requirements.

Can they be trained to fill majority of the posts that will come up?

This is the challenge HR has to meet.

Threats: New hospitals may come up; but that is actually not a major threat as the hospital is well established.

The challenge for the HR is mapping the requirement of the staff according to a time plan, making a good training plan, selecting the right motivated and competent people, and identifying the institutions in India and abroad that can fulfil the manpower needs as they come. Very few people should be recruited from outside the organisation by head hunting. Junior- and middle-level staff should preferably be developed from the hospital itself. The staff may be asked to sign a bond if they are being sent for costly trainings abroad at hospital's expense.

Technological planning

The hospital can maintain a cutting edge only if it has the latest technology with trained manpower. If manpower planning is a challenge, the technological planning is a still

bigger challenge. Planning for the increase in the number of beds in the hospital or increasing the outpatient services in the next 10 years may not be affected much by unforeseen factors. It is generally seen as a 'stable product'. The laundry requirement over the years may not see a drastic change and, at best, cotton bed sheets may be replaced by some other material. The detergents may change but by-and-large the requirements will not change much. The technology on the other hand is changing at a pace never seen before. The CT angio was seen as breakthrough advancement. Tracing its path since its introduction in less than a decade, we saw it improving from 64 slices/s to 128 slices/s to 256 slices/s to dual core to multidetector technology. The hospital that installed a 64 slice/s CT angio 6-years back and boasted of the latest technology is today with an outdated technology. The cost is prohibitive and getting trained manpower is equally difficult. This is not only for CT angio but for virtually every technology, whether in radiology, radiotherapy, pathology or the surgical specialities. These are known as 'unstable products', and are not easy to plan and forecast. This is one of the biggest challenges for the hospitals today and the HR should gear up to meet this challenge. It is something like the mobile and computer industries' challenge.

PERFORMANCE APPRAISAL⁶

There is a small 60-bedded hospital in a town of half-a-million population. The surgery department has a male and female ward of six beds each. Each ward has a junior resident and a senior resident. The consultant is overall in-charge of the department. Both the senior residents, who happen to be MS in general surgery, assist the consultant in the surgery. The junior residents are rarely called for assistance in the operation theatre. Their job is to look after the patients, prepare them for surgery and dress them after surgery. Infections plague the hospital—not only the surgery department. The HR Manager joins the consultant for the performance appraisal of both the junior residents. He studies the statistics and finds that the percentage of patients developing urinary tract infection is equal in both the male and female wards. The performance appraisal goes as follows:

Resident A from the female surgical ward

Background: A poor student with three supplementaries from a below-average medical school.

HR Manager: Were you trained in catheterisation by your senior resident?

A: No Sir.

HR Manager: Do you wash hands before catheterisation?

A: Yes Sir.

HR Manager: Show me how do you wear gloves?

A: Demonstrates a wrong technique.

HR Manager: Were you ever taught how to wear gloves?

A: No Sir.

HR Manager: Were you ever told to wash hands before catheterisation?

A: No Sir.

HR Manager: Then why do you wash hands before catheterisation?

A: Sir, I once heard senior resident yelling at B that you should wash hands before catheterisation.

Resident B from the male surgical ward

Background: An average student from an average medical school.

HR Manager: Were you trained in catheterisation by your senior resident?

A: Yes Sir.

HR Manager: Do you wash hands before catheterisation?

A: Sometimes Sir.

HR Manager: Show me how do you wear gloves?

A: He demonstrates and the method is not correct.

HR Manager: Were you ever shown how to wear gloves while catheterisation?

A: Yes Sir.

HR Manager: Were you ever told to wash hands before catheterisation?

A: Yes Sir.

HR Manager: Why don't you wash hands before catheterisation and wear gloves as taught to you?

A: Sir, the gloves are not properly sterilised by the CSSD and washing hands—both before and after catheterisation—with cold water is a pain.

HR Manager: Were you reprimanded by your SR?

B: Yes Sir, but he is generally yelling.

Question: What will you write in their performance appraisal reports?

The performance appraisal has been done as an annual ritual in the government offices and is called as Annual Confidential Reports (ACR), and is generally referred to as 'chamchagiri' (sycophancy) report as the closeness to the bosses or the corridors of power was generally directly related to the quality of assessment in the report.

The individual was supposed to fill a self-appraisal in which the activities done in the financial year were filled in the form and sent in a sealed cover to the reporting officer—the boss—who would write her/his comments and mark it to the reviewing officer in a confidential cover. The reviewing officer, who at times did not know the worker being reported on leave alone her/his work, would write the final comments. The document then would be sent back in a sealed cover and kept under lock-and-key to be opened on the judgement day of the Departmental Promotion Committee (DPC). The worker was never informed of the comments unless they were adverse, in which case a representation was permitted.

Reporting Officer: The officer is punctual, knowledgeable and competent, but needs supervision.

Overall grade: Good

Reviewing Officer: I agree that Mr. so-and-so is a good worker.

The report was kept in sealed cover and not communicated (as the comments were not adverse). It was opened on the day of the DPC and the officer was not promoted, as 'very good' was the criteria for promotion.

No communication, no objectivity and no promotion if no chamchagiri; and the result, a sincere employee stopped working and started creating problems for which the boss could not do much as the disciplinary process favoured the employee the way the CRs favoured the boss.

In the recent years, the process has been slightly reformed and some transparency is introduced in many organisations. A copy of the report with the comments of the reporting and reviewing officer is sent to the person concerned and she/he can make a representation, if not satisfied. The Sixth Pay Commission had recommended an increased rate of increment for high performers (like the private sector), which however was not accepted by the government. Perhaps it doubted the integrity of the system.

The performance appraisal in the private sector has generally been the appraisal or review of the last years' performance of the subordinate by the boss. It is used for deciding the raise or promotion or a pink slip, at times. Over the years, the system has been refined with the review being made more scientific and useful—both for the employee and the organisation.

Two systems are followed: anniversary and the calendar method.

- In the anniversary system, the candidate's appraisal is done on the anniversary date of appointment. The advantage of this method is the appraisals are staggered over the year, and there is no rush and the office work is not affected.
- In the calendar system, the appraisal of all the employees is done around the same time. The advantage of this method is that comparison between employees becomes easier and may help the manager in making appropriate decisions. The flip side is that too much time is spent in the appraisals affecting the routine working.

Normally, the employee, the immediate supervisor and the HR Manager fixes an appointment, giving everyone the time to prepare for the meeting. The meeting is done in a quiet place with no disturbance like the telephone. The employee is made comfortable and given time to explain the work that was to be done or planned for the year and the extent to which it was achieved. The conditions helping and the obstacles are also asked for. The employees' assessment about own self and how it could be improved upon is probed into. A fairly good assessment is possible and is being followed in most of the organisations. The raise in salary is often decided upon this review.

The assessment of the individual by the immediate supervisor is generally not considered good enough as there may be biases and interpersonal conflicts.

A 360° Appraisal or Review

The employee's review is done by the supervisor, the subordinates and the peers. Even the opinion of the clients

whom she/he is dealing with is also asked in order to review the employee. The result of all the reviews is then collated and the feedback is given to the employee. The 360° appraisal has helped the organisations in improving their performance and has come out with excellent feedback—both for the employees and the supervisors. In fact, the reviews have even recommended counselling by experts and that has helped the employees, supervisors and the organisations. The counselling is not only restricted to the employees but also of the supervisors as they may be responsible for the suboptimal job performance of the employee.

Recent Views on Performance Review

The annual performance reviews consume a lot of time of the organisations; and managers are coming out with methods that not only review the workers but also help the organisation and the workers.

The students should be assessed on what they are supposed to learn. Similarly, the workers should be assessed for what they are supposed to do. So first of all the worker and supervisor should decide what the worker has to perform in a year based on the mission and vision of the organisation and her/his job responsibility. This should form the benchmark for the review.

The performance should not be reviewed at the end of the year as a summative assessment but throughout the year—as sort of formative assessment. The support given throughout the year by the supervisor should also form an integral part of the review. This holistic assessment helps the worker and the organisation in assessing the performance and gives vital feedback to the worker and the supervisor.

Coming back to the review of the two residents, what is your view?

The resident **A** had a poor academic record, but did try to work diligently. Overhearing the other senior resident about the importance of hand-washing, she/he immediately adopted the practice. The resident could not wear gloves in the right manner as it was never taught. The fault lies with the senior resident and not **A**. The rate of UTI was the same as **B**; but UTI is more common in women and perhaps the hand-washing reduced the UTI.

Resident **B** though better-qualified made no attempt to catheterise properly despite training and being reprimanded. **B** was wearing gloves for her/his protection than preventing UTI in the patients.

Question: So what is your judgement?

The senior resident of **A** is a poor supervisor and should be counselled to take the job of supervision more seriously, especially on the job training. **B** should be warned that if the job is continued in this callous manner she/he may lose it.

CHALLENGES IN HR

Culture and Secularism

The workforce today is very diverse—multicultural with great ethnic, religious, language and racial diversity. It needs a handling with kid's gloves. Problems may erupt spontaneously and, at times, without provocation due to misunderstandings. There are no clear cut solutions; but a fair and sensitive HR can generally manage it without much problems. Framing and implementing nondiscriminatory rules with due sensitisation of the staff is the need of the hour.

Harassment

Harassment of the staff by the superiors and bullying by the colleagues is occasionally seen and sexual harassment is raising its ugly head. The policy of zero tolerance by the management should be followed. The HR has to work closely with the departments and needs constant monitoring.

Gender sensitisation of the staff should be done and the policy needs to be clearly explained. The language, gestures and jokes need to be avoided in mixed settings and the behaviours by the male staff with their female colleagues that will not be tolerated should be made public. Educating the males and informing the females about their rights is essential. A woman harassment cell needs to be formed and the complaints need to be dealt in a fair and serious manner.

Confidentiality

Information may be confidential for official or legal reasons. This has to be maintained and the HR should frame a policy on it. One of the principles is that when in doubt don't give the information. Withholding the information may be safer than giving it and facing consequences. Get clarifications from the seniors.

Grievance Redressal

The organisation should be fair to all, and every employee with a grievance should get justice. There should be a grievance cell that should look into every complaint by the employees. Rules need to be framed by the HR, which should be nondiscriminatory and fair. The enquiries should be fair and should not be tilted in favour or protecting the boss or the management.

Sadly, the handwork put in by the HR is rarely appreciated by the staff. Hardly anybody in the staff praises them and the clients hardly realise their contribution as they are working behind the scenes. They only receive brickbats and criticism, quite often for no fault of theirs. As we have seen in the

chapter, HR is the key to client and staff satisfaction, staff welfare, workforce retention, upgradation of the hospital and conflict resolution. An imaginative, innovative and proactive HR is the prime force in taking the hospital to great heights.

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Problem Solving Among Hospital Staff

45

Prof D Behera

“We cannot solve our problems with the same level of thinking that created them.”

—Albert Einstein

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- identify and analyse the root cause of the problems related to hospital support staff.
- devise various short-term and long-term solutions to such problem.

BACKGROUND

Hospital staff of different classes is an important component of the hospital administration for day-to-day running of the hospital. Hospitals are mainly meant for patient-care activities; therefore, it is essential that the functioning should be smooth and problem-free as far as possible. Since most of our hospital-related activities are human-driven, problem, if any, needs redressal. It is very important for the hospital administration to identify the problem first and then to take appropriate measures to mitigate them. The hospital administrator should devise methods of getting regular information regarding hospital activities on every day, weekly, fortnightly, monthly or yearly basis. While hospital information collected on yearly basis is usually useful for long-term planning, short-term information collected on a daily basis by the administrator is more useful in problem solving by operational management. Once the problem is solved, a system has to be developed for both the identification and solution of the problem(s), which requires continuous monitoring and control to avoid any deviation and occurrence of same or similar problem in future. Activity status (data) received on regular basis should be interpreted in a meaningful way. It is of paramount importance for the administrator that the desired information is received timely, accurately and adequately through a proper channel and the system. Thus, there are two logical approaches for problem solving are:

- Identification of the problem.
- Finding a solution to the problem—both short-term or long-term basis.

TYPES OF PROBLEMS, THEIR IDENTIFICATION AND SOLUTIONS

Problem identification is the most crucial step of problem-solving exercise. The solutions of problems vary with situations. In this chapter, I have concisely categorised problems into three types and suggested few solutions.

Problems within Junior Employees

In a hospital setting, different classes of workers are required for providing good and effective service to the patient. For example, there are hospital attendants, sanitation workers, paramedical staff including nursing staff, and the doctors. Although every class of employee is supposed to work according to the norms/job description for the particular job, it is a general observation that problems still do occur and one needs to handle them carefully. Everyone is paid for the duty he/she performs; but still there are issues that need to be addressed. While taking appropriate steps are to be taken to solve the issue, it is also important to realise that every worker does not have the similar type of commitment or motivation to work; although everyone needs to know his/her duties and perform those as well. It is also important to realise that in our social milieu, there are certain issues that need to be addressed. For example, a sanitation worker does not turn up for his duty suddenly without prior information/sanctioned leave. How do you tackle such a problem? The understanding of the importance of the hygiene and cleanliness in a hospital may be very limited in a sanitation worker, because of his educational status, upbringing and

social background. He/she does not care for such a situation. Whereas, a senior functionary like a doctor has a different perception of the particular issue. The absence of a sanitary worker or hospital attendant may be because of a sudden illness, which is unavoidable. Similar problems can be in another form. For example, a staff nurse, invariably a female comes late for her shift duty. One has to understand that the female employee has to look after her children, may be the old parents or in-laws. On the other hand, she has to fulfill her duties for which she is paid and, moreover, she has to relieve a similar female employee who will have similar responsibilities. If the particular employee claims that she has to drop/see-off her children to school at a particular time only, which is not suitable for her shift duties and therefore she will report for duties late every day, it is not acceptable. This cannot be a regular excuse or cause for her reporting to duties late on a regular basis. She has to make her own arrangements for that. In most situations, the administration has arrangements for crèche system or other welfare measures for its employees to take care of these issues to a certain extent. However, the supervisor or her colleagues should take care of some of these genuine issues off-and-on; but not on a regular basis.

Problems with the Superiors

The immediate superior needs to understand the problems/issues with the employee under his/her supervision. Most of the time, the employees complaint that their grievances have not been addressed to in time, particularly, in administrative matters. This may include timely sanction of leaves like casual leave, earned leave, leave travel concession (LTC), etc. The other grievances with the administration are not holding timely Departmental Promotion Committees (DPCs) or selection of vacant post, etc. that increases the burden of work on the employee. Although the administration should take timely action for all these issues, the employees itself also should understand the problem on the other side. Some of the issues, as mentioned above, can be sorted out by approaching the higher authorities personally or through the immediate superior/supervisor, who in-term can approach the next higher authority. Sometimes, it is usually a problem that the lower-rung employee might not have access to the highest authorities, and in many administrative setup still there is an iron curtain between various classes of employees. This system needs to be abolished and the administration should be approachable with least resistance. An unsatisfied employee will not deliver his best that will affect the ultimate output and quality service to the hospital. On the other hand, the administrative authorities should try to meet/interact with the employees with time-to-time to solve their problem. Just discussing the issues with the employees gives a psychological impact on the mind of the employee that his/her grievances are being addressed to.

Although it is not desirable to interfere with anybody's personal affairs, the seniors at times can enquire about certain personal issues, which may help a good and conducive atmosphere in the working place. The senior nurse or the supervisor may enquire about the welfare/well-being of the family members like 'how are the children?' 'What happened to your parents who were not well few days back, as you had informed few days back?' etc.

Problems within the Employees of Same Rank

As mentioned above, the problem amongst the similar classes of employees like the hospital attendant, sanitary worker and the nursing staff, etc. can be solved in a better-coordinated manner. All the employees should try to take care of various difficulties of their colleagues to certain extent. Suppose someone has some real and genuine personal problem for which he/she needs adjustment of duties, it can be readjusted with prior approval of the immediate senior supervisor. Another set of problem that can happen is the sudden absence of a sanitary worker or a hospital attendant or a staff nurse. In that event, the in-charge of the ward—usually a senior staff nurse—should try to solve the problem. It is a fact that the hospital needs cleaning or supply of essential hospital items or shifting of the patients to other areas for investigations, etc. for which a hospital attendant or a sanitation worker is very-very crucial. On the other hand, the ward in-charge should also understand that the officers controlling these staff might have similar problems also. So, how can he provide substitute in a short notice? This is usually a matter of contention between the ward-in-charge and the person-in-charge of HR management. The best way to handle this issue is a clear understanding between the two senior officials of the hospital. For example, if there is sudden absence of a staff, the ward-in-charge should first try to reallocate the duties amongst the available staff, giving priority to critical areas. If that is not possible, it is better to pick up the telephone and speak to the HR manager about the critical requirement of such a person. In that event the HR manager will try to send somebody either from his own reserve (which is a myth rather than a reality) or he can reallocate persons from other less-critical areas. The in-charge of the ward should speak directly rather than sending a complaint/indent to the HR manager. If the problem is still not solved then he/she should inform his/her senior, usually a senior official from the hospital administration.

Another problem encountered in the wards is the entry/restriction of attendants with the patients that creates sanitation as well as crowding in an indoor ward. Although, there are strict guidelines and duties assigned for visiting hours and control by the security staff, the nursing staff as well as the doctors in the ward should extend a helping hand in crowd controlling.

Sometimes, there are genuine problems of essential hospital supplies like essential surgical items, e.g. IV drip sets, syringes, gloves or sanitation items like phenyl, etc. It is to be understood that the procurement process follows certain rules and regulations, and there may be problems at various levels. This includes the store not sending the requirements in time, the procurement division delaying because of processing requirements or even the supplier may not supply the item approved in time. Even if everything is on time, sometimes the supplied items may not be of the approved standard that the hospital will not accept. Therefore, the persons directly involved in the sanitation or other patients-care items need not make a hue-and-cry without knowing fully the complex issues involved. Rather he or she should inform the higher authorities through their seniors like the ANS/DNS/NS so that alternative arrangements like local purchase, short tenders or quotations can be adopted as per the rule to tide over the crisis.

It should be very clear for every hospital employee to understand the very complexities in managing a hospital.

Before raising a problem, one should understand the possible underlying cause for such a problem. At all levels, person-in-charge should try to mitigate the grievances. Of course, the hospital administration has a greater role and responsibilities to see that such problems do not arise; and if at all they arise, they are to be attended to as soon as possible in a timely manner. This will help the employee to deliver his best and ultimately the hospital will be benefited. In this context WHO has devised a tool on human resource development. Compliance with its parameters by the hospital may help to solve the related problems.¹

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Patient Satisfaction

Dr Atul Sharma, Dr Sonu Goel and Dr Amarjeet Singh

“Sick people, particularly those with serious conditions, greatly prefer the company of their friends and family to residence in a hospital or nursing home.”

—David Mixner

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the concept of patient satisfaction and its importance in assessing quality of healthcare services.
- understand various patient-side and provider-side constructs that contribute to levels of satisfaction among patients.
- apply the knowledge of these constructs for bringing improvement to healthcare service provision for the benefit of the patients as well as of the hospital.

INTRODUCTION

Undergoing gradual evolution through many centuries, hospitals have now come of age. The concept of today's hospital is fundamentally different from the old idea of a hospital as a place for the sick. With a wide coverage of every aspect of human welfare, be it physical, psychological or social well-being, the healthcare services have undergone a steady metamorphosis. Stress is now being laid upon quality of care rather than the episodic care concept of earlier times. The focus is being shifted to provide the benefit of state of the art developments in healthcare knowledge and technology to the people. More importance is now being given to satisfaction of patients and their caregivers with the hospital care. It is expected that this simple and cost-effective strategy involving continuous monitoring of expectations of people will help to catalyse improvements in quality of hospital care.¹⁻⁴ It is all the more important in case of inpatients who are seriously ill and require a plethora of nursing care and other variety of services, as the landscape of their problems make them expect highly from the hospitals. As opined by Pascoe in his paper, such feedbacks will not only help the hospital administrators to revise their patient-care strategies, but will also inform about patients' health-related behaviour.⁵

Patterns of quantity and quality of care received by the patient from hospital staff including doctors, among patients and caregivers has thus been an emerging topic of research in recent years.⁶ Good pre- and postoperative consultation services, satisfactory nursing care during the period of hospitalisation and subsequent improvement in quality of life following medical and surgical treatment as a basic right of the patient is a subject of significant focus of attention now. In 2002, Thorne et al. published a paper in *British Journal of Neurosurgery* showing patients were by and large satisfied with clinical care but not with various administrative arrangements.⁷ Saaq in July 2006 wrote that dissatisfaction was usually seen more frequently in younger, educated, male respondents.⁸

Dissatisfaction with hospital care has also seen to be associated with depression among patients.⁹ Jawahar in 2007 stated that it is not only the health of patients that suffers, this dissatisfaction also adversely affects the sustainability of hospital in long run.¹⁰

Knifed et al. in a paper in February 2008, explained that knowing about the resident doctors and about the procedures to be done on them gave the patients and their caregivers a sense of satisfaction. They concluded that telling patients beforehand and satisfying their need to know helped in postoperative recovery.¹¹

On similar lines, a lot of research studies have been conducted to determine patient satisfaction and factors influencing the same, as it may not only help the administrators in planning upgradation of clinical setup for improving hospital's quality of care but also, in addition, surveys addressing questions to healthcare consumers quench a social desire for patient representation in quality assessment in a service-oriented economy.¹²

Measurement of Patient Satisfaction

However easy it might be to understand the importance of assessing patient and/or caregiver satisfaction, is an intricate task. Patient/client satisfaction is an attitude based on their expectations from as well as to their current or previous experience of the care received by them. It may also change with time.¹³⁻¹⁵ Thus, patient satisfaction assessment involves looking into multiple dimensions of the satisfaction complex and different perspectives that govern the expression of the same by patients.

Various tools have been developed by different researchers/organisations for this purpose, focusing on use of qualitative, or quantitative or a mixed methods technique. The tools can also be differentiated on the basis of approach used—direct or indirect. The direct method asks patients questions on their encounters with particular health facilities, whereas indirect methods collect opinion of general population on healthcare delivery services in place.¹⁶ Though case studies, observations and interviews are commonly used techniques to obtain data, it is not unusual to see use of surveys and customised questionnaires.¹⁷⁻²⁰ Many tools have been reported in literature from time to time; the latest being that by Webster et al., who developed two brief questionnaires for assessing patient satisfaction in low-income settings in 2011,²¹ and by Hojat et al., who developed a small tool in 2011 that included a 10 item questionnaire.²² As all these different questionnaires focus on different aspects of patient satisfaction, it is prudent to select one that works in a particular specific case, based on the type of influencing factors one needs to study to determine overall patient satisfaction levels with a healthcare provider.

FACTORS INFLUENCING PATIENT SATISFACTION

Patient satisfaction is a subjective phenomenon. Many factors influence it directly or indirectly. It is also affected by patient's expectations as well as their level of understanding of the instructions given to them by the doctors/nurses.¹³ Overall literacy rate of the concerned community and the prevailing health culture also affects satisfaction level. On the part of the healthcare providers, different dimensions of health service episodes that people experience and rate, range from access to these services to the outcomes of medical care. In brief, the factors that play a role in modelling the satisfaction construct can be summarised into two categories (Table 46.1).

Table 46.1 Patient satisfaction construct

Consumer side factors ¹³	Healthcare provider side factors ¹⁴
<ul style="list-style-type: none"> • Literacy levels • Financial status • Intellectual and physical/sensory disability levels • Demographic factors (urban/rural) • Language proficiency • Ethnicity and cultural diversity • Knowledge and understanding of technology 	<ul style="list-style-type: none"> • Access to services • Cost of services • Overall quality • Humaneness • Competence • Information supplied • Bureaucracy • Physical facilities • Attention to psychosocial problems • Continuity of care • Outcome of care

As most of the data collection tools have consumers of healthcare services as their subjects under study, the results that are directly obtained are for provider side issues, while consumer side factors can only be commented upon after conducting data analysis. Many studies from across the globe have mentioned their results for these supply side factors, using both qualitative and quantitative approaches. Satisfaction levels with accessibility and affordability of care, travel time to and from healthcare facility, duration of the outpatient department (OPD) services, facilities in the waiting hall and waiting time in the hospitals, time taken for registration, presence of signboards, overcrowding, availability and cleanliness of toilets, availability of seats have been commonly discussed in most of the studies reported in literature.

Overall patient satisfaction pertaining to doctor-patient communication, availability of doctors, explanation by staff about the disease, treatment, investigations and advice about prevention of diseases, satisfaction regarding examination and consultation, history taking about the allergy to drugs, nature of prescription, information imparted about the side effects of drugs are some other prominent themes that keep on emerging in various forms in different studies. Young age, chronicity of illness and prior dissatisfaction with medical services have been reported in literature to be linked to higher dissatisfaction rates. Complaints pertaining to the heavy load of patients in the hospital departments and subsequent delays in receiving treatment are also usually observed.²³ Timings of health facilities in case of OPD services are also frequently mentioned to be a source of inconvenience by unsatisfied patients, as these usually clash with the daily working hours of the patients.²⁴

Case Study 1: Feedback from patients and grievances redressal

A 32-year-old young man brought his father to the emergency ward of X hospital in a state of acute pain. Due to heavy work load, the patient could receive medical care only after 40 min of his arrival at the hospital. As the son of the patient had a previous bad experience with the

services of that particular hospital, he started complaining loudly and creating further hindrances in service delivery to other patients as well.

Issues identified

Problems occurred due to heavy workload and preconceived notions for quality of services being delivered at the hospital.

Remedial measures

The hospital management decided to undertake a need-assessment analysis to identify manpower crunch at the emergency ward and resolved to fill this gap as soon as was possible. It was also decided to put patient satisfaction questionnaires to outgoing patients at discharge, so that their expectations and problems suffered by them can be duly noted and taken care of.

Behaviour of the staff personnel, including nurses and Class IV employees have always been shown as a routine cause of concern. Complaints related to the non-divulgence of details to the patients/caregivers by the doctors are also recorded. Imam et al. in (2007), Schubart (2008) and Gomez-Carretero (2007) also reported that many respondents in their study could not understand the explanations given by doctors in response to their queries.^{9,25,26} Sharma et al. recorded patients' complains regarding the noncooperative behaviour of the support staff in other complementary departments in the hospital as well.²⁷ Goel found high discontentment with the behaviour of clerical staff, especially the ones at registration counters in his study. He mentioned that patients also faced problems in getting laboratory investigations done and in getting the prescribed drugs.²⁴ Jeet et al. also recorded complaints of patients against the staff at pharmacy and inadequate provision of medicines meant to be provided free-of-charge to patients.²⁸

Case Study 2: Patient satisfaction is much more than just clinical care

A man brought his 2½-month-old daughter to paediatric OPD services in a hospital for her scheduled vaccination. Despite his curiosity about the vaccines being given to the child, neither the staff nurse nor the attending doctor explained to him the purpose of the particular vaccines or their side effects. The next day his daughter developed mild fever and slight soreness at the site of injection. He was very worried and dissatisfied with the services at hospital.

Issue identified

Lack of sensitivity on healthcare providers' part to understand patients/caregivers' requirement towards receiving knowledge on the services that are being provided to them.

Remedial measures

The hospital management initiated a series of personal development workshops for the staff personnel, to sensitise them towards patients' and caregivers' psychological and emotional needs, and to train them to handle the same effectively. All the employees were encouraged to be soft-spoken and considerate when discussing patients' concerns.

In case of inpatients, inadequate levels of satisfaction with the stay arrangement for the patients' attendants and caregivers are sometimes observed. Complaints pertaining to the lack of adequate number of toilets and lack of cleanliness in toilets are also frequently reported in literature. Bhattacharya et al. had reported similar findings that 85% patients were not satisfied with the number of toilets in the wards.⁴ Thus dissatisfaction with general facilities and amenities for patients is also a common observation, especially in relation to healthcare providers in developing countries.

Case Study 3: A hospital is as good as its toilets

A woman at the time of her delivery, escorted by accredited social health activist, went outside the labour room in a hospital to find a toilet. She found the first two toilets shut and being used as storerooms. The nearest toilet was on the next floor, and while answering the call of nature, the baby's head emerged out. Health activist got panicked, but kept holding the head of the baby, while a stretcher was procured to get her back into the labour room. The child suffocated in the meantime, and the woman in a critical condition, had to be rushed to another hospital with better emergency services.

Issue identified

Lack of working toilets and other general amenities for patients costed the life of a newborn child, incurring severe physical and emotional damage to mother of the child. The incidence highlighted apathy of hospital management, and led to fall in reputation of healthcare services being delivered at the same.

Remedial measures

Toilets and others facilities for patients were immediately restored. The hospital publically apologised for their fault and instituted a series of follow-up home visits to reinstate physical and emotional well-being of the patient. An internal committee was setup to take primordial measures to prevent such incidences in future.

"The concept of hospital today is different from what it used to be in the past. Earlier, importance was given to traditional custodian functions; but today it is recognised as a social institution. As we are moving to service

economy, the customers are more critical and keen towards quality services and high standards.² With rise in literacy rate patients tend to be more demanding. They like to be involved in decision making about their treatment.²⁹ Further, a lot of evidence is now generated that suggests that patients can judge the quality of care received. Their feedback can be used as a yardstick to gauge the standards of services provided by a healthcare provider. This can also aid the learning and development of hospital administration speciality academically.^{13,30} Hence, studies for assessing patient satisfaction should be conducted in routine; findings of such studies provide a significant feedback for evaluation and reshaping of the hospital services. Further, grievance redressal mechanisms should be instated in all healthcare facilities, wherein people dissatisfied with the services can lodge their complaints related to health issues to get them addressed in a time-bound and satisfactory manner.

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Nursing Management

Dr Suresh Kumar Sharma

“I attribute my success to this – I never gave or took any excuse.”

—Florence Nightingale

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- define the role of nursing management in a hospital.
- describe the job responsibilities of various categories of nursing personnel in a hospital.

INTRODUCTION

The hospital is a healthcare providing institution, the main function of which is to provide preventive, curative and rehabilitative services to the individuals, family and community. The hospital is also a place to provide education and training to medical, nursing and paramedical healthcare workers and to conduct healthcare research. In other words, hospital is a centre to diagnose and treat the sick and injured people; and, furthermore, healthy persons are facilitated to promote and maintain the optimum health and well-being.

Hospital provides healthcare services to the needy people through a variety of personnel including technical, administrative and auxiliary staff, etc. Nursing is a major component of any hospital and nurses make up the largest employment group within these institutions. Nursing services are necessary virtually for every patient seeking any type of healthcare. Nurses are responsible for helping the people to promote the health, prevent the illness and caring the individual, family and community during sickness to attain, maintain and recover the optimal health and quality of life from womb to tomb. Nursing is such an important part of any hospital that success of any such institution largely depends on the nurses' participation in delivering quality patient care.¹

Nursing care is such an important element of the hospital care activities that overall patient's outcome largely depends on the quality of nursing care provided to the patient. It is very well said by one of the eminent medical educationist that 'patient comes to hospital because of the

doctors but only discharged because of the hard work of the competent nurses; therefore we must understand the importance of nurses in success of a healthcare organisation'. The success of patient care and reputation of the hospital depend to a large extent on the efficiency and the tender loving care extended by the nursing staff. Ensuring high level of nursing care is a big challenge for the hospital administrator.²

MEANING AND SCOPE OF NURSING MANAGEMENT

Nursing management is a coordinated system of activities, which provides all the facilities necessary for rendering nursing care to patients. Therefore, it is an integral part of any healthcare organisation that strives to provide effective nursing care. According to Herman Finer, 'Nursing management is a segment of the total-care management that actively takes part to fulfill the objectives of health programmes and policies to constitute, to serve the patients, with the help of other health workers, to make the services more friendly and effective.'³ Nursing management combines the perspective of nursing care with the methods of management. Expressing similar viewpoints, Gorddard stated that 'nursing management at any level is the application of the principles of management for the ultimate purpose of providing nursing services to the individual'. The practice of nursing management focuses on the management of organised nursing care services to a group of patients for the purpose of delivering a quality nursing care.⁴

The objectives of the nursing management focus on three basic elements: (i) high quality of nursing care services rendered to patients by trained nurses and technical assistants, (ii) a structured yet flexible and stimulating environment in which all the personnel may gain job satisfaction from their work and have opportunities to develop their own knowledge and skill potentials and (iii) a management process that results in an efficient and effective pattern of nursing care and nursing services in the most economical manner.⁵

OBJECTIVES OF NURSING MANAGEMENT

Alexander L. Edythe in his book 'Nursing administration in the Hospital Healthcare System' discussed the objectives of nursing management, which are to⁶:

- Establish a flexible organisational design consisting of a set of human relationships through which all the levels of nursing service personnel can accomplish their job duties and responsibilities through systematic management processes of planning, organising, controlling, coordinating and evaluating, which are reflective of good management, work satisfaction, high morale and the achievement of the goals of the total hospital system.
- Establish a systematic nursing service and staffing pattern for patient care so that all members of each department can function in accordance with their skill level for the maintenance of continuity of nursing care and management of nursing services.
- Evolve, articulate and interpret hospital and nursing service standards and nursing practice consistent with biomedical, social and technological advances through a communication system within the departments of the division and with other related professionals.
- Develop and maintain programmes for analysis and evaluation of nursing care services and utilisation of personnel as a mean of improving the quality of patient care and the economy of human and material resources. Work with personnel experts and scientific management researchers to develop more empirical evidences for further improvement in patient care.
- Develop job descriptions for the various positions in the nursing service department in cooperation with the operations; research staff; revise descriptions of jobs in accordance with changes in the organisational structure, and the role and functions of nursing services in the delivery of patient care.
- Assist hospital management in the maintenance of effective personnel appraisal and recruitment programmes.
- Share nursing care information with others in the hospital and with other patient-care agencies through an established system of relationships.
- Establish and interpret nursing service policies consistent with the general policies of the hospital and make recommendations to the executive officers for the improvement of policies and procedures of the hospital.
- Initiate a system with hospital management for predicting and determining budgetary cost containments of the departments and for controlling and evaluating performance against the established philosophy and objectives of each department.
- Participate in interdepartmental programmes and hospital committees delegated to improvement of patient-care services.
- Encourage a stimulating environment in which the personnel have opportunities to be creative innovators in the improvement of nursing care services.
- Develop and initiate orientation and training programmes for new employees in cooperation with hospital management and other health disciplines.
- Provide an environment conducive to learning of students for formal programmes affiliated with the hospital and participate through established channels for sharing of information and establishing an effective partnership between the faculty and nursing service leaders.
- Assist in the development of a sound, constructive programme of leadership in the management of nursing care services to assure intelligent management by the people and for the people they serve.
- Safeguard, conserve and preserve nursing resources of the hospital through the use of expert nurse leaders having necessary capacities.
- Initiate programmes to improve the practices of nursing to keep up with the advances in the biomedical and social sciences affecting the quality of nursing.
- Participate in use of evidence-based information useful for patient care.

FUNCTIONS OF NURSING MANAGEMENT

Nursing managers are responsible for organisation and coordination of the hospital nursing services based on the philosophy of the particular institution. Some of the prominent activities or functions of the nursing management are⁷:

- Organise the nurses in a manner so as to render high quality of nursing care consistent with the philosophy and objectives of the hospital.
- Establish and implement the philosophy, standards, policies, rules, and procedures for smooth and efficient functioning of the nursing services in the hospital.
- Formulating rules and regulations applicable to nurses, including their working hours, code of conduct, discipline, reporting system and appraisal.
- Developing and periodically revising nursing policies and procedures related to patient care, in general, and nursing care, in particular.
- Delineate the responsibilities and duties to nursing officials and various categories of nursing personnel.
- Estimate the requirement for nursing personnel, advice on appointment of adequate and competent nurses, and

establish policies and programmes for their orientation, placement, on-the-job training and supervision.

- Selecting and assigning/reassigning nurses to various wards and specialised service areas depending on vacancies/need and abilities/interests of the staff concerned.
- Establish the need for facilities, equipments and supplies, and implement a system for evaluation and control within the administrative and financial framework of the hospital.
- Develop and maintain system of recording patient care and administrative nursing data.
- Receiving periodical reports from the nursing units.
- Maintaining record of nursing service activities and compiling reports, plans and budget as and when required.
- Monitoring personnel records of nurses.
- Organise and oversee the functioning of wards and other specialised service areas (such as outpatient department, operation theatres, day care unit, etc.), which are generally managed by nurses.
- Ensure healthy work environment, close collaboration and mutually supportive relationship between nursing and other departments in the hospital.
- Establish good rapport between nurses and patients, patient attendants and visitors.
- Periodically appraise the performance of nurses and carry out regular nursing audit, which is necessary to maintain and improve the standards of nursing care.
- Carry out in-service training and thereby augment staff development to update knowledge and skills of nursing staff.
- Train student nurses and provide facilities for advanced training of nurses and other personnel.
- Dealing with professional and personal problems of individual nurses and attending to their welfare.
- Investigating incidents, complaints and allegations of misconduct pertaining to nursing staff.
- Provide grievances redressal facilities for nursing staff and ensure job satisfaction among them.
- To ensure patients' satisfaction by ensuring delivery of high-quality patient care.

ORGANISATIONAL STRUCTURE

Organising can be defined as relating people and things to each other in such a way that they are all combined and interrelated into a unit capable of being directed toward organisational objectives. The basic objective of the organisation is the development of a structure or framework called formal organisation structure. The most basic premise of organisation is that division of work is essential for efficiency; work activities required for organisational performance are separated through the process of vertical and horizontal differentiation. Vertical differentiation establishes the hierarchy and the number of levels in the organisation. Horizontal differentiation comes about because of the need

to separate activities for more effective and efficient performance.

Organisation structure chart is a picture of an organisation or department, which can help in identifying hierarchy.⁸ An organisation comprises group of people working together, under formal and informal rules of behaviour, to achieve a common goal. In simple term, structure is the pattern in which various parts or components are interrelated or interconnected. Thus, organisation structure is the pattern of relationship among various components or positions of an organisation. Since these positions are held by various persons, the structure is the relationship among people in the organisation.^{9,10} In other words, organisational structure refers to the line of authority, communication and delegation in an organisation; it can be formal or informal (Ann Boyle Grant, 1999).¹¹

Organisation structure chart is a picture of an organisation or department that can help in identifying hierarchy.¹² Organisational structure in government and private hospitals is not uniform. Line organisational structure was observed in almost all hospitals, where authority was concentrated at top administrative level. In addition, existing organisational structure of nursing departments at government and private hospitals is not in accordance with Indian Nursing Council guidelines.¹³

Span of Control

The concept of 'span of control' is central to the classical theory of organisation. 'Span of control' refers to the number of subordinates an administrator can directly supervise in an effective manner.¹⁴ Every organisation faces this problem. How many subordinates can a supervisor manage effectively? Studies of management have found that this number was usually four to eight subordinates at upper level of organisation and eight to fifteen or more at the lower level. There is no agreement for the exact number; but generally it is believed that the shorter the span, the greater will be contact, which leads to more effective control.¹⁵ According to the classical theory, an executive must have intimate and direct contact with his subordinates. Therefore, the span of control should be such that it permits effective coordination. Five to eight at higher level and ten to fifteen at supervisory level is considered appropriate span of control.¹⁶

Staffing

After planning and organising, staffing is the third phase of administration. In general, staffing is a process comprising selection, training and retention of personnel in an organisation. However, staffing patterns are the plans for nursing personnel at different levels to carry forward the goals of the particular units comprising it. Staffing pattern determines the actual number of employees present at different positions in an organisation against recommended guidelines. Staffing pattern is an important component of

administrative process in hospitals, especially in nursing department because such organisations are usually labour intensive (i.e. many employees are required to accomplish its goals). Majority of the healthcare organisations are open 24 hours a day, 365 days in a year; and nurses have to work round the clock with variable demands and needs of the patients seeking multiple healthcare services. The large workforce of healthcare organisation must have appropriate balance of highly skilled, competent professional staff from administrative to operational level.¹⁷ The main purpose of staffing pattern is appropriate coverage of different positions to ensure effective services in the interest of the patients visiting hospitals. It also facilitates equitable and effective utilisation of a nurse in an optimal manner.

In a hospital, staffing pattern depends on several factors including patient's needs, the needs of the patients varying according to pattern of illness, e.g. intensive care unit requires more staff than the general wards. Staffing pattern in nursing service also depends upon patient-related factors, staff factors, environmental factors, nursing and institutional objectives. Patient factors include level, complexity and duration of care needs; type of patient served; their condition, illness, age group and other selective factors; number of patients and fluctuation in numbers; and socio-economic factors influencing health needs and patients' expectations of care. Further, staff factors depend upon number of nursing personnel, hours and rotation policies, job descriptions and role functions, personnel policies, education and experience, levels of personnel, competitive market for staff in community and the work ethics of staff members.¹⁸ Environmental factors comprise physical layout of institution and patient unit, number of patient beds, facilities, supplies available, supporting services from other divisions and departments, supportive services from other agencies, strength of medical staff, and kind and frequency of treatment ordered and chosen by the medical staff. Lastly, nursing and institutional objectives include type of hospital and type of care an institution desires to give to patients; selected-care-assignment patterns; service education and other benefits that institution desires to give to the personnel; nursing administrative supportive services; proportion of trained nurses to student nurses, manner in which professional nursing services are used, e.g. non-nursing duties the professional nurses perform.¹⁹

The recommendations of Indian Nursing Council (2002) regarding staffing pattern of nursing personnel in hospitals are depicted in Table 47.1.²⁰ Indian Nursing Council (INC) recommended one Chief Nursing Officer for 500-bedded hospital. One Nursing Superintendent, Deputy Nursing Superintendent and Assistant Nursing Superintendent were recommended for 500 beds, 300 beds and 250 beds, respectively. One supervisor for 150 beds and one ward sister for 25 beds were also recommended. Indian nursing council recommended one staff nurse for nine beds in wards and in ICU one staff nurse for three beds during each shift.

Table 47.1 Indian Nursing Council recommendations for staffing pattern

Categories	Recommendations
Chief nursing office	1 for 500 beds or above
Nursing superintendent	1:500 beds
Deputy nursing superintendent	1:300 beds
Assistant nursing Superintendent/Matron	2:500 and 1 more for every additional 50 beds
Supervisors	7:1000+ 1 for every additional 100 beds
Nursing sisters/ Ward sisters	1:25+ 30% leave reserve
Staff nurses	
• Wards	1:9 in each shift + 30% leave reserve
• OPDs	1:100 out patients + 30% leave reserve
• Emergency/ICUs	1:3 in each shift + 30% leave reserve
• OTs	3:1 tables

Source: Indian Nursing Council published guidelines.

A case study done by Sharma mentioned that in private hospital number of staff nurses was nearly adequate¹³; however, in public hospital the number of nurses was alarmingly low. Similar findings were also reported by Serena Josephine that in government hospitals of Puducherry one nurse was taking care for 40–60 patients in general wards and 20–30 patients in special wards.²¹ Similar findings were reported by Anuja Jaiswal at PGIMER Chandigarh, where shortage of nurses was as high as 30–40%.²² The number of staff nurses and their skill play a critical role in patients' outcome; research^{23–26} has reported that poor nurse–patient ratio leads to several negative outcomes for patients and nurses.^{23–26}

Promotion of Nurses

Promotion, in the words of L.D. White, 'means an appointment from a given position to a more difficult type of work and greater responsibilities, accompanied by change of title and usually an increase in pay.'²⁷ In other words, promotion means rising to a higher post carrying a higher grade. The change in duties and responsibilities form the essential characteristics of the promotion process. A promotion system keeps the employees interested in the job and work as a continuously effective incentive to them. As Procter has put it, 'To the employee promotion is of direct significance as a reward or possibility of reward.'²⁸ Actual promotion is a reward, while the opportunity for promotion is a possible reward, something still in the future.'

Promotion system helps in retaining the services of the most deserving amongst its employees and also giving them an incentive to improve their capabilities and qualifications. In the absence of promotion, ambitious, intelligent and capable persons leave the job. Promotions are, in fact, one of the most important aspects of personnel management, meant to keep the employees contented, disciplined and

efficient. It serves as an inspirational source for hard work among employees. The inclination of candidate for a job depends to a great extent upon the promotional opportunities available in an organisation as one qualified and experienced person is likely to join any service and stick to it, if the chances of promotion in the service are bleak.²⁹ In other words, it helps in retaining professionals of potential ability in service.

Sixth Central Pay Commission (2008) highlighted the need for a promotional policy to provide adequate career progression to the employees, in general.³⁰ The Sixth Central Pay Commission recommended the existing scheme of Assured Career Progression Scheme (ACPS) with two financial upgradations. Sharma in his case study found that there is serious problem of career stagnation for nurses¹³; on an average a nurse did not get promotion inspite of her more then 30 years of services on same position, which needs to be seriously addressed in future pay commission recommendations.

JOB DESCRIPTION OF VARIOUS-LEVEL NURSING PERSONNEL IN HOSPITAL³¹

Nursing Superintendent

Job summary

Nursing superintendent is responsible to the Medical Superintendent, in a hospital having 250 or above bed strength, and is accountable for the safe and efficient running of the various nursing departments in the hospital. Nursing superintendent is assisted in carrying out her duties by the Deputy Nursing Superintendent, Assistant Nursing Superintendent, ward Supervisors, and clerical, linen room and domestic staff.

Nursing service

- Participate in the formulation of the philosophy of the hospital, in general, and those specific to the nursing service.
- Determine goals, aims, objectives and policies of nursing services.
- Implement hospital policies and rules through various nursing units.
- Decide and recommend personnel and material required for running various nursing service departments of the hospital.
- Interview and recruits nursing staff.
- Assists in student selection and recruitment of other auxiliary staff whose duties are related to nursing.
- Ensure the safe and efficient care rendered in the various nursing departments of the hospital.
- Make regular rounds in hospital and wards.
- Check if standard of care is maintained and patients are nursed in a clean, orderly and safe environment.
- Take hospital rounds with medical superintendent.

- Select and secure proper equipments needed for the hospital or nursing home.
- Look after the welfare of the patients, their relatives and the nursing staff.
- Prepare budgets for the nursing services departments.
- Function as a member of the condemnation board for linen and other hospital or nursing home equipments.
- Prepare duty roster, plan staff leaves.
- Provide counselling and guidance to the subordinate staff.
- Maintain discipline among nurses and other auxiliary staff.
- Enforce implementation of the hospital rules, regulations and policies.
- Participate in the hospital and intrahospital meetings/conferences.
- Investigate complaints and takes necessary steps.
- Evaluate confidential staff reports and recommends for promotion or higher studies.
- Plan staff development programmes and arranges for in-service education and orientation programmes, etc.
- Inspect hospital kitchen and dietary services of the hospital.
- Arrange students' clinical experience and council examinations.
- Initiate and participates in nursing research.

General and office duties

- Attend to the general correspondence.
- Maintain necessary records concerning the nursing staff, confidential reports, etc.
- Submit annual report of the nursing services departments to medical superintendent, Indian Nursing Council and Nurses' Registration Council.
- Participate in professional and community activities.
- Maintain cordial relations with public and volunteer workers.

Deputy Nursing Superintendent

Job summary

Responsible to the nursing superintendent and assists her/him in the nursing service administration of the hospital. Deputy nursing superintendent is independently incharge of Nursing Service Department of a less than 400-bedded hospital.

Nursing service

- Officiate in the absence of nursing superintendent.
- Participate in the formulation of nursing services, philosophies, objectives and policies.
- Assist in the recruitment of nursing staff and students' selection.
- Make master duty roster of the nursing staff.

- Help in allocating nursing personnel to various nursing services departments.
- Keep records and reports of the nursing services.
- Assist in planning and organising the new units in the hospital, e.g., ICU, Central Supply Department, etc.
- Maintain confidential reports and records of the nursing staff.
- Take regular hospital rounds.
- Supervise care given in various departments.
- Serve on several hospital committees, e.g. purchase committee, class-IV employees committee, etc.
- Interpret the policies and procedures of the hospital care to the subordinate staff and others.
- Act as a liaison officer between the nursing superintendent and the nursing staff of the hospital.
- Receive night reports from the night supervisor. Maintain the attendance and leave register for nurses.
- Assist in the supervision of nurses' home, nurses' hostel.
- Conduct regular physical verification of hospital stock.
- Initiate condemnation of old and worn-out articles and procurement of new articles.
- Attend to emergency calls in rotation concerning hospital or hostel problems.

Educational functions

- Assist in planning and implementing staff development programmes.
- Ensure clinical experience facilities for student nurses in various clinical areas of the hospital.
- Guide and counsel nursing staff.
- Arrange orientation programmes for new nursing staff.
- Maintain discipline among nursing personnel.
- Organise experience programmes for postgraduate students from different hospitals.

General duties

- Escort special visitors, nursing superintendent, medical superintendent for hospital rounds.
- Arrange and participate in professional and social functions of the staff and students.
- Maintain good public relations.
- Carry out the other duties assigned to her by the nursing superintendent.

Assistant Nursing Superintendent

Job summary

Assistant nursing superintendent is responsible to the nursing superintendent and deputy nursing superintendent, and also for developing and supervising nursing services of a department or a floor consisting of two or more wards or units managed by the ward supervisors. These units may be inpatient wards, outpatient departments/clinics, operation theatres, obstetric units, central supply department, etc.

Patient care and ward management

- Organises and plans nursing care activities of the department or a floor according to hospital policies and service needs.
- Plans staffing pattern and the other necessary requirements of her/his department.
- Compiles and submits nursing statistics to the concerned authorities.
- Conducts and attends departmental and interdepartmental meeting/conferences from time to time.
- Makes regular rounds of her/his department.
- Sees to the safety and general cleanliness of the department.
- Looks into general comforts of the patient and their relatives.
- Receives report from the night superintendent of the department.
- Evaluates nature and quantum of care required in each ward/unit.
- Makes rotation plan for the nursing staff under own jurisdiction.
- Plans ward management with the ward/unit supervisor of each ward/unit.
- Reinforces the principle of good ward management in each ward.
- Helps ward/unit supervisors to procure their ward/unit supplies.
- Supervises the proper use and care of the equipments and supplies in the department.
- Acts as a public relations officer of the unit and deals with the problems faced by the ward supervisor, if any, especially with the Class-IV employees and patient's attendants.
- Keeps the nursing superintendent and deputy nursing superintendent's office informed of the needs of the nursing units/wards under charge and of any special problem/problems.

Educational functions

- Arrange classes and clinical teachings of the nursing students in the department, related to the specialty experience.
- Implement the ward teaching programmes and clinical experiences of the students with the help of doctors and ward sisters.
- Does counselling and provides guidance to the nursing staff and students.
- Arranges and conducts staff development programmes of their department.
- Assists in planning for and participation in the training of auxiliary personnel.
- Writes the confidential reports of their ward/unit supervisors.

General

- Escorts the nursing superintendent/deputy nursing superintendent and special visitors in the departments.
- Participates in various professional activities, e.g. staff education, staff meetings, etc.
- Acts as a liaison officer between the nursing department and higher hospital authorities.
- Carries out other duties delegated by the nursing superintendent/deputy nursing superintendent.

Nursing Sister/Ward Sister**Job summary**

Nursing supervisor is accountable for the nursing care management of a ward or unit. Nursing supervisor is responsible to the nursing superintendent and assistant nursing superintendent for ward management, and takes full charge of the ward and assigns work to various categories of nursing and non-nursing personnel working alongwith. Nursing supervisor is responsible for safety and comfort of the patients in the ward, and in a teaching hospital, it is expected to ensure good learning environment.

Direct patient care

The direct patient-care responsibilities of the nursing sister/ward sister are as follows:

- Ensures proper admission, discharge of patients.
- Plans nursing care and makes patient assignment as per their nursing needs.
- Assists in the direct care of the patient as and when required.
- Sees that total health needs of patients are met.
- Ensures safety, comfort and good personal hygiene of patient.
- Assists in planning and administration of the therapeutic diet to patient.
- Sees that proper observation records of the patients are made and necessary information is imparted to the concerned authorities.
- Takes nursing rounds with nursing staff and students.
- Makes rounds with doctors and assist him in diagnosis and treatment of the patients.
- Implements doctors' instructions concerning to the patient treatment.
- Assists patient and their relatives to adjust in the hospital and its routine.
- Coordinate patient care with other departments.

Supervision and administration

The supervision and administrative responsibilities of the nursing sister are as follows:

- Ensures safe and clean environment in the ward.
- Makes duty and work assignments.

- Indents ward store and keeps necessary records.
- Does regular inventory checking of the ward.
- Makes list for condemnation of articles and submit it to all concerned.
- Assists in making ward requirements.
- Establishes and reinforces ward standards prescribed in the procedures and manuals of the ward and the hospital and policies that are in force.
- Acts as a liaison officer between the ward staff and hospital administration.
- Maintains good public relations in her/his ward.
- Sees that ward statistics are regularly submitted.
- Maintains discipline among the ward workers, e.g. staff nurses, students and domestic staff.
- Deals appropriately with any adverse situation that has occurred in the ward and reports to the concerned authorities.
- Reports about any medicolegal cases in the ward.
- Writes and submits confidential reports of the staff.
- Sees that students get desired learning experience in the ward.

Educational functions

The educational functions of the nursing sister/ward sister are as follows:

- Organises orientation programmes for new staff.
- Organises formal and informal ward teaching, conducts bedside clinics and demonstrations.
- Conducts ward conferences/meetings.
- Gives incidental teaching to patient relatives, staff nurses, students and domestic staff.
- Guides in formulation of nursing care studies, and nursing care plans, etc.
- Evaluates the students' performance and submit reports to school authorities.
- Helps in medical and nursing research.
- Encourages staff development programmes in the ward.

Staff Nurse

Classification: Group-I nursing staff

Qualification: GNM/B.Sc. (N), RN, RM

Related to patient care

- Evaluates in detail everyday the care requirement for each patient assigned:
 - Prepares a plan of care according to the nursing needs and programmes of therapy, as prescribed by the medical team.
 - Communicates the plan to coworkers and delegates duties according to their qualification and abilities.
 - Applies knowledge, skill and judgement to provide hygiene, comfort and optimum health for each patient.

- Performs necessary procedures and treatment appropriately and with proficiency.
- Prioritises workload to attend to critical patients and essential duties first, responsible for dispensing medication and ensuring that treatment is done correctly and at prescribed time.
- Coordinates nursing care functions with other team members to enhance efficiency and patient comfort.
- Maintains and ensures an accurate and legible record of observations, measurements, procedures, medications, treatments, positive and negative reactions, patients' progress and any other significant information.
- Discusses with ward sister about any concerns; seeks advice and exchanges ideas and information to provide the best-possible nursing care.
- Receives report on patients and ward activity from previous shift and gives accurate and complete report to successive duty shift.
- Informs ward sister/master immediately of any unusual events or concerns during the shift.
- Demonstrates knowledge of purpose, principles and precautions associated with drugs, therapeutic methods and diagnostic lists.
- Share responsibility with ward sister/master/clinical supervisor and medical team to provide quality and appropriate nursing care.
- Observe or supervise activities of the auxiliary nursing staff, student nurses and nonprofessional workers to ensure that accurate safety techniques (methods) are performed and utilised.
- Recognises and utilises the resources available in the institution, supplies, equipments, personnel and diagnostic tools. Communicates needs to specialised departments, dietary, physiotherapy, fellowship, etc.
- Ensures that emergency cart is readily accessible, containing required emergency equipments and supplies as designed by emergency care advisory committee, is fully stocked at all times and is checked regularly by using a checklist to verify assessment.
- Promotes optimal and economical use of supplies, equipments and utilities.
- Performs, enforces and instructs coworkers regarding the importance of strict infection-control practices.
- Recognises and promotes the value of keeping the patients and family informed of medical conditions, treatment, prognosis and methods by which they can participate effectively in therapy and rehabilitation.
- Provides physical, spiritual and emotional support to patient and family during time of crisis and/or bereavement.
- Recognises the present relevant health-teaching sessions to patient and relatives.
- Participates in ward rounds with medical team, discusses nursing observations and concerns, and becomes a patient advocate.
- Assists physician with treatment and procedures, checks chart daily for new orders and changes in treatment plans, and ensures implementation.
- Direct daily routine of ward/department
 - Sends requisitions and specimens.
 - Receives reports and supplies.
 - Maintains admission, discharge and death registration
 - Ensures admission, discharge procedures followed.
 - Informs medical team immediately of every sudden change in patient's status.
 - Maintains environment conducive for patient's stay.
- Responds promptly and appropriately to complaints made by patients, relatives and doctors regarding nursing care.
- Practice and reinforce confidentiality of sensitive information at all times.
- May be required to:
 - Perform overtime or call back duty when deemed and unavoidable.
 - Accept assignment to an area other than own work area.
 - Accept duties and responsibilities of ward sister/master when required.
 - Perform any other task as requested by the superior or management personnel.

Related to personnel

- Attends departmental and staff meetings and participates in committees as required.
- Receptive to new ideas and concepts, contributes opinions and shares concerns.
- Supports and encourages membership of nursing organisations.
- Observes and evaluates the work performance of subordinate staff.
- Assists with orientation of nursing staff and students.
- Encourages and participates in intradepartmental activities to boost morals.
- Prepares self for schedule performance evaluation by intraoperation, seeking advice and reflecting future aspirations.

Related to education

- Supports the bearing process and offers prompt and timely advice or interactions to nursing students as they gain clinical experience.
- Participates in training, in-service education programme whenever possible.

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Recording and Reporting Systems in Hospitals

Section X

SECTION OUTLINE

- Chapter 48** Fundamentals of Statistics
- Chapter 49** Hospital Utilisation and Statistics
- Chapter 50** Hospital Management Information System
- Chapter 51** Medical Record Management and Audit
- Chapter 52** Office Management and Administrative Issues



Fundamentals of Statistics

Dr Sahul Bharti and Dr Bhavneet Bharti

“The coming century is surely the century of data.”

—David Donoho

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand basic statistical concepts.
- cognizant of ethos underpinning hypothesis testing.
- demystify P -value and confidence intervals.
- comprehend ‘Power’ of a study.

INTRODUCTION

Statistics is the science of dealing with data. With rapidly expanding repertoire of new statistical techniques and software, large volumes of data can be unlocked and analysed with potential ease. A rigorously collected and systematically analysed data can, indeed, underpin good planning, management and organisation in any hospital setting. To meet this goal, statistics plays two key roles: (i) to precisely and accurately summarise loads of data into efficient, robust and consistent summary statistics and (ii) to make valuable inferences as well as predictions. It is, indeed, very

important for researchers to understand and apply principles of statistics for optimising healthcare functioning, management of bottlenecks and policy framework. Statistics, in short, offers a new vision of looking at things (Figure 48.1 A, B and C).

After this brief introduction, it is time to waltz readers through a series of interactive as well as resonating question-answer sessions between an imaginary ‘*Stat Guru named Mr P-value*’ and his favourite ‘*Stat Chela named Mr Alpha-Beta*’ (*disciple means Chela in Hindi*), both of them on a short statistical trip through PGIMER hospital in Chandigarh (Figure 48.2).

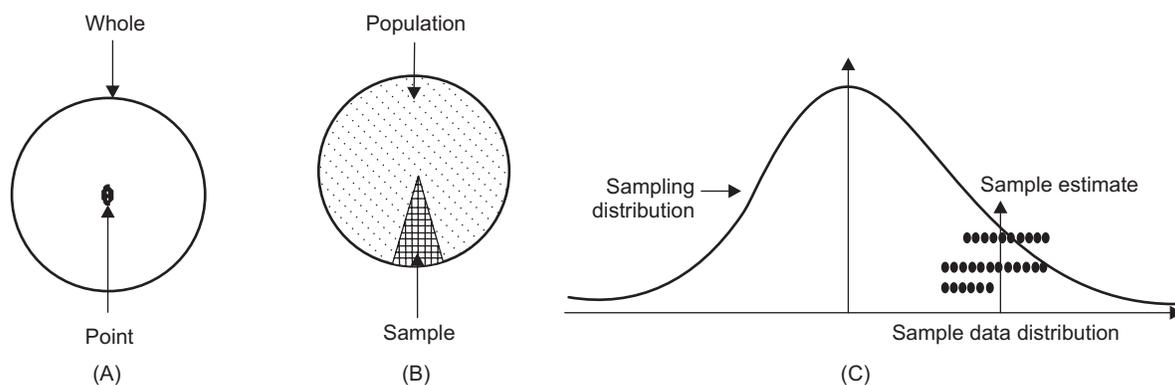


Figure 48.1 (A) From point to whole; (B) From sample to population and (C) From ‘sample estimate’ to ‘sample data distribution’.

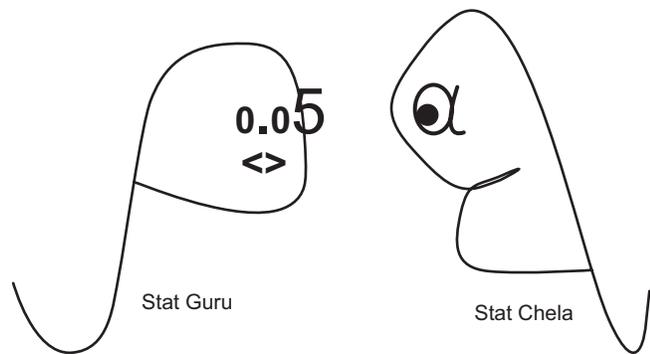


Figure 48.2 Imaginary *Stat Guru* (*Mr P-value*) and his favourite *Stat Chela* (*Mr Alpha-Beta*).

TYPES OF VARIABLES

Stat Guru: My dear *Alpha-Beta*. Can you describe the organisation of this hospital using some basic statistics?

Stat Chela (excitedly): Of course, various organisational characteristics of this wonderful hospital can be dichotomised into two groups of variables: (i) **Qualitative variables** that can be nominal and ordinal variables and (ii) **Quantitative variables** that can be discrete and continuous. Starting with nominal variable, this hospital caters to patients mainly from three states—Punjab, Haryana and Himachal Pradesh (names of three states constitute a nominal variable). The faculty in every department of this hospital can be ranked from lowest (assistant professor) to highest rank (professor and head of department) as an ordinal variable. Total number of deliveries conducted per month in labour room averages 75 on discrete scale. On the other hand, monthly income—a continuous variable—of resident doctors in this

hospital is more than postgraduate doctors from state medical colleges.

Mr P-value (Stat Guru): Wonderful my dear student! You have provided a nice statistical overview of hospital organisation. When we are describing some characteristic or property only by its existence, form or name and not by its value, that variable is **qualitative or categorical**.¹ From the perspective of hospital organisation, Table 48.1 gives more examples related to types of variables.

FUNDAMENTAL GOAL OF STATISTICS AND SAMPLE SELECTION

Stat Guru: Dear *Alpha-Beta*, you must understand one vital distinction before we proceed further in our statistical journey. Statistics is a bridge between researcher's study result (also called estimate or sample statistic) and value of same characteristic (known as parameter) in the target population of which the sample is one part. Thus, job of statistics is twofold—to summarise results of a given study sample yielding various sample statistics or estimates (*descriptive statistics*) and to unearth corresponding parameter values in the target population (*inferential statistics*). To facilitate metamorphosis of study results on to a much larger population (theoretically all possible subjects in the whole universe mirroring the study subjects), it is extremely important to have optimal size of study sample and more importantly, sample should be representative of target population as closely as possible. Latter prerequisite is fulfilled when probability sampling design is used in subject selection. Three common probability sampling methodologies are simple random sampling, stratified random sampling and multi-stage/cluster sampling.²

Table 48.1 Statistical classification of various types of variables

Name of variable	Categories or values of variable	Type of variable
Categorical or qualitative variables		
Type of hospital	Government/private	Nominal
Hospital services	General/specialised	Nominal
Level of hospital care	Primary/secondary/tertiary	Ordinal
Utilisation of hospital resources	Nil, minimal, moderate, maximum	Ordinal
Annual quality assurance report	Poor, average, good, best	Ordinal
Numerical or quantitative variables		
Number of patients admitted/day	50 or 60 or 100	Discrete variable
Number of beds in the hospital	1000 or 1500 or 2000	Discrete variable
Severity index score in emergency	Score from 10 to 100	Interval type of continuous variable
Average temperature in ICU	25°C	Interval type of continuous variable
Average waiting time in OPD	60 minutes	Ratio type of continuous variable
Mean daily cost of ICU care	Rs 5000	Ratio type of continuous variable

DESCRIPTIVE STATISTICS

Statistical journey progressed further to next station. The head of department of hospital administration has called an urgent meeting to inform *Alpha-Beta (Stat Chela)* that a prominent professor from Harvard University is visiting the department next week. *Alpha-Beta* is entrusted with the job of summarising and describing the data collected by the department over last 1 year. In order to give his best performance, *Alpha-Beta* immediately started working on his assignment and sought the help of his *Stat Guru, Mr P-value*. *Stat Guru* offered him following guidelines for statistical optimisation of collected data.

Stat Guru: Let us start with quantitative variable, say for example 'mean daily drug expenditure' for admitted patients in each department. You need to document mean (measure of central tendency) and standard deviation (measure of dispersion) of drug expenditure for inpatients daily in each and every department. Measure of central tendency simply points

at the average value of all data observations. However, it is always influenced by outliers or extreme values. There are three types of means [(arithmetic, geometric and harmonic means) (Table 48.2)]. Unlike mean, median is not much influenced by presence of outliers or deletion of certain values. Yet, it requires that data must be ordered in ascending or descending series (Table 48.2). On the contrary, how far or how close each observation is from the central value of mean can be described by measures of dispersion (also called measures of variability or scatter). *Classically, dispersion is depicted as 'standard deviation' (SD) around mean value. Other measures of dispersion are range and interquartile range (IQR)*. Table 48.2 further explains the above-mentioned summary statistics and their calculations using simple examples.

Alpha-Beta raised one doubt at this point. Which single measure is best to describe the central tendency as well as dispersion in our data? This led *Mr P-value* into little reflective mood and their statistical journey to another major station.

Table 48.2 Various types of summary statistics, their calculations and indications for statistical use

Summary measure	Definition and formula	Calculation with examples	Statistical use
Measures of central tendency: Used for individual observations, discrete and continuous series			
Mean			For quantitative variables
Arithmetic mean (AM)	Total values of items/total number of items (n)	1, 5 ($n = 2$); $AM = 1 + 5/2 = 3$	Best for normally distributed data series
Geometric mean (GM)	n th root of product of n numbers/or antilog of the mean of logarithms of the n values	2, 2; $GM = \sqrt{2 \times 2} = 2$ or 2, 2 = $\log 0.3, 0.3$; $AM \log \text{ values} = 0.6/2 = 0.3$ and $GM = \text{Antilog of } 0.3 = 2$	Mainly for exponentially distributed data, role in index numbers, averaging ratios or percentages
Harmonic mean (HM)	Reciprocal of arithmetic mean for inverse of all the data values (n)	3, 5 ($n = 3$); $HM = \frac{1}{(\frac{1}{3} + \frac{1}{5})/2} = 7.5$	Mainly in averaging rates, time, distance, speed
Median	Central value in ascending or descending order of data series ($n + 1/2$)	2, 3, 4, 5, 6 ($n = 5$); Median = $5 + 1/2 = 3$ rd value, i.e. 4	Primarily for discrete variable series
Mode	Most frequently repeating value in data	(2, 3, 2, 4, 2, 5, 2, 6, 2); Mode = 2	Easiest to calculate by inspection of data
Other positional measures			
Quantile	Measure that divides data distribution into 4, 5, 8, 10 or even 100 equal parts	Quartile (4 parts), quintile (5 parts), octile (8 parts), decile (10 parts) and percentile (100 parts)	
Measures of dispersion: Used for individual observations, discrete and continuous series			
Range	Largest value – smallest value	(2, 3, 2, 4, 2, 5, 2, 6, 2); Range = $6 - 2 = 4$	Simplest measure, role in quality control
Interquartile range (IQR)	75th percentile – 25th percentile ($Q3 - Q1$); $Q1 = \text{Value of } (n + 1/4) \text{ item}$; $Q3 = \text{Value of } 3(n + 1/4) \text{ item}$	1, 3, 5, 8, 9, 12, 17 ($n = 7$) $Q1 = 7 + 1/4 = \text{Value of } 2\text{nd item} = 3$ $Q3 = 3(7 + 1/4) = \text{Value of } 6\text{th item} = 12$ $IQR = Q3 - Q1 = 12 - 3 = 9$	More reliable than range, suitable for open-end distributions
Standard deviation (SD)	Square root of sum of squared deviations ($\sum d^2$) from mean divided by n ; $SD = \frac{\sqrt{\sum d^2}}{n}$	(2, 3, 4, 5, 6); Mean = $20/5 = 4$ $\sum d^2 = (2 - 4)^2 + (3 - 4)^2 + (4 - 4)^2 + (5 - 4)^2 + (6 - 4)^2 = 4 + 1 + 0 + 1 + 4 = 10$; $SD = \frac{\sqrt{10}}{5} = 0.63$	Also called root mean square deviation—the best method of dispersion
Coefficient of variation (CV)	(Standard deviation divided by mean) $\times 100 = (SD/\text{mean}) \times 100$	Mean = 4; SD = 1 $CV = (1/4) \times 100 = 25\%$	To compare the variability of ≥ 2 series

TYPE OF DATA FREQUENCY DISTRIBUTION³

Stat Guru: To find out which is the most efficient, unbiased and consistency measure of central tendency as well as measure of dispersion of data, we must assess the nature of frequency distribution of collected data. Broadly, frequency distribution of data can be grouped into two main headings: (i) distribution for continuous variables and (ii) distribution for discrete variables. Former classically includes 'Gaussian' (normal), 'exponential' and 'lognormal' distribution, while latter is typically described by 'Poisson', 'binomial' and 'uniform' distributions. Overall, there are at least 30–40 theoretical distributions described in the textbooks of statistics.⁴ For most part of probability-based statistical thinking, 'Gaussian or normal' distribution plays a big role in inferring from a study sample data. On this, *Alpha-Beta* immediately enquired about ways to assess or confirm 'normal' data distribution for quantitative variables. *Stat Guru* demonstrated four ways of assessing whether given study data follow or violate the assumption of normal distribution.

Stat Guru: First method is by simply visual scanning of your data. Plot your data as histogram and look at its shape. If it is bell shaped with data peaking in the centre and symmetrically tapering off in the peripheries, you can safely bet about the Gaussian or normal distribution of data. Second method is to go for proper statistical tests of normality. Two best-known tests of normality are *Kolmogorov-Smirnov test (KS test)* (best for samples having >50 subjects) and *Shapiro-Wilks test* (most powerful test for samples <50 subjects).⁵ If any of these tests give a significant *P*-value of <0.05, it is a clear indication that assumption of data normality is violated. On the contrary, normally distributed data will have nonsignificant *P*-values >0.05 on both tests. Third method is to look for coefficient of skewness and its standard error. If the *z*-value for skewness (coefficient of skewness divided by its standard error) is not centred around zero and goes beyond -2 to +2 *z*-scores, data is not 'Gaussian'. Skewness of data can be positive (right sided) or negative (left sided) as shown in Figure 48.3 (A and B).

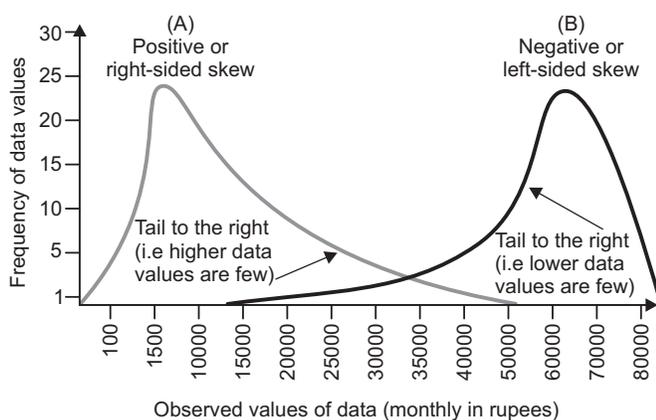


Figure 48.3 (A) Right sided or positively skewed; (B) left sided or negatively skewed data.

Fourth and final method is popularly known as Q-Q plots (Quantile-Quantile plots). Here observed data points are graphically assessed against a diagonal line representing the normal probability distribution. If all data points completely overlap the diagonal line with only minor drifting, data are considered consistent with normal distribution. Any obvious or major detour of observed data values from the diagonal violates 'normality' assumption.

INFERENCE STATISTICS

Interrupting *Mr P-value, Alpha-Beta* sought more clarification about an often confusing issue to beginners in statistics.

Stat Chela: Can we use standard error (SE) instead of standard deviation (SD) as a measure of dispersion?

Stat Guru: Standard deviation tells variability of data collected by researcher, whereas SE points out the relative dispersion of 'given sample mean' against a backdrop of underlying distribution of 'means of collectively exhaustive and comparable samples' from same target population. As a matter of fact, SE is not calculated by actually taking infinite or exhaustive number of equal-sized samples from one target population but is a mathematical novelty 'estimated' from a single-study sample data. The measure of SE forms the very foundation of inferential statistics by which study results are extrapolated to whole of the target population. Indeed, parameterisation of any sample estimate produced by a given study sample (e.g. mean, proportion or mean difference) is scaffolded on estimated SE. 'Hold on please!! Kindly do not choke me with myriad of new statistical concepts and terminology', pleaded *Alpha-Beta*. 'I am unable to grasp these abstract terms and connect them to underlying practical relevance. Please do me a favour by explaining them in simpler yet comprehensive way', requested *Alpha-Beta*.

ESTIMATION APPROACH USING CONFIDENCE INTERVALS

Stat Guru: Our statistical journey is gradually inching towards its final destination. To explain these concepts, let me continue with hypothetical situation where professor from Harvard University has reached your department and your presentation had gone nicely. In your presentation, you described the mean (SD) duration of laparoscopic operation/patient in department of surgery and proportion of patients suffering from complications due to laparoscopic surgery in last 1 year. Suppose mean duration was 30 min and SD was 10 min/laparoscopic surgery after analysing data of 100 patients in last 1 year. Moreover, only 10 (10%) of the patients suffered complications during laparoscopic surgery in last 1 year. Now, true aim of statistics is to generalise results of 100 patients to a larger population of all possible similar subjects undergoing laparoscopic surgery in similar clinical setting all over the world. Are you confident in

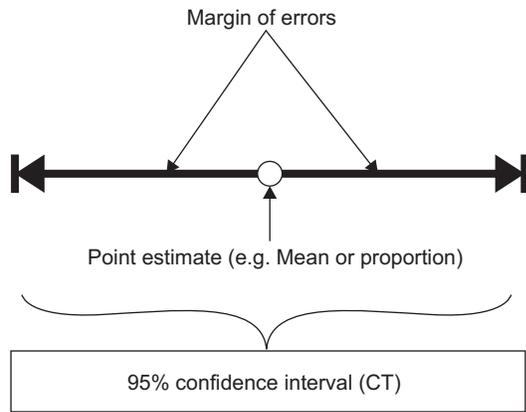


Figure 48.4 Confidence interval and margin of error around a point estimate.

claiming that every subject undergoing laparoscopic surgery in a larger target population will incur an average duration of 30 min? This average value of half-an-hour is just one point estimate obtained from a single study sample of 100 subjects. Similarly, how confident are you that true complication rate of laparoscopic surgery in whole target population will be around 10%? There is always an element of uncertainty around these point estimates in mirroring the true average value for all such patients in the population. Is there any statistical solution to ebb this uncertainty in capturing true population parameter? Yes, vulnerability of any point estimate in a study sample can be safely mitigated by using interval estimates around the point estimate. These interval estimates have been popularised in statistical literature as Confidence Interval (CI) and most widely used CI is known as 95% CI. Latter represents range of values, lower bound on one end and upper bound on other end, which are known as limits of CI.^{6,7} The upper and lower bound values are equidistant from point estimate; and width of interval on either side of point estimate is called margin of error (Figure 48.4).

How to Calculate Confidence Interval?

Stat Guru: The generic formula used to calculate CI around a given point estimate is as follows:

$$CI = \text{Point estimate} \pm \text{Margin of error}$$

(Margin of error is given by product of ‘Reliability Coefficient × SE’)

Hence, $CI = \text{Point estimate} \pm \text{Reliability Coefficient} \times SE$

Let us actually calculate 95% CI for the aforementioned example.

Example 1: Mean cost of laparoscopic surgery is Rs 5000 (point estimate); its standard deviation (SD) is Rs 1000 and sample size (n) of study is 100 subjects. The interval estimate is calculated below.

$$95\% \text{ CI} = 5000 \pm \frac{1000}{\sqrt{100}} 5000 \pm 196 = 4804 - 5196$$

Therefore, the true population value of mean cost of laparoscopic surgery in parent population could fall anywhere between Rs 4804 and 5196, and we are 95% confident about this. Still, there are 5% chances that this interval estimate may be wrong in capturing true population value. Now, another example to calculate 95% CI for point estimate of a proportion.

Suppose you carried out a hypothetical study to find out prevalence of complications during laparoscopic surgeries in the department of surgery. You studied 100 randomly selected patients who had undergone laparoscopic surgery and found 10% of them had complications. Since n is 100, P is 10% and Q is 90% (100% – P).

Example 2: Suppose you carried out a hypothetical study to find out prevalence of complications during laparoscopic surgeries in the department of surgery. You studied 100 randomly selected patients who had undergone laparoscopic surgery and found that 10% of them had complications. Since n is 100, P is 10% and Q is 90% (100% – P).

$$95\% \text{ CI} = 10\% \pm 1.96 \times \frac{\sqrt{10 \times 90}}{\sqrt{100}} \quad 10\% \pm 1.96 \times 3 = 10\% \pm 5.88 = 4.12 - 15.88\% \\ = \text{approx } 4-16\% \text{ (Figure 48.5)}$$

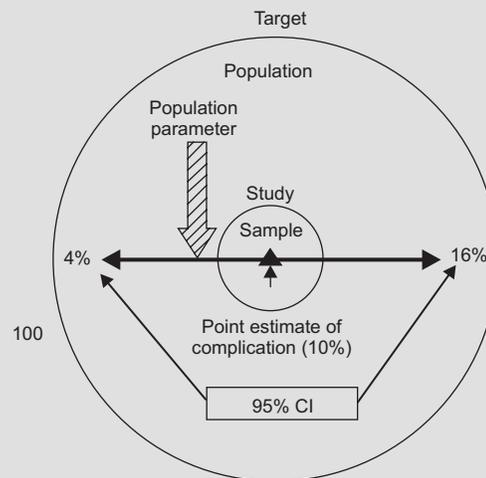


Figure 48.5 95% confidence interval for a point estimate of proportion.

This indicates that though prevalence of complications in study of 100 patients who had undergone laparoscopic surgery was 10% in a given hospital, yet the true prevalence of complications in all the tertiary hospitals of world could be anywhere from as-low-as 4% to as-high-as 16%, provided every selected study sample is randomly and fully representative of target population. *Alpha-Beta* got really very excited to know all this. He now realised that tool of CI is quite practical and offers a simple metric to capture truth.

HYPOTHESIS TESTING AND P-VALUE

Next issue, however, troubling *Stat Chela* was the concept of ‘P-value’. Sensing this, *Stat Guru* continued: In order to

understand the core concept of P -value, we need to venture into a new statistical field of hypothesis testing. Approach of hypothesis testing has been the mainstay in field of research and typically pivoted on 'null-versus-alternate hypothesis'.⁸ P -value is nothing but a metric used to decide in favour of one or other hypothesis. Simply speaking, P -value less than 0.05 (i.e. <5%) favours alternate hypothesis while P -value 0.05 or more (i.e. $\geq 5\%$) favours null hypothesis. Conspicuously, P -value never tells the researcher whether null or alternate hypothesis is true or false; it only tells us the likelihood of observing our data, given null hypothesis is true. Null hypothesis is exactly opposite of what a researcher believes. On the contrary, alternate hypothesis is the yield of researcher's mindset and it always signals that something new is happening and needs to be confirmed. In tug-of-war between null and alternate hypothesis, evidence obtained from data will be crucial and deciding factor. Results going in favour of alternate hypothesis will be declared as 'statistically significant', whereas results going in favour of null hypothesis will be labelled 'statistically nonsignificant'. P -value denotes the likelihood or probability of getting the given data, provided the statistician's belief or null hypothesis is true. If this probability is very low (<0.05 or 5%), we reject statistician's belief and decision goes in favour of researcher's belief or alternate hypothesis. In contrast, if the likelihood of getting the given data is high (≥ 0.05 or 5%) when statistician's belief or null hypothesis is true, we cannot reject statistician's belief, and decision goes against research-

er's belief or alternate hypothesis. This critical value of 5% is called *level of significance* and is decided arbitrarily without any mathematical assumptions. Researcher can vary this level of significance from as low as 1% to as high as 10% depending upon the importance of primary research finding.

From technical perspective, two most common approaches for inferring from sample data to target population in hypothesis testing are: (i) **Parametric tests**: They must meet certain assumptions regarding distribution of corresponding parameter of target population (primarily Gaussian/normal distribution, homogeneity of variance, interval or ratio data) and (ii) **Nonparametric (distribution free) tests**: Here actual data values are arranged in ranks from smallest to largest and tests are carried out on these ranks instead of raw values. These tests are used when data fail to meet the necessary assumptions of parametric tests. Various statistical tests used in different hypotheses testing are shown in Table 48.3.

Types of Error in Hypothesis Testing

By now, Alpha-Beta was deeply engrossed on his statistical journey with his Stat Guru. He was constantly surrounded by new doubts, followed immediately by excellent clarifications by his Stat Guru.

Stat Guru (in a tone of caution): Statistical approach of hypothesis testing for comparing groups, however, is fraught with two types of error: **Type 1 (Alpha error) and Type 2 (Beta error)**. When study groups share same population

Table 48.3 Various parametric and nonparametric tests used for statistical analyses

Hypothesis	Example	Parametric test	Nonparametric test
Compare one sample mean with an expected or hypothesised value	Average bed occupancy in PGI is higher than national figure	One-sample t-test	One sample median test
Compare two means (independent samples)	Difference in mean extramural funds received by PGI versus AIIMS in year 2012	Independent samples t-test	Mann-Whitney U-test
Compare two means (dependent samples)	Mean blood sugar levels of patients before and after 4 weeks of daily yoga training	Paired t-test	Wilcoxon signed rank test
Compare two or more independent categorical variables for association	Outcome (died/survived) of trauma patients with or without head injury	Relative risk or odds ratio Chi-square test/Fisher exact test	
Compare two or more dependent categorical variables for association	Comparing customer satisfaction (satisfied/not satisfied) in same subjects using two different rating scales	McNemar test	
Compare three or more independent groups	Mean hospital expenditure during admission in public, private and charitable hospitals for acute pneumonia	One-way ANOVA	Kruskal-Wallis test
Compare three or more dependent groups (serial data)	Quarterly medical bill reimbursements by hospital staff (Group 1: Jan-March, Group 2: April-June, Group 3: July-Sep, Group 4: Oct-Dec)	Repeated measure ANOVA	Friedman test
Correlation between two quantitative variables	Working hours of nurses versus junior doctors	Pearson correlation	Spearman correlation
Time to event data	Time to computerised scan (CT) of head in road traffic accidents patients brought to emergency	Kaplan-Meier survival analysis	
Predicting an outcome	Predictors of staff absenteeism from night duty	Simple or multiple regression analysis	
Diagnostic accuracy of various cut-off scores for an evaluation marker	Performance appraisal scores predicting early discharge from hospital/severity index scores in ICU patients predicting poor outcomes	Receiver operating characteristic (ROC) curve analysis	

Table 48.4 Type 1 and type 2 errors in hypothesis testing for comparison of two groups

Is the variability in outcome between two study groups by random chance (i.e. statistically not significant) or due to some systematic assignable cause (i.e. statistically significant)?	Statistician's believe for null hypothesis favours no significant difference or variability (i.e. $H_0 = 0$)	
	If H_0 is true (outcome variability is due to random chance only)	If H_0 is false (variability is indeed due to systematic or discernable cause)
Researcher's conclusions	Fail to reject statistician's H_0 (i.e. confirm random variability) Reject statistician's H_0 (i.e. confirm systematic variability due to some assignable cause)	Correct decision (Confidence level= $1-\alpha$) False-positive result or Type 1 error (α -error) False-negative result Type 2 error (β -error) Correct decision (Power = $1 - \beta$) (favours alternate hypothesis)

parameter, but difference between study samples has been statistically significant, we are trapped in Type 1 or Alpha error. This error is also called 'false positive' or 'overshoot' response. On the opposite, when study groups indeed have different population parameters, still their difference is statistically not significant, our inference is duped by Type 2 or Beta error. This error is also called 'false negative' or 'undershoot' response. These two types of errors (alpha and beta) can never coexist as it is impossible to simultaneously overshoot (alpha) as well as undershoot (beta) the target.⁹ Table 48.4 highlights the two types of error in terms of null-versus-alternate hypothesis.

Alpha-Beta, who was deeply immersed in this interactive statistical discourse by his Stat Guru, realised that both of them have waltzed through the thicket of statistical realities and their journey has ended. Alpha-Beta's inquisitive mind was yet not satisfied and he had many more doubts. Noticing that Stat Guru is now tired, Alpha-Beta requested for concluding remarks. Realising his sense of duty to succinctly summarise their lengthy discourse, Mr P-value (Stat Guru) made following valuable concluding remarks:

- Statistics is a useful tool for finding truth provided methodology of the study and data collection has been done in a rigorous and scientific way.
- Results of statistical analysis will be valid only when two prerequisites are fulfilled. First, sample size of a study for given outcome is optimal and study is, therefore, adequately powered. Second, study subjects are enrolled either by probability sampling method or by random assignment so that they closely mirror the target population, making results more generalisable.
- Based on point estimate of an outcome in a study with given sample size, a precision range for the corresponding true parameter in the target population can be easily provided as 95 or 99% CI. Technically speaking, 95% CI tells that if samples are taken infinitely from a same target

population and 95% CI is calculated around each of their point estimates, 95% of those CIs would capture the true population parameter anywhere along their range.

- Statistical significance deals with likelihood or probability of getting the study result of given magnitude (or larger than that) when null hypothesis (statistician's belief) of no difference or status quo is true. P-value is nothing but the largest value of alpha at which the 'true' null hypothesis can be rejected.
- Two predominant approaches of hypothesis testing in inferring from sample data to larger target population entail parametric and nonparametric methods. Parametric tests are more powerful but assumption dependent. Nonparametric tests are less powerful but quite flexible to various assumptions of the parametric tests.
- Hypothesis testing for comparing groups is to be safeguarded against two types of error. If a study is repeated infinitely from a given target population using same sample size, Type 1 or alpha error is the percentage of study samples showing false positive results and Type 2 or beta error is the percentage of study samples showing false negative results.
- A good study must be forearmed with appropriate plan of statistical analysis much before actual data collection or intervention starts.

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Hospital Utilisation and Statistics

49

Gp Capt (Dr) Sanjeev Sood, Dr Pramod Gupta and Dr Sonu Goel

“99 percent of all statistics only tell 49 percent of the story.”

—Ron DeLegge II

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the uses of healthcare statistics.
- understand the type of statistical information collected in hospitals on a periodical basis.
- workout the formulae used for the calculation of rates and percentages used in the collection of statistical data.
- interpret and prepare appropriate statistical reports.

INTRODUCTION

Hospital statistics may be defined as the science that deals with collection, presentation, analysis and interpretation of quantitative data as applied to hospital services. Though the scope of services provided by a hospital are comprehensive and quite vast and includes inpatient ambulatory and domiciliary care, preventive medicine, and health education, hospital statistics typically applies to inpatient care and morbidity and mortality patterns.

The collection of meaningful statistics is one of the important functions of any hospital, since they are important measures of performance for a range of services provided by a hospital. These statistics measure morbidity and mortality patterns, workload of hospital and adequacy, efficiency, effectiveness and/or utilisation of services provided by a hospital. These may include ratios, proportion and rates, and may pertain to all specialities or specifications to a given speciality.

The study of hospital statistics serves the following purposes:

- Exercising administrative control over functional activities.
- Assess utilisation of hospital facilities.
- As an indicator for evaluation of quality of medical care.
- Provide a basis for preparing budgets.
- Planning for future requirements and justifying the same.
- Provide data for health intelligence to public health authorities.

- For comparison of services rendered by different departments of the same hospital or two or more hospitals or present and past performance of the hospitals.
- Evaluation of performance by the care providers.
- Research and data analytics for business intelligence.
- For evaluation by accreditors, investors, auditors, finance agencies like venture capital funds.

The medical record department is overall responsible for the collection, analysis, interpretation and presentation of statistical data. Today, the digital systems automatically collect and compute many of the statistics that were previously done manually.

HOSPITAL SERVICES UTILISATION PARAMETERS

Before proceeding further, it is important to realise that uniform definitions and standards should be universally adopted with regard to statistical units used to measure various hospital activities. The use of standard statistical methods also facilitates to compare operating results within the hospital and to compare 1 year's operations with another. Furthermore, to be effective, any statistical report must mean the same thing to the person who reads it as it does to the person who prepares it. A clear understanding of some of the terms used in hospital statistics is therefore essential.

Admission: It is the formal process whereby a patient is accepted by a hospital for the purpose of treatment as an inpatient, typically for a duration of more than 24 h.

Hospitalisation for durations shorter than 24 h may be termed 'detention'. If an inpatient is formally discharged from the hospital and then reports for further treatment, the admission process is repeated.

Live births in the hospital are not considered as inpatient admissions, while premature and diseased newborns are considered admission. Newborn babies are always recorded separately as newborn admissions whether or not they require during their hospitalisation, special medical care in the nursery or in another critical care area (for example, neonatal intensive care unit). A newborn admission is deemed to occur at the time of birth in the hospital.

Visit or medical attendance: A visit is a single encounter with a care provider that includes all of the services provided during the encounter. This term is usually used to refer to outpatient services. An outpatient is one who receives ambulatory care services in a hospital-based clinic or department. A visit occurs each time an outpatient attends a hospital and receives one or more occasions of service.

Occasion of service (touch point): It is a specified, identifiable service involved in the care of patient that is not an encounter, such as a lab test ordered during an encounter. Any consultation(s) or treatment(s) or other service(s) provided to a patient by a functional unit of a hospital. On each occasion such service, each specimen or simultaneous set of specimens for the one patient, referred to a hospital department, constitutes one occasion of service.

Bed complement or bed count: The number of beds (occupied or unoccupied) established and manned in an inpatient area of a hospital that are readily available to be used by inpatients.

Based on dimensions and the purpose, there are three kinds of beds: (i) adult beds of standard dimensions, (ii) cribs for younger children and (iii) bassinets for sick infants/newborns.

Exclusion: Bassinets used by normal newborns are counted and reported separately from other hospital beds. Recovery room beds and labour beds are not counted as hospital beds, if patients who occupy them for brief periods are assigned to another bed in the hospital. Certain beds (e.g. recovery room beds, observation beds in the casualty, beds located in diagnostic and therapeutic departments, labour room beds, examination couch and so on) that are necessary for hospital purposes but are not normally available for full-time care of patients are not included in the bed complement. However, beds in intensive care, isolation ward, side rooms attached to the wards where patients are regularly kept and bassinets used for sick and premature newborns are included in the bed complement.

Hospital patient: A hospital patient has been defined as a person who avails the comprehensive services of a hospital for observation, care, diagnosis or treatment, or as one who makes use of the diagnostic or therapeutic services of a

hospital, though not hospitalised. There are two major types—inpatient and outpatient.

Inpatient: Patients who are held for observation in the emergency department or other observation areas, pending a decision whether to admit or not to admit to an inpatient bed should not be regarded as inpatients. However, if a decision is made to admit such a patient, the time of admission should be regarded as the arrival time at the emergency.

Daily census (daily inpatient census): The daily census is the number of patients present at census taking time, usually at midnight, plus any patients who were admitted after the previous census-taking time and discharged before the next census-taking time.

Patient day: Patient day or bed day is a statistic denoting the service rendered to one inpatient in the hospital census between one day and the succeeding one. Sometimes the day of admission and the day of discharge are counted as one day. In other cases a full day is counted only when admission is before mid-day or discharge is after mid-day. Thus, the data given should be the annual total of the daily census of occupied inpatient beds throughout the reporting year. Patient days should not include data for healthy, newborn infants.

The 'patient day' is a key statistic as it is used for computing the cost per patient day, which facilitates the evaluation of the performance of the hospital.

Total patient days (total inpatient service days): This indicator is derived by adding up the sum total of all inpatient days for each of the day of service provided during a given period. This is taken from the census forms. Every inpatient receives one inpatient service day, each day during hospitalisation.

Length of stay (discharge days): It is the total number of patient days for an inpatient episode. The duration of an inpatient's hospitalisation is considered to be 1 day if he is admitted and discharged on the same day and also if he is admitted on one day and discharged the next day. The day of admission should be counted but not the day of discharge.

Discharge: It is a formal process whereby an inpatient leaves the hospital on completion of the treatment. The number of discharges includes discharge to home, transfer to other hospitals and deaths of patients who were admitted at the time of death.

Under certain circumstances, patients may not adhere to a laid down process or follow medical advice and leave against medical advice (LAMA) or be discharged by the hospital authorities against medical advice (DAMA) for not following the institutional rules and regulations. These patients must be explained in writing about the consequences of leaving against medical advice and their signature obtained in the presence of a witness.

Surgical procedure: Any single separate systematic manipulation upon or within the body, which can be complete in

itself, normally performed by a licensed practitioner or dentist, either with or without instruments, to restore disunited or deficient parts, remove diseased or injured tissues, extract foreign matter, assist in obstetric delivery or aid in diagnosis.

Surgical operation: Although surgical procedure and surgical operation are considered synonymous, a surgical operation is more specifically defined as one or more surgical procedures performed at one time for one patient via a common approach or for a common purpose.

End of life: Period of time, usually 6 months, marked by progressively deteriorating disease or disability until death. The focus is on palliative care during end of life.

Hospital death: Death of an admitted patient is considered as hospital death. Death in the casualty department, outpatient department (OPD) or in an ambulance before the actual admission of a patient is not considered as hospital death.

Sudden death/found dead: As per International Classification of Diseases 10 (ICD 10),¹ 'sudden death cause unknown' could be as follows:

- R96.0: Instantaneous death.
- R96.1: Death occurring less than 24 h from onset of symptoms, not otherwise explained.
- R98: Death in circumstances where the body of the deceased was found and no cause could be discovered. Found dead.
- R99: Death NOS (not otherwise specified). Unknown cause of mortality.

A medicolegal case has to be initiated for sudden death/found dead cases.

Underlying cause of death: The disease or injury that initiated the chain of morbid events leading directly to death or the circumstances of the accident or violence that caused the fatal injury.

Patient record/medical record/clinical record: A document that contains the chronological sequence of events that a patient undergoes during his stay in the healthcare organisation. It includes demographic data of the patient, assessment findings, diagnosis, consultations, procedures undergone, progress notes and discharge summary (death certificate where required).

The following hospital statistics are related to **maternal and child health:**

Delivery: The act of giving birth to either a live baby or a dead fetus. A pregnant woman who delivers may have multiple births. For example, a woman who gives birth to twins will have one delivery but two births.

Live birth: The complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes

or shows any other vital signs of life, such as beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles, whether or not the umbilical cord has been severed or the placenta is attached; each product of such a birth is considered live born (WHO, ICD 10, Vol. 1, page 1235).

Foetal death: Foetal death is prior to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy; the death is indicated by the fact that after such separation the foetus does not breathe or show any other evidence of life (WHO ICD 10: Vol. 1, pages 1235–1236).

Neonatal death: The neonatal period commences at birth and ends 28 completed days after birth. Neonatal deaths (deaths among live births during the first 28 completed days of life) may be subdivided into **early neonatal deaths**, occurring during the first 7 days of life, and **late neonatal deaths**, occurring after the 7th day but before 28 completed days of life (WHO, ICD 10, Vol. 1, page 1237).

Perinatal death: A perinatal death is one occurring during the perinatal period, which commences at 22 completed weeks (154 days) of gestation (the time when birth weight is normally 500 g) and ends 7 completed days after birth (WHO, ICD 10, Vol. 1, page 1237).

Maternal death: Death of any pregnant woman or death within 42 days of termination of pregnancy, irrespective of duration and site of pregnancy, from any cause related to or aggravated by the pregnancy, or its management, but not from accidental or incidental causes.

Maternal deaths should be divided into two groups:

1. Direct obstetric deaths

Those resulting from obstetric complications of the pregnant state (pregnancy, labour and puerperium) from interventions, omissions, incorrect treatment or from a chain of events resulting from any of the above.

2. Indirect obstetric deaths

Those resulting from previous existing disease or disease that developed during pregnancy and was not due to direct obstetric causes, but was aggravated by physiological effects of pregnancy, e.g. CHD (WHO, ICD 10, Vol. 1, page 1238).

PATIENT MOVEMENT STATISTICS²⁻⁵

These statistics represent the activities in connection with patient's movement, i.e. admissions, duration of stay and discharges or deaths and are calculated in rates and percentages. These statistics are indicators of utilisation of hospital services and operational efficiency. Most of the statistical analysis of hospital activities is carried out on the basis of discharges because the number of admissions does not represent the complete picture of the hospital's activities with regard to a particular patient.

Average daily census: The average daily census is the average number of inpatients, excluding newborn receiving care, in the hospital at midnight on that day. The average daily census is therefore calculated by adding up the daily census of that period and dividing it by the number of calendar days in that period. Average daily census can also be calculated on the basis of discharges by adding up the number of patient day's care rendered to each patient over a period of dividing the same by the number of calendar days in that period. For example, if there were 25,000 patient days of care rendered during the year, the average daily census for the year would be 68. The figure represents the average daily load of patients over a given period.

Formula

$$\frac{\text{Total number of patient days for a period (except newborn)}}{\text{Total number of days in the same period}}$$

Percentage of occupancy: The percentage of inpatient beds occupied over a given period. It may also be expressed as the ratio of the average daily census to the bed complement during any period. The percentage occupancy may be calculated as:

Formula

$$\frac{\text{Total number of patient days for a given period} \times 100}{\text{Available beds (bed complement)} \times \text{Number of days in the period}}$$

Normal rates of occupancy vary with the size and type of hospital and other factors affecting utilisation of hospital facilities. Small hospitals usually have lower occupancy rates than large hospitals. In India, where hospital care is partly free and inadequate as compared to needs, patients are put on nonregular beds; the occupancy may go to 110 or higher per cent. 75–85% occupancy is considered optimum for good quality patient care and hospital economics without stretching the resources. Higher occupancy means overutilisation and consequent lowering of quality of care, and low occupancy may mean over provisioning as such wastage of resources. Few beds may be left vacant for unforeseen situations like disaster or outbreak of epidemics. The occupancy rate can also be worked out departmental ward/unit wise in order to find out the load of work on different areas of the hospital during different period of the year of the same period over successive years.

Average length of stay (ALOS): The average length of stay is the average number of patient days of service rendered to each inpatient during a given period. This is obtained by dividing the total number of patient days (sum of daily census) during a period by the total number of discharges and deaths during the same period. This formula is of practical value in acute general hospitals with a quick turnover but is inadequate where there is a considerable difference between the number of patients admitted and

those discharged during the period or where the average length of stay is unusually long or greater than the period under consideration. A more accurate procedure adopted these days is to calculate the total patient days based on discharged (instead of or daily census) and dividing the same by total discharges including death during the same period. This method is very accurate and the average length of stay can be calculated unit wise, ward wise or disease wise and even physician wise. In India, the average length of stay in acute general hospitals is 10–12 days. It is more in case of teaching hospitals and less in district hospitals. In USA, this figure is as low as 4–5 days for most of the acute general hospitals. Hospital bottlenecks and longer turnaround times (TATs) increase the average length of stay and can be taken as an index of inefficiency to some extent. A shorter ALOS shall mean that more number of patients can be treated on same number of beds, which are a scarce resource in India.

Formula

$$\frac{\text{Total length of stay of discharged patients for a given period}}{\text{Total number of discharges and deaths in the same period}}$$

Turnover interval: Turnover interval is the average period in days a hospital bed remains vacant between one discharge and another admission. It is calculated by subtracting actual patient days from the maximum-possible patient days and dividing the resultant figure with the total discharges during the same period. ALOS indicates the time that available beds are free.

Turnover interval indicates a shortage of beds when negative, and underuse of the hospital or an inefficient admission system, if positive. A negative interval or short interval indicates overutilisation, whereas large positive interval indicates low demand of defective admission and discharge procedures. The index is also dependent upon occupancy rate, and increase in occupancy may not be beneficial. This indicator is more useful for paying beds where maximisation of revenue is the aim. This is not of much use for government sector where demand on beds is excessive.

Formula

$$\frac{\text{Available beds} \times \text{Days in the period} - \text{Patient days for the period}}{\text{Number of discharges, including deaths, in the period}}$$

Bed turnover rate: This is the mean number of patients 'passing through' each bed during a period. This indicates the use made of available beds.

Formula

$$\frac{\text{Number of discharges (separations) in the period}}{\text{Available beds}}$$

Other statistical performance indicators are:

(a) Number of patients treated per available bed.

- (b) Staff per inpatient case (divided into principal categories of staff).
- (c) Theatre sessions per bed.
- (d) Energy (power) used per airconditioned volume.

PATIENT MORBIDITY/MORTALITY STATISTICS AND AUTOPSY RATES

These statistics are useful to evaluate the quality of care rendered in a hospital and gross variations over different periods' call for analysis of causes and effecting appropriate controls and remedial action. These statistics should be risk adjusted as far as possible. Normal figures quoted in succeeding paragraphs refer to western hospitals. Standard figures of Indian hospitals are not yet available.

Death rates: The gross death rate is the percentage of total number of hospital deaths during any given period by relation to the discharges and deaths during this period. Patients who are dead on arrival (DOA) at a hospital are not included while calculating these rates.

Formula

$$\text{Death rate} = \frac{\text{Total number of deaths} \times 100}{\text{Total number of discharges and deaths in the same period}}$$

A figure of 5% is considered to be as acceptable gross death rate and does not take into consideration the time the patient spends in hospitals between the admission and his death.

Net death rate: A death rate, also known as the institutional death rate that does not include deaths that occur within 48 h of admission (24 h of admission in some countries). Normal figure for net death rate is 2–4%. However, with today's technology, this concept is no longer thought to be valid. Therefore, it is recommended that net death rates cannot be calculated unless there is a special reason to do so. Similarly specific net death rates can be calculated for individual departments and specialist units for comparative purposes.

Formula

$$\frac{\text{Deaths} - \text{Those within 48 h of admission in a given period} \times 100}{\text{Total number of discharges and deaths} - \text{Deaths within 48 h of admission within the same period}}$$

Postoperative death rate: The ratio of deaths within 10 days after surgery to the total number of patients operated on during that period. The normal figure is 1–2%, but varies considerably with the type of surgery undertaken. The death rate is likely to be higher in cardiac and neuro-surgery units.

Formula

$$\frac{\text{Total number of patients who were operated on for the period} \times 100}{\text{Total number of deaths (within 10 days of surgery)}}$$

Anaesthetic death rate: An anaesthetic death is defined as death occurring within 24 h of administration of anaesthesia due to causes related to anaesthesia. However, a revived cardiac arrest case, even if he dies after 10 days, is considered as anaesthetic death.

Formula

$$\frac{\text{Number of anaesthesia deaths} \times 100}{\text{Total patients anaesthetised}}$$

The normal figure quoted for such deaths is 1 in 5000.

Maternal death rate: This is defined as percentage of death of obstetric patients in relation to total discharges and deaths in obstetric wards. Normal value should be about 0.25%.

Foetal death rate: A ratio of foetal deaths to the total number of live births and foetal deaths in a period.

Formula

$$\frac{\text{Total number of foetal deaths for the same period} \times 100}{\text{Total number of births and foetal deaths for a given period}}$$

Neonatal death rate: This is defined as percentage of deaths of neonate (up to 28 days of birth) in relation to total viable newborn discharged including deaths. Acceptable rate is about 2%.

However, these rates vary from country to country and region to region within the same country. These rates serve as a sensitive indicator of quality of healthcare services provided to community.

Hospital autopsy rate: The percentage of all autopsies performed in the hospital to all inpatient deaths in the hospital. Patients who are dead on arrival (DOA) at the hospital and foetal deaths are excluded from both the numerator and the denominator.

Formula

$$\frac{\text{Total number of autopsies for a given period} \times 100}{\text{Total number of inpatient deaths for the same period}}$$

Hospital Care Evaluation Statistics

In addition to patient mortality and movement statistics as described above, there are certain hospital statistics that reflect on the quality of care rendered by the hospitals. These are sometimes used in comparing the standard of care provided in different hospitals or in the same hospital at different periods. These are presented in Table 49.1 with normal figures (American standards).

Table 49.1 Indicators for quality of care

Indicator	Average figures (in %)
Postoperative infection rate (SSI rate)	1–4
Postoperative complication rate	3–4
Caesarian section rate	4–5
Autopsy rate	15–20
Consultation rate	15–20
Rate of normal tissue removed	10–12
Conflict between final and pathological diagnosis	10–15

The graphical analysis of the hospital performance on basis of average length of stay (ALOS) and bed occupancy rate (BOR) and categorises various healthcare facilities into four quadrants (Figure 49.1).

In some government-run hospitals, psychiatric and rehabilitation facilities, ALOS may be high with low-to-moderate bed occupancy rates (top-left quadrant). These hospitals need to attract more patients. In well-managed trust run or charity hospitals with low ALOS and high bed occupancy, the margins are good and there is a scope for bed expansion and improving processes (bottom right quadrant). In long-term care hospitals with moderate margins, there is a scope for improvement of processes (top-right quadrant). In large, well-managed corporate hospitals with focus on patient care

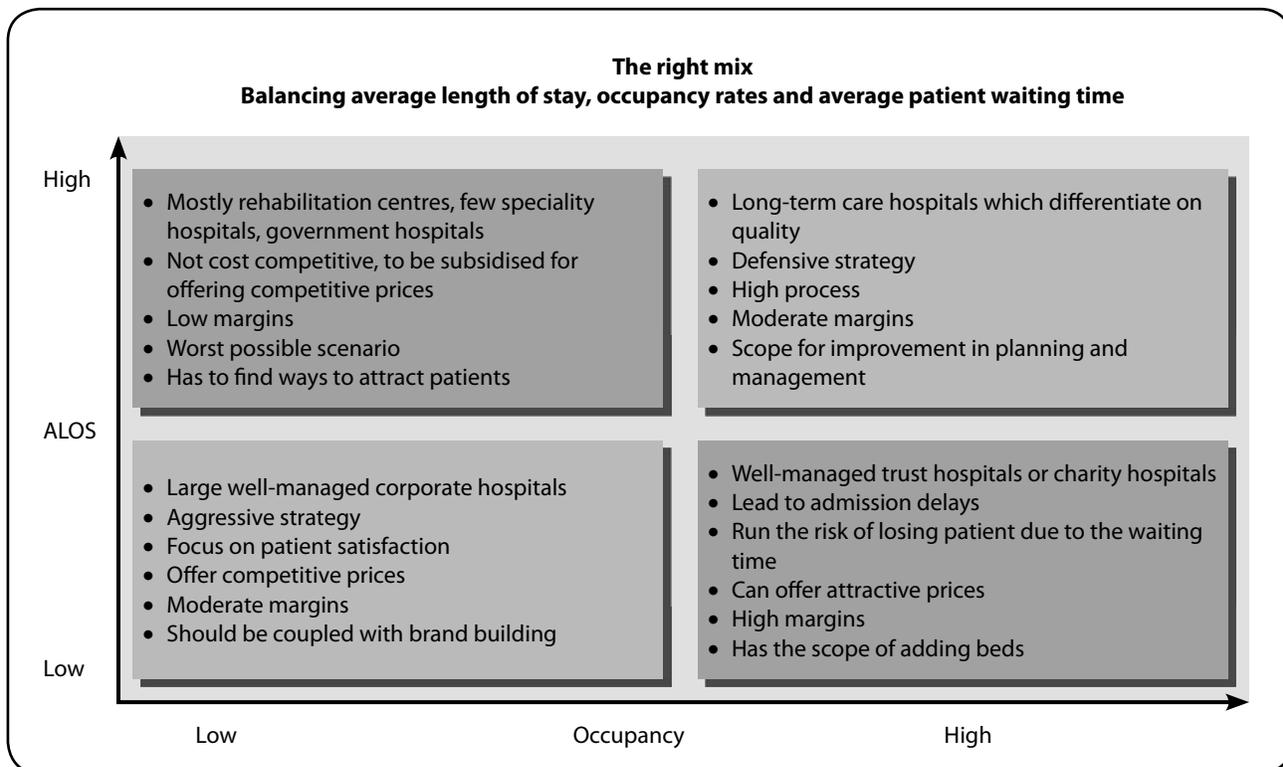
and competitive costs, there is short ALOS and low-to-moderate bed occupancy (bottom-left quadrant). These hospitals can focus on brand building and enhance bed occupancy.

Overall, the trend in healthcare facilities is to reduce ALOS to 3–5 days and achieve BOR of 80–90% for optimal utilisation of resources and maximum productivity. Thus to reach optimum balance, hospitals should strive to achieve operational efficiencies by reducing TAT, streamlining work-flows and processes, admitting right mix of cases, shorten ALOS, and increase bed turnover and bed occupancy rates so as to reduce average cost per admission. Increasing the BOR through higher admissions per day rather than longer stays will allow more patients to be served, and thus improve hospital productivity and margins.

Interpretation of Statistics

When managing statistical data or if reviewing existing collection systems, the hospital administrator should understand the purpose of compilation of the data and what use this information is going to be.

Statistics are only as accurate as the original source from which they are compiled. However, it has to be remembered that statistics by themselves prove nothing. Like all evidence they must be subjected to critical examination and analysis

**Figure 49.1** A graph depicting the relationship between ALOS and bed occupancy rates.

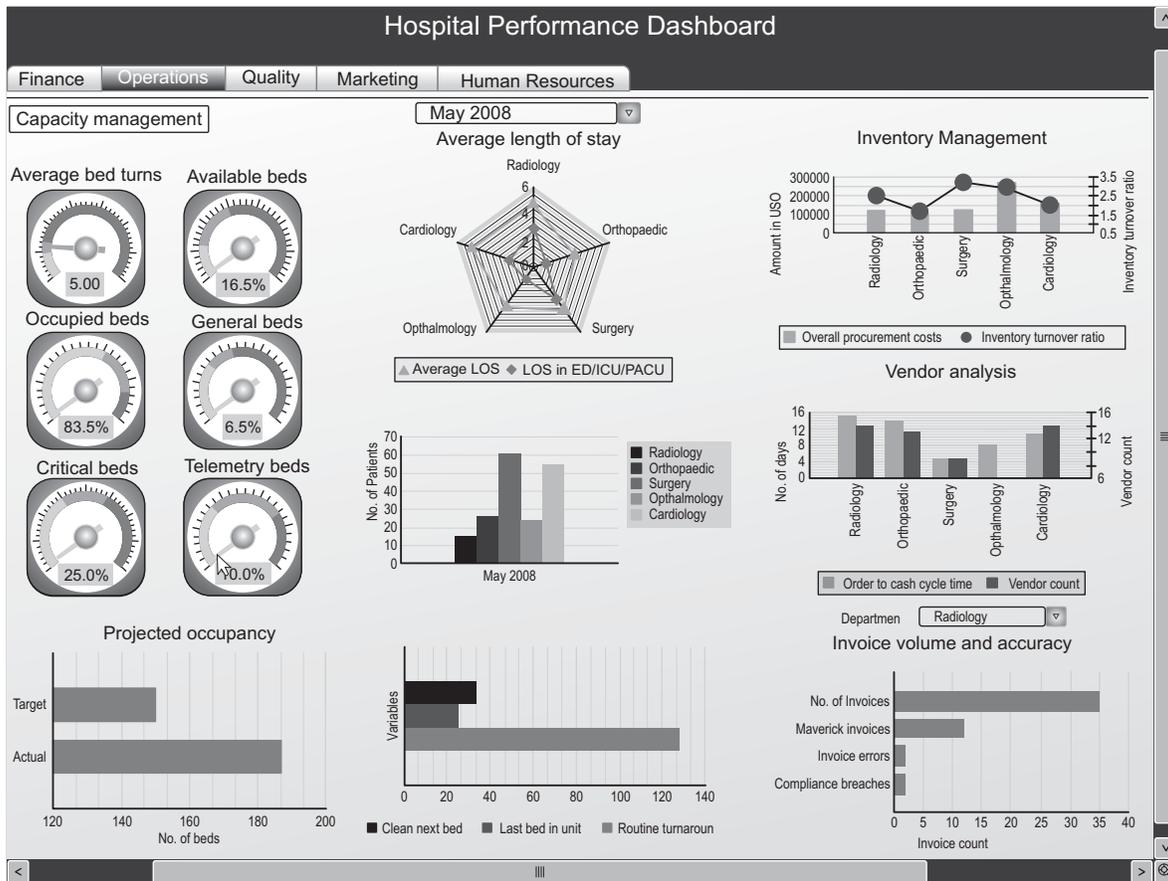


Figure 49.2 Dashboard of hospital operations.

to determine their true significance. Since they present only the numerical side of the problem, conclusions drawn from the figures alone may be misleading.

Presentation of Reports

The hospital administrator, accreditation agency or a government agency establishes various reports that must be presented periodically. It is important to ensure that these reports are compiled in a timely and accurately, since this reflects upon the performance of the medical records department.

The data collected and reports prepared should be reviewed and examined on at least an annual basis to determine if they are being used. Data that are collected for no apparent reason or reports that are prepared that no one uses are a waste of staff time and resources.

The hospital statistics can currently be presented at a glance through quality dashboards applying analytic tools (Figures 49.2 and 49.3). These dashboards are easy to interpret, enable meaningful comparisons and effective decision making.

Hospital statistics is an important tool to evaluate hospital performance, utilisation and efficiency of services provided and quality of care rendered. Prior to collecting or computing any statistical information, the healthcare professional must find out what information is needed, and how and when it is to be utilised.

The reports generated are also very important and serve as a tool of communication. All presentations should be simple and legible with important points highlighted. Although most reports are in tabular form, they would be easier to read if visual aids such as bar charts, graphs, pie diagrams and dashboards were used to illustrate clearly what the figures represent. Additionally, reports should be unequivocal and leave no room for doubt as to what the statistics represent. Currently, most Indian HCOs are data-poor; some are data-rich, but information-poor; very few could be data and information rich.

Many health facilities around the world today use automated systems to analyse and present their statistical data. This enables collection of more than basic data, which is readily retrievable and useable to make effective and smart business decisions.

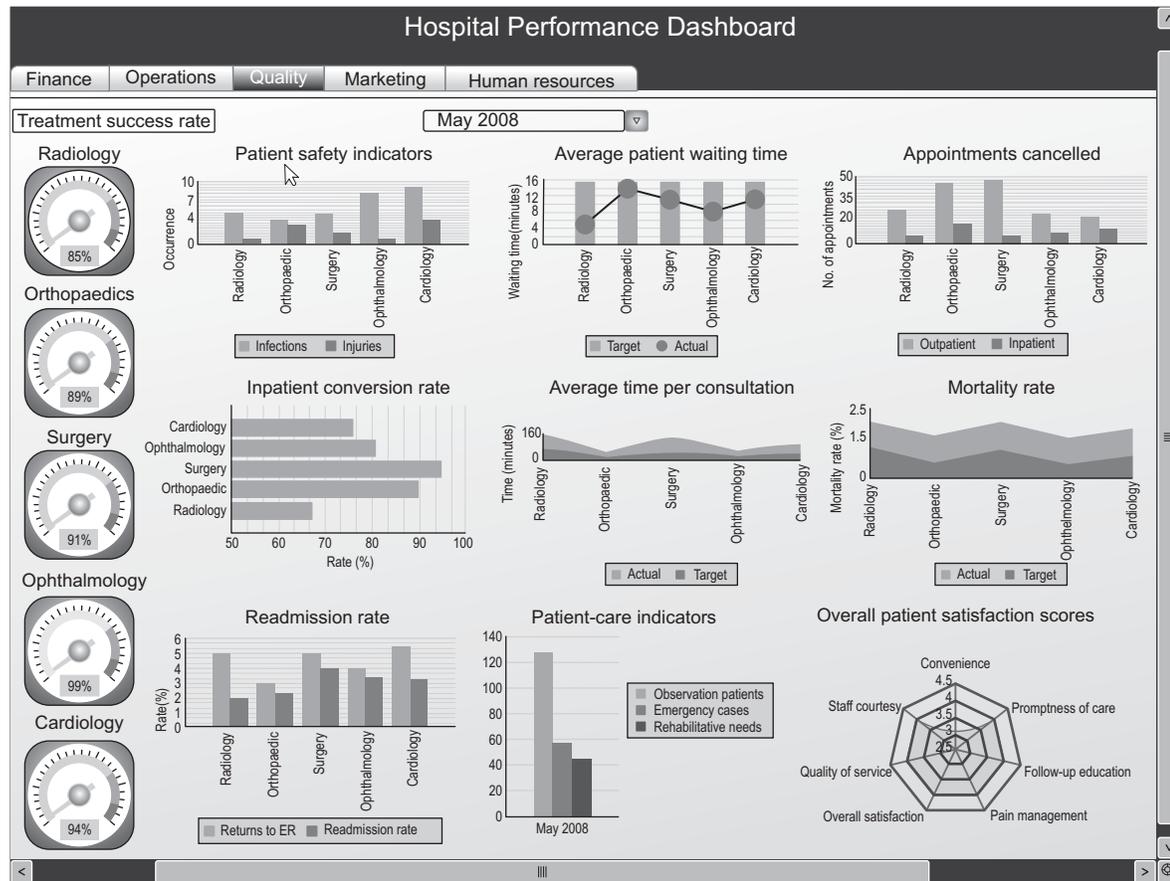


Figure 49.3 Dashboard of some quality indicators.

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Hospital Management Information System

50

Gp Capt (Dr) Sanjeev Sood and Dr Sonu Goel

“Information is a source of learning. But unless it is organised, processed and available to the right people in a format for decision making, it is a burden, not a benefit.”

—William Pollard

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the need for hospital management information system (HMIS).
- describe the features of HMIS to meet the primary information requirements of a healthcare organisation.
- describe the analysis of HMIS modules—the clinical, financial and administrative functions provided by a HMIS.
- enlist the advantages and possible disadvantages of HMIS—how HMIS can transform healthcare delivery?

INTRODUCTION

Healthcare is an information-intensive industry. The moment a patient enters a hospital, a vast amount of data is generated in terms of medical history, clinical condition, treatment and laboratory investigations. The need for implementation of hospital management information system (HMIS) emerged to capture and organise this information and leverage the competencies and benefits of information and communication technology (ICT) to transform healthcare delivery.

Effectiveness of any healthcare institution depends on its stated objectives and goals, its overall strategy, soundness of its operations and efficiency of its management systems. The administrator's effectiveness depends upon ability to make effective and evidence-based decisions based on information made available by HMIS. Some of the major factors determining the effectiveness of a healthcare institution include patient-care management and patient satisfaction. Healthcare organisations are challenged daily by the need to manage and integrate clinical, financial and operational information, and process vast amounts of information. As this need grows and evolves, there is requirement for a hospital information system that can keep pace with this burgeoning data. Proper information dissemination across

the healthcare organisations (HCOs) is a must for administrative efficiency and effective patient care.

Hospital management information system (HMIS) is a comprehensive information management system dealing with all aspects of information processed in an HCO as well as the human operator or technological dimension involved in this information-processing role operating in a federated model. It is an integrated automated system designed to collect, store, and share, manipulate and retrieve information pertinent to the administrative and clinical aspects of services provided within the HCO.

Information systems are sociotechnical systems. Although they are composed of machines, devices and 'hard' physical technology, they require substantial social, organisational and intellectual investments to make them work properly. Since problems with information systems—and their solutions—are rarely all technical or behavioural, a multidisciplinary approach is needed.¹

The purpose of an HMIS is to manage the information that healthcare providers need to perform their jobs effectively and efficiently. HMIS enable communication, integrate information and coordinate action among several healthcare professionals. In addition, they assist in the organisation and storage of information, and support certain recordkeeping and reporting functions. An HMIS also supports the financial

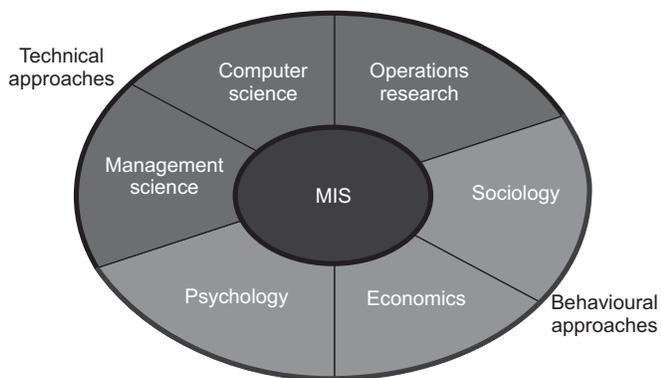
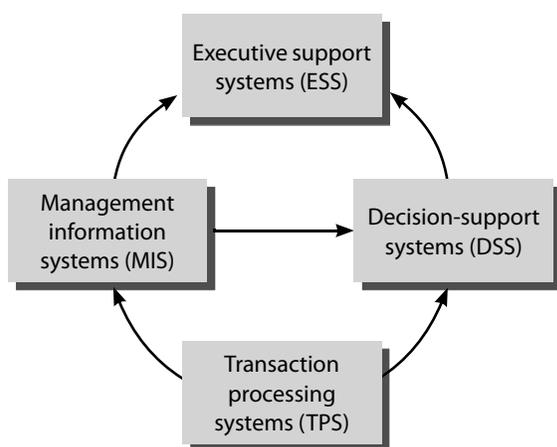


Figure 50.1 Contemporary approaches to information systems.

and administrative functions of a health organisation and associated operating units, including the operations of ancillary and other clinical support departments. The evolving complexities of HCOs place great demands on an HMIS. The HMIS must capture, organise, manage, and integrate volumes of clinical and financial data collected by diverse users in a variety of settings and must provide healthcare providers (and, increasingly, patients) with timely access to complete, accurate and up-to-date information presented in a useful format.^{1,2} The study of information systems deals with issues and insights contributed from technical and behavioural disciplines (Figure 50.1).

EVOLUTION OF HOSPITAL MANAGEMENT INFORMATION SYSTEM

The automation of industry process started with manufacturing industry. Manufacturing management systems have evolved in phases over the past three decades from a simple means of calculating materials requirements to the automation of an entire enterprise (Flowchart 50.1 and Table 50.1).^{2,3}



Flowchart 50.1 Interrelationships among systems.

Table 50.1 Evolution of hospital management information system

MIS	Timeline	Objective
Material requirement planning (MRP)	1970s	A tool for manufacturing sector to accurately computer materials requirement in optimum quantities
Manufacturing resource planning (MRP II)	Mid-1970s	A closed loop system for capacity planning, scheduling shop floor control and other calculations
Decision support system (DSS)	1980s	A MIS to provide managerial end users with dynamic support for decision making processes
Enterprise resource planning (ERP)	1990–1999	Embraces all business functions. Information that was previously fragmented in different systems can seamlessly flow throughout the organisation so that it can be shared by business processes in accounting, human resources, and other areas of the firm
Strategic information system	2000 onwards	IT becomes an integral component of business processes, products, and services that help a company gain a competitive advantage in the global market place

Features of HMIS

HMIS have to deliver on following key parameters and criteria that one has to look for^{3,4}:

- **Performance:** Should be comprehensive and cover all aspects of organisational activities. Broadband network connectivity for easy accessibility and quick response time for media-rich healthcare data.
- Information flow should follow organisational structure and should keep in view the delegation amongst various authorities.
- Should concentrate on developing information rather than collection of facts. Only relevant information should be provided, while irrelevant data is omitted.
- **Security, privacy and confidentiality:** On a robust and secure platform with back up for prevention of loss and unauthorised access to critical data.
- **High storage capacity of servers:** For deep archiving of large volumes of healthcare data.
- Ability to interface and operate with legacy systems across various departments, hospitals, and other systems and sources like biomedical equipment and devices.
- Integration with other system functionalities, such as electronic medical records (EMRs), computerised provider order entry (CPOE) for prescription drugs and electronic reporting of performance measures and clinical decision support system (CDSS).

In its typical form, a HMIS is usually a broad-spectrum system that addresses all specialities of a hospital with a single integrated information system. Some tertiary-care level hospitals may also have developed HMIS to meet the needs of specific departments like cardiology, endocrinology,

rheumatology and neurology, etc. However, the benefits of a single integrated HMIS are now being appreciated by many HCOs. Some HMIS systems include virtually all patient data, while others are limited to certain types of data. Some HMIS systems provide decision support (e.g., preventive service reminders, alerts concerning possible drug interactions, clinical guideline-driven prompts), while others do not.

CATEGORISATION OF HMIS MODULES (Figure 50.2)

- Operations managements
- Finance and HR system
- Hospital management system
- Support services system
- Clinical systems

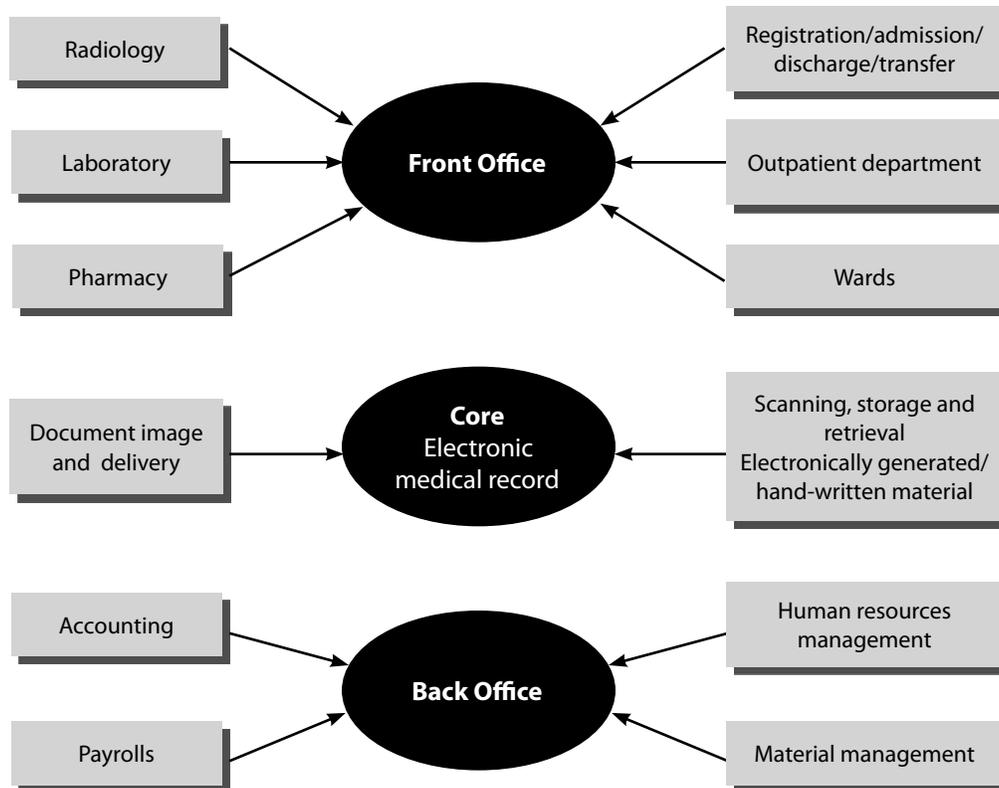
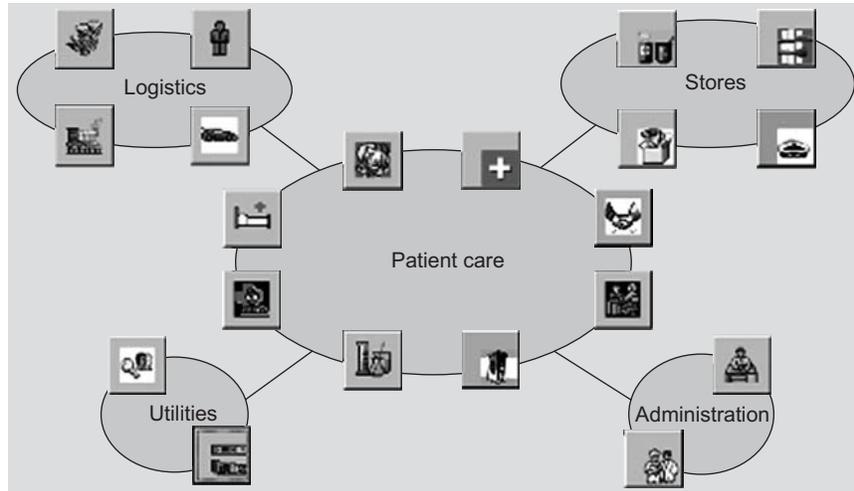


Figure 50.2 Modules in a typical HMIS.

Operations Management

Patient administration system

It includes registration, appointment scheduling, admission, bed management, discharge; transfer, billing and medical record folder tracking ward management. The patient administration system allows the registration of patients visiting the hospital along with the capture of demographics details. It enables the scheduling of appointments in outpatient departments and also maintains details about patients admitted to the system. The patient billing module facilitates comprehensive collection of payments like advance bills and also allows discounts and refunds. In addition, the patient billing module permits assessment of the paying capacity of the patient and specialised corporate and insurance billing.

Finance and HR System

Financial accounting: This is an important module in a HMIS that keeps track all financial matters for the hospital, including account receivables, account payable, profits and losses, financial planning including budgeting. This also includes computation and disbursement of doctor's shares in private institutions.

Human resource management system: Healthcare institutions employ diverse categories of staff members like doctors, nurses, operation theater staff, laboratory staff, attendants, etc. The human resource management system captures information about their leaves, salary details, provident fund details, training details, etc.

Budgeting: A budget is an important tool for financial planning and control. HMIS helps in budgeting activity using the HMIS history facts and information. It also provides the tracking mechanism and the control over the money spent on each activity defined in the budget. It also controls the overbudget of system while providing the proper information as to when the budget of that task is over.⁵

Hospital Management System

Management information system: This management information system (MIS) provides the aggregated information regarding all hospital activities to management. It also helps in decision-making process to management. MIS basically captures aggregated facts and figures about the various activities undertaken in the hospital. MIS is the reporting system that can be archived by good appropriate of reports.

Doctor's compensation management: This section deals with the visiting doctors who have not joined hospital permanently but are providing special services based on time duration. This module handles all the compensation-related details about nonpermanent doctors.

Materials management: Healthcare institutions require a large amount of varied materials when rendering health-care services like medicines, syringes, needles, cotton and disposables, etc. Thus, for proper inventory management a very strong materials management system is mandatory. Actions like raising indents from various departments and receiving items sent by the central stores to the department are supported as also raising of purchase requisitions, purchase orders, goods receipt notes, etc. Sophisticated functions like classification of materials as per their criticality and further analysis for costing, alerts upon reaching reorder level and computations of economic order quantity for each item also assist the hospital administrators in efficient inventory management. The pharmacy management and central sterile supplies management parts of the HMIS materials management system are specialised to manage the activities of these specific departments (drug dispensing and stock management, and sterile supplies preparation and stock management, respectively).

Support Services System

Pharmacy/stores: This part of HMIS tracks the medicines used and generates the bills for the same. At the last, it verifies the medicine given to the patient and the amount recovered from the patient for that. It basically removes the possibility of missing medicines while treating the patient. It ensures that all the medicine bills are recovered from the patient. Most HMIS also incorporate the FIFO system to prevent usage of medicines exceeding their expiry life.

Laundry and housekeeping: This part of the HMIS keeps track of the washing, routing, recycling and ultimate discarding of linen used in the hospital in wards, outpatient department operation theatres, etc. The housekeeping function alerts housekeeping staff whenever a bed is vacated in the hospital such that they can clean the same and make it available for the next patient.

Kitchen management: Every large healthcare institution has kitchen services to cater for the needs of inpatients. The kitchen management module in an HMIS facilities dispatching of meals for such inpatients and is often integrated with the diet planning functions in the clinical modules of HMIS.

Engineering services/maintenance services: Healthcare institutions utilise a large number of sophisticated equipment and instruments to render healthcare services. These need to be regularly maintained and serviced for good performance. The engineering services module of an HMIS maintains a register of all such equipment and instruments that need to be regularly kept track of.

Clinical System

*Electronic medical record (EMR) containing clinical assessments information*⁶: In a manual paper-based system, physicians often do not have easy access to the previous medical records of a patient. In HMIS, it is possible to maintain a lifetime electronic patient record for each patient. All information like consultation notes (history, physical examination) diagnostic work-up details like tests done and their results, prescription details and follow-up information can thus be captured. Access to this historical patient medical information can be accessed by physicians at their fingertips on a need to know basis anytime, anywhere within the institution or even outside. All information is organised in such EMRs in a structured and standardised format that can be retrieved easily for future analysis and research. This function of maintaining the life-long detailed electronic record for the patient so that it is accessible to clinicians at their fingertips is probably the most important function of the EMR. Further, EMRs avoid unnecessary lab investigations, since the previous results are easily accessible. They also serve as an important tool in improving patient safety, since the patient's past history of allergies and interaction is available and can guide further choice of treatment. EMRs are legally valid in several countries as long as the information within them can be printed out with all details in hard copy format for reference purposes and for signature by healthcare professionals.

Clinical decision support systems (CDSS): A CDSS is an active knowledge system that uses two or more items of patient data (like signs, symptoms and lab results) to generate case-specific advice. It assists the physician in applying new information to patient care through the analysis of patient-specific clinical variables. Many of these systems are used to enhance diagnostic efforts and include computer-based programs that provide extensive differential diagnoses based on clinical information entered by the clinician. Two other forms of clinical decision support systems, including antibiotic management programmes and anticoagulation dosing calculators, seek to eliminate medical errors and enhance patient safety.⁷

Order and result communication (including scheduling features): Numerous diagnostic investigations and therapeutic procedures have to be done for patients when rendering healthcare services. Those are done by departments like the clinical laboratory, radiology, cardiology, neurology, etc. When a clinician experiences the need to get these done for a patient, a requisition for the same is prepared. In a manual system, such a requisition has to be carried out to the department performing the test or procedure. But with an HMIS these requisitions can be made directly within the system as orders that get communicated instantaneously to the destination and the results

when available are prepared back to the physicians who made the requisition. Computerised provider order entry (CPOE) system has already been mandated by law in the interest of patient safety in some countries. Thus, the orders and results communication is the pivotal module of the clinical information systems in the HMIS, which communicates requests from one part of the hospital (from clinicians/service requestors) to the other (service providers) and conveys back the results/reports of their findings.

Laboratory information system (LIS) with instrument interfacing: The clinical laboratory in a hospital has a lot of procedural functioning with collection of samples from patients, receiving of samples in the lab with checking of sample quality, processing of samples in the lab to generate the results for the requested tests and reporting of the results to the physicians. An LIS automates all these workflows to enable minimisation of human involvement and steps, and improve turnaround time. Further, automated instrument interfaces transfer results directly into the HMIS, making them available right away to those who need them (bidirectional interfacing). This minimisation of turnaround time enables faster decision making and reduces average length of stay (ALOS). HIMS has bar code system for laboratory samples for correcting sample processing; and along with bidirectional interfacing, it also eliminates the preanalytic errors arising out of misidentification of patients.

Blood bank information system (BBIS): A blood bank information system module automates all the functions of a blood bank, like donor registration and physical checkup of donor sample, acceptance blood unit typing and testing for (HIV, HBsAg, HCV, VDRL, MP), blood unit matching when it is to be given to recipients, as also the blood unit inventory management when units have to be discarded due to expiry, donor discarding or reconsidering, etc.

Radiology information system (RIS): The radiology department is another important centre that carries out imaging tests like X-rays, CT scan, MRI, ultrasound, etc. A RIS automates all these tasks done in radiology departments and can even communicate information about the tests to be done to the appropriate equipment. The digital images generated can be archived in and transmitted from specialised systems called picture archival and communication system (PACS) in accordance with the DICOM (digital image communications protocol).^{1,3,8}

ADVANTAGES OF HMIS^{8,9}

The advantages of a well-implemented HMIS are enumerated below:

- HMIS enhances operational efficiency and TAT in hospitals. Efficient and effective patient care determines repeat visits by the patients.
 - Enhances the patient safety by improving communication among care providers using common information sharing in the different departments and preventing drug/allergic reactions.
 - HMIS provides better information security and confidentiality to patient's sensitive data, which ultimately leads to patient satisfaction and repeat visit of patients.
 - HMIS can improve the efficiency of the hospital in the following ways:
 - Maximise the utilisation of hospital resources: HMIS can streamline scheduling of active and passive resources, thereby optimising their usage.
 - Remove oversight in processing: HMIS can do away with oversight in manual systems.
 - Remove unnecessary manual intervention: In manual systems, laboratory staffs have to pick up the results, list output by the automated instruments and transcribe them onto paper result reports (which often introduce errors) that are then delivered across the hospitals by attendants. Whereas in automated environment, results given by instruments are directly transferred via an interface to the HMIS, thereby obviating manual intervention.
 - Reduce turnaround time (TAT): Considering the above example in manual systems, the transcription of results onto paper result reports takes a significant time, as also the distributions of reports all across the hospital by attendants. In an automated setting the results transferred through an interface into the HMIS are instantaneously available to all across the hospital, thereby significantly reducing TAT.⁹
 - Swiftly and accurately prepare bills: While this can often take up to several hours in a manual system, a well-conceptualised HMIS can achieve this at the click of button.
 - Improve quality of patient care and satisfaction: The outcome of successful HMIS implementation is that patients appreciate the healthcare institution as a friendly partner. This improves quality of patient care and satisfaction significantly.
 - Provide easy access to medical data for research: Perhaps the most important advantage that well-designed HMISs can offer is the ability to capture medical data in a standardised and structured format over a period of time to maintain comprehensive lifelong records for patients and permit high-quality reliable research. They also permit statistical analysis reports of various kinds to be generated accurately and conveniently.
 - Implement best practices, protocols and perform business process re-engineering: Best practices and business process re-engineering are buzzwords in the field of information technology. In simple words, best practices mean the practices that yield the best result (from time, money and resource perspective) in a certain activity or business process. Thus, when an activity can be done in more than one way, humans usually analyse experience of people who have followed the various practices and try to find out which is the best practice that should really be adopted. It is the endeavour of software produce houses to support best practices (best practice workflows) in their software. Business process re-engineering is actually a software solution fitment strategy wherein implementation consultants convince client sites to adopt the best practice for various activities. It is called re-engineering because it entails a radical change from the pre-existing workflows and protocols. The staff has to be then convinced that they need to adopt the alternative best practice. However, in the interest of their own organisation, they are to be persuaded to change over to the new practice.
 - HMISs basic aim is to integrate all departments with one common application. This reduces the burden and error in transferring information across departments and improves the efficiency and accuracy of work.
 - It reduces operation cost by effectively utilising resources and reducing the human errors marginally.
 - Standardisation of various materials/items usage in the hospital can be easily achieved as data is readily available. Various alerts/pop-ups generated proactively will help to avoid catastrophe.
 - The usage of HMIS leaves an audit trail of all users through a log-in system, thereby ensuring accountability of care providers towards the patient and helps in investigating any care of medical negligence.
- However, it must be understood that although productively implemented HMIS can make all these advantages possible, only a smart hospital administration team can actually harness these potential benefits in reality.

POSSIBLE DISADVANTAGES OF HMIS

- *High initial acquisition and ongoing maintenance costs:* The initial investment for an HMIS is often perceived to be high by healthcare institutions. However, case studies on return on investment (ROI) analysis and cost benefit analyses for successful implementations of HMIS in client sites with a management will to apply information technology in healthcare have shown that such a cost is soon

recovered by the benefits that can be reaped from an HMIS.

- HMIS maintenance requires a high expertise for maintaining complex computer network structure.
- It is required to enhance the HMIS as per the current technological changes.
- If HMIS is not properly designed, it may increase the overhead to manpower and end up with a higher cost to the organisation.

PROCURING A HOSPITAL MANAGEMENT INFORMATION SYSTEM

Installation of an HMIS is a big decision for any healthcare institution. It is not easy to altogether change a system installed in a hospital in a very short period of time. The system selected will run in the institution for many years.

'Preparation is a process that begins with the decision to switch to HMIS. What you want is more important than what the software companies have on offer; therefore, before demos and meetings each and every issue must be pinned down in detail. This process could also be seen as the hospital reorganising itself before HMIS.'

What is the Best Solution?

In principle, hospital information system or HMIS is more widely known to integrate the information used by various departments of hospital and converts it into a unique management control system. This enables different departments to use the same database, therefore, using the same information instead of managing information without being able to share this with other departments. The aim of this approach is to enable each employee to access this shared information, to speak the same language and to use resources such as machines, human resources and money in a more efficient manner.

Many hospitals now prefer HMIS solutions to control their growing organisations in a more effective manner and reduce their costs. However, the changes in technology, new trends, new companies and the changes in requirements have made it increasingly difficult to choose the right hospital management solution. When the high investment figure is taken into consideration, it is exceedingly important that the selected HMIS company and product can meet the requirement completely and assure the investment. Therefore, the HMIS software purchase process requires a thorough analysis.

This analysis must cover the experience to the company in the field, its references and its financial structure is addition to technical issues. In the selection of hospital information system software, the most important issue is product adequacy. If the product meets the present and potential

future requirements of the hospital—both in terms of technology and infrastructure—an important part of the process for the purchase decision is completed.^{2,10}

Guidelines for Selecting the Appropriate Product

- *Usability*: Does the user get the information he needs? How easy-to-use and flexible is the system? Is guidance available when needed? Usability depends heavily on the user interface design.
- Lower employee learning curve and minimal user training costs.
- *Efficiency and reliability*: Does the system perform its tasks fast and reliably enough? Is the system accessible when needed and does it recover from failures and errors?
- *Security and scalability*: Does the system adapt easily to small and large number of users and transactions, and to other differences in the operational environment?
- *Interoperability, compatibility and portability*: How easy it is to make the system interact with other systems? Are open architectures and standards used? How easy it is to part the system to new technological platforms, presently and in the next couple of decades?
- *Cost effectiveness*: Are the financial and healthcare benefits gained by the system in balance with the initial and running costs? Is the cost benefit ratio of this investment better than competing other investment needs in healthcare? The evaluation of cost-effectiveness is a complicated task and could not be reliably done in beforehand of implementing real-life applications.

HMIS Selection Process

- *Test the product*: The demos and brochures presented by the solution provider may not always explain a number of important points relevant to the selection process. A product test will provide the most reliable information about the HMIS product. By all means test the product if possible in a client environment that is already using the product; if not, carry out a test in an environment designated by the solution provider.
- *Speak to references*: The vendor may have answered all questions satisfactorily, given some guarantees and even made a turnkey proposal. But it is better not to settle for what the company has stated and it is advisable to speak to the company's references. The most accurate information regarding the quality of consultancy service, problems experienced and solutions offered can only be provided by companies that have purchased and used the product.
- *Examine the future of the product*: An issue that frequently crops up when hospitals are selecting their HMIS is the consideration of present requirements only. Whereas it must not be forgotten that the requirements of hospitals

constantly change and new solutions are needed. If HMIS has been chosen because it meets the current hospital requirements and is cheaper than other products, it is highly probable that HMIS investment will cost more in the long term. To choose an HMIS product a comprehensive research of the company is carried out.

- *Compare:* Define your criteria in accordance with your processes and requirements to compare the HMIS with your existing working methodology. Make department-wise selection criteria, and compare and assess the candidate products against these criteria.

Infrastructure

- Must be customisable and should have a parametric structure.
- The system must be formed with years of experience, sufficiently tested stable and devoid of error.
- The performance must remain high-increasing operation and data load.
- It must have easily provide data exchange with external systems.
- The system must be self-sufficient. It must have minimum dependency on external solutions.
- It must not require large and expert teams for maintenance and support.
- The system must be able to run on different operating systems and database.
- The system must be transportable to another operating system and/or database even after installation.
- The cost of hardware and infrastructure to increase system performance in the future must be low.

System Features

- It must allow flexible reporting. It must allow new-report products easily.
- It must be available in more than one language.
- It must use more than one currency.
- It must have a modular and integrated structure.
- Its concepts and solutions must have international validity.
- It must have a detailed authorisation and security system.
- The system must be open to new development and must be easily customised.
- It must have an interface standard that provides ease of use.
- It must be usable on the internet and support web-based and mobile technologies

Risks

- The solutions provider must have strong references and a financial structure.
- The project team of the solution provider must be highly experienced.

- The solution provider must have international experience.
- The solution provider must be able to show the functions it promises in presentations or in references.
- The solution provider must present a clear and detailed implementation plan.
- The system documentation must be complete.
- The license service and support pricing policy must be clear and detailed.

IMPLEMENTATION OF HOSPITAL MANAGEMENT INFORMATION SYSTEM

HMIS has always been a challenge to implement. This scenario is not only true for hospitals in India but also in the West. The implementation challenges in Indian hospitals are multifold and broadly fall in the following categories:

- Setting up right expectations from the management and users in the hospital.
- Availability of accurate and exhaustive master data.
- User training.
- Acceptance and appreciation of computerisation by medical, paramedical and other healthcare specialists.
- Quantifying return on investment and key performance indicators' implementation of HMIS in hospitals is not mere computerisation of the hospital, it is just not about automation of existing paper trail. This approach, if followed, will not only lead to failure of the implementation but also transfer the inefficiencies of the manual system to the computerised environment.

Proper business processes, re-engineering, and accurate definition of workflows incorporating global best practices will improve the effectiveness and efficiency of the hospital and, in turn, provide better patient care. This scenario is best suited for the large hospital chains. Business process re-engineering (BPR) and software implementation runs parallel. But it differs in a way from second scenario in that BPR has high impact while starting the project; and, at last, before the final implementation of project, BPR should have been finished.

A good HMIS product should not only cover the functionality of all the business processes in a typical hospital but also more importantly have the flexibility of customisation to the specific needs of the hospital through parameterisation and the ability to configure alternative workflows. There will be resistance from users who may feel that feeding information into the computerised system is additional work and not their primary responsibility.

Rigorous and continuous training, user-friendly screens, hand-held devices for data input and most importantly showing tangible benefits are the answers to overcome this initial resistance. The need for extensive training and preparation cannot be overstated.

It is equally important that the right infrastructure in terms of rightsizing the servers and PCs with good bandwidth network connectivity and clean power supply will go a long way in ensuring smooth and satisfactory implementation.

The return on investment of an HMIS implementation can be viewed as both tangible and intangible benefits. A well-managed inventory system can bring in savings up to 20% in the first year itself, thereby justifying the investment for an HMIS in big hospitals. The benefits include improved bed turnover ratio, online billing to capture all transactions across all departments, drug expiry management, accurate and reliable laboratory results due to online interfaces to laboratory equipment; all these contributing to accountability and higher profitability in hospitals.

Case Study: PACS improves delivery of healthcare services

PD Hinduja Hospital's radiology department was facing many challenges with existing processes. Since radiologists could only report for images in reporting stations attached to console rooms of the machines, consultants depended on patients bringing the films for subsequent follow-up consultations. In case of wear-and-tear and loss of report, re-printing of radiology films/images was almost impossible. Also, each radiology study took an average of 24 h to reach the prescribing consultant. In order to resolve these challenges, Hinduja Hospital implemented the picture archival and communication system (PACS), which archives the diagnostic images in a form of DICOM (digital imaging and communication in medicine). The hospital also implemented digital signatures for all radiologists, as physical

authorisation (signature) is not possible on radiology reports. The system has enabled consultants to view the images from real-world settings. Since the images are available for retrieval for lifetime of the patient, the problem of patients not bringing their radiology films or losing them is taken care of. Postdeployment, turnaround time for reporting has come down from 24 to less than 6 h. Only essential films are printed, while the entire study is given to patients in the form of CD, resulting in significant savings in the cost of film and their development process.

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Medical Record Management and Audit

51

Dr Harmanjit Singh and Dr Bikash Medhi

“To write it, it took three months; to conceive it three minutes; to collect the data in it all my life.”

—F Scott Fitzgerald

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- list the uses and needs for materials management in healthcare sector.
- describe various components of material-management cycle.
- list the techniques of inventory control.

INTRODUCTION

Record management is an area of management that is responsible for the efficient and systematic control of the formulation and disposition of records, including processes for creating and maintaining evidence and information about a patient's transaction in the form of records.

Records are the information and documents kept in a systematic, scientific and easy ways that help to produce the required data at the time of necessity and medical record is a systematic way of storing the necessary data, information and other relevant material with the objective of making easy availability of required data at the time of its need. It is a permanent document that contains the history and progress of medical care of a patient.

Records are utilised for assessment of patient care to deal with and verify insurance claims as a legal document, which tells about the course and duration of medical care of a patient and also provides statistical and information facts for hospital administration.

IMPORTANCE OF MEDICAL RECORDS

- A meaningful arrangement of medical record is very crucial thing for the hospital authorities in understanding the problems, personal details of a patient and nature of the illness so that these data can be easily accessed at an organisation level for making some alterations in the existing plans and policies and formulating new policies

so as to deliver a better and more standardised service in future.

- It consists of name of the patient, address, age, sex, occupation, type of illness, diagnosis and instructions given by the concerned doctor in the course of undergoing treatment. It guides patient to take the right and appropriate medication.
- The information given in the medical record can be used as legal evidence. This is important for both patient as well as doctor.
- It provides health authorities with useful data concerned with the health of people and the burden of specific diseases in a specific region.
- On the basis of information given in medical record, one can easily obtain the methods of improving the health services, diagnosis pattern, treatment strategies and management pursued by the concerned health sectors.
- It plays an important role in conducting research work at an organisation as one can easily receive data pertaining to health of patients. It also helps in imparting health education to the people.
- It contains the name and signature of concerned doctor, so more caution is necessarily taken while giving of treatment. As a result, a patient derives a right treatment after quick and appropriate diagnosis of disease.
- Medical record is noteworthy for the nation in several aspects. It contains various data like personal details of patient, illness, diagnosis, methods used to diagnose the disease, severity of the disease, medicines used, and full

names and signature of concerned doctors, the country can attain the health-related information through thorough check up of these medical records.

- The government, in turn, can utilise these records in making short as well as long-term health plans by knowing the health condition of people, disease prone areas, cause and effects of disease, availability of health workers as well as resources in order to deliver the appropriate health service.
- Through the study of medical records, preventive measures can be timely adopted in order to save health of people. This is because the epidemics and other diseases spreading rapidly can conveniently be well-informed in time.
- It is a good evidence of healthcare given to patients serving for legal assessment when there is suspect of malpractice.

CHARACTERISTICS OF AN IDEAL MEDICAL RECORD

The medical record is the principal mean to keep all the data produced during hospitalisation. It has medical and legal importance and therefore it must have certain characteristics. These are:

- It must be complete and legible.
- Its content must have all the events, examinations done, and treatment given to the patient.
- It must include history, background, physical examination, diagnostic techniques, laboratory and radiological investigations.
- It should describe the treatment administered and planning of all activities during the hospital stay of a particular patient.

MEDICAL RECORD ORGANISATION

- It should contain the patient's name and identity number.
- Personal/biographical data includes address, employer, home and work telephone numbers, and marital status should also be included.
- All entries in the medical record contain the author's identification. Author identification may be signature, a unique electronic identifier or initials.
- All entries must be given appropriate dates.
- The record must be legible.
- Laboratory and other investigations are ordered, as appropriate.
- Information regarding follow-up care, calls or visits. The specific time of return is noted in weeks, months.
- If a consultation is requested, there must be a note from the consultant physician in the record.
- Records of hospital discharge summaries, emergency department visit and physical therapy reports are maintained in the member's record.

Methods of Record Keeping¹

The traditional method of keeping records that is followed in most of the hospitals across India is the manual method involving papers and books. There are serious limitations of manual record keeping, including the need for large storage areas and difficulties in the retrieval of records. However, it is legally more acceptable as documentary evidence, as it is difficult to tamper with the records without detection.

The computerisation of medical records makes them neat and tidy, and easy for storage and retrieval; but the possibility of easy manipulation without detection is a serious concern. Hence, they may not be universally accepted as valid documentary evidence. Another major concern is maintaining confidentiality of the patient records as the patient can hold the doctor and the hospital negligent for breaking confidentiality of his medical records. Video tapes of endoscopic procedures, electronic foetal heart monitor charts, continuous ECG or pulse oximeter charts could become important evidence in a court of law.

Electronic medical recording is in the evolution process of and is becoming more popular. Though the total avoidance of paper records is the ideal aim, there are many areas that need to be addressed, e.g. the electronic signature of the patient, doctors and witnesses on informed consent forms.

Discharge notes

This is an important document and evidence regarding the inpatient treatment of a patient. It is important to give due importance to make a proper discharge note, as this is kept by the patient and reflects the treatment received. The discharge summary should highlight the patient's records with a brief summary, relevant investigations and invasive procedures. The dates of admission, discharge and surgery are useful when the sequence of events is an important issue in litigation later. It should also include instructions to be followed by the patient after discharge, including dietary advice and date of next follow-up. The doctor can be held negligent if proper instructions are not given regarding the medications and other measures. The discharge summary must be signed or countersigned by the consultant. A copy of this must be preserved for future use, if required.

Referral notes

Referral notes are an important component of patient records. They should include the date and time of issue, general condition of patient, reason of referral and steps to be taken. It is important for the doctor to keep a duplicate copy of the referral note because it could be proved by the duplicate copy of the referral note kept by the doctor if the patient does not go immediately on referral, as advised. This could save a doctor who could be sued for alleged late referral in case the patient's condition deteriorated.

Confidentiality of Medical Records

Medical records can be used as a personal or impersonal document.

- *Personal document:* This information cannot be released without the consent of the patient, except in some special conditions.
- *Impersonal document:* Here the patient's consent is not required, e.g. for research purposes.

Confidentiality is important for the rights of the patient. The maintenance of the confidentiality of the personal medical records records is the legal duty of the hospital management, and if not done properly, patient can claim against the hospital or the doctor. However, there are some situations where it is legal for the authorities to give patient information, e.g. during referral or when demanded by the court or by insurance companies in case patient seeks his rights, and sometimes when required for workmen's compensation cases, consumer protection cases, or for income tax authorities.

MEDICAL AUDIT²

The word 'audit' means an independent examination of the records by external auditors or consultants. In its broader sense, the word 'audit' describes a review or scrutiny of a particular system. It provides a mechanism for regular scrutiny and improvement of systems.

Medical audit is a systematic process aiming at objectively monitoring and evaluating the clinical performance of all practitioners, which identifies scope for improvement and provides mechanism through which action is taken to make and sustain those improvements. It is the systematic and objective review of healthcare medical records performed by experts with the purpose of improving the quality of healthcare.

On the other hand, clinical audit aims to improve quality of patient care through the systematic assessment of clinical practice against a defined standard, with a view to recommend and implement measures to address specific deficiencies in healthcare.³

The auditor can be a physician's committee or a doctor recognised by peers, whose authority guarantees that audit will be objective and fair.

The principal objective of medical audit is to evaluate healthcare quality; but one of its consequences is the incentive towards excellence of the medical team and consequently favours the continuous education of professionals and improvement in all the activities inside hospitals that imply the correction of deficits found in the audit.

It has been demonstrated that regular audit can improve medical record quality by itself because clinicians would be more accurate when they know that their medical records will be audited.

Audit is a management tool to evaluate the quality of procedures inside hospitals and can also be used in the analysis of medical records.

Need for Medical Audit⁴

- *On professional grounds:* Healthcare providers can identify their lacunae and deficiencies and make necessary changes.
- *On social grounds:* To ensure safety of public and protecting them from taking inappropriate, suboptimal and harmful healthcare, and to reduce the patient sufferings.

Approaches and Methods

Starting point should be defined. All team members and disciplines should start from the same point, i.e. share a level of understanding and definitions of terminology and acknowledge alternative viewpoints on quality to discuss professional overlaps, recognise differing models of patient care and acknowledge each other's skills.

Selecting audit topics

The priorities and basis for selecting audit topics should be defined, e.g. high volume, risk, cost or wide variation or an area of local concern. The method of selecting topics should incorporate all members of the group.

Methods: Identify available sources of advice and provide practical guidance on appropriate methods.

Resources: The amount of time to be given to audit should be fixed beforehand. In certain settings, it is assessed for half-a-day/month or 5% of total clinical time.

Identify and develop sources of information for audit. In particular:

- Are clinical records accessible? Do they include information on what patients are told, outcomes, etc.?
- Are statistics on case mix, complications, procedures and treatments accurate, up-to-date and readily available to clinicians for audit?
- Are facilities available to all clinical staff to access literature on clinical practice, and on audit, for example, journals, newsletters and annual reports?
- Are clinicians aware of these and have access to them?
- Are the support staff sufficient in numbers and skilled to service the audit needs of all clinical groups?
- Identify staff available to support clinical audit. Clarify their function, accountability and funding.
- Does information staff gives time to audit or is there any clerical and technical help?
- Define responsibility and funding for training. This should include audit staff, clinicians and managers.
- Recognise the need for behavioural as well as technical skills.

- What facilities are available locally, regionally or nationally?
- Identify the source and application of existing funds.

Methods of clinical audit⁵

Audit should involve the objective peer review of patterns of care, should be sensitive to the expectations of patients and other clinical disciplines, and should be based on scientific evidence of good medical practice. To this end, cases for review can be selected randomly or by preagreed criteria. Patterns of practice, quantified where possible, can be compared with explicit guidelines and these guidelines, though agreed locally, should be consistent with regional and national advice and with the body of scientific knowledge. No single approach is universally applicable. Indeed, by using a variety of methods, an audit group is more likely to maintain flexibility, innovation and interest. Some methods screen 100% of cases for predefined events, which are then subjected individually to peer review. Others—the majority—focus on a limited sample of cases with a common characteristic (such as a symptom, investigation, treatment or complication).

ELECTRONIC MEDICAL RECORD

An electronic medical record (EMR) is a digital version of a paper chart that contains all the information regarding patient's medical history and other particulars. It is a computerised medical record created in an organisation that delivers care, such as a hospital or physician's office. An EMR is mostly used by providers for diagnosis and treatment.

Benefits of the Electronic Medical Record^{6,7}

There are several potential benefits of the EMR over paper records. These are:

- It can be accessed easily from distant sites such as a clinic across town or even across the country.
- It is unlikely that data will be lost or misplaced. With an appropriate back-up mechanism, it should serve as a permanent record of a patient.
- With the availability of the entire patient's data, new views and other summaries can be generated instantaneously.
- Electronic medical record is also likely to benefit the larger population. Clinical research will likely be enhanced, as researchers have easier access to information about patients that will increase understanding of disease and its treatment.
- Screening and other preventive measures will become easier to implement as patients of various attributes (i.e., gender, age, presence of other risk factors) can be identified and contacted.

Most of the documented benefits of the EMR have emerged from settings where clinicians use the system

highly interactively as opposed to a passive replacement for the paper record. This requires clinicians to use the system for order entry where orders for tests and medications are entered directly by the clinician.

Drawbacks of Electronic Medical Record^{6,7}

A number of problems have been identified with the EMR, including increased provider time, computer down time, lack of standards and threats to confidentiality.

- A concern with EMR systems is computer down time. Although the threat of not having access to the right piece of information at the right time is real, the increasing reliability of computer systems makes this less of a problem.
- A more significant problem with EMR systems is the lack of standards to interchange information. While a number of standards exist to transmit pure data, such as diagnosis codes, test results and billing information, there is still no consensus in areas such as patient signs and symptoms, radiology and other test interpretation, and procedure codes.
- A related problem to standards is that a large proportion of clinical information is 'locked' in the form of narrative text. Although a number of systems have been successful in limited domains, the technology for natural language processing (NLP) is still unable to interpret narrative text with the accuracy required for research and patient-care applications.
- A final concern about the EMR is the problem of security and patient confidentiality. This problem, of course, exists independent of the EMR, as a great deal of medical information abstracted from paper records already exists in electronic repositories.
- As noted above, the paper record is no barrier to duplication, as medical records are routinely copied and faxed among healthcare providers and insurance companies already. While some fear that the EMR will exacerbate this problem, others note that computer-based records with appropriate security are potentially more secure and, at a minimum, leave a trail of documentation of those who access them. Most medical centres already have security. Employees given access are usually required to sign a confidentiality statement indicating their understanding of the privacy of patient data. At most centres a password is required to enter the system; although some institutions also use a physical device, such as a key card. Virtually all systems also keep an audit trail of who accessed which patient's data, providing a retrospective mechanism for discipline should breaches of security occur.

Record Retention and Disposal

Record retention may take the form of electronic medical record, paper documents, microfilm, electronic data storage, etc., but must be maintained in such a way that the information is available for clinical reference upon request.

Opportunities for loss and/or damage must be minimised and records must be secured to prevent unauthorised access. The following will be kept indefinitely:

- Master patient index.
- Death register.
- Surgery register.
- Transplant register.

Medical record retention and destruction⁸

- Disposal of protected health information (PHI)
- Record destruction and disposal

All documentations containing PHI must be destroyed in a manner that prevents reconstruction. Destruction will be in the following manner:

- *Paper*: Incinerating—shredding or pulverising.
- *Computerised data*: Reformatting, magnetisation or physical destruction.
- *Radiology films*: Shredding or pulverising.
- *Patient labels*: Shredding.

Destruction of the legal medical record must be documented and maintained permanently and includes the following:

- Date of destruction.
- Method of destruction.

- Description of the destroyed documents.
- Inclusive dates covered.
- Statement that the records were destroyed in the normal course of business.
- Signatures of the individuals supervising and witnessing the destruction.

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Office Management and Administrative Issues

52

Dr Nirupam Madaan

“A successful team is a group of many hands but of one mind.”

— Bill Bethel

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- establish the office of the medical superintendent.
- aid in the smooth functioning of the office.
- develop skills for human resource management.
- acquire an understanding of administrative law.
- familiarize the reader with the issues that confront the MS office.
- guide decision-making.

INTRODUCTION

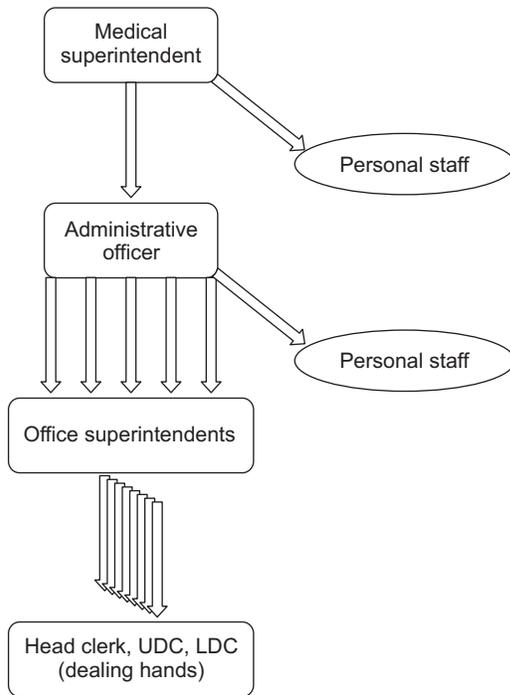
The core of hospital administration is the office of the medical superintendent, the nerve centre from which all the activities of the hospital are ought to be monitored, assimilated, analysed and coordinated. This vital hub of the hospital sets the flavour for the functional, human resource and public relations-related image of the hospital, and as such, needs to have a well-equipped office and a wholesome office environment. This office is neither a self-contained, isolated unit nor a policing squad for the hospital. It is rather a facilitating unit that works in tandem with the various specialties within the hospital and continuously receives inputs from them to translate them into effective policy and execution. These different units of the hospital exist in an advisory capacity to the office of the medical superintendent, and as such, are often able to relate to and accept the decisions of the office that flow back from the inputs provided by them.

ORGANISATION OF THE OFFICE

The office of the medical superintendent's establishment must be headed by an Administrative Officer—ostensibly the captain of the ship, a person well-versed in the vision and mission of the organisation, and aware of the law of the land,

the various law-enforcing agencies and statutory bodies, and the policies, rules and regulations of the hospital vis-a-vis its staff as well as the public, the community and the administration. As such, it is required that the administrative officer should either be a functionary of the government who has risen to the ranks through years of experience or a person who is selected suo moto for the job on the basis of his vast knowledge of the working of such matrix organisations and their liabilities. Some of the competencies that he is expected to possess are problem-solving and decision-making abilities, integrity, assertiveness, flexibility, accuracy and the ability to cope with pressure. Some officers may also represent their superiors at meetings. Much of this work is self-appointed and requires a high degree of professional independence, initiative and self-discipline.

The administrative officer should have at least five office superintendents working under him to facilitate him in the discharge of his duties. The work profile of each office superintendent can be divided in accordance with his job responsibilities, each looking after different categories of staff. The office superintendents may have clerical staff working under them (Flowchart 52.1). They are responsible for maintaining the personal files of all the employees of the organisation, updating them, and processing them in accordance with the rules and regulations as well as the human resource policy of the organisation. They are also responsible for putting up



Flowchart 52.1 Line of authority in a hospital.

information to the administrative officer and thence to the medical superintendent with respect to any requirements, leave applications, financial, legal, professional issues, awards, appreciations, disciplinary action, entitlements, benefits, etc. concerning hospital staff. Many organisations prefer having a separate office superintendent to look after their outsourced services, a separate desk for handling legal issues, right to information (RTI) and so on, as suited to their requirements. It is generally a better idea to divide the responsibilities of each organisational structure (OS) in accordance with the personnel under them and to let them handle all aspects of service with respect to that particular cadre of personnel. This helps in providing a more holistic picture of the status of that cadre of employees, fixes accountability for work, and provides exposure and experience to the office superintendents with respect to all the aspects of service; and, thence, helps in evolving a sound transfer policy and organisational development. On the obverse side, it takes a lot of time and patience to develop the skills of all personnel, and deadlines may be difficult to meet.

A well-organised office must be anchored around Fayol's principles of management,¹ keeping in mind the following parameters:

- **Division of work:** Work should be divided among individuals and groups to ensure that effort and attention are focussed on special portions of the task, as also to maintain equity among different desks. If a particular cadre of personnel is very big, as is mostly seen with the nursing staff, it is always wise to have more than one desk dealing

with the same cadre. It is usually wise to ensure that the number of files under one dealing hand do not exceed 250–300.

- **Authority:** The concepts of authority and responsibility are closely related. Authority is the right to give orders and the power to exact obedience. Responsibility involves being accountable, and is therefore naturally associated with authority. Whoever assumes authority also assumes responsibility.
- **Discipline:** A successful organisation requires the common effort of workers. Penalties should be applied judiciously to encourage this common effort, and rewards and recognition given where possible.
- **Unity of command:** Workers should receive orders from only one manager.
- **Unity of direction:** The entire organisation should be moving towards a common objective in a common direction, in line with its vision and mission.
- **Subordination of individual interests to the general interests:** The interests of one person should not take priority over the interests of the organisation as a whole.
- **Remuneration:** Any extra work done by an individual or group must be recognised and remunerated in accordance with laid-down norms.
- **Centralisation:** The degree to which centralisation or decentralisation should be adopted depends on the specific organisation. It is always wise to decentralise some of the more mundane office functions such as leave, pensioners' benefits, maternity benefits, etc. for which the policies and rules are clearly spelled out, so that the medical superintendent may focus on the vital issues concerned with the maintenance and improvement of hospital functions.
- **Scalar chain:** The existence of a scalar chain and adherence to it are necessary if the office is to be successful. Lower-level functionaries should always keep upper-level managers informed of their work activities, and communication from above to below and vice versa must flow strictly in accordance with the scalar chain.
- **Order:** 'Everything in its place and a place for everything.' The new definition of heaven is order; and this may easily be extended to include efficiency, which is an off-shoot of order.
- **Equity:** For the sake of efficiency and coordination, all materials and people related to a specific kind of work should be treated as equally as possible.
- **Stability of tenure of personnel:** Retaining productive employees should always be a high recruitment and selection costs, as well as increased product-reject rates are usually associated with hiring new workers.
- **Initiative:** The office should ensure ownership, accountability and recognition for work; these go a long way in encouraging worker initiative, which is defined as new or additional work activity undertaken through self-direction.

- *Espirit De Corps*: Harmony and general good feelings among employees creates a positive work environment.

SKILLS REQUIRED BY THE OFFICE STAFF

- *Technology skills*: A medical superintendent has neither the time nor expertise to operate office technology; rather relies on tech-savvy secretaries to perform a variety of computer-based tasks such as creating spreadsheets, preparing presentations, entering time for billing purposes, creating and typing documents, maintaining calendars and tracking deadlines. Therefore, dealing hands who are proficient in a variety of computer software applications are required.² Some of the most common technologies that administrative secretarial staff must master include:
 - Word processing
 - Spreadsheet
 - Presentation
 - Document management
 - Time and billing
 - Calendar and docketing
 - Transcription
 - Desktop publishing
 - Videoconferencing
- *Interpersonal skills*: Office superintendents interact daily with superiors, colleagues, hospital staff, paralegals, representatives of statutory bodies, unions, vendors and other third parties. Therefore, top-notch interpersonal and communication skills are essential.² In addition to face-to-face contact, they must be proficient in communication by e-mail, telephone and videoconferencing systems. Over a period of time, they become well versed in office rules and regulations, and often have the delicate task of steering their superiors towards decisions commiserate with hospital policy, where good communication skills and a respectful deference to the superior officer becomes an asset.
- *Organisational skills*: Organisational skills are essential to efficiently manage the office.² Office clerical staff must maintain paper and electronic files, manage projects, track multiple deadlines, maintain calendars, schedule meetings, organise events, and keep everything orderly and accessible.
- *Writing skills*: Office secretaries are frequently responsible for drafting routine correspondence and filing memos as well as proofreading legal documents such as pleadings, briefs, discovery and transactional documents. Writing is an integral part of the secretary's job; they have to know the format for memos, official, semi-official letters; those who develop strong writing skills will become indispensable to the officers they assist.
- *Transcription skills*: Transcription skills are foundational to secretarial practice.² In addition to a fast typing speed (employer requirements vary from 50 to 100 words/min-ute), keen listening skills are required to comprehend voice dictation files. Strong grammar, spelling, vocabulary and language skills are necessary as well an understanding of legal terminology. In addition, secretaries must be proficient in word processing applications, working on Excel files and PowerPoint and transcription equipment.
- *Attention to detail*: Attention to detail is critical in the office. For example, issuing an award letter in the name of Messrs. Prahari Ltd. instead of Messrs. Prahari Securities Ltd. may cost an official his job and an organisation its reputation. Office staff has to know how to handle the minutiae of daily practice and attention to detail is important in nearly every secretarial task from drafting and proofreading documents to scheduling meetings and calendaring deadlines.
- *Familiarity with legal documents and terminology*: Terms like subpoena, legal notice and representation should not befuddle office staff. They must understand the nuances of legal procedure and know how to create and format pleadings, discovery and transactional documents, attend court, prepare defence along with inputs from the legal counsel.²
- *Teamwork*: Office staff must know how to work together in keeping with the esprit de corps.
- *Multitasking skills*: Most legal secretaries work for more than one person on more than one file. Simultaneously performing multiple tasks is second-nature to a competent legal secretary. They know how to juggle multiple assignments and competing priorities and how to manage growing workloads in today's busy law office where one person frequently performs the job of three.
- *Research skills*: Office staff must know how to perform Internet research for a multitude of tasks such as finding directions, gathering information, researching judgments and looking up statutes, cite checking and tracking down case law.
- *Executive assistant skills and necessary attributes*: Executive assistants must know how to manage appointments, communications and schedules for an upper-level manager.
- *Time management*: There is usually an overload of file work in the office. It is very important that the staff know how to prioritise their activities. Developing and maintaining time management skills is essential for any office. Time management skills reduce stress and lead to a more productive day. The staff must create a schedule to get the time-sensitive items done first. Checking emails can fit in-between tasks during the course of the day. One of the biggest reasons there are time-management struggles is because office staff is simply working inefficiently.
- *Conflict resolution*: It is but natural for situations of conflict to arise in any office. Whether conflicts are internal or external, conflict resolution techniques are important skills to learn. It helps to be flexible, courteous

and respectful. It is necessary to communicate openly in a positive and productive manner. One step in the resolution process is very important for any administrative staff—remain neutral at all times.

- *Stress management:* Stress occurs in human beings when there is failure to adapt to changes in their environment. It is imperative to remain a positive role model, especially during high-stress situations. One way to reduce stressful situations is to maintain an organised environment. Employees should have clearly defined roles, responsibilities and rules.

FUNCTIONS OF OFFICE MANAGEMENT

Office management is the administrative handling, controlling and maintaining a balance process of work inside the office of an organisation—whether big or small company/business, which is necessary to achieve the best service it can provide to the people who will receive a great benefit. Broadly, these functions revolve around the following parameters:

- Human resource management.
- Budget development and implementation.
- Purchasing, contracting, outsourcing.
- Book keeping, accounting, calculation of dues, payroll.
- Printing, records management, forms management.
- Facilities management.
- Space management.
- Risk management.
- Grants administration.
- Affirmative action and equal employment opportunity.
- Information technology and telecommunications.
- Monitoring the management of health and safety in the hospital.
- Assisting medical superintendent in identifying health and safety needs in the hospital.
- Responsibility for the day-to-day running of the office.
- Attending to RTIs, parliament questions, queries from statutory bodies like the NCHRC, CPCB, various ministries, courts and government departments.
- Managing a range of budgets including accommodation, health and safety of the staff of the hospital.
- Plan, consult and manage office moves for the improvement of various aspects of care in the hospital.

BASIC ELEMENTS OF ADMINISTRATIVE LAW³

Typically, administrative laws pertain to the government and the way its organisational units function. In this context, administrative law comprises three specific elements:

- Repetition of transactions as per a prescribed mode.
- Coordination of diverse efforts into a larger whole.
- Continuing all day-to-day activities of the organisation in smooth operation to help attain the set goals.

For the same reason, public personnel are accountable to the country's legislature and to the public; and all public acts have to be properly documented and maintained in files.

TYPES OF ADMINISTRATIVE PROCEDURES

There are two types of procedures, namely institutional and working procedures.

- The institutional procedures are prescribed by statutes; but this may vary based on the intent of the statute. It usually covers:
 - Cover mail
 - Communication
 - Distribution of documents
 - Budgetary and fiscal administration
 - Personnel administration
 - Internal reporting
- The working procedures are of two types, namely:
 - Those that are publicly issued.
 - Those that are not publicly issued.

Publicly issued working procedures comprise a body of set rules to attain the purpose and goals of a statute. They specify procedural law requirements too. For example, if one wants to procure a piece of equipment for the hospital, one has to follow publicly issued working procedure specifications.

ADVANTAGES OF ADMINISTRATIVE PROCEDURES

- Ensures smooth functioning of the system.
- Ensures transparency and efficiency.
- Establishes routine modes of conduct.
- Mirrors the culture and structure of the organisation.

Case Study 1: Suspension of employee following detention in police/judicial custody

Mr 'X' was working as Hospital Attendant in a tertiary-care hospital for the last 12 years. He did not turn up for duty on 24 November 2007 and subsequently thereafter. On the 10th day of his absence, he sent a communication to the office where he was working, intimating them that he had been taken into police custody in a fraudulent land dispute under Section 406/420/120-B. He was under police custody for 2 days from 24 November 2007, and in judicial custody from 26 November 2007 to 3 February 2008. He was bailed out on 4 February 2008 by the court.

Mr 'X' was suspended with effect from 3rd December 2007 under Rule (2) (A) of Rule 10 of CCA Central Civil Service Rules, 1965. A communication was sent to Senior Superintendent of Police (SSP) of the concerned area

asking for details of this case. No response was received. Mr 'X' reported to office on 9 June 2008. In the meanwhile, he filed an appeal under Rule 23 of CCA Rules, addressed to Honourable Minister of Health requesting for the following:

- He may be allowed to join his duty from 2 June 2008 (backdated).
- Subsistence allowance paid to him may be increased by 50%.
- Prolonged and unjustified suspension may be revoked with immediate effect and period of suspension be treated as duty.

The Ministry forwarded the case to the competent authority of the hospital to look into the matter. The case was decided by the suspension committee framed by the competent authority on the following terms:-

- Departmental disciplinary proceedings were initiated under Rule 14 of CCS (CCA) Rules 1965 after obtaining necessary information from the police.
- Subsistence allowance was reviewed as per rules.

In the meanwhile, while the departmental proceedings were under process, the police informed that compromise between two parties had been affected. Consequently, suspension of employee was revoked on 21 April 2009.

In this context the following questions arise:

Q. Was the suspension of employee justified?

Q. What should be the suspension period of the employee?

Explanation

Under Rule 10(II)⁴, a government servant shall be deemed to have been placed under suspension by the order of the appointing authority.

- With effect from the date of his detention, if he is detained in custody, whether on a criminal charge or otherwise, for a period exceeding 48 hours.
- With effect from the date of his conviction, if, in the event of a conviction for an offence, he is sentenced to a term of imprisonment exceeding 48 hours and is not forthwith dismissed or removed or compulsorily retired consequent to such conviction.

The employee was suspended in accordance with the existing rules; however, the period of suspension should have started from 24 November 2007, and not from 3 December 2007.

Q. What should be the entitlement of the employee during the suspension period?

Section 53 (I) (ii) (a)⁴ of the CCS (1964) states that a government servant under suspension or deemed to have been placed under suspension by an order of the appointing authority shall be entitled to the following payments, namely:

- In the case of a Commissioned Officer of the Indian Medical Department or a Warrant Officer in Civil employ who is liable to revert to Military duty, the pay and allowances to which he would have been entitled had he been suspended while in military employment.
- *In the case of any other government servant:*
 - A subsistence allowance at an amount equal to the leave salary, which the government servant would have drawn, if he had been on leave on half average pay or on half pay and in addition, dearness allowance, if admissible on the basis of such leave salary. Provided that where the period of suspension exceeds 3 months, the authority that made or is deemed to have made the order of suspension shall be competent to vary the amount of subsistence allowance for any period subsequent to the period of the first 3 months as follows:
 - The amount of subsistence allowance may be increased by a suitable amount, not exceeding 50% of the subsistence allowance admissible during the period of the first 3 months, if, in the opinion of the said authority, the period of suspension has been prolonged for reasons to be recorded in writing, not directly attributable to the government servant.
 - The amount of subsistence allowance may be reduced by a suitable amount, not exceeding 50% of the subsistence allowance admissible during the period of the first 3 months, if, in the opinion of the said authority, the period of suspension has been prolonged due to reason, to be recorded in writing, directly attributable to the government servant.
 - The rate of dearness allowance will be based on the increased or, as the case may be, the decreased amount of subsistence allowance admissible under subclauses (i) and (ii) above.
 - Any other compensatory allowances admissible from time-to-time on the basis of pay of which the Government servant was in receipt on the date of suspension subject to the fulfillment of other conditions laid down for the drawl of such allowances.

No payment under subrule (1) shall be made unless the Government servant furnishes a certificate that he is not engaged in any other employment, business, profession or vocation.

The employee could be paid a subsistence allowance at half his basic pay, to be increased or decreased to 75 or 25% of his basic pay at the discretion of the competent authority, after a period of 3 months of suspension (with DA calculated on the subsistence allowance thus decided) provided he furnished a certificate to the effect that he was not engaged in any other employment, business, profession or vocation.

Q. How is the period of suspension of the employee to be decided?

As per CCA RULES 54 (B)(7), where the competent authority is satisfied that the suspension was not wholly unjustified, the period of suspension shall not be treated as period spent on duty, unless the Competent Authority specifically so directs for some specific purpose.

- However, if the Government servant desires, it can be converted into Leave of Kind Due (LOKD).
- When suspension is revoked, pending finalisation of disciplinary or court proceedings, any order passed before the conclusion of the proceedings shall be reviewed on its own motion after the conclusion of the proceedings by the competent authority.

The Competent Authority can allow the employee to join back after receiving the clearance from the police; however, this decision is to be reviewed and revised in case the courts give an apposite judgment. The time frame for which the employee remained under suspension may, at best, be converted to LOKD in this case and not revoked, since the suspension seems to have been justified.

Q. What will be the effect of the episode on service of the employee?

The government servant cannot be treated as 'on-duty', since his suspension is not considered to be wholly unjustified.⁴

Also, as per CCS 54 (B)⁴, where the competent authority is satisfied that the suspension was not wholly unjustified, and the employee has not been exonerated on merit; hence the government servant can be paid part of his pay and allowances, as the competent authority may determine, after giving notice of at least 60 days to the government servant of the proposed salary.

The amount determined shall not be less than the subsistence and other allowances admissible during suspension.

Case Study 2: Claim of the relatives for compassionate appointment after the death of an employee

An employee of a tertiary-care hospital committed suicide by self-immolation. The wife of the said employee applied for a job at the hospital on compassionate grounds. Her application was rejected on the following grounds:

- She was tried in the court for abetment of suicide of her husband, although she was acquitted.
- The court had made an observation that she was a woman of loose character.

After 11 years, the daughter of the employee who had now attained the age of 18 years applied for a job in the

institute on compassionate grounds. After deliberation, the concerned committee quoted Para 8 of the chapter related to compassionate ground appointment in Establishment and Administration Manual, which is as under:

While considering belated requests, it must be kept in view that the concept of compassionate appointment is largely related to the need of for immediate assistance to the family of the government servant to relieve it from economic distress. The very fact that the family had managed somehow for all these years shows that they have some other means of subsistence.

In this situation the question arises:

Q. Should the daughter be given a job based on the justification given, i.e. application after such a long time gap?

Let us consider a few facts:

- The daughter of the said employee was 7 years of age at the time of her father's death.
- As per rules stated in the Establishment and Administration manual, she could apply for a job only after attaining the age of 18 years.

CHAPTER 32 (5) (i)5 – Compassionate Appointments of Dependants say that maximum age-limit may be relaxed wherever necessary; but no relaxation is permissible in the minimum limit of 18 years. If the ward is below 18 years of age at the time of death of the government servant and if he alone is available for employment, he should apply as soon as he attains 18 years.

However, CHAPTER 32 (17)5 – IV (4) Compassionate Appointments prescribes a 1-year limit for the grant of compassionate appointment; though it admits that this limit is often resulting in depriving genuine cases seeking compassionate appointments on account of regular vacancies not being available, within the prescribed period of 1 year and within the prescribed ceiling of 5% of direct recruitment quota.

CHAPTER 32 (17) – IV (4)5 Compassionate Appointments(3) states that the maximum time a person's name can be kept under consideration for offering compassionate appointment will be 3 years, subject to the condition that the prescribed committee has reviewed and certified the penurious condition of the applicant at the end of the first and the second year. After 3 years, if compassionate appointment is not possible to be offered to the applicant, his case will be finally closed, and will not be considered again.

In view of the above, the claim of the daughter to compassionate appointment becomes weak. However, it may be noted that these rules are interpretative and may be applied contextually.

Case Study 3: Medical negligence and National Human Rights Commission

A patient named Mr G was admitted to a hospital with diagnosis of Ca colon, chronic liver disease and diabetes. He was critically ill since the day of admission. He was operated twice on for Ca colon. But his condition kept deteriorating. The patient sustained a cardiac arrest after 5 weeks of admission. As part of cardiopulmonary resuscitation (CPR), the patient was given a shock using a defibrillator. The apparatus allegedly sparked leading to some burn injuries to the patient and burning the tubing of the ventilator and the blood pressure cuff attached to the patient. The patient could not be resuscitated and was declared dead by the resident doctors. This incident was reported by several newspapers as death of a patient due to electrocution. The issues at hand were:

- Whether the fire was the cause of death of the patient.
- Any neglect/ oversight on the part of the doctors.
- Behaviour of the doctors.
- Behaviour of the patient's attendants.

The hospital framed a committee composed of specialists and biomedical engineers to look into the incident.

The committee reviewed all records, and gathered data from doctors, paramedical staff and adjoining patients.

The concerned patient's attendants were contacted but they refused to cooperate. The inquiry committee setup to investigate the incident made an on-the-spot inspection of the concerned ward and examined the equipment. The report of the service engineer who checked the defibrillator was also seen. Based on all these, the committee came to the following conclusion:

The fire that started during the resuscitation of Mr G was a result of sparking of the defibrillator in an oxygen-enriched environment. It is a rare adverse event recorded in medical literature. It is also felt by the medical fraternity that despite the risk involved, the benefits of defibrillation far outweigh the risks. The residents on duty have acted appropriately in their management of the patient. The fire was doused by the treating doctors and they continued with the resuscitation after the fire incident.

The National Human Rights Commission (NHRC), Delhi received a complaint from a third party namely Mr M who alleged reported that the patient died due to electrocution because of short circuit in the defibrillator. He also quoted the relatives of the patient in his complaint alleging that the patient was actually improving after the surgery and died immediately after being burnt on using the defibrillator on the patient. The NHRC filed this complaint and sent a notice to the medical superintendent and SSP, asking them for a report relating to the incident within 4 weeks of receiving the notice.

Defence of the Hospital

- Since the hospital had already held an internal enquiry, the documents related to the enquiry were submitted to the NHRC, Delhi as response of the tertiary-care hospital to their notice.
- Copies of scientific articles, with references, were provided to the commission showing that during external defibrillation, electrical energy is delivered to an erratically beating heart through paddles, or sometimes disposable defibrillation electrodes, that are placed on the surface of the skin, which can stimulate the heart to respond and restore its normal electrical rhythm, thereby saving the life of the patient. If a good interface between the defibrillation paddles and the patient's skin is not established, an electric arc can result. A poor interface can be caused by insufficient force during paddle application, an insufficient or excessive amount of conductive gel, use of the wrong gel (e.g. ultrasound gel), application of paddles over irregular surfaces (e.g. bony prominences, wires, ECG electrodes), or misapplication of paddles to disposable defibrillation pads (e.g. the metal surface of the paddle not completely on the pad, a fold in the pad, a pad smaller than the paddle's metal surface, a dry pad). Placing a paddle close to an ECG electrode can also cause an arc.
- Although an arc may cause minor damage to the paddle surface or cause insufficient energy delivery to the heart, it will not cause a fire in room air. However, if a localized oxygen-enriched agent, in this case the tubing of the ventilator, is in the vicinity of the arc (e.g. on the bedding, around the patient's upper body), the energy contained in the arc can be sufficient to ignite body hair and the surface fibres on most fabrics, resulting in a flash fire, which will quickly return to ambient when the source of enrichment is removed.
- All case records of the patient indicating his condition at admission, the course of his illness, the deterioration of his condition, the end-of-life event that prompted resuscitative measures and the use of the defibrillator, failure to respond to the first two attempts at cardiac stimulation, and the minute to minute recording of the measures taken by the hospital staff were sent to the commission. It was also explained that the ventilator in the vicinity of the patient can act as an oxygen-enriched source, but as per the recommendations of the experts, the advantages of using life-saving equipment (defibrillators and ventilators) far outweigh their disadvantages.

The transparency of the hospital, the procedural and timely internal enquiry, the meticulous documentation of the treatment and condition of the patient exonerated the hospital from any liability in the death of the patient.

Case Study 4: Grant of family pension after an employee's disappearance

Mr X was an employee (*safai karamchari*) at a tertiary-care teaching hospital from the last 22 years. He failed to turn up for duty on one day, and thereafter subsequently. Disciplinary proceedings were initiated by issuing a show-cause notice followed by a charge sheet. No reply to either of them was received from the employee or his family. After ex-parte proceedings, due to lack of any reply from the employee or his family to repeated notices, penalty of removal from service was imposed after 2 years of his initial disappearance.

After 4 years of removal, i.e. after 6 years of the employee's disappearance, his wife made a representation on for grant of family pension to her, which was rejected. After another 4 years, she filed a representation on 18 August, 1998 with the hospital that her husband went missing 10 years ago and she had filed a DDR dated 23 May, 1990 regarding the same and reiterated her request for a family pension.

A careful reconstruction of the events of the fateful day when the employee had disappeared, with the help of the police records, indicated that the employee had perhaps become the victim of a mishap 10 years ago and had not reached home from office. The family, being uneducated, had failed to take appropriate and timely action/intimation to various statutory bodies as well as the office of the employee, resulting in his being struck off the rolls.

The question that arises now is:

Q. In view of the facts provided by the employees' wife now, after 23 years, can the dismissal orders of the employee be revoked and pension restored by the Competent Authority?

As per CCS (CCA) Rule 24(3), the family has to take recourse to an appeal to an authority higher than the authority, which has taken disciplinary action against the employee. The Competent Authority, even if it wants, can no longer

revoke the dismissal and provide pension to the family. The family, on the other hand, can either take recourse to filing an appeal under Rule 24 of the CCS(CCA) or the aggrieved wife can take her remedies in law and as per rules.

Recommendations for competency for administrators in the healthcare setting⁶:

- Knowledge of organisational policies and procedures including human resources policies relating to confidential information.
- Knowledge of ethical decision making and familiarity with sources of assistance for difficult ethical issues.
- An understanding of the legal nuances of their work place.
- A willingness to seek solutions that can be justified as morally correct.
- The spirit to assist others.
- Clarity of task is the key to the successful completion of any work.

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Recent Advances in Hospital Administration

Section XI

SECTION OUTLINE

- Chapter 53** Operations Research in Hospitals
- Chapter 54** Hospitals and Laws of the Land
- Chapter 55** Emerging Health Insurance in India
- Chapter 56** Sectoral Coordination in Hospital Management
- Chapter 57** Setting up a Telemedicine Clinic
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Operations Research in Hospitals

53

Prof S Vivek Adhish, Dr Sangeeta Gopal Saxena and Dr Sonu Goel

“To steal ideas from one person is plagiarism, to steal from many is called research.”

—Anonymous

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- describe the application and techniques of operations research (OR) in prudent decision making in hospitals.
- discuss the phases of OR project design in conceptualising a project.

INTRODUCTION

The science of operations research (OR) began with finding the most effective utilisation of limited military resources (antiaircraft artillery efficiency) during the Second World War using quantitative techniques.

Operations research is the representation of real world systems by mathematical models together with the use of quantitative methods (algorithms) for solving such models, with a view to optimising and decision making. Operations research typically deals with decision problems and can help making better decisions. It is a subject/discipline that has much to offer in making a real difference in the real world. Some people argue that OR does not need application of advanced analytical tools but it is research into intervention, strategies, tool or knowledge that can enhance the performance (quality, coverage, effectiveness and efficiency) of the programme.

Operations research improves programme outcomes, assesses feasibility of new strategies in specific settings and advocates for policy changes at wider level. Examples: Does voluntary counselling, human immunodeficiency virus (HIV) testing and adjunctive cotrimoxazole reduces mortality in tuberculosis (TB) patients in Malawi (improve programme outcome and assessing feasibility)? Assesses feasibility of HIV treatment in conflict settings of Bukavu, Democratic Republic of the Congo (DRC) (assessing feasibility); antimalarial effectiveness in a time of change to artemisinin-based combination therapies— Médecins Sans Frontières (MSF) studies in 18 countries (policy change).

The British/Europeans refer to ‘operational research’, the Americans to ‘operations research’—but both are often shortened to just ‘OR’. Many people have also named it as health system research, implementation research, health service research, etc. They have more or less similar principles and does not differ much, as far as their application is concerned.

Guiding principles in setting operations research question:

- Define objective of programme/health system.
- Identify constraints in meeting the objectives.
- Ask research questions around the constraints.

The answers to the questions should have direct and practical relevance to solving the problem and improving healthcare delivery.

PHILOSOPHY OF OPERATIONS RESEARCH

In general terms we can regard OR as being the application of scientific methods/thinking to decision making. Underlying OR is the philosophy that:

OR is done when either there is a lack of knowledge on the subject or lack of tool/intervention or the tool exists but is inefficiently used.

Examples:

Lack of knowledge: Our objective is 85% treatment completion rate in TB. The constraint is high loss to follow-up. The research question that can be framed is why people are lost? (Is it because of payment/side-effects/transport cost to clinic/unreported deaths?)

Inefficient use of tool: The objective of TB programme in India is high-quality sputum microscopy using three sputum smears. Constraints are that three smears are demanding for patient and laboratory staff. The research question can be whether two smears are as efficient as three smears?

- Decisions have to be made; and
- Using a quantitative (explicit, articulated) approach will lead (on average) to better decisions than using nonquantitative (implicit, unarticulated) approaches.

It may be argued that although OR is imperfect, it offers the best-available approach to decision making at many instances (which is not to say that using OR will produce the right decision).

Often the human approach to decision making can be characterised (conceptually) as the 'ask Fred' approach; simply give Fred ('the expert') the problem and relevant data, shut him in a room for a while and wait for an answer to appear.

The difficulties with this approach are:

- Speed involved in arriving at a solution.
- Quality of solution: Does Fred produces a good-quality solution in any particular case?
- Consistency of solution: Does Fred always produce solutions of the same quality (this is especially important when comparing different options).

Any research design like descriptive or case-control or cohort or qualitative research qualifies for being an OR.

What is not an operations research?

Basic science research or randomised control trial (RCT), where experiments/research is carried out in a strict environment (thus measuring efficacy and not effectiveness, which measures workability in real world) is not an OR.

In this chapter, phases and models in OR will be discussed. You can form your own judgment as to whether OR is better than this approach or not.

PHASES OF AN OPERATIONS RESEARCH PROJECT

Problem Identification

Problem has to be diagnosed from its symptoms, which may or may not always, be obvious. For example, to be able to formulate the duty roster for the emergency ward, it would be difficult to predict when the quantum of emergency arrivals would be more. At other times, delineation of the problem to be solved would require that some aspects of it need to be ignored; for instance, the physical space available for a hospital would be a limiting factor while considering expansion, as extra land may simply not be available. To be successfully able to derive a mathematical solution, it is important to first clearly establish the objectives, limitations and requirements.

Formulation as a Mathematical Model

There can be different ways of formulating the mathematical model; and it is essential that the appropriate model is selected if the desired results are to be achieved. Each mathematical model would require different inputs and this is an important consideration for the selection of the appropriate model. In a healthcare setting, some inputs may not always be available. For instance, in today's world we are facing an epidemic of obesity, and data of the requisite intensity of rays required for getting appropriate X-rays of morbidly obese patients is simply not available. Computerised tomography (CT) scans of such patients are also currently not possible. Mathematical models for performing the investigations on such patients would require either the use of mathematical models (which is not available) or would require estimation of data. Such estimations are practical only if the potential benefits from the project are substantial enough to warrant the efforts required for such projections.

In the real world, some situations are naturally data poor, i.e. the data is of poor quality or nonexistent and some environments are naturally data rich. As examples of this you would understand that data from the developing world, data concerning rare or new diseases would be either miniscule or of poor quality, whereas data from the developed world, data about well-researched conditions such as diabetes, data from emergency wards would be plentiful and, in all likelihood, more reliable.

Model validation (or algorithm validation)

Model validation involves running the algorithm for the model on the computer in order to ensure that the input data is valid, the computer programme is free of viruses, the model actually represents what it is expected to, and the results from the model are realistic and feasible in the real world.

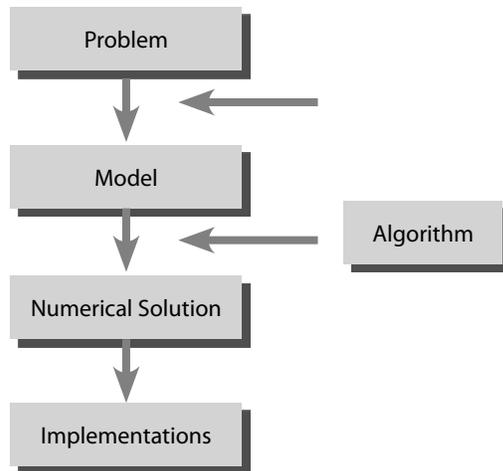
Solution of the model

Standard computer packages or specially designed algorithms have been used to solve the model (as mentioned above). In practice, a 'solution' often involves many solutions under varying assumptions to establish sensitivity. For example, what if we vary the input data (which will be inaccurate anyway), how will this affect the values of the decision variables? Questions of this type are commonly known as 'what if' questions nowadays.

Implementation

This phase may involve the implementation of the results of the study or the implementation of the *algorithm* for solving the model as an operational tool (usually in a computer package).

In the first instance, detailed instructions on what has to be done (including time schedules) to implement the results



Flowchart 53.1 Graphical description of problem analysis.

must be issued. Secondly, operating manuals and training schemes will have to be produced for the effective use of the algorithm as an operational tool. A graphical description of this process is given below in Flowchart 53.1.

OPERATIONS MANAGEMENT¹

The development of the secondary sector broaden the manufacturing industry and necessitated the need of a production manager. The roles started enlarging, especially with the development of the service sector, and the production manager graduated to an 'operations manager' and the development of the science of operations management. Operations management department have directors of human resource (HR), finance, marketing, research and development (R and D) and operations reporting to the chief executive officer (CEO). Hospital is a service sector with little use for marketing director and R and D (except some). Director—operations management is very important and is generally designated as the 'medical superintendent' with the heads of departments (HODs) reporting to him. The directors of HR and finance, though reporting directly to the CEO, are junior in rank to even the HODs. The medical superintendent (director—operations management) uses the science of operations research in better management of the services.

Relationship between Operations Management and Operations Research

Operations management is running the management of the hospital and operations research is a science to help in better decision making or the best-possible decision making, which may not always turn out to be right. Operations research is thus a science to help the operations manager in decision making.

TOOLS AND TECHNIQUES OF OPERATIONS RESEARCH

Models

An object, situation or a process in the real-world represented in a simplified form is a model. It simplifies a huge mass of information to a manageable size and shape. Models are simplification of a complex activity by incorporating only the essentials and doing away seemingly unimportant facts. The model building is the essence of the OR.

Types of models²

- **Diagrammatic models**

Models are frequently used in our day-to-day life and the use of a road map is an example of a diagrammatic model. How do we use these models in healthcare, especially in hospitals? Medicine is not a perfect science like mathematics and there can be more than one right treatment or more than one method to handle an emergency. Medicine, along with being a science, needs excellent teamwork for good results. Even if there is more than one treatment, for the best interest of the patient the team should follow the same management. Therefore, algorithms are pasted in the walls of the wards, intensive care unit (ICU), etc. which have to be followed by all. This ensures uniformity and similar management by the entire team. In fact, the attempt is to have the same management for all the patients with, say, stroke or myocardial infarction. These algorithms are what is commonly called flowcharts in OR.

- **Conceptual models**

Studying the behaviour of individuals or situations and trying to make predictions that are not in quantified terms.

- **Mathematical models**

These models may be broadly classified as:

- *Deterministic model*

The parameters vary in a predictable manner or are constant or the output is proportionate to inputs such as the children immunised is proportionate to the vaccine used.

Types of deterministic models:

- Assignment problems
- Linear programming problems
- Transportation problems
- Dynamic programming
- Sequencing problems

- *Stochastic model*

Also called as probabilistic models, the magnitude depends partly on chance or takes account of variability, e.g. arrivals rates in the outpatient department (OPD).

Some of the important types of probabilistic/stochastic models used in operations research are:

- Network analysis—programme evaluation and review technique (PERT) and critical path method (CPM) techniques
- Inventory control and forecasting
- Replacement theory
- Queuing theory
- Work sampling and work studies
- Game theory
- Decision theory
- Computer simulation procedure

Network Analysis

Network analysis is the general name given to certain specific techniques that can be used for the planning, management and control of projects.

A project is a temporary endeavour undertaken to create a 'unique' product or service.

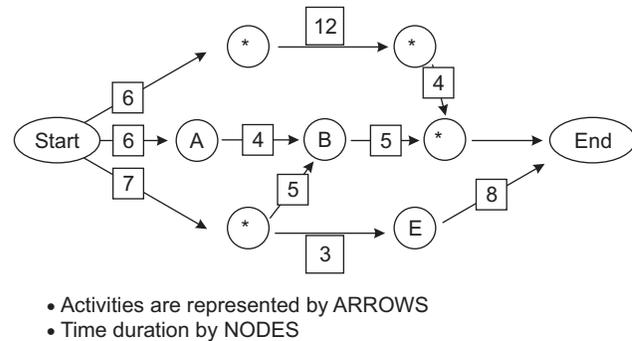
This definition highlights some essential features of a project.

- It is temporary: It has a beginning and an end.
- It is 'unique' in some way.

Network analysis is a vital technique in project management. It enables us to take a *systematic quantitative structured approach* to the problem of managing a project through to successful completion. Moreover, as will become clear below, it has a graphical representation, which means it can be understood and used by those with a less-technical background.

Programme evaluation and review technique

Programme evaluation and review technique (PERT) is a decision-making tool to help in the timely completion of the project. The technique is generally applied to projects of a huge magnitude like holding the Common Wealth Games, wherein the timely completion of the project is of utmost importance. The project is broken into smaller activities and the sequence is marked by arrows. The specific point in time at which an activity begins or ends is called a *node*. It is thus clear as to which activity has to be completed before the next one can begin. A graphic representation of projects' operations composed of activities and nodes is prepared. A task may be detailed as a subtask on another page of the PERT chart in order to have better management. Float or slack is the time by which the activity can be delayed without delaying the project. Positive slack is being ahead of schedule, negative slack is being behind schedule and no slack is being on time. A diagrammatic representation of PERT is shown in Flowchart 53.2.



Flowchart 53.2 PERT diagram showing time relation to activities.

Critical path method (CPM)

Critical path method (CPM) is one of the techniques to know the key activities that could hamper the timely completion of the project so as to identify and carry out a stricter monitoring for them. In fact, efforts can also be made to hasten or 'fast tract' the project. An arrow diagram is prepared for all the activities in the project, their interrelationship and the time duration of each activity. This helps in knowing the longest and the shortest time for each activity. The longest activity is called '*critical path*', as any delay will delay the timely completion of the project. This helps the manager to prioritise the supervision and management of this activity. The activities having a shorter time have a 'float'—the delay that would not delay the project.

Fast tracking: In attempting to complete a project before the expected time, the 'critical path' is studied and means by which it can be reduced either by increasing the resources or performing more activities in parallel are determined.

Free and independent float: Two other varieties of float (for noncritical activities) are also conventionally distinguished:

- *Free float:* It is the delay possible for an activity if all preceding activities start as early as possible whilst all subsequent activities start at their earliest time. An equivalent (and easier) definition is the delay possible in an activity if it starts at its earliest time and all subsequent activities start at their earliest time
- *Independent float:* It is the delay possible for an activity if all preceding activities start as late as possible whilst all subsequent activities start at their earliest time.

Here by delay we strictly mean 'the increase in completion time'.

Any activity with a float of zero is critical, as any delay will result in the project being delayed.

Gantt chart

The scheduling of the activities corresponding to the time deadlines is depicted in a chart form. The activities are

Activity	T	I	M	E	W E E K S								
	1	2	3	4	5	6	7	8	9	10	11	12	13
A		X	X	X						X	X	X	X
B				X	X	X	X	X	X	X	X		
C	X	X	X						X	X	X	X	X
D					X	X			X	X		X	
E	X		X	X	X								
F					X				X	X	X		
G		X		X	X	X					X	X	X
H				X	X		X	X	X		X	X	

Figure 53.1 Gantt chart showing scheduling of the activities.

plotted vertically from the left and the time in days or weeks on the right. All the workers thus clearly know what work has to be completed by when and it is very easy to monitor the progress of work if it is on time or behind schedule (Figure 53.1).

Inventory Control and Forecasting

The dream of the hospital manager is to have a supply of drugs and other materials in the hospital, whenever and wherever needed by anyone. The headache for him is the operation list being cancelled due to shortage of anaesthetic gases or some other important material. The nightmare is a patient dying due to the nonavailability of an emergency drug or worse still oxygen in the intensive care unit. Do these things happen by chance or is there a science that can help us in managing them?

Practically, a manager would like to have the right item in right quantity of the right quality at the right time bought at the right price. Seems like utopia, but is feasible.

Logistics, a term borrowed from the military sciences, aims at ensuring the availability of the material, as discussed in the better interest of the patient and the hospital. The management of materials can be viewed as a balance or an optimum mix of the cost, necessity and a value for money or cost balance between shortage and excess. The science of OR plays an important role in the efficient and effective materials management.

The materials needed in the hospitals are consumable items like drugs, bandages, reagents, medical gases, disposable syringes and needles, etc. Then there are durable items like BP instruments, equipment, etc. that last for a number of years and are referred to as durables. In between the two come semidurables, i.e. those last for a few years like linen, surgical instruments, etc. An efficient materials management would involve an efficient system beginning from the need through purchase, maintenance till the ultimate disposal.

Once we need an item, it has to be purchased. Prudence then starts from reducing this 'purchase cost'. The clarity in knowing what has to be bought in terms of its specification is the first step in reducing this cost. The next step is to buy its right quantity through healthy competition. Cost is associated with stock and needs to be dealt in an effective,

efficient and economic manner. The question then arises is *how much stock should we have?* It is this simple question that inventory control theory attempts to answer.

There are two extreme answers to this question:

A lot

- This ensures that we never run out.
- Is an easy way of managing stock.
- Is expensive in stock costs and cheap in management costs.

None/very little

- This is known (effectively) as just-in-time.
- Is a difficult way of managing stock.
- Is cheap in stock costs and expensive in management costs.

Seemingly buying in bulk would be a solution for all problems. The item would be bought cheap and be available all the time. Though bought at a cheaper unit price, it makes the hospital pay in other forms. The capital investment increases, storing the material and its safekeeping add in the form of invisible costs. Pilferages increase and so does deterioration and obsolescence. Increased insurance premiums further add to the costs. These invisible costs—commonly called as the 'carrying cost'—at times add up to a quarter to a third of the total inventory cost. Buying in small quantities increases the unit cost, utilises a lot of the time of the personnel and would result in repeated shortages. So we see that the purchase and carrying cost oppose each other.

Ordering cost is incurred in placing an order in terms of the time of the staff, stationery postage, etc. Too many orders end up in employing more people and thereby increasing the ordering cost. Large and infrequent orders reduce the ordering cost.

The annual carrying cost keeps on rising as the order quantity increases. The annual ordering costs decrease with the increase in the quantity of orders. What is needed is determining the optimum mix of the item and buying it in that 'right' quantity. This is known as the economic order quantity (EOQ).

Softwares are available in plenty and these costs need not be calculated manually. The EOQ for different items would be different. Dividing the total annual demand by the EOQ gives us the number of times the inventory order for that item that needs to be placed. The EOQ calculation gives us a *quantity* to order; but often people are better at ordering on a *time* basis, e.g. once every month.

In other words, we need to move from a quantity basis to a time basis. EOQ is calculated as:

$$EOQ = \sqrt{\frac{2AC}{P_i}}$$

- Q = Quantity to be ordered
- A = Annual consumption of the items per unit
- C = Cost of placing and receiving an order
- P = Price per unit
- I = Inventory carrying cost

Shortage cost

This is the cost that a hospital has to pay for the shortage or nonavailability of an item. This cost will vary from item to item. Shortage of a cough syrup may not result in a loss to the hospital, but the shortage of an inexpensive drug like adrenaline may result in the death of a patient in anaphylactic shock. The cost of life cannot be measured and the tarnished image of the hospital by the media may prove very expensive to the hospital. Restricting this shortage cost is of utmost importance for the hospital manager and will be discussed later.

Materials management³

The general principles of management are the guiding principles of materials management. A well-conceived purchase system implemented efficiently is all that is needed and is easier said than done. A requisition and distribution system along with written policies and procedures goes a long way in good materials management.

Figure 53.2 describes the important elements of materials management. Just to quote a CEO of a hospital. 'I want to give my patients nothing but the best. My cardiologists tell the stents he needs to the purchase department, which then negotiate with the dealers for the price. No tendering.'

All the items in a hospital are not of equal importance. The principles of OR helping in determining the techniques of optimal need-based selective control are:

- **ABC (always better control) analysis:** It is an inventory categorisation technique which controls on the basis of cost of item.

It has been observed that a set of items that is hardly 8–10% of the total number of items, but contributes to about 70–80% of total inventory value are classified as 'A'-class item.

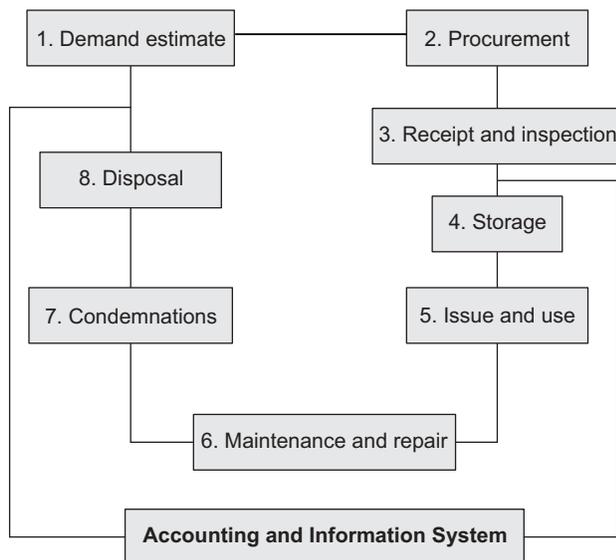


Figure 53.2 Elements of material management.

On the other hand, there is a set of items that numberwise is about 70–80% of total number of items, but value-wise contributes to hardly 10% of total inventory value, is classified as 'C'-class item. The set of items in between 'A' and 'C' class are classified as 'B'-class item—around 20%.

- **VED (Vital items-Essential items-Desirable items) analysis:** On the basis of criticality or importance of the item and not the cost.

V = Stands for vital items, the scarcity of which may be life-threatening, viz. adrenaline, oxygen.

E = Stands for essential items, without which the functioning of the hospital is adversely affected but is not life-threatening.

D = Denotes desirable items that are necessary but do not cause much disruption in the services if unavailable for sometime.

A situation could be where an item is in C-group, i.e. very cheap but vital, whereas some may be in A-group, but desirable. So how does OR help in it.

We observe in Figure 53.3 that the 'A'-drugs are costly and 'V'-drugs should always be present, as their absence may cost the life of a client. Thus, all the A- and V-drugs need a strict monitoring and that too by the senior management. The medical superintendent cannot count these medicines every day; so what is the solution.

Checklist should be made for all these drugs and staff should be deputed to check them using this checklist on a weekly or bi-weekly basis, depending on the necessity (V) of the drugs. His check should be counterchecked by the middle-level and senior managers on a weekly basis.

The 'B'-drugs and the 'E'-drugs should be monitored by the middle-level management.

The 'C'- and 'D'- drugs may be left under the supervision of first-line supervisors.

- **SDE (Scarce items-Difficult items-Easily available items) analysis**

This analysis is based upon the availability position of an item.

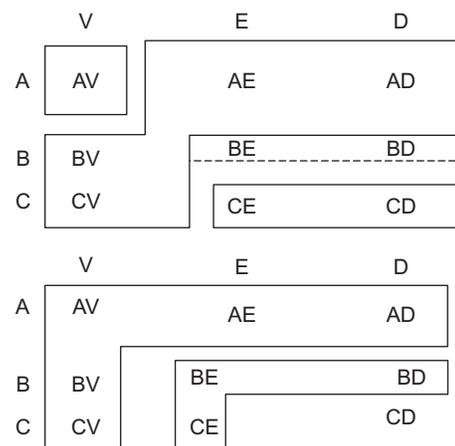


Figure 53.3 Linking ABC and VED analysis.

S = Refers to scarce items, especially imported items and those that are in short supply.

D = Refers to difficult items that are available in indigenous market but cannot be procured easily. For example, items that have to come from far-off cities or for which reliable suppliers are difficult to find.

E = Refers to items that are easily available (mostly local) items.

- **HML (High cost-Medium cost-Low cost) analysis**
The cost per item (per unit) is considered for this analysis and all the items are classified as high-cost (**H**), medium-cost (**M**) and low-cost (**L**) items. This type of analysis is useful for keeping control over consumption at department level and for deciding the frequency of physical verification.
- **FSN (Fast moving-Slow moving-Nonmoving) analysis**
Here the quantity and rates of consumption are analysed to classify the items as—Fast-moving (**F**), slow-moving (**S**) and nonmoving (**N**) items.

Break-even Analysis

Hospitals nowadays have become highly capital intensive and the technology is becoming obsolete very fast. The CEOs therefore are keen to know when they will break-even, i.e. recover the money invested. A headache for the Director—finance, the result is reached by combining OR with economics.

Suppose a radiologist wants to establish a magnetic resonance imaging (MRI) scan. He will need to have space for it, construct the requisite infrastructure and get an MRI scan. The MRI would need insurance, an AMC and would undergo depreciation. The loan may also have interest payable. All these costs are 'fixed costs', i.e. the cost that will have to be borne irrespective of the fact whether there are any clients or not.

'Variable' are incurred on labour, consumables, electricity, etc. These costs would vary by the number of clients.

'Revenue cost' is the money received from the clients. The revenue cost per unit is more than the per unit variable cost.

'Contribution' is the difference between the revenue and variable cost per unit.

When the total contribution becomes equal to the fixed cost, the break-even point is said to have been reached. This means that there is no profit or loss.

The break-even point would depend on many factors, viz. contribution per unit, number of clients and the fixed cost. A rapidly updating technology may necessitate reaching the break-even point earlier than it being outdated. So the need may be to use the equipment for the maximum permissible time. Different equipment will have different break-even points and may need different strategies. Break-even points can be calculated mathematically by equations or graphically; but the easy availability of computer softwares has made the job simpler for the managers.

Queuing Theory²

Scenario I

Ten patients come in a clinic at 10.00 am and there are 10 doctors. The patients do not have to wait at all and are attended immediately by the doctor.

Scenario II

Ten patients come in a clinic at 10.00 am and there is one doctor. The patients have to wait a lot before they are attended by the doctor.

In the first scenario, the patients are happy. The cost for the clinic would be huge in terms of capital investment for infrastructure, and the salaries of the doctors and personnel. The cost has to be borne by the patient and the setup may not be cost effective. In the second scenario, the cost of the clinic is low and is very cost effective for the patients. However, the patients have to wait a lot and are not happy. Some may get disgusted and go to another clinic, causing a financial loss to the clinic. The need is that there should be a system where the waiting time is not much as well as the doctors are not idle, i.e. an optimal mix. This would be different for emergency departments where waiting may be life-threatening for outpatients.

Queuing theory, in healthcare settings, is basically an OR approach wherein a mathematical model is developed for the analysis of waiting lines of patients (Kleinrock). The goal of queuing analysis and its application in healthcare organisations is to 'minimise costs' to the organisation—both tangible and intangible, and provide quality treatment at the same time. The costs that are considered are capacity costs, waiting costs, cost of waiting space, cost to the society and effects of loss of business to healthcare organisation if patients refuse to wait and decide to go elsewhere.

Application of queuing theory is the most beneficial in the following areas:

- Emergency department
- Outpatient departments (OPDs)
- Cardiac catheterisation laboratory
- Radiology and interventional radiology
- Operating room
- Laboratories: Inpatient and walk-in

Linear Programming⁴

Linear programming (LP) is a powerful tool that can incorporate many decision variables in a single model to attain an optimal solution. LP is a technique for allocating resources when the supplies of these resources are strictly limited. The structure of linear programming includes decision variables, an objective function, constraints and the parameters that describe the available alternatives or resources.

The decision variables represent the levels of activity for an operation (e.g. number of inpatient hospitalisations, number of outpatient visits); their values are determined by the solution of the problem. The variables are shown with

symbols $\times 1$, $\times 2$, $\times 3$ and so on in a linear equation. Decision variables cannot have negative values.

The objective function describes the goals, which the healthcare manager would like to attain (creating a reasonable margin for the survival or the financial health of the healthcare organisation). Such a goal might be maximisation of revenues or margins, or minimisation of costs. The objective function is a linear mathematical statement of these goals (revenue, profit, costs) described in terms of decision variables (per unit of output or input). That is, the objective function is expressed as a linear combination of decision variables that will optimise the outcome (revenue, profit, costs) for the healthcare organisation.

Constraints are the set linear equations that describe the limitations restricting the available alternatives and/or resources. Especially in healthcare, scarce resources impede the management of facilities and/or the development of new healthcare services. The constraints to which the objective is subject to arise from the healthcare organisations' operating environment. By factoring in constraints, a healthcare manager can see whether offering a new healthcare service would be feasible at all.

Linear programming models are solved given the parameter values, i.e. the values of the given resources.

Soft Operations Research⁵

In recent years approaches to problems that have come to be labelled collectively as 'soft OR' have appeared. By contrast, the classical OR techniques such as linear programming, integer programming, etc. are labelled collectively as 'hard OR'.

Hard OR is used here in the sense that traditional/classical OR techniques are:

- Tangible
- Easy to explain
- Easy to use

Any doubts arising over the value of hard OR are not to do with the correctness of the techniques themselves, but to do with their applicability (i.e. the number/variety of real-world problems to which they can be successfully applied).

Soft OR, by contrast, is:

- Somewhat intangible
- Not easy to explain
- Not easy to use

Doubts that arise over the value of soft OR concern *both* the correctness of the techniques/approaches as well as their applicability (i.e. the number/variety of real-world problems to which they can be successfully applied).

Soft OR is still relatively controversial. In many respects, soft OR has taken on some of the attributes of a religion:

- It has adherents and followers (believers).
- Believers believe that soft OR is 'the one true way'; all other ways are wrong.
- Believers attack (verbally) nonbelievers in the scientific press.
- Believers often want to 'change the world for the better'; this often manifests itself in a desire to use soft OR to impact upon strategic/social issues.
- Belief is based on faith rather than evidence.

With respect to this last point, belief in soft OR appears to be founded on relatively few applications. This is in sharp contrast to the many success stories reported over the years for hard OR.

By-and-large, hard OR has avoided some of the religious excesses of soft OR, although some recent hard OR techniques have unfortunately taken on some of these characteristics. Genetic algorithms, a technique from computer science being applied in OR, also has some of these religious characteristics.

A collective generic name for these particular soft OR approaches is *problem-structuring method*.

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Acknowledgement

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Hospitals and Laws of the Land

54

Prof Anil Kumar Gupta, Dr Sonu Goel and Dr Shweta Talati

“The safety of the people shall be the highest law.”

—Marcus Tullius Cicero

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- get an overview of unavoidable rules, regulations, procedures and laws related to healthcare in Indian scenario.
- understand key legislations with the help of case studies.

INTRODUCTION

With increasing awareness among the public about various duties and responsibilities of hospital authorities, time has come when hospital administration has an obligation to have clear understanding of its ethical and legal responsibilities towards seamless and safe hospital stay. In addition, the hospitals are also governed by regulations of government with respect to patients' rights, i.e. right to information, consumer protection, labour laws, patient and healthcare, workers's safety and building laws, etc. which have to be strictly followed.

RIGHT TO INFORMATION ACT, 2005¹

An act to provide for setting out the practical regime of right to information for citizens to secure access to information under the control of public authorities to promote transparency and accountability in the working of every public authority.

The Act [u/s 2(j)] includes the right to inspection of work, documents, records; taking notes, extracts or certified copies of documents or records; taking certified samples of material; obtaining information in the form of diskettes, floppies, tapes, video cassettes or in any other electronic mode or through printouts where such information is stored in a computer or in any other device.

Any material in any form including records, documents, memos, emails, opinions, advices, press releases, circulars, orders, log books, contracts, reports, papers, samples,

models, data material held in any electronic form and information relating to any private body, which can be accessed by a public authority under any other law for the time being in force.

Public Authority u/s 2(h) means any authority, body or institution of self-government established or constituted:

- by or under the Constitution;
- by any other law made by Parliament;
- by any other law made by State Legislature;
- by notification issued or order made by the appropriate government, and includes any
 - body owned, controlled or substantially financed;
 - non-Government organisation substantially financed, directly or indirectly by funds provided by the appropriate government.

Exemptions from Disclosure u/s 8 (1)

It includes information (i) which would affect the sovereignty, integrity and security of India; (ii) forbidden to be published by any court of law; (iii) which would cause a breach of privilege of Parliament or the State Legislature; (iv) including commercial confidence, trade secrets or intellectual property; (v) available to a person in his fiduciary relationship unless competent authority feels or larger public interest is involved; (vi) received in confidence from foreign government; (vii) endanger the life or physical safety; (viii) which would impede the process of investigation/apprehension/prosecution of offenders; (ix) cabinet papers including records of deliberations of the council of ministers, secretaries

and other officers; (x) personal information with no public interest and invasion of privacy.

Penalties u/s 20(1) and 20(2)

It can be levied if there is nonperformance of the officers; delay in providing information; providing incomplete or false information or rejecting applications for malafide reasons. The Central Information Commission (CIC) can impose penalty of Rs 250/day with maximum penalty of Rs 25,000. There can be disciplinary action against public information officer (PIO) under the service rules.

Section 19 (8)(b): "The Central Information Commission or State Information Commission, as the case may be, has the power to require the Public Authority to compensate the complainant for any loss or other determinants suffered."

Case Study 1: Subjudice matters

Issue

The applicant was denied inspection of the relevant file as the case was subjudice (Mr X versus AIIMS).

Judgement

Central Information Commission in judgment "...the matter being subjudice cannot be held as a reason for withholding the information and hence directs the PIO to allow inspection of relevant files by the complainant."

Case Study 2: Medico-legal case

(a) Issue

Information was denied (to a third party) as it was a medical report of a medico-legal case.

Judgment

Central Information Commission in judgement... "Medical records in medico-legal cases, as per Code of Medical Ethics, are provided only to the patients themselves or to their authorised representatives. Hence information cannot be provided unless the assaulted victim himself seeks the information or authorises someone to collect the same."

(b) Issue

The patients brought to the hospital by the police in criminal cases are denied medico-legal reports stating that information is exempted from disclosure as belong to a third party and also since it is held in a fiduciary relation with the patient.

Judgement

The judgment goes "Medico-legal cases are indeed legal requirements in criminal cases and that they are not prepared at the instance of the patient but to record injuries inflicted on a person, to be used by courts in criminal proceedings and hence are not held in fiduciary relation with the patient and that refusal of information under Section 8(1)(e) is unsustainable."

Case Study 3: Postmortem report in Batla House case

Issue

The certified copies of postmortem reports were sought. Central public information officer (CPIO) denied information stating the same would impede the process of investigation.

Judgement

Judgment follows: "The CPIO to provide for postmortem reports as FIR in this particular case has already been exposed to much publicity and the postmortem reports are now irrevocable. Their disclosure in no way could impede the process of investigation or prosecution."

Case Study 4: Fiduciary relationship

Issue

The applicant was denied information about her husband with regard to his treatment.

Judgment

"Information can be denied since it is being held by the doctor in a fiduciary relationship. The appellant was advised either to get an authorisation letter from the patient permitting his wife to collect the information or get a court order declaring the wife as the legal guardian."

TRANSPLANTATION OF HUMAN ORGANS ACT, 1994²

The general dictum "*when you can buy one, why donate?*" led to an outcry from the physicians nationally and internationally at the growing numbers of exploitative transplants being done in India. Removal of organs from 'brain-stem-dead' cadavers was also difficult. This led to the birth of Transplantation of Human Organs Act (TOHA).

It provides for the regulation of removal, storage and transplantation of human organs for therapeutic purposes and for the prevention of commercial dealings in human organs and for matters connected therewith or incidental thereto. For the words '*human organs*', the words '*human organs or tissues or both*' shall be substituted in Amendment of TOHA in 2011.

Salient Features

- To prevent commercialisation, two authorities were formed under the Act, appropriate authority (AA) and authorisation committee (AC).
- To grant or suspend/cancel registration to a hospital for the removal, storage and transplantation of any human organ.
- License issued to a hospital for a period of 5 years. The application for the renewal to be forwarded within a period of 3 months prior to the expiry of the original certificate of registration.
- To enforce standards for hospitals engaged in the removal/storage or transplantation of human organs.
- To investigate any complaint or breach of any provision of the Act or the rules made there under.

The *Transplantation of Human Organs (Amendment) Act (2011)* had added features like organ swapping is legalised; includes grandparents and grandchildren in the list of near relatives; if a neurologist or neurosurgeon is not available, registered medical practitioner may nominate an independent surgeon or physician and an anaesthetist or intensivist; makes it mandatory for a doctor in an intensive care unit to ascertain if a patient wants to donate organs; no human organs or tissues or both shall be removed from the body of a mentally challenged person before his death; where the donor or recipient being near relative is a foreign national, prior approval of the AC will be required; AC will not approve removal or transplantation, if the recipient is a foreign national and donor is an Indian, unless they are near relatives; maintenance of national registry of donors and recipients; cornea can be retrieved by a certified eye technician because eye surgeons may not be always available; allowing nongovernment organisations to be registered who wish to work on human organ transplantation; and mandatory appointment of transplant coordinator for all registered hospitals for organ retrieval and transplantation.

Role of Appropriate Authority

Appropriate authorities have the powers to summon any person, seek production of a document and issue a warrant for the search of any place suspected to be indulging in unauthorised transactions in human organs. The state government and the union territories shall constitute one or more ACs, which is to approve the transplants between unrelated donors and recipients after confirmation that they are not under any coercion or unduly influenced by monetary considerations to donate their organs.

Role of Authorisation Committee

Authorisation committee is involved in obtaining 'no objection certificate' (NOC) from their respective country's embassy, if the donor or recipient is a foreign national.

Authorisation committee also seeks NOC from respective domicile states, if donor, recipient and place of transplantation are in different states.

Punishment for Violation

- Whosoever carries out removal or transplantations without authority is punishable for up to 10 years and a fine of up to Rs 5 lakhs.
- Offending registered medical practitioner is liable to be removed from the state medical council roll for 2 years for the first offence and permanently for any subsequent offence.
- Commercial dealings like indulging in monetary transaction for trading in human organs, brokering human organ trade deals and advertising to solicit clients are punishable with imprisonment ranging from 5 to 10 years and a fine of Rs 20 lakhs to 1 crore.

Case Study 5: Rejection of application for organ donation

Issue

Authorisation committee had rejected the application for organ donation by the sister-in-law as Section 9(3) states that no human organ removed from the body of a donor before his death shall be transplanted into a recipient unless the donor is a near relative of the recipient. Donor being sister-in-law was not genetically related to the recipient. The prospective recipient filed a writ petition before the High Court of Karnataka against the order of the AC. Petitioners seek direction to the respondents (AC) "to give clearance for the transplant operation."

Court direction

Court directed to consider the application afresh as there is no provision in the Act which prohibits a person, who is not a "near relative" by definition, from donating his kidney, merely because the "near relatives" have not been considered as donors by the family for kidney transplantation.

Final court direction

The court directed the committee to ascertain from the second petitioner whether she would be donating the kidney out of "affection and attachment". When presented with the provisions of the law, the AC concludes that if the recipient and donor pledge affection in front of them, they should not object unless there is a complaint or some gross oversight. Finally permission was granted by the AC for the transplant.

CONSUMER PROTECTION ACT, 1986

It is an important Act in the history of the consumer movement in the country. It was drafted to provide better protection and promotion of consumer rights through the establishment of consumer councils and quasi-judicial machinery.

The Consumer Protection Bill (1986) was introduced in the Lok Sabha on 5th December, 1986. The motive of Consumer Protection Act (CPA) was to ensure better protection of the interest of consumers from exploitation and for the purpose to make provisions for the establishment of consumers councils and other authorities for the settlement of consumer's dispute and for matters connected therewith.

Salient Features

- Consumer Protection Act (1986) was enacted for the promotion and prevention of the consumer's rights of redressal, to information, to choosing, to be heard and to safety.
- Deficiency means any fault, imperfection, shortcoming in quality, nature and manner of performance, which is required by or under any law for time being in force or has been undertaken to be performed by person in pursuance of contract or otherwise in relation of any service.
- Any act of omission or commission which causes any damage to the consumer on account of negligence or consciously withholding of relevant information to the consumer.
- A doctor when consulted by a patient owes him duty of care and administration of most appropriate treatment. A breach of any of these duties gives the right of action for medical negligence to the patient. The main relief provided under the Consumer Protection Act is compensation for the damage caused due to deficiency in service, which in the case of medical services is negligence.
- Compensation may be provided if there is violation of that duty to provide care or damage/injury/death occurred due to violation in duty.
- Complaint can be brought against:
 - Medical services provided at government/nongovernment hospitals, where fees are required to be paid/provided free service/employer or insurance company bears the expenses of medical treatment.
 - ESI hospitals/any other hospital/clinic run by an industrial house or company for the benefit of their employees and members of their families.

Exemptions Under the Act

- Nongovernment hospitals/government hospitals where all patients are given free service.
- Services provided by CGHS dispensaries, hospitals, etc. where some token charges, such as membership

fee/registration fee is charged but treatment and medicines are provided free.

- Where there is question about excessive fee of doctor.
- When there is no evidence, documents, receipts, etc. and no affidavits to support the complaint.
- Where case has already been filed/decided in a civil court for the same cause of action.

When to Make a Complaint?

When anyone feels or is able to prove that the patient has been made to pay the fees for a service not actually provided or when there has been a deficiency in the medical service provided as breach of duty described above. The complaint needs to be lodged within 2 years from the day of cause of action. However, exception can be made with valid documented reasons.

Who can File a Complaint?

A consumer for himself and/or for his beneficiary including parents, guardians for minor wards and children, etc. can file a complaint. The complaints can be either handwritten legibly or typed, but preferably typed. It may be in a local language. The complaint can be submitted in person, through agent/lawyers, or by registered post.

Consumer Disputes Redress Forum

- At district level, a three members committee comprising of at least a retired district judge (as president) and one lady. The power is compensation up to 20 lakhs.
- At state level, a three members committee comprising of at least a retired High Court Judge (as president) and one lady. The power is compensation from 20 lakhs to 1 crore.
- At national level, a three members committee comprising of at least a retired Supreme Court Judge (as president) and one lady. The power is compensation can be over 1 crore.

Appeal Against the Decision

The appeal with higher court can be made within 30 days. The compensation awarded by lower court is required to be deposited in this case.

Reliefs Granted by Consumer Courts

The relief can be refund of the charges paid, to award compensation for any loss or injury suffered due to the negligence, to rectify the deficiency in services and to compensate the financial losses to the affected party (e.g. lawyer fees, loss of wages in case of earning member and potential future earning).

Case Study 6: Indian Medical Association (petitioner) versus VP Shantha and others (respondent) (Date of Judgement: 13 November, 1995)

Issue

Whether the services provided by a doctor to a patient fall under the ambit of 'service' as defined under Section 2(1) (0) of this Act.

Judgement of Supreme Court

The Honourable Court directed that services provided to a patient by a doctor by way of consultation, diagnosis and treatment, both medicinal and surgical, would fall within the ambit of 'service' as defined in Section 2(1) (0) of the Act with inclusion and exclusion criterias.

PRECONCEPTION AND PRENATAL DIAGNOSTIC (REGULATION AND PROHIBITION) TECHNIQUES ACT, 1994

This is an act to provide for the prohibition of sex selection, before or after conception, and for the regulation of prenatal diagnostic techniques for the purpose of detecting genetic or metabolic disorders or chromosomal abnormalities or certain congenital malformations or sex-linked disorders and for the prevention of the misuse of such techniques for the purpose of prenatal sex determination leading to female foeticide; and for matters connected there with or incidental thereto.

This Act was proposed with the intention of following objectives: (i) No sex determination or communication must be done as per the regulation of preconception and prenatal diagnostic techniques act. (ii) Right person, right place, right equipment should be there. (iii) No advertisement of sex selection must be done. (iv) Display of certain documents must be done prominently. (v) Maintenance of records by the institute/organisation/clinic, and inspections and monitoring by appellate authority must be done. (vi) Penalties for violations. (vii) Notification for sale of any ultrasound machine with affidavit from buyer.

Obligations Under the Act

The person performing techniques should be a:

- *Gynaecologist* with a qualification of MBBS + MD/ DGO + 20 procedures (GC) or MBBS + MD/DGO + 4 weeks training/6 months experience (GCC).
- *Paediatrician* with qualification of MBBS + MD/DCH + 4 weeks training/6 months experience (GCC).

- *Radiologist* with qualification of MBBS + MD/ DMRD or RMP MBBS + 6 months diploma, registered medical practitioner MBBS + 1 year experience in sonography.
- *Medical geneticist* with a degree/diploma in genetics + prenatal diagnostic techniques/sex selection or MBBS/ MSc Biology + 2 years experience in prenatal diagnostic techniques/sex selection.
- *Lab technician* with a degree of BSc Biology/MLT.

Obligation of displaying

- Registration certificate given by appropriate authority.
- Notice in English and local language to the effect that sex determination/disclosure of sex of foetus is prohibited under law.
- Registration certificate of concerned doctor issued by SMC/MCI.
- Degree/diploma of qualified person.
- List of ultrasonography (USG) machines both portable and stationary.

Records

Records which are mandatory to keep are as follows:

- Copy of the complete record regarding the registration of a place under the Preconception and Prenatal Diagnostic Technique (PCPNDT) Act (Form A).
- Forms D, E, F, G, wherever applicable.
- Copy of PCPNDT Act.
- Copy of the intimation to the AA for any change in employee.
- Place, address or equipment installed.
- Code of conduct of employees.
- Undertaking by doctor that sex determination will not be done and the sex of the foetus will not be communicated by any gestures.
- Monthly record of tests performed, to be submitted to the AA by the fifth of the next month.
- Receipts from AA's office regarding the monthly record submission.
- Register showing names and addresses, date of service to the client.
- Informed consent of pregnant women.
- Printed copy where electronic records are kept. The records are to be kept for 2 years/final disposal or as prescribed.

Violations/Penalties

Minor offences include nonavailability of copy of the PNDT Act in the registered centre, nondisplay of registration certificate in the centre, nondisplay of board in the premises in English and local language that *disclosure of the sex of the foetus is prohibited under law*.

For minor offences, punishment may extend to 3 months imprisonment alone or with fine, which may extend to

Rs 1000 for first offence, additional fine up to Rs 500/day for the period of contravention for subsequent offence. Show cause notice u/s 20(1)(2) for temporary suspension of registration. Under Section 20(3) for advertisement relating to preconception and prenatal determination of sex.

Under section 22(3) of the PNDT Amendment Act, imprisonment which may extend to 3 years and with fine which may extend to Rs 10,000. Case is to be launched in the court u/s 28 of the Act unregistered centres. It includes all such centres where any portable equipment capable of detecting sex before or after conception is used. The owner of such equipment may be having a registered facility somewhere else. Any such equipment has to be sealed and seized by the AA concerned. Such centres can be registered after receiving five times the registration fee as penalty and after taking an undertaking as per the PNDT Rules – Rule 11(2) or case can be launched in the court u/s 28 of the Act. Irregularities in record keeping as per revised form 'F' are a major offence, which is punishable u/s 23(1) of the PNDT Act. Penalty is fine up to Rs 10,000 and imprisonment up to 3 years for first offence and Rs 50,000 with 5 years for subsequent offences. Suspension of license for 5 years for the first offence and permanently thereafter can also be done.

Request for Sex Selection/Determination

Request for sex selection/determination is punishable u/s 23(3) and penalty is fine up to Rs 50,000 and imprisonment up to 3 years for first offence and 100,000 with 5 years for subsequent offence. All offences under the Act are cognisable, nonbailable and noncompoundable (Section 27).

Even a case has been registered by the police, no court shall take cognizance except the complaint has been filed by the AA or by the person/group who had served a legal notice of 15 days to the AA already (Section 28).

Action u/s 20 and filing of criminal complaint u/s 28 can go simultaneously (Section 20).

Case Study 7: Rejection of registration on the grounds of delayed communication

Dr XYZ, a registered medical practitioner (RMP) with Delhi Medical Council (DMC) was a 6-month diploma holder in USG from a private centre [recognised by the Indian Medical Association—Academy of Medical Specialities (IMA-AMS) and the Federation of Obstetric and Gynaecological Societies of India (FOGSI)].

The centre was registered under PNDT for a period of 5 years from 2002 to 2007. A decision on the application for renewal was not communicated to the practitioner within 90 days, following which a backdated rejection letter was received on the grounds that Dr XYZ was not a qualified radiologist.

Issue

Challenge over rejection of renewal on the grounds of delayed communication, and qualification and experience.

Court decision

The rejection of registration of Dr XYZ was declared ultra vires and unsustainable and the AA was told to review the application and give its decision within 4 weeks.

There is an absence of clear rules and guidelines spelling out unambiguously the qualification, training and experience required for operating a diagnostic clinic offering ultrasound tests.

As a result of the weak definition of the term 'sonologist' under the PNDT Act, the mushrooming growth of diagnostic clinics is unable to be effectively regulated.

BIOMEDICAL WASTE (MANAGEMENT AND HANDLING) RULES, 1998

The main objective of the Act is to ensure safe and proper generation, segregation, storage, transportation and disposal of biomedical waste in healthcare facilities. Noncompliance to Biomedical Waste (Management and Handling) Rules (1998) can lead to imprisonment up to 5 years and fine up to 1 lakh or both for first offence and additional fine to the tune of Rs 5000/day and imprisonment up to 7 years, if contravention continues.

Implication of Section 17 for a Healthcare Administrator

Healthcare administrator should maintain documentary evidence of all steps taken by him to impress upon healthcare workers to follow all provisions of rules. If violation occurs, the healthcare worker who did not manage biomedical waste (BMW) properly will be held liable and the healthcare administrator would be saved of vicarious liability.

Authorisation for Handling BMW (Rule 8)

Authorisation for BMW management to be taken by every healthcare facility serving 1000 or more patients per month. The authorisation is initially for 1 year, then for 3 years and to be renewed every 3 years. Fully filled Form I along with the prescribed fees must be submitted to the prescribed authority, i.e. pollution control board/committee.

Salient Features of Rules

These rules apply to all persons who handle BMW in any form. It is duty of every occupier to ensure that BMW is handled in such a manner that it has no adverse effect on human health and environment.

Biomedical waste shall be segregated at source in colour-coded container. No untreated biomedical waste shall be kept stored beyond a period of 24 hours [Rule 6 (5)]. Records related to BMW to be maintained properly so that they can be produced for inspection and verification by the prescribed authority at any time, chemical treatment of waste sharps and disposable items shall be done at source to ensure disinfection. Mutilation of waste sharps such as hypodermic needles and disposable items shall be done at source to prevent their unauthorised recirculation. Items to be incinerated shall not be chemically pretreated, chlorinated plastics shall not be incinerated.

Clause 5 (2) of BMW (M and H) rules (1998) allows the occupier to avail facility of common biomedical waste treatment facility (CWTF) for disposal of waste generated in the premises. Every occupier/operator shall submit an annual report to the prescribed authority by 31st January every year to include information about the categories and quantities of biomedical wastes handled during the preceding year.

Schedules of BMW (M and H) Rules, 1998

Table 54.1 shows six schedules of biomedical waste (management and handling) rules (1998).

Table 54.1 Schedules of BMW (M and H) Rules, 1998.

Schedule I	Prescribes 10 categories of BMW
Schedule II	Prescribes colour coding and type of container for disposal of BMW
Schedule III	Prescribes label for BMW containers/bags
Schedule IV	Prescribes label for transport of BMW containers/bags
Schedule V	Prescribes standards for treatment and disposal of BMW
Schedule VI	Prescribes time limit for installation of BMW treatment facilities

BIOMEDICAL WASTE (MANAGEMENT AND HANDLING) DRAFT RULES, 2011

Salient Features of Draft Rules, 2011

- Every occupier shall take authorisation irrespective of number of patients visiting healthcare facility.
- Categories of BMW reduced from 10 to 8 (liquid waste and incineration ash now not separate category).
- Colour coding of waste collecting bags and treatment options respecified to avoid overlapping and confusion.
- Nonchlorinated plastic bags for all categories of BMW.
- Occupier shall also observe applicable guidelines issued by Central Pollution Control Board (CPCB) from time to time.
- To provide training to all healthcare workers (HCWs).
- To immunize all HCWs.
- To ensure occupational safety of all HCWs by personal protective equipments.

- Recyclable waste (plastics and glass) may be disposed through authorised recyclers after autoclaving or microwaving followed by shredding,
- To conduct annual health check-up for all HCWs.
- To establish a BMW management cell, if there are more than 30 beds in health facility, such cell will meet once in every 6 months, records of the minutes to be sent to prescribed authority with annual report.

Monitoring Committee

Every State and Union Territory shall constitute a monitoring committee to monitor compliance to rules. It shall submit its report to state advisory committee, CPCB and State Pollution Control Board/Committee in every 6 months. Every healthcare facility to have equipments like autoclave or microwave, shredder, etc. and should join CWTF. Healthcare facility with more than 500 beds may install incinerator subject to environmental clearance. Municipal corporation to provide land for CWTF or installation of incinerator.

CONTRACT LABOUR (MANAGEMENT AND ABOLITION) ACT, 1970

Salient Features

Contract labour, a significant and growing form of employment, is prevalent in almost all industries including service sectors. It refers to workers engaged through an intermediary and workers belong to the unorganised sector.

Pros and Cons of Outsourcing

Pros

- Cost reduction with improved productivity.
- Quality improvement.
- Increased managerial control.
- Effective use of staff.
- Capacity on demand.
- Improvement in responsiveness to user demand.
- Less establishment hassles, viz. disciplinary problems etc.

Cons

- Possibility of loss of motivation after sometime.
- Loss of quality.
- Lack of commitment.
- Loss of competitive advantage.
- Loss of accountability.

The main stakeholders under contract labour laws are (i) principal employer/owner or the person who exercises ultimate control supervises and manages the affairs of establishment and (ii) undertakes to produce a given result for the organisation by supply of goods/articles/equipment/manpower or a combination of these.

Contract labourers have little bargaining power, no social security, engaged in hazardous occupations endangering their health and safety, denied minimum wages, little or no job security. The system of contract labour is justified as the nature of work from them is sporadic, there is difficulty in ensuring closer supervision by the employer, the system is cost effective, there is flexibility in manpower deployment and the employer can focus on core job.

Need of the Act

To protect the interests of contract labour, the Contract Labour (Regulation and Abolition) Act (1970) was brought to regulate the employment of contract labour in certain establishments and to provide for its abolition in certain circumstances and for matters connected therewith. The Act came into force on 10 February, 1971.

Applicability of the Act

Any organisation/establishment with 20 or more workmen. It does not apply to establishments where the work performed is of intermittent or seasonal nature. Exception is (i) intermittent nature but more than 120 days of work per annum. (ii) seasonal but more than 60 days per annum. Applies to establishments of the Government as well as to local authorities.

Application for Registration of Establishments

The establishments are required to be registered as principal employers (Section 7). The application in Form I along with demand draft of fees shall be made in triplicate (Rule 17). The certificate of registration granted under Section 7 of Contract Labour (Regulation and Abolition) Act. Any change in the particulars, the principal employer to intimate within 30 days (Rule 18).

Conditions of Contract

Contractor is required to obtain a licence under Section 12 of the Act. Hours of work must be mentioned, fixation of wages and other essential amenities in respect of contract. License is granted to contractor if accompanied with a certificate by the principal employer in Form V, security deposit (refundable), license fees, labour department scrutiny and validity of the license is 12 months from the date it is granted or renewed.

Facilities for Labour Under Contract Labour Act

The Act has laid down certain amenities to be provided by the contractor to the contract labour for establishment of canteens and rest rooms, supply of wholesome drinking water, latrines and urinals, washing and first aid facilities have been made obligatory. In case contractor fails to provide these facilities, the principal employer is to provide

these facilities. All expenses incurred may be recovered by the principal employer from the contractor.

Disbursement of wages must be ensured in the presence of the authorised representative of the principal employer. In case of failure on the part of the contractor to pay wages either in part or in full, the principal employer is liable to pay the same and recover the amount so paid from the contractor (Section 21).

Penal Provisions (Section 23)

Whoever contravenes provisions of this Act is liable for punishment with imprisonment up to 3 months, or fine or both, on continuing contravention, additional fine up to Rs 500 for every day during contravention.

Record Maintenance

Every principal employer must maintain a register of contractors in Form XII. Every contractor must issue an employment card in Form XIV to each worker and shall maintain the following records:

- Muster roll.
- Register of wages.
- Register of deductions.
- Register of overtime.
- Register of fines.
- Register of advances.
- Wage slip.

Notices need to be displayed in English, Hindi and in local language at conspicuous places showing the rates of wages, hours of work, wage period, dates of payment of wages, names and addresses of the inspectors having jurisdiction, date of payment of unpaid wages, returns. Principal employer need to submit annually a return in Form XXV (in duplicate) not later than 15th February.

Case Study 8: 'Equal Work Equal Pay' to contractual employees of Post Graduate Institute (PGI)

Issue

Post Graduate Institute (PGI) has engaged workers through contractors on various jobs as a replacement to regular workmen of PGI. Contractors have not been paying same and similar wages to contract labours. As per rules and regulations, Group D employees are being paid minimum wages at DC rate and Group C employees are being paid Basic + DA as consolidated pay.

Rule 25(2)(v)(a) states that in cases where the workmen employed by the contractor perform the same or similar kind of work as the workmen directly employed by the principal employer of the establishment, the wage

rates, holidays, hours of work and other condition of service of the workmen of the contractor shall be the same as applicable to the workmen directly employed by the principal employer of the establishment on the same or similar kind of work.

PGI's preliminary objection

There is no provision in the Contract Labour (R&A) Act, 1970 and Contract Labour (R&A) Central Rules, 1971 relating to representation of contractual employees by regular employees.

Labour court decision

Deputy Chief Labour Commissioner (Dy CLC) referring to Section 36(1)(c) of the Industrial Dispute Act (1947) allowed the workman be represented in any proceedings by any other workman employed in the industry in which the worker is employed and authorised in such manner as may be prescribed.

The proceedings under Rule 25(2)(V)(a) is akin to the proceedings under the Industrial Disputes Act, i.e. PGI Employees Union has a locus standi.

PGI's defense on "Equal work Equal Pay" to contractual employees was that the HA/SA are outsourced in the institute because government has banned recruitment (Sixth Pay Commission). PGI denied that workers engaged through contractors perform same or identical job.

The dispute raised by the union is *primarily between the workmen and the contractor*. Contractual employees cannot be equated with the regular employees of PGIMER as they are neither selected nor appointed by PGIMER.

Basic requirements of regular employment viz. age, education qualification, medical fitness, rules of discipline are not followed. Hence rule 25(2)(v)(a) is not applicable.

Verdict of Dy. CLC

- Contractual workers shall be entitled to (i) same hours of work in a shift and (ii) weekly rest day.
- Contractor to pay equal wages for equal work.
- Principal employer, i.e. PGIMER to pay equal wages if contractor fails.

PGI filed writ petition in High Court against Dy. CLC order. Appeal admitted but Dy. CLC orders of equal pay not stayed.

To conclude, the hospital administrators should be aware of related legislations and its implications. It is high time that medical service providers should be made aware about various laws pertaining to hospitals, so as to provide satisfactory patient-care services.

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Emerging Health Insurance in India

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Dr Vikrant Kanwar, Dr Sonu Goel and Prof Anil Kumar Gupta

“Health is an expensive gift. It should have some (monetary) value.”

—Vikrant

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- describe the concept of health insurance, its components and various models existing in India.
- elaborate the healthcare financing system in India.
- cite the roles of health and hospital administrators in implementation and monitoring of various health insurance schemes.
- describe the feasibility and uses of universal health insurance for healthcare financing of India.

INTRODUCTION

Health insurance is a financial instrument, coverage by contract where by one party (insurer) agrees to indemnify or guarantee another (insured) against loss or occurrence of specified disease condition.

Basic formula of health insurance: Prepayment + Pooling of funds + Guarantee of services.

Fact Sheet

- India spends 5% of gross domestic product (GDP) in health
- Rs. 1699/person in a year
- Approximately 20% contribution by government
- Approximately 75% contribution from people's pockets
- Nearly 5% contribution by donor agencies
- 70% people take treatment from private healthcare facility
- 30% take treatment from public hospitals

What a paradox!

First health insurance in history was developed in seventeenth century by Germany with a solidarity-based relief fund of the medieval guilds. Workers contributed every week to sickness fund that was used in meeting medical or funeral expenses. Bismark passed first insurance law in 1883, bringing all voluntary funds into a 'social health insurance scheme'. Presently, this form of health financing covers 90% of German population. Belgium, France and other European countries followed the similar developments.

In India, the first social health insurance system came into existence with the inception of the Employee's State Insurance (ESI) Act in 1948, followed by Central Government Health Scheme (CGHS) in 1954 in Delhi. The General Insurance Company (GIC) came into existence in 1973, which subsequently launched its MEDICLAIM policy in 1986–1987. The private health insurance philosophy is hardly a decade-and-half old and came into existence with liberalisation in economy in early 1990s, but did not make great strides as only 14 insurance companies till date came forward to provide health insurance services.

Case Study: Differential access to healthcare

- Mr Om Ram lives in a remote village of district Chamba, works as labourer and earns a meagre amount of Rs. 3000 monthly; his elder brother, Mr Jai Ram, works in a private pharmaceutical company in a nearby town and earns Rs. 9800 monthly and his younger brother, Mr Jagdish Ram, lives in a metropolitan city, is an Indian Institute of Management (IIM) graduate and works with an MNC and earns a monthly salary of Rs. 1 lakh. If any of the three falls sick, what will be their respective approach in existing healthcare scenario? The possible answers are:

- Mr Om Ram has following options available:
 - He may go to a public health facility in the hope that he will get a free treatment where he can be duped and might have to pay from his pocket to purchase medicine or for the investigations prescribed by the doctor and will be indebted.
 - He might consult a quack, where he will be further harassed economically as well as physically.
 - He might opt not to seek care because of poverty and jeopardize his health. He feels disheartened and broken.
- If Mr Jai Ram falls sick, he might go to a hospital where his company has a contract to provide healthcare to the employees. If he needs further care from a tertiary-care hospital, his company might refuse to bear further expenses for his treatment. He might be left with only one option of spending his entire savings for treatment or get into debt by borrowing money (from relative or bank). He feels depressed.
- If Mr Jagdish Ram falls sick, his company might provide him the best-available treatment in a corporate hospital. However, after recovery, he will come to know that the corporate hospital overcharged and company might deduct these expenses from his pay package, he feels cheated.

This situation represents every family in India. There are different approaches for treatment in the same country where the healthcare system claimed 'Health for all by 2000'. However, this is mere bookish concept of equitable distribution of healthcare, did not become a practice, but was restricted to slogans.

HEALTH INSURANCE FRAMEWORK

The following values are expected to be followed in health insurance sector.

- **Solidarity:** It means that the return to their investment may not match the resources they invest in the system, but awareness of unity and willingness to bear consequences is there, which is a fundamental basis of any health insurance.
- **Equity:** It is 'sameness' in contribution; it is further divided into two types:
 - **Horizontal equity:** When for a particular income level, equal contributions are made by the members to meet the unequal needs of the members.
 - **Vertical equity:** When across income levels, unequal contributions are made by the members to meet the needs of the members.
- **Risk pooling/sharing:** It is related to solidarity, as people are willing to contribute for the sake of others. It implies that there is sharing of risks/pooling of resources between

high-risk and low-risk populations, i.e. sharing of risks between poor and rich, as well as between diseased and nondiseased.

- **Participation/Empowerment:** As health insurance is contributory in nature, the members have more freedom to express their concerns related to health services, thus, feeling empowered by participating in decision making. A component of collective bargaining exists in health insurance.

Components of Health Insurance

- **Community:** Every health insurance scheme requires people to contribute towards the risk sharing. It can be in the form of groups, e.g. employees of public sector organisations, employees in the formal sector and villagers of a village, or may be random individuals contributing in private insurance.
- **Organisers:** The organiser is the institution that manages the health insurance scheme. Main role of the organiser is to coordinate between various stakeholders and take responsibility for the operations.
- **Providers:** They are the facilitators, whether private or public, who provide healthcare services to the insured people.
- **Insurer:** It is an entity that manages the fund and takes the risk. Many a times insurer and the organiser are the same organisation, e.g. in Employees' State Insurance Corporation of India (ESIC). The insurer develops a product and manages the risk so that insured gets the benefit. In India, insurer has to be registered with the Indian Insurance Regulatory and Development Authority (IRDA) before jumping into business.
- **Premium:** Premium is the amount contributed by the insured. It may be collected annually or monthly (as in payroll deductions). The premium is determined by the size of the benefit package. It can be calculated as follows:
 - **Risk-rated premium:** Here, the insurer calculates the premium by the risk covered. Therefore, a person with a chronic illness and a high probability of falling sick will have a higher premium compared to a young and healthy adult who has a low probability of falling sick. This means that different individuals pay different amounts for the same level of insurance coverage. Thus, the elderly or those with poor health generally pay more. There are equity issues in risk-rated premiums, as those who need healthcare more (and probably cannot afford it) are asked to pay more. Private insurers usually use this type of premium for insuring individuals.
 - **Community-rated premium:** Here the insurer pools the risks of both high-risk and low-risk group of people and charges a premium that reflects the average risk of illness. This is more equitable than the risk-rated premium as everybody shares the cost of illness, equally. This is usually used in community health insurance schemes.

- Income-rated premiums: This is usually prevalent in social health insurance programmes. Here, the premium is calculated according to the income levels. Thus, those who have higher income will pay a higher premium and vice versa. The total premium collected is expected to cover the cost of the insurance programme. This is the most equitable type of premium among the three categories.
- *Benefit package*: It is the return for the contribution. Usually, a benefit package contains events that are of low probability but high cost, e.g. hospitalisation. However, there are many schemes that provide for just the opposite, events that are of high probability and low cost, e.g. outpatient visits. A mixture of both is also possible. Please note that, as the benefit package increases, the premium also rises proportionately.
- *Co-payment*: A type of cost sharing arrangement whereby insured or covered persons pay a specific, flat amount per unit of service or time and the insurer pays the rest. The co-payment is incurred at the time that the service is rendered. Unlike co-insurance, which involves payment of some percentage of the total cost, the co-payment paid does not vary according to the cost of a service. For example, the insured beneficiary pays the first Rs 100; the rest of the bill is reimbursed by the insurer.
- *Cost sharing*: Sharing the costs of providing a particular type of healthcare between the patient and agencies such as the provider of care and the employer of the patient. The main aim of this is to reduce frivolous/small claims.
- *Payment*: There are basically two ways of settling insurance claims:
 - The organiser pays directly to the provider through third party administrators. This form of reimbursement has the least burden for the patient.
 - Many private health insurance schemes have an indemnity mechanism where the patient pays the bills upfront and is reimbursed by the insurer after submitting the bills and documents. The reimbursement to the provider can be either a fee for service or a case-based payment or a capitation payment.
- *Administration*: The insurer usually has to perform many administrative functions apart from the onerous task of managing the funds. These include:
 - Creating and maintaining insurance awareness among the insured
 - Fixing premiums and benefit packages
 - Processing claims
 - Negotiating with providers
 - Redressing grievances
 - Providing feedback to the insured
- *Insurance Regulatory and Development Authority*: It was established by the Indian Parliament under the IRDA Act, 1999. Mission of the authority is to protect the interest of the policy holders, to regulate, promote and ensure orderly growth of the insurance industry. It has the following major responsibilities:
 - Protection of policy holders in matters concerning assigning of policy, nomination of policy holders, settlement of claims, surrender value, terms and conditions of the contract.
 - Calls for information regarding enquiries conducted, audits of the insurer and the intermediaries.
 - Specifies code of conduct for surveyors and loss assessors (in general insurance), promotes and regulates the conduct of insurance business.
- *Third Party Administrator (TPA)*: Third Party Administrators (TPA) is a firm that performs administrative functions like providing quality medical care, claim processing, membership to the providers and collection of premium for the insurance company. It can also be called administrative service contract.

The concept of TPA was rooted from USA where it is a major tool of cost containment to the insurer and provides quality services to the insured. In India, the IRDA has given permission to insurance companies to employ TPA to administer the policies. In March 2009, there were 27 registered TPAs.
- *IRDA guidelines (2001) for TPA working in India*: Following are certain guidelines laid by IRDA for the optimum functioning of TPAs:
 - A TPA should have a working capital of one crore.
 - TPA has to procure a license from IRDA, which has to be renewed in every 3 years.
 - A TPA has to undergo a training of minimum 100 h in the field of health insurance.
 - As a TPA, they are barred from becoming directors of insurance company, insurance agents.
 - TPAs are allowed to enter into pacts with more than one insurer for providing (rendering) health insurance services.
 - The TPA would also have to maintain all the transactions on the behalf of insurer and report to the IRDA.
- *Risk management*: Health insurance has many risks to manage, e.g. moral hazard, adverse selection, fraud and cost escalation. An effective programme will introduce measures to minimise these risks.
- *Monitoring and evaluation*: Health insurance programmes need to be closely monitored. There are many indicators that are specific to health insurance, e.g. claims ratio, liquidity ratio, etc.

EXISTING HEALTH INSURANCE SCHEMES IN INDIA

Most health insurance schemes can be classified into three broad categories—social health insurance, private health insurance and community (or micro) health insurance. In India, we have a fourth category called government-initiated health insurance schemes that do not fit into any of the above three categories. Each has its own specific features. However,

there are some features that overlap among various types of health insurance.

Types of Health Insurance

The four types of health insurance are:

- Community-based health insurance (CBHI)
- Private-/voluntary-based health insurance (PBHI)
- Social-based health insurance (SBHI)
- Government-based health insurance (GBHI)

Community-based Health Insurance (CBHI)

This model comes under the concept of 'Microinsurance', which may be defined as the protection of low-income people against specific perils in exchange for regular premium payment proportionate to the likelihood and cost of the risks involved. Community-based health insurance (CBHI) is defined as 'any not-for-profit insurance scheme that is aimed primarily at the informal sector (e.g. farmers, labourer, street vendors) and is formed on the basis of a collective pooling of health risks. The community has a role in the management of the programme. This definition includes mutual health organisations (MHOs), local health insurances and microhealth insurances (MHI).

Currently, there are about 100+ CHBIs in the country, many of which have begun operations in the past 2–4 years. International Labour Organisation (ILO) estimates that more than 1 crore individuals are members of CBHI schemes in India.

CBHI schemes have three models in India.

Three models of health insurance

- *Type I or provider model:* It is the model where the hospital is both the provider of care as well as the insurer for the scheme. The classical example is the Medical Aid Programme by the voluntary health services (VHS), Chennai. Here the VHS has organised the programme and its field workers collect an annual income-rated premium ranging from Rs. 75 to 400. The insured are given a card, which they can use in the VHS hospital only. When they fall sick, they go to the VHS hospital and get both outpatient and inpatient care. They have to pay a nominal amount; the rest is reimbursed from the insurance fund.
- *Type II or the mutual model:* The nongovernmental organisation (NGO) acts as the insurer and manages the risk. A good example of this is the RAHA medical insurance scheme. Here an NGO called RAHA operating in three districts of Chhattisgarh collects an annual premium of Rs. 20/person from the rural communities in these districts. The insured is given a card with which he/she can receive outpatient and inpatient care at selected rural health centres and three referral hospitals. If the bill

crosses Rs. 2500, then the patient has to pay the extra amount. Refugee affected and hosting areas programme (RAHA) reimburses the health centres and the hospitals on a monthly basis.

- *Type III or partner-agent model:* The NGO is mainly the facilitator. Self-Employed Women's Association of India (SEWA) collects a premium of Rs. 250/family/year from members of the SEWA union. This is handed over to an insurance company that covers the insured against the following risks—illness requiring hospitalisation, loss of assets and loss of life. The claims are processed by community representatives and the insurance company reimburses the patient.

In order to include CBHI within the regulatory framework, the IRDA has passed the microinsurance regulations 2005. It recognises the role of the NGO in reaching out to the informal sectors and providing microinsurance (health, life, assets, etc.) to those who are not reached by the formal insurance companies. It requests the NGOs to link up with the insurance companies and act as their agent. The NGOs' role is then to create awareness about insurance and enrol those interested with the insurance company.

This scheme has the following advantages:

- Affordable and acceptable.
- Community involvement and participation.
- Social control.
- Less chances of fraud.

It also has certain drawbacks as mentioned below:

- Many a times, NGOs do not have technical skills, leading to ineffectiveness.
- Design flaws.
- Small pool, chances of bankruptcy.

Private-/Voluntary-based Health Insurance (PBHI)

Private health insurance is different from social health insurance in that it is voluntary and for profit. The insurer is usually a for-profit insurance company that collects the premium from the individuals who can afford to pay. It then invests this to supplement the insurance fund. It may or may not empanel hospitals to provide healthcare for the insured. It may either reimburse the hospital directly or may reimburse the insured when she/he produces all the bills and documents after treatment. Private health insurance can be a stand-alone primary health insurance product that provides health security for the individual or a family or a group or can also be used as a supplementary health insurance for those with social health insurance or some other form of health cover. In this latter form, it covers medical care that is not covered by the original scheme. In India, private health insurance is relatively a new phenomenon.

In 2000, the insurance market was liberalised and foreign players were allowed to enter the market in partnership with Indian companies. Since then, 14 new insurance companies

have sprung up; some of them like Star Health and DKV Apollo are dedicated health insurance companies.

Why PBHI is not so popular? There are several reasons:

- Covers only wealthier population.
- Voluntary in nature.
- Premiums are risk rated, i.e. those who have the risk have to pay more.
- Lot of problems while getting reimbursement.
- Current products are nonflexible and customer friendly.

Social-based Health Insurance (SBHI)

Social health insurance schemes are statutory programmes financed mainly through wage-based contributions and are related to level of income. SBHI schemes are mandatory for defined categories of workers and their employers. It is based on a combination of insurance and solidarity. SBHI has been implemented mainly for the civil servants and the formal sector. This can lead to gross inequities. For instance, in India, 18% of the central government budget is used to finance an SBHI for the civil servants who constitute only 0.4% of the population. In India, there are three well-known SBHI schemes—the Employees' State insurance Scheme (ESIS), the Central Government Health Scheme (CGHS) and the Ex-servicemen's Contributory Health Scheme [(ECHS) Table 55.1].

Salient features of SBHI schemes

Limitations of SBHI schemes are:

- Cover only formal sector, which is only 10% of the population.
- Schemes are not managed properly, which leads to corruption and fraud.
- Quality of care provided by the facilities is not standardised.

Government-based Health Insurance (GBHI)

In India, in addition to three classical types of health insurance, there is a fourth type called the government-based health insurance scheme (GBHI). The main characteristics of these are that they are launched by the government for a specific constituency, usually the poor, the premiums are heavily subsidised and the benefits are varied. While the insurer is invariably a private insurance company, the organiser varies from nobody to independent bodies. Some of the classic examples of GBHI schemes are the Universal Health Insurance Scheme (UHS), the Rashtriya Swasthya Bima Yojana (RSBY), the Yeshasvini Farmers Cooperative Health Scheme, the Aarogyashree Community Health Insurance Scheme, etc. Let's discuss these schemes in detail.

The Rashtriya Swasthya Bima Yojana (RSBY)

The Ministry of Labour, Government of India launched the RSBY in October 2007. Aimed to cover the informal sector, all BPL families (as per Government of India guidelines) were eligible to enrol in this scheme. On payment of Rs 30 per family of five, the insured would receive a smart card with family details on a microchip. They could avail hospitalisation benefits at empanelled hospitals (private and public) up to a maximum of Rs. 30,000/family/year. There were minimal exclusions. The smart card helped in making the scheme cashless and the hospitals were reimbursed directly by the insurance companies. Insurance companies bid for this scheme in each state and agreed to competitive premiums ranging from Rs 500–700/family/year. While the Government of India paid 75% of the premium to the selected insurance company, the state government paid up the balance 25%. The entire scheme was administered by the insurance company but was monitored by a state nodal agency comprising representatives from the departments of

Table 55.1 Comparison of various SBHI schemes

Component of health insurance	ESIS (1948)	CGHS (1954)	ECHS (2003)
Community	Employees in factories earning <10000/month	Central government employees, pensioners, MPs, etc.	Ex-servicemen from army and their families
Organiser	ESI corporation	Ministry of Health	Ministry of Defence
Insurer	ESI corporation	Department of Health and Family Welfare	DGAFMS
Provider	ESI network of hospitals and empanelled hospitals	Various public sector hospitals of central government and empanelled private hospitals	Various ECHS clinics, military hospitals and empanelled private hospitals
Premium	Joint contribution by employee (1.75%), employer (4.75%) and by state government	Ranges from Rs. 5–150/month	One time contribution of uncommuted basic pension + dearness pension by all ex-servicemen
Benefit package	Healthcare, maternity, disability benefits, life insurance, funeral expenses	Healthcare benefits	Healthcare benefits
Payment	Cashless system	Reimbursement system	Cashless + reimbursement system
Enrolled	More than 1 crore families	43 Lakh	34 Lakh

labour, health, finance, rural development and also the insurance company. Only 16 of the 28 states have taken up the programme so far. Some states like Gujarat, UP and Haryana have taken up many districts, while in others, the scheme has been introduced only in a couple of districts. Of the 120 lakh below poverty line (BPL) families targeted for the first year, 37% have been enrolled. The main reason for this underperformance is the problems that the scheme faced with technology. There were problems with sourcing adequate smart card printers and readers, fitting the BPL lists with the smart card software and synchronising the entire operations across many software programmes. This along with the discrepancies between the state and central BPL lists were the main cause for delay in enrolment. Hopefully this will catch up in the subsequent years.

Other schemes operational under GBHI are:

- Rajiv Aarogyashree Community Health Insurance Scheme (RAS).
- Yeshasvini farmer's cooperative health fund.

ADVANTAGES OF HEALTH INSURANCE

Today, many countries are shifting over to health insurance as a mechanism of financing their healthcare programme. In India, we need to shift from the current predominance of out-of-pocket payments to a health insurance programme. The reasons are very clear:

- Direct out-of-pocket payments are a financial barrier to accessing health services. On the other hand, an insured patient can walk into a health facility without the fear of financial burden.
- Direct out-of-pocket payments can push families into indebtedness or poverty. Health insurance protects the patient from the burden of raising funds at the time of illness.
- Direct out-of-pocket payments are inequitable as they place the burden on the vulnerable. Insurance through its risk-pooling mechanism is more equitable.
- Direct out-of-pocket payments do not permit patient's participation in his/her treatment. On the other hand, by its collective nature, a health insurance programme can negotiate for better quality care.

COMMON PROBLEMS OF HEALTH INSURANCE SCHEMES

- *Adverse selection:* Adverse selection occurs when those who anticipate needing healthcare choose to buy insurance more often than others. This will mean that an insurance scheme with adverse selection will be full of people with high risk of illness. This, in turn, results in a financial drain on the scheme and may challenge the viability of the scheme. The opposite of adverse selection is 'risk selection' or cream skimming. This happens when insurers (usually private) only select people with low risks

and avoid enrolling people with high risks. While this will be a profitable venture for the insurer, it is a burden on society.

- *Moral hazard:* Moral hazard refers to the way in which insurance changes people's perspectives. It is defined as 'the tendency of individuals, once insured, to behave in such a way as to increase the likelihood or size of the risk against which they have insured'. For example, knowing that if a person is insured, he may indulge in more risky behaviour (e.g. smoking, fatty diet) or may use more health services. This is called consumer moral hazard or demand-side moral hazard. On the other hand, knowing that a third party is paying the medical bills, providers may alter their treatment patterns for insured patients. This is called *supplier moral hazard*.
- *Administrative costs:* There are substantial administrative costs associated with marketing, processing claims and countering frauds. These are known as loading costs. If these costs are high, insurance coverage can become expensive. This can be reduced through economies of scale, e.g. if the health insurance policy covers a large number of people, then the administrative cost is distributed among them and so there is a lower cost per capita.
- *Fraud:* Fraud is a big problem with health insurance, especially in India where the provider is totally unregulated. There are two types of fraud. The first is that committed by the insured. This may be in the form of producing false or inflated bills and claiming for treatment that never occurred or cost much less. However, the most important fraud is usually committed by the hospitals. They may do unnecessary investigations or provide irrelevant treatment or inflate the bill in case of an insured patient.

ROLE OF HEALTH AND HOSPITAL ADMINISTRATORS IN HEALTH INSURANCE

Administrators in hospitals and healthcare have the following responsibilities when dealing with health insurance:

- Hospital administrators can play a key role in effective implementation of health insurance schemes.
- Being head of the hospital, the administrator must ensure that all of their employees are covered under ESIC (which is binding under the contract labour laws) or other social health scheme.
- The hospital administrator must keep a vigil over all the insurance schemes or related public welfare schemes operating in the hospital and check fraud or corruption.
- The health/hospital administrators can collect, maintain and provide the vital data pertaining to beneficiaries under government health insurance schemes suggesting further improvements in the existing scheme.
- The hospital administrators ensure compliance with the IRDA guidelines during contracting with any private health insurance company or any TPA (verify licence).

They can ensure transparency in claim processing and reimbursements.

- The health/hospital administrators can create awareness among people through public relation department or NGOs working in the hospital.

WHY HEALTH INSURANCE IN FUTURE?

It is astonishing that only 19.6 crore (16%) of 121 crore Indians are covered by any form of health security (Table 55.2). Health services anywhere in the world have to be financed by somebody. There are 'no free lunches'. What varies is the amount of money that is spent on healthcare.

Table 55.2 Health security by insurance in India

Health insurance scheme	Approximate coverage (in Crores)
ESIC	3.5
CGHS	0.4
Railways	0.8
Defence	0.7
Private health insurance	2.5
Community health insurance	1.1
Government health insurance	10.6
Total	19.6

There are predominantly four sources of healthcare financing (Figure 55.1). In India, we have a mixed form of healthcare financing system. The government is supposed to provide 'free' healthcare for all the citizens by raising funds from taxes. Unfortunately, because of the small tax base, the government's revenue is low, resulting in a small proportion being allocated for healthcare. Because of this chronic underfunding, most government facilities are not able to provide healthcare to all its citizens. So, many patients go to the private sector institutions and pay for their healthcare. Health insurance, till date, plays a very small part in financing health services.

The proportions vary from country to country. In high-income countries like UK and Australia, the main mechanism is tax-based mechanism. On the other hand, some high-income countries like Germany and USA are dependent on insurance-based financing mechanism. Most citizens from low-income countries pay their health providers directly through out-of-pocket payments. This is one of the highest in India.

Indian households pay a large amount of money from their pockets (Figure 55.2) towards healthcare.¹ Most of this is used for curative care, especially at the primary and secondary level. This out-of-pocket expenditure is one of the highest in the world and has obvious consequences:

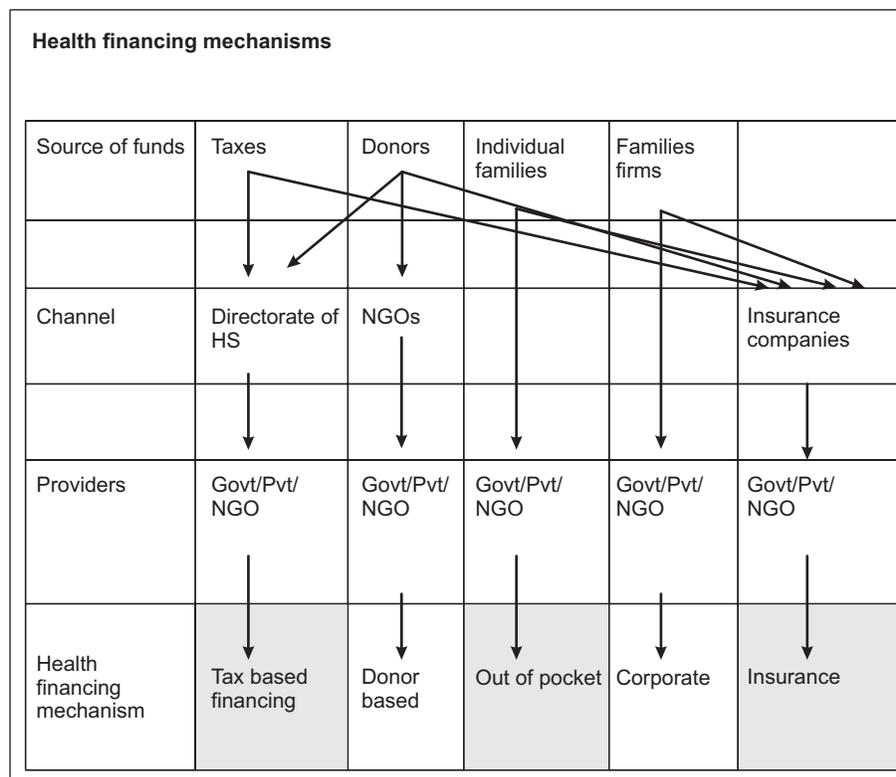


Figure 55.1 Healthcare financing mechanisms in India.

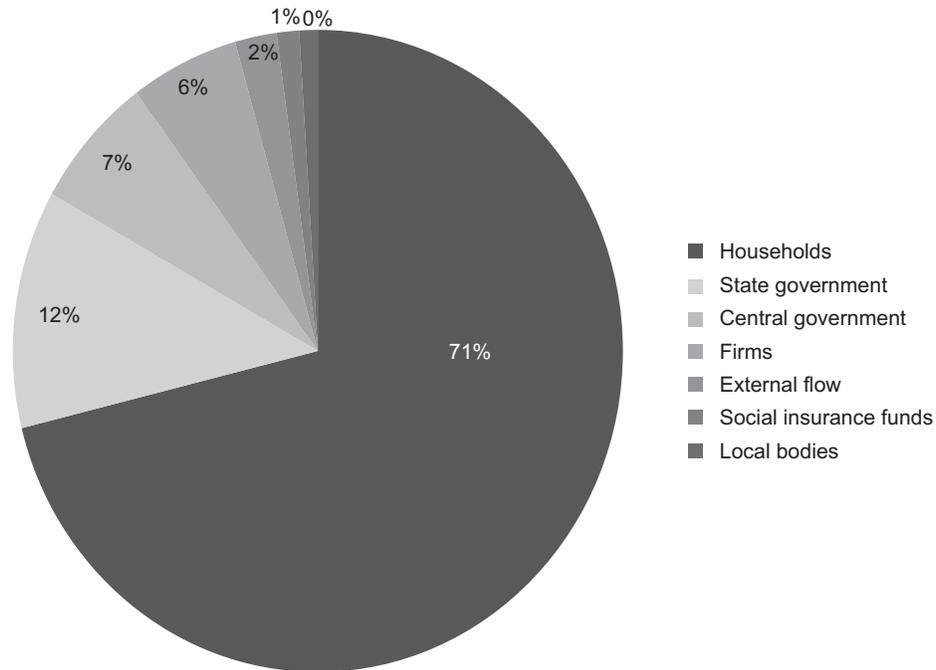


Figure 55.2 Sources of health financing in India.

- According to the NSSO report of 2007, more than 5% of the patients did not utilise health services because they did not have money (**Om Ram case**).
- Seventeen to thirty four per cent of Indian patients are impoverished because of hospitalisation expenses (**Jai Ram case**).
- Out-of-pocket payment at the time of illness is inequitable. The most vulnerable (even economically sound) also bear the economic burden of illness (**Jagdish case**).

To protect these families (Om, Jai, Jagdish), one can increase the budget allocation for healthcare (which is always scarce). The other possibility is integrating health financing mechanism (with innovative health insurance schemes) with healthcare delivery system of the country.

WHAT CAN BE A FUTURISTIC MODEL OF HEALTH INSURANCE TO FINANCE HEALTHCARE?

It is important to realise here that there are many countries that use health insurance as a main mechanism of financing healthcare. Some of the Western European nations (Germany, Belgium and France) are good examples. Other than this, Canada, Thailand, Taiwan, the Philippines, Latin American countries, China also find health insurance as an effective mechanism to protect their citizens from medical expenses. Forty per cent of all health expenditure in the world was through a health insurance mechanism, be it social health insurance (24%) or private health insurance (16%). Financing through taxes contributed to only 31% of this expenditure, while, out-of-pocket payments were 24%. One can see that

the predominant mechanism of financing healthcare in the world is the insurance mechanism.

Table 55.3 Proposed universal health coverage model

	High income	Middle income	Low income	Poor (BPL)
Organised sector	Mandatory SBHI + Optional PBHI			GBHI
Self-employed	Mandatory SBHI + Optional PBHI		CBHI	GBHI
Unorganised sector	PBHI	PBHI	CBHI	GBHI
Unemployed			CBHI	GBHI

In India, one can propose a universal health coverage model for health financing by taking into consideration the economic (income) and employment status of the different strata of the population. Also, one can integrate the healthcare delivery system to this insurance model (Table 55.3). This re-engineering of the system can only be possible by the strong political will and administrative commitment from healthcare administrators.

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Sectoral Coordination in Hospital Management

56

Dr Sutapa Bandyopadhyay Neogi, Ms Projna Sadhukhan and Mr Sourav Neogi

“Unity is strength. When there is teamwork and collaboration, wonderful things can be achieved.”
—Mattie Stepanek

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- differentiate intersectoral from intrasectoral coordination.
- enumerate few sectors that are intrinsically related to hospitals.
- discuss ways to improve referral system within the existing health system.

BACKGROUND

Health and development are related intrinsically. The interlinkages between the two got impetus in the Alma Ata conference. It brought out very clearly that ‘Health for All’ cannot be achieved without intersectoral coordination. This understanding brought new ideas in the development field to integrate the services and bring holistic change in the society. There are various sectors that directly or indirectly affect health and development, viz. agriculture, education, environment, livelihood, etc.

The technological advances made in past few decades along with economic liberalisation have brought about sea changes in the functioning of hospitals and have created unprecedented demand on hospital services. Simultaneously, there is an ever-increasing emphasis on quality of services. This trend is further encouraged by changes in the legal aspects of hospital care, e.g. Consumer Protection Act, RTI Act, etc. However, delivery of any hospital service is contingent upon concerted efforts of hospital personnel of different departments. Establishing and maintaining a good coordination in such a team aids smooth delivery of services. This chapter gives an overview of the importance of coordination in hospital management. It also touches upon few practical and pertinent aspects of intra- and intersectoral coordination of hospital with other departments.

SECTORAL COORDINATION—IMPORTANCE FOR HOSPITAL ADMINISTRATORS

With regards to health, coordination can be broadly categorised into inter- and intrasectoral. As the name suggests, intersectoral coordination means coordination with nonhealth organisations, sectors and agencies to achieve certain goals. On the other hand, intrasectoral coordination ensures coordination between its various subsystems and units or agents within the hospital.

The following figure gives a schematic view of the various components of inter- and intrasectoral coordination (Figure 56.1).

Intersectoral Coordination

Hospitals essentially provide curative services. Its functioning requires significant cross-departmental and cross-role coordination at all times. To add to the efficiency of hospital-based services, there should always be an effort to achieve coordination among all the sectors/departments contributing directly or indirectly to the hospital functioning.¹ The hospital administrator and the team thus need to recognise who the key stakeholders outside the hospital are and thereby need to maintain dedicated relationship for integrity of services. The coordination begins from the very first day of laying the foundation stone or even before that. For a

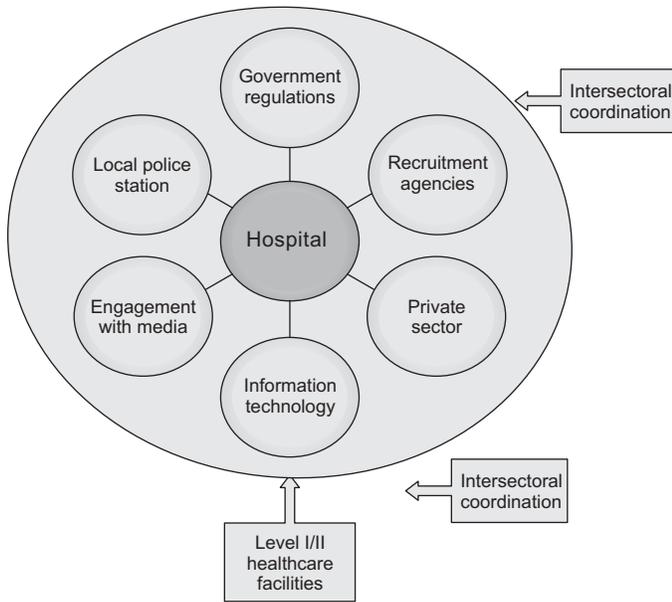


Figure 56.1 Schematic diagram to depict intra- and intersectoral coordination.

government hospital and a privately owned hospital, the category of agencies required to get involved varies to some extent. The kind of service mix that a hospital provides is another deciding factor for sectoral coordination. For example, if the hospital is having an inhouse diagnostic and imaging service, then coordination with atomic energy regulatory body (AERB) is essential.² However, there are few

instances where a hospital needs to have mandatory coordination. For instance, government regulations form one of the important aspects where maintaining regular coordination is highly demanded. The section highlights the various agencies whose involvement at various stages would be required. Following are the key sectors with which a hospital needs to be in good accord for its day-to-day functioning:

- Government (rules and regulations)
- Recruitment agencies
- Media
- Information technology
- Local police station

Government regulations

Cases like these often are related to protocols and rules, which are further decided by government regulations. To ensure that hospitals follow all the required norms, the administrator needs to coordinate with other sectors/civic authorities. And this starts right from the stage of commissioning—in the form of getting clearances. Even later, there is a protocol of submitting periodic reports with which an administrator should be familiar.

The following chart gives a brief description of some of the rules and regulations,³ which an administrator needs to maintain from time to time (Table 56.1).

In a recently reported news item, 195 out of 225 private hospitals and nursing homes in Bhopal were covered by Madhya Pradesh Pollution Control Board (MPPCB) for biomedical waste management.⁸ There was no clue as to

Table 56.1 Examples of laws and acts deemed essential for functioning of any hospital

List of licenses	Mandatory/ optional	Agencies	Involvement from phase	Process involved for acquiring (Brief)	Periodicity of renewal
Building permit	Mandatory (this is called consent to establish)	State municipality	Upon submission of structural drawings (before commencement of construction)	The drawings to be submitted for approval	Yearly
No-objection certificate from the chief fire officer ⁴	Mandatory	Chief fire officer of the state ⁵	Upon submission of structural drawings (before commencement of construction)	The drawings to be submitted for approval	Yearly
License under biomedical management and handling rules ⁶	Mandatory	Pollution Control Board	After construction, before commissioning of the facility	The documents showing compliance to the rule have to be submitted to the PCB	Yearly
No-objection certificate under Pollution Control Act	Mandatory (this is called consent to operate)	Pollution Control Board	After construction, before commissioning of the facility	The documents showing compliance to the rule have to be submitted to the PCB	Yearly
Radiation protection certificate in respect of all X-ray and CT scanners	Mandatory if it is a radiation facility	AERB ⁷	Before commissioning of machines	Drawings and documents have to be submitted to AERB	Yearly
Permit/License to operate lift under the Lift and Escalators Act	Mandatory if lift is installed		Before and after installation of lift	Physical inspection from authorities along with submission of documents	Yearly
Narcotics and Psychotropic Substances Act (related license)	Mandatory if narcotics used	Drug and Cosmetics Act (excise)	Before commencement of the narcotic pharmacy	Drawings and documents have to be submitted to excise	Yearly

how the remaining 30 nursing homes were handling their waste. The MPPCB board had given a contract to a private firm to report if any nursing home did not abide by the norms. However, no such report was obtained in the previous year.

This is just an incident to exemplify how lack of coordination between sectors and lapses on the part of regulation can affect the functioning of hospitals. In yet another incident in Kolkata, fire in a reputed private hospital resulted in many deaths few years back. The cause of the fire could not be established, but investigations indicated that fire safety norms were violated. Fire brigade officials involved in relief and rescue operations opined that the basement of the hospitals earmarked for parking was utilised for storing medical equipment. The incident happened because of the highly inflammable substances kept there, which caught fire probably because of some short circuit.

Case Study 1: Importance of relevant certification

A 150-bedded hospital was functioning with its inhouse pantry service. The department was located in the basement of the three-storied building. One day, sudden smoke was detected from the pantry, which was located adjacent to the elevator. With this, there occurred severe panic among the staff and everyone rushed towards the exit. Unfortunately, as per the exit signage provided, when people reached there, it was found that the door was locked and all the condemned items were piled up, which eventually blocked the passage. This led to more confusion and many got stuck as the fumes became intense. Later the fume was controlled by the fire department. Fortunately, the incident did not lead to any serious injury or casualty. But during the post-incident meeting with the fire station, it was reported that the hospital was functioning without any 'no-objection certificate' from fire department. The hospital authorities were given a notice period to clear the no objection, which is mandatory for its operation. Similar to this, the hospital needs no-objection certificates from various agencies like Pollution Control Board, Estate Department, etc. Here lies the role of inter-sectoral coordination.

Recruitment agencies

Placing the right person on the right job is indeed a task, which requires good understanding of the nature, purpose of the task. For a setting like hospital, every service, be it outpatient or inpatient services and administrative responsibilities, require a complex mix of human resources to deliver the services round-the-clock.

Thus to ensure efficiency, planning for human resources is very critical.⁹ Detailing out the job roles and responsibilities

at the very beginning, which could be even before commissioning the hospital, is a crucial activity. A good planning helps to understand the entire spectrum of 'how', 'when', 'what' and 'why'—the pillars for human resources. Accordingly, with these details, a planner seeks to search for appropriate personnel from various agencies. However, the scenario varies in a government and private setup. In a government setup, even though the entire process is centralised, hiring external agencies is needed on certain occasions. It is then that the role of hospital comes into play to provide the details on the category of staff, their job profile and job description. For a privately run hospital, the process is different, as they are always in direct contact with various recruitment agencies. The agencies can be located based on internet search or institutional records or even by word-of-mouth. Selecting a suitable recruiting agency and its verification is also an important task for the planners. A comparable list of recruiting agencies should therefore be kept with the hospital for reference.

Case Study 2: Importance of good recruitment agencies

In a 20-bedded neonatal care unit, the displayer of the radiant warmer was found to be nonfunctional for almost a month's time. The equipment was tagged nonfunctional for some time, but had to put into use due to case overload in the unit. Thus, with persisting disorder, the temperature regulation could not be appropriately followed. An incident of over warming occurred where 5-day-old newborn had faced severe burn. During investigation, it was reported that the staffing pattern was inadequate as well as inappropriate, as there was no biomedical engineer appointed. On further inquiry, it was gathered that the personnel who was hired neither had the required qualification nor the experience.

Information technology

The hospital management information system (HMIS) has been envisaged as a better monitoring and reference medium for the administrator, doctors and nurses alike. A systematic way of keeping patient records has been the main contributing factor behind strengthening HMIS. It has been used to promote better-care provision to patients by coordinating with major functional areas of the hospitals and its activities.

Advances in information technology have been well-utilised to improve quality of services in hospitals. An example of this is the setting up of telemedicine units in some district level hospitals. The telemedicine department of tertiary-care centres connect with those at the lower levels on a periodic basis.¹⁰ The facilities are utilised to solve their queries specifically related to patient management.

A similar example is the system setup Narayana Hrudalaya Group. In association with the Indian Space Research Organisation, it manages the world's largest telemedicine programme and has treated over 53,000 heart patients.¹¹ The facility caters to the PAN-African satellite network, which connects 56 African cities. To bring about such a smooth functioning and flow of information, the administrator along with his team should decide upon the model that they need to install, based upon the information flow. The customisation has to be done in close consultation with information management expert and with a team of selected service providers. Maintaining a constant coordination with the agency is highly required not only for module designing but also for upgrading as and when it is required.

Case Study 3: Importance of maintaining case records

The 100-bedded XX hospital was functioning quite successfully by offering its best service. Owing to its delivery standards, the case load was high. However, even though the service delivery was maintaining its standards, the hospital did not have any provision of electronic method for keeping patient records. The details of all the patients were maintained by keeping a hard copy of the patient file in the medical records department. In one of the instances, identification of one patient with another who happened to have similar name led to a disaster. The report of an investigation of the patient got swapped with the other, and the treatment suggested to the patient accordingly. After investigation, it was found to be a gross error that resulted primarily because of negligence, which could have been averted if the information management system in the hospital was strong. Thus, a good IT system is an enabler to inter- and intrasectoral coordination.

Engagement with media

Engagement with media is a powerful tool for communicating with the external world. Channelising the communication through appropriate sources is thus very imperative. In order to reach out to the community, the hospital needs to be in good contact with media. However, advertising with the view of promoting hospital service is not a legalised activity. For a government hospital, since most of the promotions and announcements are taken care of by the Information Education and Communication (IEC) wing, it is important to reach out to the mass for sharing any experience when provision of hospital services to the community has been successfully conducted.

It is important to coordinate with the local media as they are aware of the sociocultural issues. The perspective of the local media helps in fulfilling the objective of the announce-

ment. At the same time, the hospital management team should be cautious enough while handling such agencies to help them deliver the message in much fair and unambiguous way.

Case Study 4: Coordination with agencies always help

It was a nutrition counselling day for all the school children of age 3–7 years arranged by the hospital on 14th of November. The nearby schools were invited for the programme. For ensuring a successful coverage and participation, the hospital had to tie up with the advertising agency, which prompted and evoked interest of participation by the majority. The success story was well-covered in one of the daily magazines and it encouraged other health-care organisations to conduct similar activities.

Local police station

In healthcare delivery, a doctor performs necessary functions with optimum skill and care. Besides, paramedical assistance and nursing care become important in rendering clinical services. Failure to deliver these services owing to advertant or inadvertent errors in care can give rise to medical negligence.

Medicolegal cases are such cases where we need involvement with police.

Following are few cases that can be considered as medicolegal cases¹² and on such occasions the involvement of police is required:

- Cases of trauma/burns, the circumstance of which suggest commission of offence by somebody
- Cases of poisoning
- Cases of all vehicular, factory or unnatural deaths
- Cases of sexual offence/rape
- Cases of suspected or evident of criminal abortion
- Unconscious patient where cause is not clear or natural
- Cases of hanging, strangulation, suffocation, etc.
- Any other case not falling under above categories, but has legal implications

The local police station is notified immediately during any such above-mentioned occasion, when the patient is admitted or discharged. Also, if the medicolegal case expires or absconds, the body is preserved in the mortuary till legal formalities are completed and police releases the body to the lawful heirs. The dead body is never released to the relatives directly by the hospital. It is only handed over by the police. Hence, it is crucial for a hospital to function in close coordination with the police to complete all its proceedings in legal manner.

This section highlighted the role of other nonmedical sectors that equally contribute and support the service

delivery of a hospital. The following section brings about the close interdepartmental/interinstitutional coordination that takes place in the healthcare system.

Interdepartmental Coordination: This refers to coordinating different groups in an organisation and orchestrating their effort to achieve the common goal of good patient care and efficient cooperation. Effective coordination enables to bring about perpetual harmonious dependency among all individuals and the departments to work towards the common goal of the hospital. A hospital is characterised by heterogeneous group of workers, varied specialisation, complex interrelationship, orientation on handling crisis, and readiness to deliver services round-the-clock.¹

Following are the managerial activities for which consistent coordination is the key driver, common for all hospitals:

- *Determination of goals and objectives of each department:* Departmental goals as well as organisational goals jointly enables the hospital to accomplish its objective of service to its patients.
- *Facility and programme planning:* This includes remodeling existing facilities, its expansion, and institutional strengthening.
- *Financial management:* This includes, budgeting for departmental activities, costing, managing finance and maintaining accounts.
- *Personnel management:* This is pertinent for any hospital due to its varied staff mix of qualification, job roles, and purpose and engagement. It deals with planning, selection, staffing, etc. motivation, personal development, salary and wage, attendance administration.

The day-to-day internal functioning of all the hospital departments is coordinated interdepartmentally. Periodical follow-up and update meetings are conducted by the departmental heads to understand the functional status of the respective departments. The activities that the departments should undertake includes programme review and evaluation (the functioning of the clinical services and programmes are reviewed as a continuous process); public and community activities (developmental activities with other health services institutions is maintained and carried out by the hospital); activities specified by government rules (this is concerned with legal problems of the hospitals and dealing with local, state and central government agencies); educational development (promoting all continuous education process for hospital personnel and encouraging participation in professional societies).

Multiple pyramid of hospital organisation

The salient characteristics of hospital are the absence of a single line of authority to the organisation; the authority does not flow along a single line of command as it does in most formal organisations. A dual and at time, multiple pyramid of relationship due to the relationship of medical

component to administrative component is a peculiar characteristic of hospital organisation.

For instance, at times many employees such as the nursing staff are subject to more than one line of authority. They need to follow the administration operating procedures as well the clinical procedures. In case it happens, none in the administration hierarchy gives command to the medical staff or do not have direct control over the clinical staff on various matters. Considering direct patient care, the physicians exercise professional authority and might at times need to frame their own operating procedures, which is not exactly in line with the administrative set protocol.

Coordination in matrix organisation

A good functioning calls for a combination of hierarchical and horizontal coordination—a more suitable coordinating framework. Pertaining to the complexity in the task differences, departments performing routine activities [central sterile and supply department (CSSD), laundry, kitchen and so on] have more task-oriented workers and more formalised structures than those having different levels of task complexity [wards, intensive care unit (ICU), laboratory] which are informally structured and more interpersonally oriented.

The matrix organisation involves horizontal organisations across departments and vertical coordination that is hierarchical. For instance, in a cardiac operation the medical team, administrative team and technical come together to play their roles. It starts with the booking of the operation theatre (OT), looking out for suitable slots of it in a planned manner in close coordination with the nursing team. The CSSD comes into play for the supply. The role of clinical team then comes in comprising of surgeons and anaesthetists (both senior and junior level), resident doctors (if available), nurses and technicians. In the matrix, the function of each one becomes important.

Hospitals' role in public health serving the community

A hospital being within its four-walled boundary, mostly render curative care to its patients. To seek the services, the patients themselves need to make all their effort for their accessibility. However, many a times, if accessibility is made an easy process of the care givers through various programmes and reaching the mass, the bulk of the population who are deprived of the medical benefits can be made easy by offering economic solution to their health problems.

The purposes of public health services are to reach out to the patients in their home environments in the community, provide basic outdoor medical facilities such as consultation, basic investigation, diagnosis and treatment of simple nonserious ailments.

Provisioning for the outreach programmes

The ultimate purpose of the health service is to meet effectively the total health need of the community. Outreach

services by hospitals are the visible part of the public health system; hence those services can be considered as a two-way process; they start with the community and end with the community service. To build the continuum of care the services should be adequately equipped with required structure, equipment, manpower and operating guidelines.

Some of the basic amenities that should be ensured are the following:

- Space for enabling medical health checkup activities, immunisation work, health education, discussions/demonstrations.
- Staffing is another important factor in which the hospital authorities should look into. Well-qualified and, most importantly, appropriately trained for the purpose, dedicated staffs (doctors, nurses, technicians, dieticians, nursing orderlies) should be identified who can actively contribute to outreach services.
- In case of any referral, provisions should be made available. The ambulance service can be provided by government or any agency, but the ultimate accountability comes to the hospital authority for its smooth service.

For instance, if a patient visits the outreach clinic for ante-natal care, and further treatment becomes necessary, it becomes the liability of the hospital authority to arrange for transporting the patient to an appropriate facility. Thus, coordinating the referral support along with the treatment process within the hospital becomes essential to ensure the continuum of care and also confidence of the patient is maintained.

Hence, hospitals can play a significant role in coordinating public health services by reaching out to those who cannot access hospital services and meeting their health needs in the restricted home environment and secondly provide satellite clinics (filter clinics) to prevent the necessity of people with minor ailments requiring hospital visits.

Intrasectoral Coordination

In most countries there are two major types of health facilities—primary-care facilities and secondary- or tertiary-care facilities. The secondary- or tertiary-level facilities are called hospitals. Hospital functioning is complex in nature. A primary care facility is meant to provide basic primary healthcare services. Its structure is less complex compare to tertiary level or referral hospitals.

A healthcare system in any country needs to ensure that the primary care facilities as well as secondary- and tertiary-care hospitals work with coordination with each other. It is not only beneficial for the health system but also in helping the community at large. The healthcare delivery system of a country is designed to strengthen the primary-care level and then offer specialised care at higher/referral levels. If this reflects actual care-seeking behaviour, then healthcare costs for the caretaker will be minimised. This system is not only designed to reduce cost but also to optimise the resources

available. In developing countries, the healthcare systems often face crunch in terms of both financial and human resources. In this context, ineffective referral system puts a lot of pressure at the hospitals; apart from this, it also creates an environment where people/community bypasses the primary healthcare facilities.¹³

Depending on the condition of patients, even a transfer from one facility to another requires the involvement of 6–10 clinical and nonclinical staff members. Substantial improvement in the quality of care in one part of the hospital should holistically entail improvement of the hospital as a whole.¹⁴

In many countries and situations, the hierarchical model is not followed strictly. People often bypass primary-care facilities and seek care in referral centres.¹⁵ The reasons for this are varied. For instance, in India around 56% of caretakers sought care at a referral facility because they perceived that the level of care at referral facilities would be better.¹³

Referrals exist not only between lower and higher facilities but also between facilities at similar levels and within hospitals. An effective referral is a two-way process that requires a great deal of coordination between the referring facility and referral facilities. An effective referral system contributes to high standards of care by preventing unnecessary treatment, defining the roles of each facility clearly and effective use of resources.¹⁶ Sweeny (1994) in an editorial for the British Medical Journal states succinctly the advantages of a referral system.¹⁸ He sums up the article by saying,

‘... the referral system contributes to high standards of care by limiting overmedicalisation, by permitting an efficient division of tasks between generalists and specialists, by freeing specialists to develop their special knowledge and by containing the cost of medical care.’

In India, the referral system is weak and currently evolving. One of the main challenges cited in the universal health coverage report instituted by Planning Commission of India is ‘referral linkages and follow-up services are very weak, rendering the connectivity between primary, secondary and tertiary services dysfunctional.’¹⁸ Ineffective referral system ensures that tertiary health facilities become overcrowded. It has been observed over the years that people come directly to the tertiary-level hospitals and seek health service even for minor ailments. This also creates another adverse effect of low utilisation of primary health facilities.

At present, the referral system is nonfunctional or less effective due to many reasons. Coordination among different level of hospitals is important to ensure effective referral. The same is missing in most of the cases. There are many steps that need to be followed to ensure an effective referral, which includes stabilisation of the patient, preparing the case sheet properly before the patient is referred to the higher health facility. These practices ensure that the higher facility will be able to deliver its services more efficiently. An effective referral system ensures close coordination of the facilities at various levels. Optimal utilisation of services and resources makes them more cost-effective as well.

Referral system is an example of intrasectoral coordination; in the following section, the referral system has been elaborated and how the coordination takes place among the various facilities/department is described.

Referral system—An example of intrasectoral coordination

The referral can be defined as a process in which a health worker at a one level of the health system, having insufficient resources (drugs, equipment, skills) to manage a clinical condition seeks the assistance of a better or differently resourced facility at the same or higher level to assist in, or take over the management of, the client's case.¹⁹

Flowchart 56.1 shows how the two facilities need to coordinate in order to ensure that the patient gets the right and proper care. Health systems also play a major role in this.¹⁷

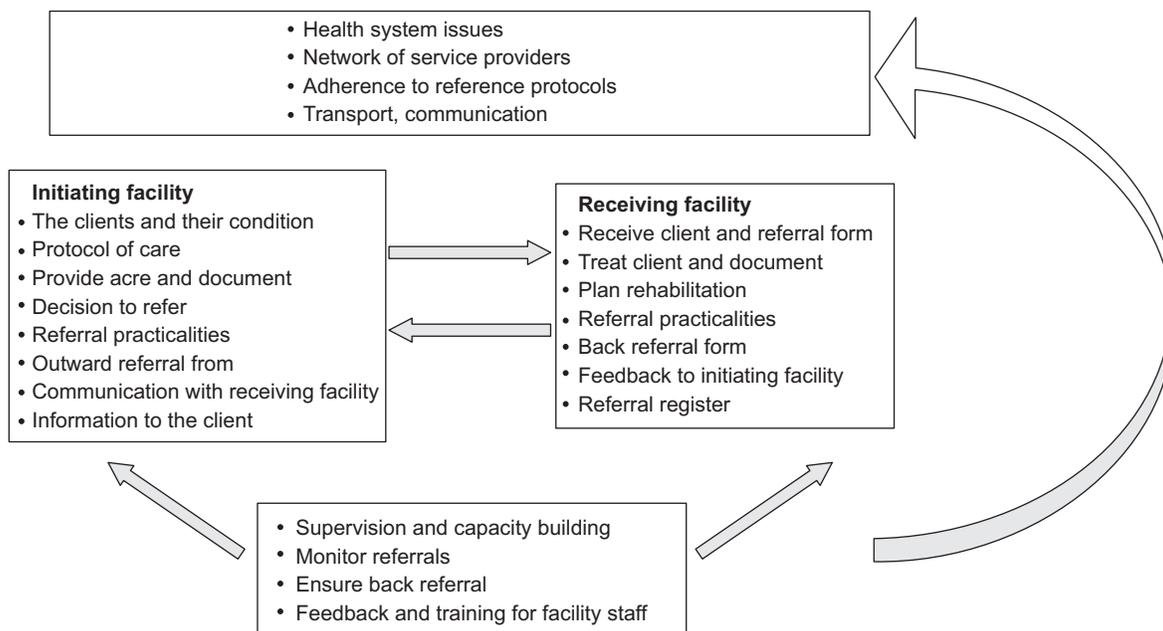
Referral to the next level (to a referral facility) should occur in case of following situations:

- When the patient needs expert advice;
- When a patient needs an investigation (such as a laboratory examination or X-ray) that is not available at the health centre/primary facility level;
- When a patient requires an intervention, like surgery, that is not within the capacity of the health centre; or
- When a patient needs inpatient care—admission and hospital-based care

In Flowchart 56.1, the nature of coordination among two facilities has been depicted. The facility that starts the referral process is called **the initiating facility**. The roles of the initiating facility are also described. The initiating facility

needs to do the initial coordination, starting from taking the decision of referral, preparing of referral case sheet, arrangement of ambulances and informing the receiving health facility. This coordination from the initiating facility eventually helps the receiving facility to treat the patient as needed. The facilities that accept the cases from initiating facilities are called receiving facilities. Back referral is the process of letting the initiating facility know about the actions taken at the referral facility. Even the receiving facility also needs to inform back the initiating facility regarding the patient's condition. This completes the referral loop or coordination loop between the two health facilities. However, in order to complete/coordinate the whole cycle, there is a need to understand other health system factors that directly or indirectly affects the coordination. These factors like **referral transport**, distance between two facilities, trained manpower, connectivity, etc. decide the effectiveness of the referral.

The Indian health system has three tiers of health facilities and during referral it is expected that the system should work in synergy. In the illustrative diagram the coordination efforts among different level of health facilities has been illustrated. In an ideal situation, it is expected that a patient from the community should visit the nearby primary health-care facility for treatment. As per the decision of the treating doctor, the patient can be referred to the next level of health facility, which is secondary health facility. It is important to understand that these levels of facilities have been designed with the understanding that primarily a few patients need advanced level of care. From the health system perspective, the coordination of primary, secondary and tertiary level of health facilities decide the effectiveness of the health system.



Flowchart 56.1 Referral system.

In a specific geographical area all the facilities that include primary health centres, community health centres, subdivisional hospitals and district hospitals should know about each other. It is also important to know the range of services provided by these different levels of institutions.

The above diagram clearly depicts that how each of these health facilities are linked with each other. The important aspect is that each level is dependent of each other. And only through proper coordination the health system could achieve the intended objective of providing better healthcare services to the community.

Among various factors of referral system, referral transport is a critical component. It requires significant coordination activities among various entities. In the following section, the role of referral transport within the referral system mechanism has been described in details.

Referral transport: In a country like India where people need to travel at least 3–4 h to reach a health facility from the villages, a comprehensive referral transport is necessary to save lives in emergency. The emergency medical service system consists of organisations, individuals, facilities and equipments to ensure timely and appropriate medical response. Various referral transport models are available in this country; these models are different from each other. The first thing that comes to our mind when we plan for a referral transport is ambulance (transport vehicle). An ambulance plays an important role in any referral transport model. Ambulances in our country are undergoing a transformation from a simple transport vehicle to a **mobile treatment and stabilisation unit**. This is a part of the historical transformation occurring at various parts of the globe leading to emergency medical services.²⁰ An ambulance is not simply a transportation vehicle; it is life saving vehicle intended to

transfer the patient from the site to the nearby health facility. Research has shown that the first hour after an emergency (especially for trauma and medical emergencies) is the most critical period. Besides taking care of the time lost to reach out to skilled services, emergency services delivered during transit can save lives. With this idea, the concept of emergency medical technicians (EMT) arose. Apart from providing prehospital lifesaving care, it also prevents secondary injuries and helps improve the prognosis.²¹ The various models that are followed in our country could be categorised into the following categories:²²

- **Government-funded service:** In this, a part or full cost of transportation is borne by the local, regional or national government (through their normal taxation).
- **Privately funded service:** Through this, cost is paid by the patients themselves or through their insurance company. This may be at the point of care (i.e. payment or guarantee must be made before treatment or transport); although this may be an issue with critically injured patients unable to provide such details or via a system of billing later on.
- **PPP-funded service:** There could be many arrangements for any PPP-funded project. Mostly the state funds for CAPAX costs and running cost/recurring cost borne by the private parties.
- **Charity-funded service:** In this category, transport by ambulance may be provided free-of-charge to patients by a charity; although donations may be sought for services received (Figure 56.2).
- **Hospital-funded service:** Hospitals may provide the ambulance transport free of charge on the condition that patients use the hospital's services (which they may have to pay for).

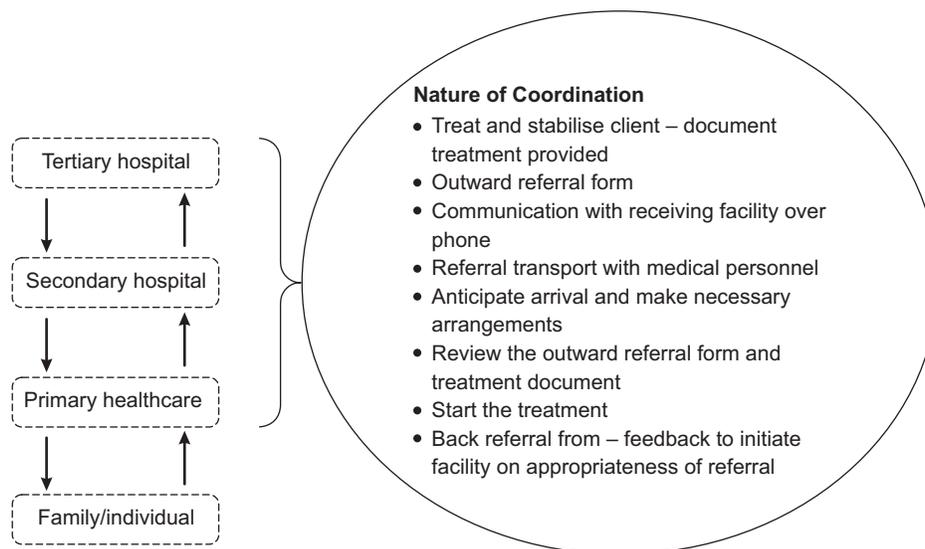


Figure 56.2 Coordination cycle in the health system.

In India, the central government supports emergency transport schemes mainly in the form of capital expenditure (capex) support. Operating expenditure (opex) is borne by the states, with the support from centre progressively reducing from 60% of opex (to begin with) to zero by the third year of operations.²¹

With new technologies, systems and guidelines coming up, the administration should strive to keep the coordination system active and thriving. This can happen only in the presence of an able hospital manager. One of the various ways to go about it is to ensure that every process functions a two-way process. Effective communication within and between sectors is the key to achieve this end. Periodic updates and consultations involving various stakeholders, appreciation and acknowledgements made by a partner or department and incentivising them are some other options. Creating a sense of ownership among staff and to realise that one can achieve great heights; but to remain there, the team needs to grow to that height; it will go a long way in improving our services.

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Setting up a Telemedicine Clinic

57

Dr Smita Sinha and Prof Meenu Singh

“Absence of evidence is not evidence of absence.”

—Carl Sagan

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- describe the scope, objectives and functions of telemedicine.
- explain the current scenario of telemedicine globally and in India, and major challenges faced.
- describe the classification of branches of telemedicine.

INTRODUCTION

India, especially the rural area, where majority of population resides, is witnessing perpetual lack of healthcare workforce. This disparity in distribution of healthcare delivery services between rural and urban area has raised the issues of access to care, equity and many others. Evidence are emerging that telemedicine has a potential for providing access to care where none exists or improve the services where some facility is available. Telemedicine is provision of healthcare services or information by using information and communication technologies. Remote access to healthcare is not an altogether new idea, but has been prevalent through use of telephonic advice or use of radio to transmit information related to health. However, recent past has witnessed technological advancement in the field of information and communication. It has touched every sphere of life including health. It has opened many opportunities for delivering quality health services at the door steps of people living in remote and far-flung areas.

Provision of healthcare services at a distant place through the use of telecommunication technology is termed as telemedicine. The term ‘Telemedicine’ came into existence in 1970s and literally means ‘healing at a distance’.¹ World Health Organisation (WHO) defines telemedicine as ‘the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies (ICT) for the exchange of valid information for diagnosis, treatment and prevention of

diseases and injuries, research and evaluation, and for continuing education of healthcare providers—all in the interests of advancing the health of individuals and their communities.² The four elements relevant to telemedicine are (i) providing clinical support (ii) overcome geographical boundaries (iii) use of ICT (iv) improve health outcomes.²

SCOPE, OBJECTIVES AND FUNCTIONS OF TELEMEDICINE

The origin of telemedicine is traceable to late nineteenth century.³ Transmission of electrocardiograph data over telephone is the first published use of this technology.⁴ Similar uses in the fields of military, space technology, psychiatry and medical education constitute the history of telemedicine.^{5,3,6} Telemedicine has emerged as a boon for healthcare, especially in developing countries.⁷

One of the most important uses of telemedicine is that it helps to increase the coverage of access to care among people residing in hard-to-reach areas. For people residing in resource-limited setting, this could provide means for accessing tertiary-care services. Telemedicine facility has been reported to reduce referral rate from lower health facility to higher centre. Healthcare system in developing countries, like India, faces various challenges that telemedicine is helping to overcome. Some of these are (i) location of tertiary-care facilities at long distances and huge travel expenses (ii) lack of regular transportation services, both in terms of vehicles and roads, especially in remote areas and at odd hours

(iii) overcrowded hospitals with no referral or appointment system (iv) lack of facilities in terms of staff and equipment at primary and secondary healthcare facilities. Therefore, it appears to increase the efficiency to higher centre without compromising the fulfillment of unmet need of access to care. It aims to complement tertiary healthcare services and to compete with them.⁸ It is vital to include telemedicine as a discipline when learning about hospital administration and describe innovative use of technology in healthcare. It also helps in planning primary healthcare delivery system. Including it as a mainstream department in healthcare system will lead to use of advanced information technology in healthcare facilities, which is easily available and that too at an affordable cost. It not only reduces the burden of the healthcare system but also ensures quality and satisfactory services to the remote patients as it has a wide range from accessing internet to performing robotic surgeries.⁸

Consultation through videoconferencing used in telemedicine is usually thought to be a process of providing curative services only. However, use of telemedicine has broader domain, not only provision of curative services. Its application can be extended to provide health-promotion services as well, not only for routine services but also in disaster situations. In the disaster situation telemedicine can help to reduce mortality as well as morbidity to a great extent. After triage of cases at disaster site, which is always the priority, disaster victims can be provided immediate curative services at the disaster site itself by field staff in consultation with specialist stationed at tertiary-care centres.⁵

Telemedicine has discovered its functions in multiple disciplines of healthcare that range from general health advice to administration of healthcare facility. Some of these functions have been cited as follows:

- *General:* The usual technological access to or exchange of health information by the doctors, nurse, and other healthcare workers deployed in community or healthcare facilities.
- *Diagnosis and reporting:* Using internet or facsimile to send diagnostic reports and seek advice regarding various health issues.
- *Self-care advice:* Providing telephonic advice for minor ailments, directly, to the people in community
- *Disease prevention and health promotion:* Using mass media, for example, newspapers, television, etc. to spread awareness about various diseases or health issues such as immunisation, HIV/AIDS, pregnancy, etc.
- *Medical records:* Maintaining patients' records in the form of electronic data.
- *Healthcare administration:* Information technology plays a major role in financial management, material management, human resource management and hospital information system, especially in tertiary-care hospitals. It can also play a major role in managing and implementing

various developmental projects within the healthcare facilities.

- *Tele consultations:* Video conferencing or telephonic conversations can be used to discuss various medical issues by the healthcare professionals. Patients can seek consultations from the doctors; it is a very good mode of providing health education.
- *Disaster management:* Coordination of relief efforts aimed at affected population in wake of a natural calamity or disaster.
- *Continuing medical education:* Healthcare professionals from different corners of the world can participate in online conferences, workshops and other training programmes.

CLASSIFICATION OF TELEMEDICINE

Telemedicine applications have been broadly classified into two basic types: based on the type of interaction between patient and the consultant, and timing of transmission of information. These are store-and-forward, or asynchronous-and-real time, or synchronous.²

In the store-and-forward method, patient information is stored and later on e-mailed to the consultant. While in real time method the doctor and patient interact through videoconferencing. For either of the method, information is sent in the form of image, video or audio.

The telemedicine system connects patient and doctor through a very-small aperture terminal system (VSAT). The diagnostic equipments like pathology microscope, stethoscope, electrocardiography (ECG) are attached at patient's end. These investigations from the patient's end are sent in a digital form with the help of computers with communication system through digital data pack of satellite links. This information received at specialist centre is reconstructed in the computers so that specialist can go through it and make a diagnosis for management that can be delivered through videoconferencing. All these networks in India are controlled by Indian Space Research Organisation (ISRO).

Broadly, these two basic types of telemedicines are applied to deliver different services in many settings like teledermatology, telepathology and teleradiology. Telemedicine is commonly used in the different area as teleradiology, teledermatology, telepathology and teleradiology. Globally, teleradiology is the most (33%) widely implemented telemedicine service followed by telepathology (17%), teledermatology (16%) and telepsychiatry (13%).⁶

- *Teleradiology:* Transmission of radiological images [e.g. X-ray, magnetic resonance imaging (MRI)] in digital form from one place to another by the use of telemedicine techniques.
- *Telepathology:* Use of telemedicine technique for the transfer of pathological reports (e.g. cell biopsy findings) to a distant place in digital form.

- *Teledermatology*: Provision of consultations for skin disorders at a distant place based on information provided in digital form and case records through videoconferencing.
- *Telepsychiatry*: Provision of consultations for psychiatric disorders at a distant place based on medical information provided through videoconferencing.

TELEMEDICINE: GLOBAL SCENARIO

Telemedicine initiatives have been widely used in developed countries. The United States of America has established permanent telemedicine system to connect rural health centres to tertiary healthcare facilities. Through secure link rural doctors can consult a specialist at higher centres to manage the patients in emergency as well as routine care situations. It helps to improve the management process and outcome of care at a lesser cost.

It has also been used during disaster situations like earthquake, floods and burns. The services provided in disaster situation ranged from provision of curative, preventive and rehabilitative services. It included monitoring of diseases and sanitation conditions at disaster site, etc.

Many initiatives have been taken to diagnose, manage and monitor infectious diseases and injury among civilians and soldiers at various places like Somalia, Haiti, Bosnia, etc.

Till date, majority of work related to telemedicine has been done in developed countries. However, given the ever increasing problem of access to care faced by developing countries, it has been emphasised that use of telemedicine can go long way. Even after more than 30 years of Alma Ata declaration, India has not been able to provide equitable access to care. Therefore, strengthening and expanding telemedicine services could have better impact for overall improvement of health.

TELEMEDICINE: INDIAN SCENARIO

India has started exploring the potential use of telemedicine to deliver healthcare services to the communities residing in far-flung areas. Most of the telemedicine initiatives are implemented by state governments and for majority of these initiatives supporting agencies are mainly Indian Space Research Organisation (ISRO) and Department of Information Technology, Government of India. A national task force has been established to look after the various issues and make policy decisions regarding telemedicine in India.

Many telemedicine networks have been implemented for both delivering healthcare services as well as implementation of proper surveillance activity to monitor the health-related events in wide geographic areas.⁹ Integrated disease surveillance programme network was implemented to strengthen surveillance and monitoring in India. Till now, nine such networks have been implemented. Establishment of OncoNET India aimed to connect peripheral health

centres with the regional centres to widen the access to comprehensive cancer treatment facilities. Besides provision of curative care, these networks facilitate preventive activities and research work in the field of cancer. Though many private sectors are using teleophthalmology services, the government has also approved these projects to be implemented in Uttar Pradesh, Punjab and Himachal Pradesh, etc. Indian Space Research Organisation (ISRO) has also proposed setting up of the national telemedicine grid in India.

Though the major implementing agency for telemedicine are in public domain like ISRO, state governments and medical institutions, private organisation has also set an evidence of successful delivery of services by using telemedicine. Apollo hospital groups, Escort Heart Institute, Asia Heart Foundation and Narayana Hrudayalaya, Bangalore have implemented telecardiology to people of remote areas. Shankara Nethralaya Chennai, Tamil Nadu; Aravind Eye Hospital, Madurai, Tamil Nadu and Sir Ganga Ram Hospital New Delhi; has been using teleophthalmology for delivery of quality eye care and also setup mobile ophthalmic units for early diagnosis and treatment of eye diseases for people residing in far-flung areas.

Various tertiary-level hospitals in public sector are actively involved in telemedicine programme. Three premier institutes in India leading this initiative are All India Institute of Medical Sciences, New Delhi, Sanjay Gandhi Postgraduate Institute (SGPGI), Lucknow, and Postgraduate Institute of Medical Education and Research, Chandigarh.

TELEMEDICINE FACILITY AT PGIMER CHANDIGARH

Telemedicine centre at Post Graduate Institute of Medical Education and Research (PGIMER) is involved in healthcare provision mainly in Punjab, Haryana, Himachal Pradesh, Uttar Pradesh and Rajasthan, and partially to other states in India. The medical consultations have also been provided to neighbouring SAARC countries. It is a centralised referral centre; the patients from peripheral locations are being provided with teleconsultation services. Regular transmission of CMEs to different medical colleges in India as well as SAARC countries is also a unique activity of the department. The centre is connected to 25 district hospitals of Punjab and all the government medical colleges for the purpose of teleconsultation and tele-education. The teleconsultations are provided through e-Sanjeevani developed by Centre for Advanced Computing (CDAC), Mohali and Indian Space Research Organisation-enabled televital.

The centre also has an experience in conducting community-based camps with linkage through telemedicine. A mega health camp at Ajmer, Rajasthan was organised in the month of February 2012 by the telemedicine department in collaboration with State Government of Rajasthan. During a two-days camp, live teleconsultation was provided to more than

250 patients of all age groups. The clinical history, investigation reports were digitalised and sent to PGIMER, which were reviewed by specialist at the institute and consultation was provided accordingly. The success of this camp in terms of coverage of patients emphasises the potential of increasing access to care among rural population. It also highlights the need of future expansion of telemedicine at PGIMER though the quality and feasibility needs to be ascertained.

SOME SUCCESS STORIES ACROSS THE WORLD

- *Kumbh mela*: Application of telemedicine technique has been successfully used by Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGI), Lucknow for not only providing the medical consultation and delivering health education but also monitoring the public health activities and public health facility. The service that was provided to large number of people attending this massive gathering was perhaps not possible without it. The use of telemedicine for this purpose has potential for mitigating disaster and prevention of many outbreaks. It can help the strengthening of disaster preparedness.
- *Norway's tele-ECG initiative*: It was started in 1995 and has resulted in improved outcome in cardio patients by 15–20%. This programme has enabled the transmission of ECG reports directly from the patient's home or from ambulance while they are en route to hospitals. The ambulances are fitted with the equipment that captures the image of ECG and transmits the information at hospitals where it is received, stored and analysed by a cardiologist. This programme is mainly run by a team of cardiologist, general physician and paramedics.
- *Application of telemedicine for maternal and child health in Mongolia*: Telemedicine project was started in September 2007 in Mongolia to improve maternal and neonatal health, and to reduce the gap to access healthcare for maternal and child health. For this doctors, nurses and midwives were trained. The project has resulted in reduced referral of cases and improved maternal and child health outcome.
- *Screening of breast cancer at Mexico*: This programme aimed to reduce the mortality due to breast cancer, a leading cause of death among 5–69 year women. For early detection of cases, screening strategy was adopted. To reach the women residing in far remote areas, use of telemedicine was adopted. Due to limited access of internet services in these areas, mammography images were stored in CDs and then were sent by courier to radiologist at hospitals. Although it took 3–4 days for result to reach the women, it overcomes the limited availability of radiologist.

Recent systematic review has reported the potential use of telepsychiatry to improve provision of mental health services.¹⁰

CHALLENGES FOR TELEMEDICINE

Although, telemedicine has made way in healthcare systems all over the world, yet it has not received full acceptance, especially in developing nations, where use of technology is still in initial stages. Following are the major challenges faced in this field:

- Healthcare professionals are not familiar with use of technology, and see remote diagnosis and treatment as insufficient for comprehensive healthcare.
- Patients feel the lack of emotional content in the form of psychological counselling by the physician in telemedicine, thus lacking trust in the treatment received.
- Implementation of this practice needs a lot of financial investment, thus making it nonfeasible.
- In the absence of basic amenities such as food, water supply, electricity, primary health services, etc. majorly in developing nations, advancement in technology would be of little help for the community.
- Illiteracy and language diversity, particularly in multilingual nations like India, application of common healthcare programme/software will be tedious.
- Lack of advancements in technical aspects can be a hindrance for correct diagnosis and treatment.
- There is a possibility of lack of uniformity in quality of services and is solely dependent on individual institutes.
- Poor government support is a barrier to proper implementation of any programme nationally.¹¹

Though telemedicine offers many advantages of improving access to care, many barriers have been reported for its implementation. In developing countries availability of infrastructure, cost, acceptance among patient as well as doctors, cultural factors, political will has been reported as major barrier; though the legal issue attached with its use like confidentiality and privacy has been reported as major concern among developed country besides these factors. For setting up of telemedicine unit at any hospital besides infrastructure, hardware and software, there is a need of separate skilled health workforce for delivery of services to avoid any likely compromise in quality of services to patients attending that hospital. In absence of cost effectiveness studies, it is reported that despite having advantages countries are facing difficulty to convince policy makers. However, by meeting the unmet need of access to care this modality is a promising tool for universal access to care, especially in resource-limited settings.

Case Study 1: Telemedicine facility: A boon to patients in far flung areas

Although telemedicine implementation remains in its infancy, interest and activity appear to be growing to provide consultation of a superspecialty doctor from a distance through videoconferencing along with exchange of medical records online. The Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh has been delivering these services since 2005. During the period of 3 years from 2005 to 2008, a total of 306 patients of both sexes aged 0–15 years were managed. The consultations were given for critical as well as for routine cases. The range of problems covered were respiratory, gastrointestinal, neurological infectious disease, hematological, cardiac, renal, oncological, dermatological, rheumatological and neonatal problems. About 26% were called for complete workup, as diagnosis could be made. However, majority of cases were managed through videoconferencing including critical patients (16%) who could not be transported due to serious illness, though they get superspecialty consultation through telemedicine. This experience of PGIMER highlights that it is possible to provide services to children residing in far-flung area at their door steps. It holds promise for the future generations to have access to quality healthcare to all, irrespective of their area of residence. Therefore, it helps to clear the dilemma of expanding telemedicine services in India and emphasises the need to expand it.

Case Study 2: Telemedicine: A cost-friendly service

The telepaediatric consultation at PGIMER witnessed increasing trend from year 2005 to 2009. During this period 431 cases were managed. Around 87% of patients were under five years; rest 12 and 2% belonged to 5–10 and 10–15 years age group. The consultations were given for critical as well as for routine cases. The range of problems covered were respiratory, gastrointestinal, neurological infectious disease, haematologi-

cal, cardiac, renal, oncological, dermatological, rheumatological and neonatal problems. The specialist assessment through telemedicine resulted into urgent intervention 74 (17%), urgent investigation 56 (13%), formal advice 240 (56%), referral advice 61 (14%) and videoconferencing 92 (21%). This study also found that total cost saved per child averaged over all consultation was Rs 1000 excluding telemedicine consultation charges. This experience shows increasing awareness and acceptability among people, which is always a serious concern due high illiteracy rate in India. The cost saving found in this study supports the benefit of using telemedicine in economic terms; therefore, it provides evidence that it is feasible to provide healthcare services to people living in remote area in cost-effective way in spite of huge illiteracy.

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Scope and Potential of Using Mobile Health in Hospitals

58

Dr Nidhi Bhatnagar, Dr Sonu Goel and Dr Amarjeet Singh

“Mobile technology could save billions of Dollars on healthcare cost.”

—Bryam Lenett

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- assess growth of mobile phones and potential of mobile health (m-health) in India.
- elaborate on possible uses of mobile phones in hospital setting.
- cite examples to health and hospital administrators on various forms of usage of mobile smartphones in health.
- describe the feasibility and issues of newer innovative models of smartphone usage in hospitals.

INTRODUCTION

World is experiencing an extraordinary phenomenon in the field of interpersonal communication. This enables people to communicate across vast geographical distances, until now inaccessible, especially in developing countries. Mobile technologies have already changed and will continue to change the lives of millions across world. Mobile phones because of their high levels of penetration hold tremendous potential as they provide opportunities, never imagined before.

GROWTH OF MOBILE PHONES AND POTENTIAL OF MOBILE HEALTH

China leads as the country with maximum number of mobile phone users followed by India and United States of America (USA). In USA, 83% have mobile phones and 60% have access to broadband services. Internet usage in mobile phones is expected to exceed desktop usage by 2014. Presently, 35% of mobile phone users in US have smartphone and the number is expected to rise to nearly 43% by 2015.¹ Amongst smartphone users in India, nearly 56% access internet in their devices for average of 3 hours/day. More than two-thirds of mobile phone users utilise smartphone browsers that view the web in a different format from regular computer browsers.²

Cell phones are used by 76% (929.37 million) people in India. Monthly cell phone addition is nearly 8.35 million in 2012. India has third largest number of mobile phone users in

the world next to China and United States of America.³ However, high number of internet users is not accompanied by high internet penetration. JUXT, a market research company, studied ‘Mobile phone users in India and their mobile usage behaviour and preferences’. Findings suggested that rural India has more number of ‘users’, ‘active subscriber identity modules (SIMs)’ with significant increase in ‘penetration’ and ‘teledensity’ compared to urban India. This is a boon, particularly to the marginalised population of such poor states who would otherwise not have access to the information or routine healthcare.⁴ Smartphone applications recently introduced in mobile phones will further enable the m-Health industry to successfully reach out to 500 m of a total 1.4 bn smartphone users in 2015.⁵ The opportunities could be in areas of communication, entertainment, education, employment and even health. However, health sector till date has been slow in adopting mobile technologies into routine operations to benefit patients and providers alike. If implemented strategically and systematically, mobile health can revolutionise health outcomes, providing virtually every mobile phone user with medical expertise and real-time knowledge. Research conducted by Pew Internet and American Life Project found 17% of adults using cell phones for seeking health information. Younger adults (18–29 years) were observed to use their phones (29%) for seeking overall health and wellness information. It is likely that these numbers are expected to increase in future. Presently, only 9% of cell phone users have downloaded applications to track health.⁶

Health sector is plagued by several challenges and many could be circumvented by intelligent use of mobile phone technologies. Repeated follow-up visits, consultations for minor ailments, reminders for basic antenatal care, immunisation, health messages on family planning, research, etc. can bolster the existing comprehensive healthcare delivery mechanism. Large number of mobile phone users in the community can be linked to hospitals that already have access to new technologies. Initially, mobile healthcare innovation in India seems to be driven by Asia, Japan, Korea and Australia.

Solidiance estimated in a study that mobile healthcare business in Asia is growing at the rate of 80%/year. Ageing and tech-friendly population is likely to give a thrust to mobile healthcare business. Asia-pacific mobile healthcare business in 2010 has estimated worth of nearly 1 billion USD with 70% of users in advanced Asian economies. Business comprised of software and applications development, system integrators, mobile integrators, mobile marketing, mobile operators, handset players, hospitals and doctors. Applications developed in the process were for remote patient monitoring, mobile nursing, access to mobile medical records and free access to healthcare information via mobile phones.⁷

MOBILE HEALTH AND ITS APPLICATIONS

Mobile health is a term coined for medical and public health practice supported by mobile devices, e.g. mobile phone, patient-monitoring devices, personal digital assistants (PDAs) and other wireless devices. It is a simple, low-cost and immensely user-friendly service with a potential to enhance the speed and accuracy of healthcare delivery.⁸

Application of mobile health (m-health) in hospitals can contribute greatly to the management of health and disease of inpatient, outpatient and emergency patients. Better monitoring, reducing follow-up visits, ensuring medication adherence and compliance, and higher patient and healthcare provider satisfaction can be the observed outcomes.

Innovations in smartphones need to address the following concerns of health:

- Contact information of healthcare provider.
- Directions.

Tools that can be built strategically in the smartphones for the same are:⁹

- Preregistration, registration for healthcare consultations.
- Appointment scheduling, fixing appointments and informing the clients. This is likely to reduce waiting time and cut short long lines for consultations.
- Medical information such as prescriptions, medical history, allergies, etc.
- Information on health insurance and tracking.

Calling

Health workers and doctors in the hospital have reported increased use of mobile phones at work place. It has been



Figure 58.1 Applications of mobile phones utilised in healthcare delivery.

used for delivering instructions, coordination, referrals and linkages between different providers. Many hospitals give mobile phones to doctors or get the monthly bills reimbursed because of extensive use of mobile phones at work (Figure 58.1).

Hospitals can setup call centres that can address patients telephonically. Calls made by patients can be used for fixing appointments and responding to small queries related to medication or treatment and counselling. Staff in the call centres can provide a link with the required healthcare provider. This will cut down the number of visits made by the patient to hospitals, unless required. Doctors will have more time in the outpatient department for patients that require initial work up. Some case studies have been done where helplines are established to provide medical care to public at large. Doctors sitting in the hospital provide medical advice on phones and depending on the need refer the patient to the required medical centre or fix an appointment for the visit.

Case Study 1: Doctor on call services: A boon to patients

In India, BPL mobile (a mobile service provider) has launched 'Doctor-on-Call' service, to provide real-time telephonic consultation between doctors and patients.

Patient will be classified under three categories depending on the condition of patient: 'acute', 'chronic' and 'emergency'. For 'acute condition', doctor who receives the call will understand the presenting complaints of patient and offer palliative home remedy along with referral to the appropriate centre. For 'chronic condition', doctor will counsel in terms of lifestyle change, preventive measures and referral to a specialist for further management. In case of an emergency, doctor will suggest if calling patient needs to be rushed to the nearest hospital, based on history.

This service will prevent loss of daily pay, waiting in long queues and stress to take prior appointments. It is of great help to old and disabled who need not worry about their mobility. It will also prevent people overlooking minute problems that may lead to serious issues, if neglected.¹⁰

Short Message Service

Text messaging between clinicians and healthcare workers is increasing in hospitals.^{11,12} Short message service (SMS) or texting is the key to mobile health. A recent study showed that repeated text reminders to diabetic patients about insulin treatments helped them adhere to their treatment schedule and manage blood glucose levels appropriately.¹³

Cell phone texting in healthcare is on rise. Survey of paediatric hospitals found nearly 57% clinicians sending work-related text messages. Moreover, 12% of the physicians who responded to the survey reported texting more than 10 times per shift. Nearly half of the hospital residents complained of receiving work-related text messages when not on call.

Text messaging connects and conveys the required message in a very short time span—the speed surpasses that of other marketing channels. A patient can read a text instantly and respond without necessary internet access and at a very-low cost.¹⁴ Improved patient satisfaction, retention and health outcome can be noticed with the use of mobile phones. When patients are reached out proactively through communication channels that best suit their needs and preferences, their experience is improved, with better service and greater retention to treatment.^{14,15–17} Business process efficiency can be enhanced using mhealth. Text messages are budget-friendly mode for appointment reminders. Manpower cost for a person to make scheduling and reminder calls include salary, work space, phone line and other support costs. The cost for text messaging service is a flat monthly rate plus marginal cost of every text. Studies have proven improved compliance for treatment of various diseases using mobile phones.^{18–25}

Case Study 2: Utilisation of SMS function of mobile phones in management of bedsores

Bedridden cases in Chandigarh will be identified. Cases in stage 0 and 1, i.e. with no bedsores but are at risk of development of bed sore, will be included in prevention package (PP). Such cases will be randomised into two groups. Group A will receive prevention package I (PP1), i.e. distribution of self-instruction manual (SIM), face-to-face interaction-based training and counselling at the first visit. All these patients will be followed up through *SMS-based interaction*. They will be sent mobile phone-based short message

services (SMS), phone calls and reminders on daily bases. The SMS/phone calls/reminders will be regarding skin care, positioning the patient, changing the posture of the patient, and active and passive exercises, etc. The caregivers will be asked if they are facing any problem while providing care to the patient and follow-up visits done.

Group B patients will receive prevention package 2 (PP2), i.e. distribution of self-instruction manual, face-to-face interaction-based training and counselling at the first visit. These patients will be followed up personally by the project staff. All these patients in both the groups will be followed for bed sore development. The observations/scores of subsequent visits (on mobile versus personal) will be duly compared.

The cases that already have bed sore and are in stage 2 and 3 will be randomised into another two groups. **Group C** patients will receive **treatment package 1** (TP1). This will include management of bedsores by using Placentex Gel along with the self-care manual, face-to-face interaction-based training and counselling. The caregivers will be taught the right technique of doing dressing at the first visit. This group will be further randomised into two categories. **Group C₁** will be followed up through mobile phone-based interaction. They will be sent SMS/phone calls/reminders regarding dressing, skin care, positioning the patient, changing the posture of the patient, and active and passive exercises, etc. on daily basis. They will also be asked to maintain a diary regarding the care being provided by them to their patients. They will also be taught how to click photograph of bed sore and send to the project staff through mobile phone. Follow-up visits will also be made. The patients included in **group C₂** will be followed up personally.

Similarly, Group D will receive **treatment package 2** (TP2). This will include dressing of bedsores by using neosporin ointment along with distribution of self-care manual, face-to-face interaction-based training and counselling. It will be again divided into two sets—one receiving mobile intervention and other without it.

However, texting carries number of risks. Text messages are stored in the mobile device indefinitely and can be subjected to theft or viewing by unauthorised persons. Text messages are not under central monitoring by the IT department and can be easily intercepted. Finally, the Health Insurance Portability and Accountability Act (HIPAA) rule requires that if text messages are used to make medical decisions, patients should have the right to access and amend that information. So texts that are not documented in electronic health records (EHRs) could be a Health Insurance Portability and Accountability Act (HIPAA) violation. If any text bears on a medical decision, e.g. any medicine or discharge, it must be documented in the medical record.²⁶

Healthcare organisations need to address the technology aspect of texting and put in place policies and procedures to address the security and privacy risks. Security tools—both cloud-based and data centre-based can be used to control the mobile devices. Automatic encryption and policy of deleting information from the phone when it is no longer necessary can be adopted.¹⁴

Access and Updating the EMR System

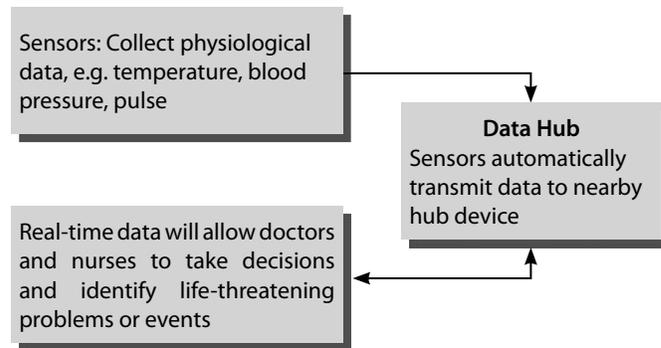
Mobile health can be utilised for automatic update of the electronic medical records (EMR). The documents and investigations of the treatment process can be used for regularly updating the EMR. The information can be fed directly from the smartphones carried by healthcare provider. Snapshots of the prescription slips, investigation reports can be sent to EMR system, access of which is provided by a secured password, available only to the concerned staff of the institution. This will help in creation of database that is updated, secured and without employment of extra manpower for the same.^{27,28}

Mobile healthcare services in Taiwan provide high-bandwidth links for doctors at Taipei Medical University Hospital, Tri-Service General Hospital and Taipei City-Wan Fang Hospital. Mobile phones and internet give doctors a virtual access to patient medical records, monitor condition of long-term sufferers of chronic diseases, provide high-quality diagnostic images and help in remote outpatient registration to improve healthcare services.

Newer Wireless Devices and Technology

Wireless technology has boomed for phones and computing being utilised in various sectors. However, it has been slow to take hold in the medical sphere. With the advancing technology, new band-aid-like sensors were introduced in place of knots of wires stuck on patients to monitor vitals (blood pressure, heart rate, oxygen level and body temperature). Wireless medical devices will raise the possibility of easier hospital–patient monitoring, fewer tubes in emergency rooms and more remote monitoring at home. The new technology called *mobile body area networks* (MBAN) will transmit signal for short distances. Sensors on patient's body will send low-power wireless signals to receivers carried by patients or placed near their beds. Those, in turn, will feed data into nursing stations or are transmitted wirelessly to computers in the room of doctors (Flowchart 58.1).

A new range of products for hospitals have been developed to monitor vital signs and process the data. Mobile technology has placed health information, e.g. laboratory results, X-rays, patient medical history or prescription drug information in the hands of clinicians in a real-time manner. Physical presence is not required and quick decisions can be taken timely.



Flowchart 58.1 Wireless transmission of data.

Patient keeper

Patient keeper's mobility products are smartphone-like devices that provide system support while connecting physicians to patient information across inpatient and ambulatory environments. With patient keeper, physicians tend to save time, increase revenue and enhance patient care. Patient keeper helps physicians manage patient information across multiple locations, view clinical results, enter charges, discharge patients and edit prescriptions, all from their smartphones.²⁹

Epocrates Rx for Android

Doctors, nurses and other healthcare professionals use this mobile drug reference application to get prescription and safety information for large number of branded and generic drugs. Verizon wireless smartphones with Android™ operating system (OS), such as DROID by Motorola or DROID ERIS™ by High Tech Computer Corporation (HTC) have application compatibility. This application offers which helps identify drug based on physical characteristics such as colour, shape and imprint code; it also details the drug interaction information.³⁰

Medicine and evidence central: These are applications designed for Verizon Wireless Android, BlackBerry®, Palm and Windows Mobile® devices.³¹

- *Medicine central* is a collection of disease and drug information with literature tracking for mobile devices. Application has features of the 5-minute clinical consult, A–Z drug facts, drug interaction facts, pocket guide to diagnostic tests and MEDLINE journals.
- *Evidence central* offers effective evidence-based medical practice by integrating analysis with current research. Clinicians can access evidence-based medicine guidelines, Cochrane abstracts, EE+ POEMs (Patient-Oriented Evidence that Matters from Essential Evidence Plus) and MEDLINE journals anytime, anywhere through their smartphones.

Motion Computing® C5 Mobile Clinical Assistant (MCA)

This is a hospital-grade device—an application that is proven to enhance clinician satisfaction and productivity, and simultaneously improve accuracy in clinical documentation. The MCA is now available with embedded wireless mobile broadband capability to stay connected to hospital system and the Internet.³²

Advertising

Hospitals need to design websites suited for mobile phones for promoting mhealth. With more people seeking health information via smartphones, hospitals need to add social features and make their site mobile friendly. For example, 2 months after Southern Regional Health System in Riverdale launched their mobile-friendly site, smartphone users represented 2.5% of the website traffic, which rose to 5% after 5 months.

Hospital that offers websites optimised for smartphone browsers:

- Attracts new patients seeking healthcare information on their smartphones. People with easy access to the required information on their smartphones find it easier to use website and meet healthcare needs.
- Patient satisfaction scores are improved. Since mobile users have global access to information and people can access information from anywhere, anytime and anyplace. Mobile tools help improve communications among patients, physicians, care providers and employees.

Medication Adherence and Treatment Monitoring

Real-time mobile solutions in areas of chronic and lifestyle disease management can be delivered by mobile phones. Device such as lifewatcher combines internet and cell phone technology to deliver real-time mobile solutions for preventing and managing lifestyle-related chronic diseases. It is a mobile phone-based health management application for people with 'lifestyle diseases', e.g. diabetes and obesity. Device can help in monitoring blood sugar levels, calorie intake, exercise and many other variables. It can collate daily, monthly or yearly data in the process. It also delivers vital medical information, reminders and alerts with escalating alarm levels in case of unmet goals. Using real-time cellular technology, patients can be in constant dialogue with medical practitioners to ensure that health measures are in check. With dramatic rise of noncommunicable diseases, doctors are welcoming this self-directed management tool that easily increases drug, nutrition and exercise monitoring compliance for patients.

World's first diabetic phone—a mobile phone (I-phone friendly) with the ability to measure blood sugar levels of diabetic user has been launched in Korea. Users place a drop

of blood on the end of a testing paper strip, stick the paper into a sensor located in the extra battery pack and get a reading on phone screen. The reading is stored in the phone and simultaneously forwarded to an online database, which can be accessed by the patient and doctors monitoring treatment. Readings obtained are transferred wirelessly to the electronic medical records of hospital.

Bupa Australia launched an innovative software application to provide customers with free mobile healthcare provider information. Application can be used to locate closest optometrists, physiotherapists, dentists and chiropractors, hospitals, etc.

Overall mhealth can be instrumental in reducing the patient load in the hospitals. This can be possibly achieved by:

- Easily accessible bioinformatics that would allow providers to easily determine whether a patient has a high, moderate, or low risk of readmission. This information can be shared with a multidisciplinary team responsible for developing a plan of care based on patient's specific needs.
- Educating patient about treatment procedures and preventive measures is integral in reducing the number of hospital readmissions.
- Mobile apps allow seamless communication between providers and beneficiary. These apps allow patients to store information, e.g. appointment times, laboratory results, prescription, etc. collectively throughout the period of treatment.
- Systems for mobile communication and medication adherence reminders given prior to being discharged from the hospital and thereafter at regular intervals can ensure that providers are aware of problems that might arise in the follow-up period and are in process of constant monitoring and guidance. This will also ensure treatment adherence and thereby reduce readmissions.
- Tele-health conferencing allows experts to supplement remote monitoring and benefit patients at high risk of readmission.

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Clinicopathological Conference: Honing the Skills of the Clinician

59

Dr Biman Saikia

“The art of medicine cannot be inherited, nor can it be copied from books.”

—Paracelsus

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- describe concept of clinicopathological conference (CPC).
- discuss the relevance of clinicopathological conference in modern medical teaching.

INTRODUCTION

Medical education and research has shown beyond doubt that problem-based learning is a very highly effective teaching/learning tool. Pioneered by Dr Walter B Cannon in the late 1800s, use of case studies in medical education became a popular method of teaching medical science and in 1900, Dr Richard Cabot of the Massachusetts General Pathology Service, formalised it as a part of the third year training for the Harvard Medical School students.¹

A clinicopathological conference (CPC) is one such medium of problem-based learning. It can be defined as a formal discussion of a patient's clinical, radiological and laboratory data, usually in front of a large group of junior and senior colleagues.² In our country, the practice of clinicopathological conference based on clinical autopsies, as a part of the postgraduate training has been pioneered by the Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh. These meetings, held twice weekly, one by the postgraduate students (two cases on Monday morning), and one by the faculty members (single case on Wednesday morning) have been a tradition of the institute since its inception in 1963. In each meeting, a physician of the institute (an internal medicine postgraduate student for the student's CPC and a faculty member for the staff CPC) is allotted a case for deducing the diagnosis based entirely on the clinical, radiological and preliminary laboratory data, i.e. tests conducted antemortem.

During CPC, the clinical data is presented to the audience in the form of a printed handout at the beginning of the session for reference. After the clinical presentation is made and the clinical diagnosis put forth, opinions from the house are invited and the clinical discussion ensues. Any further possibilities of diagnosis are recorded by the chair. The final autopsy diagnosis is then presented by a member of the histopathology department as a slide show of all gross and microscopic pathological findings based on the material of the clinical autopsy performed by the pathology postgraduates. A final pathology handout is then distributed among the audience. The case is then opened to the house and discussed in its entirety. The physician, though frequently correct in putting up a clinical diagnosis, can, at times be totally off track. This is all part of the teaching exercise and the aim is not to fox the clinician but to learn from the mistakes made. As Dr Castleman stated in 1960, *‘The clinicopathological conferences remain an exercise in deductive reasoning and clinicopathological correlation. It is less important to pinpoint the correct diagnosis than to present a logical and instructive analysis of the pertinent conditions involved. On the rare occasions when the correct diagnosis is esoteric or almost unattainable, if the discussor emphasises the practical clinical problems, it doesn't matter if the answer is wrong.’* Today the CPC remains one of the mainstay of the postgraduate teaching programme at PGIMER, and a case is published in each edition of institute's official journal; Journal of Postgraduate Medicine Education and Research

(formerly Bulletin PGI) as *Clinicopathological Conference Report*.

In the pre-IT era, all pathology presentations were in the form of transparency slides developed as positive photo-prints—a process that was inherently labour intensive, costly and time consuming. With the widespread familiarity with PowerPoint presentations now and digital photography a trend of the time, presentations have become much more conducive and content rich. In addition, it has made archiving in the form of digital information possible which was much more difficult in the past.

It is pertinent to point out here that it does not necessarily mean that performing clinical autopsies is a prerequisite to holding CPCs. Clinicopathological conference, in its most logical form, can also be based on routine biopsy-based material, though many would call this, as is the practice in our institute, the biopsy rounds. Short of performing an autopsy, where consent for the autopsy becomes the most significant stumbling block, postmortem biopsies, which can be performed more liberally compared to antemortem biopsies with its inherent risks, can be an excellent resource for CPCs. Such a CPC model based on postmortem biopsies has been well established at the All India Institute of Medical Sciences, New Delhi. For conducting a CPC all that is required is a good histopathology setup with digital photography, and a regular seminar hall and audiovisual setup. Clinicopathological conference can hence be a part of any patient-care setup, irrespective of it being a public or private setup.

Case Study 1: Signet-ring cell carcinoma of stomach misdiagnosed as tuberculosis

Clinical presentation

A 40-year-old female patient presenting following complaints:

- *Pain in abdomen (3 months)*: Off-and-on, upper and central abdomen, colicky increased after meals, associated with occasional vomiting and constipation.
- *Fever (3 months)*: Low grade with evening rise, no chills or rigor, associated with cough and scanty mucoid expectoration.
- *Abdominal distension (2 months)*: Progressive, diffuse, history of abdominal paracentesis.
- *Altered sensorium (1 day)*: Gradual deterioration leading to abnormal behaviour and irrelevant talk.
- History of significant weight loss and loss of appetite.
- No history of gastrointestinal (GI) bleed, jaundice, awareness of lump, postmenopausal bleeding.

Past history and family history

No significant medical illness.

General physical examination

- Drowsy.
- Pulse – 108/min and blood pressure – 110/80 mmHg.
- Afebrile, dehydrated.
- Pallor, no oedema, icterus, cyanosis, clubbing.
- Small cervical and axillary lymph nodes are palpable.
- No signs of chronic liver disease and cutaneous markers of visceral malignancy.
- *Chest*: Normal
- *Cardiovascular system*: Normal
- *Abdomen*: Distension
- Vague lump in umbilical region, possibly palpable bowel loops. Free fluid and bowel sound present.
- Liver and spleen not palpable.
- *Central nervous system*: E4 M5 V3, disoriented, agitated behaviour. No meningeal signs, cranial nerves grossly normal, pupils normal. No obvious focal motor deficit, deep tendon reflexes (DTR) normal, mute plantars.

Investigations

- *Haemogram*: Haemoglobin (Hb), 6.6 g%; total leucocyte count (TLC), 18,600/mm³; polymorphonuclear leucocytosis, platelets, 3,36,000/mm³; ESR, 59.
- *Coagulogram*: Prothrombin time (PT), 36 s; prothrombin time index (PTI), 36%; partial thromboplastin time activated with kaolin (PTTK), 83 s; fibrinogen, 2064, D-dimers positive.
- *Biochemistry*: Na⁺, 151 mEq/L; K⁺, 4.4 mEq/L; urea, 115 mg%; creatinine, 1.2 mg%; bilirubin, 0.3 mg%; aspartate aminotransferase (AST), 114 U/L; alanine aminotransferase (ALT), 102 U/L; alkaline phosphatase, 60 U/L; albumin, 2.2 g/dl; globulin, 2.9 g/dl; magnesium, 1.1 mg%; amylase, 23 U/L; serum uric acid, 15.6 mg%; lactate dehydrogenase (LDH), 1223 U/L (normal 240–480 U/L).
- *Fluid analysis*
 - Ascitic fluid: TLC, 30/mm³; neutrophils, 30; lymphocytes, 70; protein, 2.8 g/dl; sugar, 122 mg%; serum-ascites albumin gradient (SAAG), 1.1; adenosine deaminase (ADA), 3.0 U/L; amylase, 7.6 U/L; no malignant cells, sterile.
 - Pleural fluid: TLC, 100; L100, protein 2.1 Gm, sugar 183, ADA 10, sterile.
- *Urine*: Sugar, nil; Protein, nil; Pus cells, 4–5 /HPF; spot Na⁺, 23 mEq/L.
- *Lipid profile*: Cholesterol, 137 mg%; triglycerides, 136 mg%; low-density lipoprotein, 76 mg%; high-density lipoprotein, 21 mg%.
- *Anti-hepatitis B surface antigen (HBsAg)*: Negative; *Anti-Hepatitis C virus (HCV)*: Negative.
- *Ultrasound*: Gross ascites with septations, dilated fluid-filled small bowel loops.
- *Computed tomography (CT) abdomen and chest*: Gross ascites and pleural effusion, omental thickening, matted

loops of intestines, small mesenteric lymph nodes, thrombosis of right common iliac and internal iliac veins, nodular lesion in upper lobe of right lung.

- **CT angiography:** No evidence of pulmonary thromboembolism.
- **Electrocardiography (ECG):** ST segment depression in II, III, aVF, V4–V6.

Course and management

Patient was on antitubercular therapy (ATT) (category III) for 1 month, but without response. Metabolic abnormalities were corrected after admission and ATT was continued. Vitamins and calcium supplements were given.

Intravenous antibiotic, Ceftriaxone, was given initially, later on changed to cefepime, levofloxacin and metronidazole. She developed hypotension on third day of admission; inotropic support and hydrocortisone were started. Surgical consultation was taken and abdominal drains were put in flanks that drained serous fluid. Computed tomography scan showed evidence of right iliac vein thrombosis, so unfractionated heparin was started. The patient however continued to deteriorate and expired.

Unit's diagnosis

- Subacute intestinal obstruction
- Ascites
- Pleural effusion
- Disseminated tuberculosis
- Intra-abdominal sepsis

Cause of death

Multifactorial—sepsis, refractory shock, possible pulmonary thromboembolism (PTE).

Pathology presentation: Autopsy findings

- Partial autopsy, brain not examined.
- **Peritoneal cavity:** 2.5 L haemorrhagic fluid; both pleural cavities: 2 L pale-brown fluid.
- **Stomach**
 - **Gross:** Congested mucosa. Single ulcer measuring 3 × 4 cm with everted margins seen in the body. Ulcer base grey-white. Cut surface: Whitish, firm to feel with thickened wall. Remaining mucosa showed haemorrhagic discolouration. Serosa showed 0.2–0.8 cm diameter whitish nodules with serositis.
 - **Micro:** The ulcerated area shows diffuse ulceration of the mucosa up to muscularis propria. Diffuse infiltration by the large malignant cells, predominantly singly and in small groups. Some of the cells (>10%) showed signet-ring-cell morphology. Tumour is seen infiltrating transmurally, forming nodules over the serosa. The cells were positive for alcian blue and cytokeratin 20. Other areas showed haemorrhagic necrosis of the mucosa.

• Gastrointestinal (GI) tract

- **Gross:** The intestinal loops were adherent to each other. Serosal aspect studded with 0.5–1 cm diameter grey-white firm nodules. Mucosa showed congestion.
- **Micro:** Infiltration by the tumour cells from the serosal aspect and involving the submucosa. Appendix showed transmural infiltration by the tumour with denuded lining.
- **Mesentery:** Large tumour deposits with exuberant desmoplastic response.

• Ovaries

- **Gross:** Both ovaries measuring 3.5 × 2 × 1 cm. Surface bosselated, whitish and firm-to-feel. Cut surface: Grey-white areas interspersed with haemorrhagic areas.
- **Micro:** Nodular and diffuse infiltration of the stroma by tumour cells present singly and nodules. Signet-ring appearance is prominent. Serosal infiltration is present. Tumour cells were alcian-blue positive (Figure 59.1).

• Uterus

- **Gross:** Appears slightly bulky. Serial slicing revealed no focal lesions.
- **Micro:** Atrophic endometrium. Small, nodular and single-cell infiltration within the myometrium.

• Lungs (650 g)

- **Gross:** Subcrepitant with oedema fluid. Focal patchy consolidation in the right middle lobe. No tumour deposit seen grossly.
- **Micro:** Patchy bronchopneumonia with pulmonary thromboembolism (PTE).

• Diaphragm: Nodular grey-white deposits on the under-surface. **Micro:** Metastatic tumour deposits.

• Liver (1170 g): **Gross:** Exaggerated mottling. **Micro:** Centrizonal haemorrhagic necrosis with cholestasis. Micro and macrovesicular fatty change is seen.

• Heart (250 g): **Gross:** Normal. All chambers and valves are normal. **Micro:** Terminal ischaemic changes are seen.

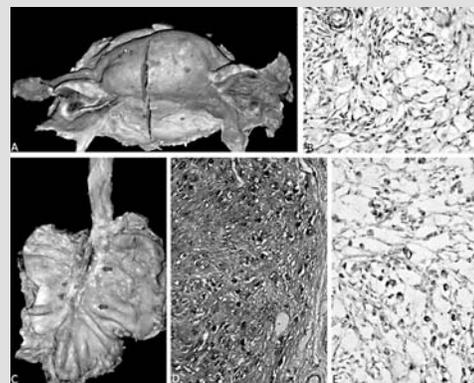


Figure 59.1 (A) Photograph of the uterus and bilateral ovaries (B) Section from ovary showing signet-ring carcinoma cells. (C) Serosal aspect of stomach showing nodules (Arrow). (D) Alcian-blue-positive tumour cells. (E) Immunohistochemistry for cytokeratin 20 showing positivity in tumour cells.

Final autopsy diagnosis

- Signet-ring cell carcinoma of stomach with metastasis
- Bilateral ovaries (Krukenberg's tumour) and uterus.
- Transperitoneal spread to diaphragm, and small and large intestine.
- Patchy bronchopneumonia and pulmonary thromboembolism.
- Features of shock—Liver.
- Ascites and bilateral pleural effusion.

Case Study 2: Amyloidosis misdiagnosed as cardiomyopathy**Clinical presentation**

A 30-year-old female patient with following complaints:

- Shortness of breath, cough, pain in abdomen, loss of appetite and weight loss for 3 months.
- Puffiness of face and abdominal distention for 1½ months.
- Pain and paraesthesias in both the lower limbs for 2 months.

The patient was initially evaluated in internal medicine services and diagnosed as a case of primary Sjogren's syndrome with leucocytoclastic vasculitis and hypertrophic cardiomyopathy with restrictive physiology. The patient was treated symptomatically, discharged on diuretics and referred to cardiology services.

She was subsequently evaluated in cardiology outpatient department and admitted for elective catheterisation and endomyocardial biopsy, and was discharged after 3 days. After 12 days of biopsy, patient was readmitted to cardiothoracic unit in view of worsening symptoms.

Examination

Conscious; oriented; BMI, 14.58 kg/m², Pulse, 98/min; regular, normal volume and character; blood pressure (BP), 100/70 mmHg; respiration, 26/min; thoraco-abdominal pallor, jugular venous pressure (JVP) raised. No icterus, clubbing, cyanosis, lymph nodes, pedal oedema.

Cardiovascular system

Apex at sixth intercostal space 1 cm lateral to midclavicular line with grade I parasternal heave, S1S2 normal, LVS3+, RVS3+ without any audible murmurs.

Respiratory system

Breath sounds reduced in bilateral infra-axillary and infra-scapular areas with stony dull note, no added sounds.

Abdomen

Distended, mild tender liver palpable 7 cm below the right costal margin, no splenomegaly, free fluid present, bowel sounds present.

Central nervous system

Generalised wasting, cranial nerves normal, tone normal; power—4/5 in all examined muscle groups, no objective sensory loss and joint position sense, Romberg sign negative.

Investigations

- *Haemogram*: Hb, 10.2 g%; TLC 9300/mm³, platelets, 5,57,000/mm³.
- *Biochemistry*: Na⁺, 42 mEq/L; K⁺, 47 mEq/L; urea, 28 mg%; creatinine, 0.08 mg%; bilirubin, 0.6 mg%; total protein, 6.8 g/dL; albumin, 3.5 g/dL; aspartate aminotransferase, 26 U/L; alanine aminotransferase, 32 U/L; alkaline phosphatase, 381 U/L; calcium, 8.8 mg%; magnesium, 3.1 mg%; phosphorus, 4.4 mg%.
- Prothrombin time and *International normalised ratio (PT/INR)*: 2–3.
- *Urine routine and microscopy*: Normal; Urine for mucopolysaccharides is negative.
- *Iron profile*: Serum iron, 110 µg/dL; total iron binding capacity (TIBC), 633 µg/dL; transferrin saturation, 17%.
- *Anti-human immunodeficiency virus (HIV)/HBsAg/HCV*: Nonreactive.
- *Thyroid profile*: T3, 0.7 (0.6–1.2); T4, 6.09 (4.8–12); Thyroid stimulating hormone (TSH), 42.37 (0.3–4.2); anti-TPO (thyroid peroxidase) antibody, 150.8 (<34.9); Free T3, 2.13; Free T4, 1.27; TSH, 31.9.
- Antinuclear antibodies (ANA), speckled; lupus anticoagulant, negative; antiphospholipid antibody (APLA), IgG negative; cardiolipin, IgG/M negative; serum homocysteine, 8.37 mmol/L.
- *Skin biopsy*: Leucocytoclastic vasculitis.
- *Serum acetylcholine esterase (ACE) level*: Normal.
- *Abdominal fat pad for amyloid*: Negative.
- *Nerve conduction studies*: Suggestive of bilateral lower limb sensorimotor axonal polyneuropathy.
- *Ascitic and pleural fluid analysis*: Transudative, increased cell counts—200 predominant neutrophils.
- *Chest X-ray*: Bilateral pleural effusion and increased bronchovascular markings.
- *Electrocardiography (ECG)*: Low-voltage QRS complexes, T-wave inversion in V4–V6.
- *24-hour Holter monitoring*: Normal.
- *Echocardiography*: Biventricular hypertrophy, severe left ventricular dysfunction, bilateral atria dilated, mild mitral regurgitation, moderate low-pressure tricuspid regurgitation, features suggestive of restrictive physiology.
- *Cardiac catheterisation*: Elevated right atrial pressure, pulmonary capillary wedge pressure, right ventricular end diastolic pressure (RVEDP), left ventricular end diastolic pressure (LVEDP); difference of 5 mmHg in between RVEDP and LVEDP, dip and plateau sign in LVEDP.

- *Contrast-enhanced computed tomography (CECT) scan, chest and abdomen:* Gross right and mild left-sided pleural effusion, hepatic vein congestion, moderate ascites.
- *Doppler study:* Inferior vena cava (IVC) and hepatic veins are dilated with anechoic lumen, no e/o any narrowing/thrombus seen. Hepatic veins show normal colour flow and spectral pattern, and normal phasic variation.
- *Doppler of both lower limbs:* Echogenic luminal contents in posterior tibial artery—possibly thrombus—causing moderate luminal narrowing with reduced peak systolic velocity (PSV) distally.
- *Right ventricular endomyocardial biopsy:* Distortion of myofibres and deposition of pale-blue material positive for alcian blue, mild patchy interstitial fibrosis and anisonucleosis, no evidence of atrophy or hypertrophy. IMPRESSION: infiltrative disorder related to mucopolysaccharodosis.
- *Left ventricular endomyocardial biopsy:* Pale-blue material dissecting through myocardial fibres, which is positive for alcian-blue stain, no features of myocarditis. IMPRESSION: Possibility of myxedema of heart is considered in view of a known case of hypothyroidism.
- *Slit-lamp examination:* No corneal opacities are seen.
- *Fundoscopy:* Normal.

Course and management

Oral warfarin was started in view of thrombosis. Tablet levothyroxine 12.5 µg was started after endocrinology consultation for elevated TSH levels.

During course of stay, patient developed worsening shortness of breath and pedal oedema. Investigation revealed increase in pleural effusion. Intravenous antibiotics were started and dose of diuretics was increased, and 1300 mL pleural fluid was tapped. She developed loss of consciousness followed by cardiac arrest from which she was revived and put on mechanical ventilation along with inotropic support. She suffered a second cardiac arrest; cardiopulmonary resuscitation was done, had recurrent ventricular tachycardia, did not respond to direct current (DC) shock and started on amiodarone infusion. Asystole was recorded and hence patient was declared dead. Autopsy was performed after informed consent.

Unit's final diagnosis

- Infiltrative cardiomyopathy with restrictive physiology.
- Subclinical hypothyroidism/autoimmune thyroiditis.
- Leucocytoclastic vasculitis.
- Bilateral lower limb sensorimotor axonal polyneuropathy.

Cause of death

Ventricular arrhythmia and refractory cardiogenic shock.

Pathology presentation: Autopsy findings

Limited autopsy was performed through a thoracic incision.

- *Serous cavities:* 600 mL straw-coloured fluid in both pleural cavities and 80 mL in pericardial cavity.
- *Heart (380 g)*
 - **Gross:** Dark brown in colour, waxy. Thrombus in right atrium. Left ventricle (LV) and right ventricle (RV) wall hypertrophy, measuring 1.6 and 0.8 cm, respectively. Left ventricular cavity narrowed, RV dilated with mural thrombi. Coronaries normal.
 - **Micro:** Endocardium thickened with deposition of pale eosinophilic, amorphous material in subendocardial region extending deep into myocardium in the interstitium surrounding myocytes. This material was congophilic with apple-green birefringence under polarised light. Electron microscopy confirmed fibrils of amyloid. In addition, there was deposition of myxoedematous material, which was alcian-blue positive within interstitium and around vessels. The interstitial vessels showed luminal narrowing with amyloid deposition (Figure 59.2).
- *Spleen (280 g)*
 - **Gross:** Enlarged. Multiple pale old infarcts, largest measuring 2–1 cm seen. *Cut surface* brownish in colour.
 - **Micro:** Depletion of white pulp. Red pulp replaced by congophilic material, confirmed to be amyloid. Large artery showed a thrombus. Infarct confirmed microscopically.
- *Liver (1200 g)*
 - **Gross and cut surface:** Alternate pale and dark areas, firm in consistency.
 - **Micro:** Sinusoidal and perivenular deposition of amyloid. The hepatic arteries showed similar amyloid deposition.
- *Kidneys (320 g)*
 - **Gross:** Enlarged and waxy with old infarcts.
 - **Cut surface:** Brownish discolouration.
 - **Micro:** Marked deposition of congophilic material around vessels and interstitium. Less than 5% of glomeruli showed focal deposition of similar material. The segmental arteries and vein also showed amyloid deposition. Occasional vessels revealed fresh thrombus and fibrointimal proliferation causing luminal occlusion. Infarcts confirmed microscopically.
- *Thyroid:* Features of lymphocytic thyroiditis with interstitial and perivascular deposition of amyloid.
- *Bone marrow:* Interstitial deposits of amyloid.
- *Pancreas and GIT:* Vascular and interstitial deposits present.
- *Lungs (650 g):* **Gross:** Subcrepitant. **Micro:** Interstitial widening with focal lymphocytic infiltrate. Prominent interstitial vessels with medial hypertrophy and intimal proliferation.

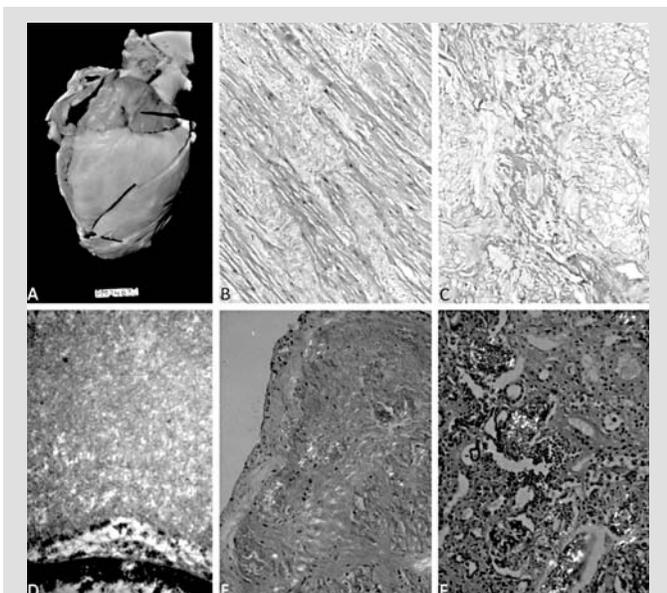


Figure 59.2 (A) Gross photograph of heart. (B) Section from the myocardium showing infiltration by pale interstitial material. (C) Masson's trichrome stain of myocardium. (D) Electron micrograph showing amyloid fibrils. (E) Apple-green birefringence under polarised light in myocardium (amyloid). (F) Apple-green birefringence under polarised light (amyloid) in glomeruli and blood vessels of kidney.

Final autopsy diagnosis

- *Primary systemic amyloidosis*: Heart, kidneys, liver, spleen, thyroid, pancreas, gastrointestinal tract (GIT), stomach and bone marrow.
- Pulmonary vasculopathy.
- Lymphocytic thyroiditis.
- Leucocytoclastic vasculitis.
- Myxoedema heart.

POINTS TO PONDER

The above two cases exemplify two situations: One where a fairly accurate clinical diagnosis is deducible with available investigations and the other where, despite all investigations, the final diagnosis comes as a surprise. In both the situations, learning through a case study revolves around a correct deduction of the relevant clinical details available, not necessarily ending in an accurate diagnosis.

The whole exercise depends on the honesty with which a particular case is presented. The clinician should present an unbiased opinion on the case, not influenced by the pathologist whatsoever and the pathologist in turn should present all the findings, including the ones that remain unexplained, and not focusing solely on the findings that differ with the clinical deduction. The degree of professional secrecy, which

the exercise demands from the pathology team is inherently required and needs to be respected. The audience in turn should always give a healthy participation, keeping always in mind not to create a war zone between the clinician and the pathologist. Active participation of the radiologist, microbiologist, molecular biologist and all other pertinent specialties enriches the content under discussion.

It is to be kept in mind that CPC case presentation is neither the sole responsibility of the presenter nor is it the testing of the clinical acumen of the presenter alone. A thorough discussion of the case with experts and senior colleagues thus before case presentation should always be part of the exercise. What is important is a logical and relevant analysis of the problem put forth for discussion and not put forth a personal opinion on the case.

Performing a good autopsy paves the way to a good CPC discussion and providing the correct final diagnosis. The team performing the autopsy should therefore be thorough and meticulous in recording findings when the tissue and lesions are relatively fresh and unfixed. In addition, sampling all relevant materials, viz. effusion fluids, bone marrow, imprint smears, sampling the pituitary, thyroid, parathyroids, lymph nodes, skeletal muscle and skin apart from the viscera has to be kept in mind. Collecting heart blood for microbiological investigation under aseptic conditions, storing serum/plasma, fresh tissue for immunofluorescence/enzyme studies and extracting DNA/RNA from pertinent material should be kept in mind. Similar meticulousness applies to biopsy-based material.

The exercise is immensely educative not only to the clinician to arrive at an accurate pathological diagnosis but also to the pathologist to make a clinical correlation of the pathological findings. In addition, case presentation in front of a large audience boosts confidence not only in the students, but also in the faculty as well.

CPC IN THE NETWORK: TELE-CPC

*Working in isolated environments where access to peers, education and information is limited is one of the highest risk factors for physicians' loss of medical competence.*³ Continued medical education thus is the key to medical competence. The limiting factor however is access to medical education. Resources in healthcare are not evenly distributed and this equally applies to resource of medical education. This holds true not only for the economically weaker sections of the medical fraternity but also to the advanced communities where everyone does not have equal access to medical resources and experience of decreased access to education is not uncommon.

Education, in its traditional concept involves three components: Learning resources, an instructor and a learner interacting at site and requiring the physical presence of

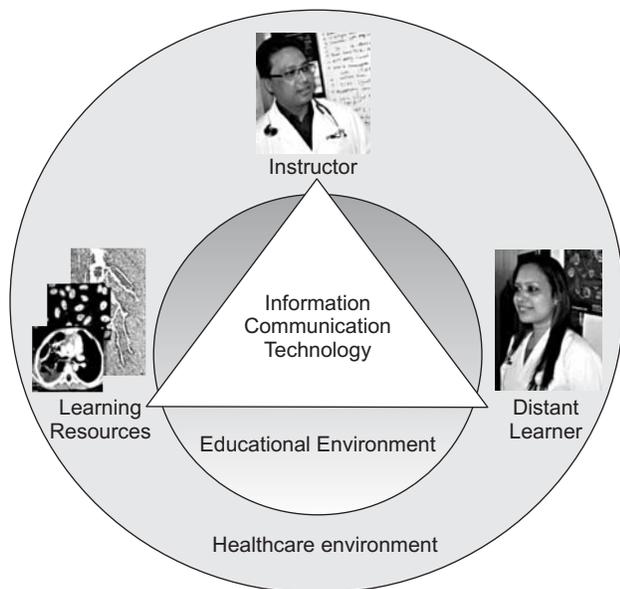


Figure 59.3 Role of information communication technology in medical education.

both the instructor and the learner (Figure 59.3). With context to CPCs, this situation represents the institute where the CPC is being conducted. For wider audience participation, the physical barrier of distance and time requires to be bridged. This is where information communication technology (ICT) has to play a role. Through ICT, there is a great opportunity to improve access to medical education, improve quality of education, and facilitate collaboration between individual learners and institutions. The Telemedicine Centre at PGIMER has been instrumental in popularising the concept of tele-CPCs over the past few years. Equipped with all modern technological gadgets required for ICT, the telemedicine facility now transmits these sessions real-time through broadband and satellite-based communications to multiple educational institutions in the region.

Telepathology is the use of telecommunication technology as a means to facilitate transfer of image-rich pathology data between remote locations for the purposes of diagnosis, education and research. Tele-CPC is an extension of telepathology and hence all concepts that apply to good telepathology practice become pertinent to tele-CPC (Figure 59.4).

Equipments required for setting up a tele-CPC setup are:

- Transmitting end
 - Video conferencing system (multipoint)
 - Projector
 - Monitor
 - Broadband connectivity
- Receiver end
 - Video conferencing system (single point)
 - Projector
 - Projection screen
 - Broadband connectivity

Exercise

The clinical handout that is prepared for the case is distributed to the receiver end 2–3 days prior to the session by email. The coordinator of the CPC at the receiver end ensures distribution of the clinical handout to the participants. The connectivity of the network is ensured well before the session starts and the participating ends are connected. The local video and the PowerPoint presentations are transmitted online as the session progresses.



Figure 59.4 Screenshots of a multiparticipant tele-CPC session in progress.

Drawbacks/Lacunae

The major constraint is of a seamless and efficient connectivity. Dedicated broadband connectivity is the optimum requirement, and even with such availability, a failure or interruption in transmission is always a possibility. For a two-way or multiparticipant discussion/interaction, time constraint restricts lengthy discussions. Regular feedback from participants should always be taken and troubleshooting done on a day-to-day basis to maintain continued participant interest in the sessions. The pathologist should keep in mind that efficient transmission of images across the internet or any other ICT network requires image compression to decrease file size. While the images can be stored at the highest resolution possible, for the purpose of transmission, file size should be smaller and images compressed.

The author has described a CPC model that is already established, but the technological evolution is ongoing, and improvements in the techniques and the advanced logistics

and equipments would pave the way for better CPCs conducted in future. The current model too has evolved greatly over time. The spirit of the CPC however has remained same over the years, and should remain same in times to come, and that is to provide efficient and quality medical education through case studies.

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Use of Information and Communication Technology in Healthcare Services

60

Gp Capt (Dr) Sanjeev Sood

“The difficulty lies not so much in developing new ideas as in escaping from the old ones.”

—John Maynard Keynes

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the scope and potential of information and communication technology (ICT) applications in transforming healthcare delivery system.
- identify facilitators and barriers to adoption of such ICT use.
- envision the potential of future growth of ICT in healthcare delivery system in India.

INTRODUCTION

Technology is a big enabler and differentiator that has revolutionised the delivery of quality healthcare. It improves the overall operational efficiency, speeds up workflows, curtails turnaround time (TAT), reduces medication errors and improves clinical outcomes. Low-cost and high-impact information and communication technology (ICT) solutions reduce overall cost in a healthcare organisation and average length of stay (ALOS) of patients in the hospitals. Applications using mobile telephone and telemedicine can greatly enhance the accessibility and penetration of healthcare services, and overcome barriers in delivery of equitable healthcare. ICT improves communications among care providers and providers-to-patients, thus eliminating medication errors, 70% of which have miscommunication as their root cause. Additionally, transactions on computer create an audit trail that improves accountability of care providers. Further, having more consistent data as generated by ICT systems promotes best practices and adherence to evidence-based medicine. Finally, the processes once devised by IT system help hospital stays compliant with State regulations.^{1,2}

Indian healthcare sector has been slow in incorporation of ICT solutions due to various reasons. Whereas, there has been no doubt in utility of low-cost and high-impact ICT

solutions to automate back- and front-end office functions, the adoption of other sophisticated high-cost and high-impact technologies like electronic medical records (EMRs), computerised physician order entry (CPOE) and clinical decision support system (CDSS) by doctors and hospitals has been impeded by resistance to changes in physician's practice patterns, high cost and time involved in training, future systems and national standards.

This chapter discusses the role of ICT in reducing human errors and improving patient safety, and recommends these as an essential tool for delivery of quality and evidence-based healthcare. Further, the availability of appropriate software, IT infrastructure and training of end-users to support and effectively utilise these systems is examined in Indian healthcare scenario.

CHALLENGES IN IMPLEMENTING INFORMATION AND COMMUNICATION TECHNOLOGY IN HEALTH

Most sectors lag behind in keeping pace with revolutionary changes occurring in information and communication technology in the past one decade. The adoption of meaningful information technology (IT) and EMRs has been slow all over the world, including United States (US) hospitals. Social sectors like healthcare and education are the most laggards in embracing ICT due to various barriers, such as

lack of resources and initial costs involved in implementation of technology projects. Further, at least the senior lot of healthcare providers is less techno savvy and resistant to change. Once installed, healthcare professionals (HCPs) have limited option for trial and to experiment with IT applications like health management information system (HMIS)/electronic medical records (EMRs). Further, HMIS/EMR innovation is inconsistent with adopters' values and beliefs; physicians view guidelines and protocols as 'cook-book' medicine. The approach to project implementation is fragmented and piecemeal in most healthcare organisations (HCOs). There are issues like interoperability, standardisation, seamless connectivity, lack of overall policy and clear long-term vision in ICT adoption in healthcare. There are also some unfounded concerns like dehumanisation of patient care, security and confidentiality of data, loss of employment due to automation, loss of customer base by sharing patient medical records, erosion of clinical acumen and perceived value of IT applications for patients. Many problems associated with HMIS/electronic health records (EHRs)—tedious data entry, increasing of staff workloads, poor user interface, disrupted workflow, faulty connectivity and inadequate software updates—have been gradually solved over the past decade by early adopters. Other challenges in healthcare delivery system is that it is incredibly complex and uniquely personal, making IT system designing a daunting task, unlike repetitive, factory chores in manufacturing industry, where one size may fit all.^{2,3}

ICT Adoption in Healthcare – A Mandate by WHO

According to Millennium Development Goals (MDGs), especially target 18, the benefits of ICT should be made available to healthcare sector. The pioneer institutions of quality and patient safety of global repute like National Academy of Sciences, Institute of Medicine, Institute of Healthcare Improvement and US Agency for Healthcare Research and Quality, strongly recommend use of ICT in improving quality of healthcare. Today, it is not a question of why, but how much and how soon? IT can enhance operational efficiency, curtail TAT of workflows, eliminate barriers of distance and inequity, reduce medical errors, manual workload, space requirements, improve clinical outcome and contain costs. Thus, IT is an important tool in achieving overall quality in healthcare today, if not panacea for several ills afflicting healthcare sector.

MEASURES TO ENHANCE ICT ADOPTION IN HEALTHCARE

The healthcare providers need to be more aware about IT applications in healthcare and see value for their patients by adoption of IT solutions. The success of IT projects depends on successful synergies between people, processes and technologies from the stage of inception. If any of these key

players is out of sync or not involved from the project inception stage, the project may not see the light of day.

The government as well as various professional bodies need to reward and incentivise (e.g. payment policy, rebate in accreditation fees or soft loans) healthcare organisations that adopt ICT with 'meaningful use' in their organisations. This will require formulation of appropriate ICT policies, guidelines and standards. Ministry of Health and Family Welfare, India, is in the process of finalising these details. Thus, while additional legislation is needed, it must be crafted in such a way that make revolution in healthcare information possible, and does not scuttle innovation and paralyse this revolution with possible unintended consequences, such as inability to effect the necessary cultural changes.^{4,5}

Achieving the full potential of ICT applications in healthcare will be challenging, but possible. If it is to occur, substantial investment will be needed to galvanise this change.

INVESTING IN ICT APPLICATIONS IN HEALTHCARE

Information and communication technologies is now so pervasive and essential that it must be treated as a lever for reducing overall costs—not only as overhead to be slashed. Healthcare organisations in India currently invest less (approximately <2%) in IT than in any other information-intensive industry, and, not surprisingly, current systems are relatively rudimentary, compared with industries such as finance or aviation. Firstly, they view IT expenditure as an overhead to be slashed, rather than cost-containment tool in the long run. Secondly, the decision makers mix up IT budget with other technologies, such as medical equipments and devices.

Furthermore, certain aspects of the industry—such as payment policies that are based on volume of patients seen or procedure performed rather than quality of outcome—do not promote IT investment. Successful implementation and seamless integration of ICT solutions into their work culture is indeed a challenging task for any Indian hospital. Nonetheless, a number of organisations have demonstrated that quality can be substantially improved if IT is used effectively in improving healthcare. However, there is still a great opportunity, since total market for Indian healthcare IT is approximately 3 billion USD.

Challenges in Technology Appraisal

The economic appraisal of IT projects and its value realisation needs systemic analytic approach applying knowledge-spanning disciplines of project management, cost accounting and finance. Calculation of return on investment of IT projects must include realisation of the following realities:

- IT projects have long gestation period and payback should be looked at only after 3–5 years.

- Most IT applications and solutions yield several intangible benefits such as improving healthcare quality, efficiency and accessibility, and are difficult to assign any monetary value.
- Certain benefits of IT adoption such as coordinated and efficient care extend and span beyond the organisational units due to integrated delivery systems. For example, use of data analytics may provide treatment breakthroughs in cancer by offering personalised medicine—the benefits may extend far beyond the immediate financial gains by the organisation.
- In situations, where the cost/impact outcomes are equivocal, more stringent methodologies to rigorously measure the magnitude of the changes in outcome vis-à-vis cost like cost-benefit, cost-utility analysis or cost-effectiveness needs to be applied.

Low-cost ICT Solutions

There are several low-cost and sustainable ICT solutions for effective healthcare delivery. The widespread penetration, accessibility and low tariffs in mobile services can be used to improve communication, counselling, reminders (appointments, immunisation schedules), contacting blood donors and treatment compliance in healthcare. Hospitals can begin with building the 'pyramid' of clinical information systems with a master patient index and results retrieval, admission, discharge, transfer and pharmacy modules. Back-end and front-end support services can be easily automated and implemented. Any physician with a webcam, broadband connectivity and minimal infrastructure can practice telemedicine.⁶

Interoperability Standards

Healthcare organisations must plan to adopt all softwares that comply with interoperability standards such as HL7, DICOM, X12, etc. Even the homegrown software should be made compliant to interoperability standards (Figure 60.1).⁷

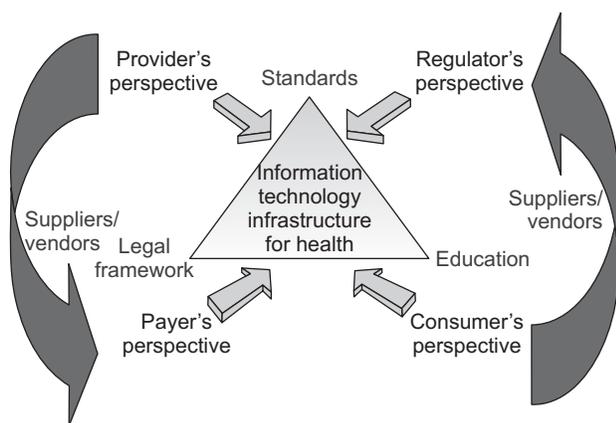


Figure 60.1 IT in healthcare ecosystem.

Change Management

Large healthcare-IT projects like HIS/EMR or ICD-10 implementation should never be treated as an isolated IT project. The team doing the implementation should have predominantly healthcare skills with some IT experience, not vice versa. All stakeholders, particularly end-users should be involved from the stage of conception to completion. The leader of the implementation project should be a Physician Executive with seasoning in IT and management. These are catalysts for change management. This team of the hospital should use this as an opportunity to drive people, process and technology improvements across the enterprise. The critical success factor is an adoption of the healthcare IT system involving all stakeholders and synchronising people, processes and technology.⁷

CLOUD COMPUTING AND SOFTWARE AS A SERVICE (SAAS)

The concept of cloud computing ensures on-demand flexible broad network access to a shared pool of computing resources to users of diverse nature. Cloud computing and SaaS IT delivery models can be viewed as a set of virtual servers working in tandem over the networking grid with immense computing power and storage capacity in terabytes. Cloud computing can help organisations lower ITs capital costs, since organisations rent capability instead of owning hardware and software. Clouds have also enabled organisations to scale their IT capabilities up and down in response to fluctuating customer demand. These IT models can universalise availability of IT applications at an affordable cost to even smaller nursing homes and clinics that provide 80% of hospital beds in India. Their technologies are inexpensive and barely need any maintenance. The data security concerns in networking grids can be suitably overcome by virtualisation and SSLs. In addition to healthcare, these technologies can also be useful for pharmaceutical analysis, storage of images, national databases and bio-surveillance.⁶

ADVANTAGES OF ICT ADOPTION IN HEALTHCARE

Information and communication technology in healthcare is a big enabler and has revolutionised the way the healthcare is delivered, e.g. telemedicine can eliminate the barriers of distance, inequity and high cost in healthcare. HMIS, laboratory information system (LIS), radiology information system (RIS) and picture archiving and communication system (PACS), facilitate collection, storage, retrieval, and transfer of information and images, smoothly and seamlessly across the continuum of healthcare spectrum. It can reduce TAT of workflows and improve operational efficiency. EMRs can reduce incidence of drug allergies and interactions, save storage space and can be accessed anywhere anytime for any duration of time by the treating physician. Computerised

provider order entry (CPOE) and clinical decision support system (CDSS) can reduce the medication errors due to human factors: poor handwriting, memory lapses, fatigue and distraction, and prevent cognitive foreclosure and facilitate early and accurate diagnosis. Business intelligence systems can make the administration and control of healthcare organisation more effective, efficient, productive and on real-time basis. Computerised dose planning for radiotherapy of tumours has been found to be superior as compared to conventional methods. When interfaced with biomedical equipment, IT applications can monitor critical parameters of patients, capture this data and analyse any systemic changes to this data, thus predicting trends. Applications of mobile telephony in healthcare (mhealth) can improve communications, tackle inefficiencies in healthcare, and improve treatment compliance and healthcare accessibility. The laboratory analysers and biomedical equipment can be interfaced with HMIS-generating alerts and cautions, thus improving patient safety. Radio frequency identification (RFID) can eliminate patient misidentification and make inventory management more efficient. Bar coding can eliminate hazards due to spurious drugs. These applications curtail average length of stay (ALOS), allowing larger number of patients being treated on same bed complement—a scarce healthcare infrastructure resource in India. Also, all computer transactions create an audit trail that increase accountability. In addition, having more consistent data to promote best practices that make the hospital more efficient, and patients safer and healthier. Finally, the IT systems help the hospital to comply with government regulations.^{8,9,10}

Only few Indian hospitals have started to archive their data into warehouses, so as to subsequently use it for the purpose of research, data mining and analytics to facilitate fact-based decision making.

Availability of 108 (24 × 7 ambulance services) that use blend of technologies can tremendously improve pre-hospitalisation care and save lives during initial critical hours. There are several other ICT applications like automatic dispensing and drug distribution system, robotic surgery, human genetics, early warning, and response system for epidemic and disaster prediction (BioSense Real-Time Clinical Connections Programme) and statistical software in combination with other modern technologies that can transform the delivery of healthcare for both provider and patients. Thus, IT and automation of healthcare services is an indispensable and vital tool to cross the quality chasm.

Can ICT Use do any Harm to Patients?

It is often said that man should ride the horse and not the vice versa. If not used or designed properly, ICT can prove to be the bane for human society. Unsupervised and uncontrolled use of ICT can play havoc with patient safety. For example, overdosing has been reported if drug administration is totally left to automation. Cases of wrong

laboratory reports or wrong billing are often seen due to computer errors. When feedbacks from patients or their caregivers are given a go-bye due to ICT use, there is a definite lack of 'human touch'. Many a times, loss of data has also been reported due to crash of computer systems. Many instances are also reported where the use of ICT has further complicated the official procedures, rather than simplifying the access of people to quality healthcare. These effects get amplified with usage of IT, and can have much wider impact and implications as far as patient safety is concerned. Further, anything that slows or disrupts the clinician's workflow could negatively affect patient safety.

ROLE OF ICT IN PUBLIC HEALTH

Well-conceived and appropriately designed ICT solutions can be as effective a tool in public health domain as in a tertiary-care hospital setting in achieving pre-stated objectives. Certain ICT initiatives at national and local level can help achieve MDGs through better and efficient management of healthcare resources, information, and improved accessibility and universalisation of healthcare services.

The MDGs place health at the heart of human development and economic growth by tackling ill-health and poverty. Three of the eight goals are directly health related and all other goals have important indirect effects on health. *Goal 4* aims to reduce child mortality; *Goal 5* aims to improve maternal health and *Goal 6* endeavours to combat human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDs), malaria and other infectious diseases by the year 2015. India is a signatory to the Millennium Summit held in September 2000 at New York, amongst 188 other nations, and committed to achieve MDGs by 2015. ICT plays a crucial role in achievement of these goals.

ROLE OF ICT IN DATA ANALYTICS IN HEALTHCARE

In recent years, there have been many breakthroughs in medical data management systems, e.g. data-capturing technologies, data standards, data storage, etc. this has facilitated large-scale analysis of healthcare data. The obvious result is speeding up of decision making in health and hospital administration. Even private medical sector has visualised tremendous business opportunities by adopting ICT in their daily operations.^{9,11}

Defining Data Analytics

All this comes under the purview of data analytics. Thus, it involves use of statistical packages to process healthcare data. This helps in developing appropriate models to improve healthcare management by refining decision making. On this basis new disciplines like medical business intelligence have been developed to monitor the performance of

hospital/health services. The approach starts with a good-quality data. This data is manipulated or processed into information that is valuable, timely, accurate, rational, feasible and reliable for decision-making.

Using Analytics to Enhance the Quality of Healthcare

As indicated above, health and hospital statistics has now progressed beyond calculating various indicators or measuring individual or community health. In this modern era of ICT, the analytics is helping the administrators to give solid evidence base to their various day-to-day as well as long term decisions.^{4,5,11} Evidence-based decision making in health administration is significantly facilitated through ICT use. For example, online clinical protocols can help in standardisation of medical care. This has an important bearing on ensuring quality of medical care in hospitals.

Apart from this ICT use has also immense potential in addressing the issues like providing solutions to many problems faced by hospitals, e.g. revenue loss, operational inefficiency, patient dissatisfaction. For this purpose many ICT-based solutions are available (but grossly underutilised). For example, tools like demand and forecasting, waiting-time management, real-time information, flow of patients, process-inefficiency reduction and variability measurement.

ICT can even help in early detection of emerging infectious diseases. It can help us in charting density of disease vectors. Computers can help in spotting outbreak of epidemics (Geographic Information System).

Transparency in the functioning of hospitals can also be enhanced through ICT. Administrators can detect and prevent financial irregularities in hospitals. Even in clinical or field epidemiology ICT can help by systemising risk profiling of chronic disease patients

Certainly management of hospital stores can be streamlined through computerised inventory management, e.g. use of RFID or barcoding to ensure quality of drugs.

Case Study 1: Private cloud improves delivery of health services

Inventory controls have helped in achieving savings of approximately 2.2 million and a saving of 525 man days at the middle-management level. Healthcare delivery organisation having a chain of eye care hospitals, Centre for Sight (CFS) was witnessing huge amount of growth in the last 1 year. This growth can be seen from the fact that the organisation expanded from 12 to 42 hospitals. As the number of locations grew, the organisation realised that the manageability of locations would be extremely diffi-

cult. Since this kind of growth could only be managed through standardisation and controls, the organisation felt the need to upgrade its IT infrastructure to support its fast growing network.¹¹

Only four out of the seven critical business functions at the organisation were running on IT support, while the other three were manual. Additionally, the four automated areas were running in isolation at each location. To address these issues, the firm wanted to standardise applications to meet the growing needs of the business and undertake initiatives that ensured scalability and brought better process automation and controls. To enable this, the firm selected a private cloud-based environment for running all the applications. Today, all the business functions are automated and integrated. Previously, multiple registrations and records for the same patient were recorded as branches operated in isolation. Today, there is single registration and record for one patient. The average cost of taking a new location live has come down from Rs 3.5 lakh to just Rs 70,000. Due to a centralised approach, the firm has also managed to save 20 min per location, which adds up to a saving of 525 man days at the middle-management level.

Case Study 2: National rural health mission gets the IT edge

National Rural Health Mission (NRHM) in India, is also using ICT in big way for data capture, analysis and transmission. Under NRHM, a name based computerised Mother and Child Tracking System (MCTS) was launched in 2009 by the government to improve the HMIS in the country. Perhaps the most significant feature of MCTS is that it promotes use of information technology by grass roots level health service providers and even by the beneficiaries at large. In this way, MCTS also contributes to reduction of the digital divide.

The core of the MCTS is the web-based database application tool which permits real time entry of the information related to pregnant women and children including the services provided to them. Facility of communicating monthly work plan to ANMs/Accredited Social Health Activists (ASHAs) through SMS in English and Hindi has been operationalised. SMS alerts to beneficiaries about services due have also been started. SMS related to mother and child registration status and telephonic verification status is sent daily to senior health officials.

MCTS is quite user friendly. A pregnant woman can use the MCTS interface to know which of the maternal care services she requires and which of the scheduled services she has received. Similarly, parents can get information about the vaccinations due to their child and the details of vaccinations already received. MCTS is currently being

implemented throughout the country with more than 1.77 crore pregnant women and 1.20 crore children being registered in the system since its inception. More than 75% subcentres have been included in MCTS so far.

Case Study 3: Tracking of hospital infections

Many private hospitals are successfully using ICT applications to track infection control related data, viz. Apollo group of hospitals, who have established ICT-based systems to track nosocomial infections. There is also provisions to capture data on hospital infection-control parameters. All this data is compared with standards. The differences in values are thoroughly analysed. Research on these issues is also carried out. This data is kept up-to-date through online dashboard. A high level committee scores, monitors and reviews this data each month.

ICT IN PUBLIC HEALTH

Like hospitals, ICT is being used extensively in public health also. For example, mobile phone-based healthcare delivery (mhealth) packages have been used in India and abroad. Also see care studies on e-Mamta and MCTS.

Case Study 4: e-Mamta programme in Gujarat

In spite of the great advancements in the medical field and the Indian Government's efforts in this regard, the maternal mortality rate continues to be high (450 deaths per 1,00,000 live births with wide regional disparities) in our country, even higher than Brazil, Russia, India and China. BRIC and neighbouring South Asian Association for Regional Cooperation (SAARC) countries with comparable healthcare resources, the figures are way behind India's MDGs, which call for a reduction to 109 by 2015. Anaemia, haemorrhage, sepsis and toxemia of pregnancy are the most common causes of nearly 70,000 maternal deaths per year reported in India, which are preventable with better healthcare management.

To address the problem, Gujarat State Government has developed a comprehensive IT application for improving mother and child tracking system from pregnancy till complete life cycle for better public health services delivery. The programme covers the entire rural, urban slum population. The application is appropriately called **e-Mamta**. The application generates unique health ID for every mother and child to ensure complete continuum of antenatal care services delivery to reduce Infant/maternal mortality rates (IMR/MMR).

The application can use mobile-based technology for data entry at source, and also sort and group data to identify beneficiaries for special public health problems like anaemia, malnutrition and disease control. The application is feature-rich and can provide feedback to the beneficiaries as well as the service providers. This will enhance the quality of healthcare service. It can also track dropouts and re-induct them to healthcare services. It also manages details of various incentives paid to all cadres of health workers, individual records for the benefits of Janani Swasthya Yojna (JSY), Bal Swasthya Yojna (BSY) and Chiranjivi Yojna (CY) schemes besides online health record/immunisation card. It can be easily integrated with the HMIS, and generates reports and registers through aggregation of services. It ensures better interdepartmental coordination—Integrated Child Development Scheme (ICDS), education department and Rashtriya Swasthya Bima Yojna (RSBY). The data can be searched on the basis of few basic parameters—name, health identity (ID), ration card number, BPL number, mobile number, unique identity (UID), family ID. It also contains database of service providers in the public/private sector and all Accredited Social Health Activists (ASHAs) with their mobile numbers.

The e-Mamta programme has resulted in comprehensive delivery of maternal and child health services, universal coverage of immunisation, reduction in anaemia, malnutrition, and reduced IMR, MMR and Total Fertility Rates (TFR). e-Mamta is indeed a great ICT initiative towards achievement of MDGs.

Case Study 5: Save the baby girl

The recent census report showing that India's sex ratio has not shown much improvement remains a matter of concern. This unique and innovative IT-led solution in form of a dedicated web-portal named as www.savethebabygirl.com endeavours to correct the adverse sex ratio and provides solutions to otherwise a recalcitrant cultural issue of gender inequality in developing Asian countries. The project was first launched on 15 August 2009, in Kolhapur and adjoining districts of western Maharashtra. A private firm Magnum Opus, in association with district administration, initiated this project of 'Save the Baby Girl' to prevent the female fetus from illegal sex determination and termination.

The project is a two-phase application, online submission of records as per Pre-conception and Pre-natal Diagnostic Techniques (Prohibition of Sex Selection) Act 2003 (PCPNDT Act 2003) and Silent Observer (SIOB) – an advanced, secured and intelligent device embedded to the ultrasound machine that records the video images of the ultrasound. Silent observer is an ICT-based device that can monitor the use of the machine for proper enforcement of the Act.

Within a month and half of its launch, all 240 sonography centres were login to Save the Baby Girl (STBG) on daily basis and submitting the relevant information of sonography tests of all pregnant women conducted by them. The information is then collected on centralised web server and application is designed to generate various reports and statistics to identify the key indicators such as total number of patients registered by centre, area specific (rural, urban, tehsil, etc.), number of medical termination of pregnancies (MTPs), deliveries, (normal, abnormal, etc.) and birth results, etc. to monitor the performance of each centre. The entire data is processed and displayed using online dashboard to have a summary status of the entire district on a single screen, categorised as rural, urban, progressive and monthly statistics. The individual login for various levels of district administration is planned so that concerned authority will view the reports of the area defined to him/her on personalised dashboard.

The intelligent reading and careful analysis of the generated information reports by the district and tehsil level, administrators indicate the culprit centres of sex determination tests. This results in inspection of such sonography centres by the appropriate authorities and punitive actions are initiated. The figures of male and female born in private maternity homes with sonography machines from October to December 2009 indicate improvement in sex ratio in favour of girls. The interaction with medical fraternity, especially with the respected doctors, known for their integrity and ethics revealed that the success in improvising sex ratio is due to continuous online monitoring of all centres on daily and weekly basis and feedback given to the doctors/radiologist of sonography centres even for minor lapses.

Since every centre is filling online record of each patient online as per Pre Conception and Pre Natal Diagnostic Techniques (PCPNDT) Act-prescribed format, there is no need of any additional record keeping system. The F-form or monthly reports can be generated through STBG online. This indirectly saves tremendous amount of time of district administration to check each and every form manually. It is very difficult to identify pregnant female with one or two previous girls and with age of above 35 from the monthly manual records of 10,000. But because of this solution, district administration does not only identify the detailed report of all pregnant females of above-35 age and of having one or two previous girls, but also locate them, define them as per the area and respected authorities to provide the healthcare support and counselling not to go for sex selection abortions.

The second initiative in the form of SIOB is path breaking and acts as an effective deterrent against the doctors indulg-

ing in unlawful practice of sex-determination tests, resulting in arresting the declining sex ratio and finally normal or equal to world average. Further, it has potential of replication all over India and thus in next 10-years' time the imbalance in the sex ratio of India will be removed all together, if implemented properly. The district administration of Kolhapur, Maharashtra has shown a way worth emulating across the nation for the serious social problem of female feticide. Now, Chandigarh administration is also planning to install SIOB on 68 ultrasound machines in UT Chandigarh.

FUTURE GROWTH OF ICT USE IN HEALTHCARE

The current Indian healthcare IT market is USD 3 billion and is likely to grow at 15–20% annually. According to Economic Times (ET) and National Association of Software and Service Companies (NASSCOM) report, the future IT growth will be driven by power, media and healthcare sectors in short and long term. Healthcare is a recession-proof sector. Use of smart mobile phones, laptops, I-phones and personal computers is likely to rise exponentially in India also. As of now, it may seem a costly proposition; however, as the volume of ICT-based operations increase, the cost will reduce.

Lately, there have been discussions of interface of other ICT related schemes and programmes with the hospital services. For example, the 'Aadhaar' card system of the Unique Identification Authority of India (UIDAI). In future, access of people to healthcare service may be seamlessly linked with their UID. ICT is also simplifying transfer of images, data/patient information, reports, etc. in the hospital. Classification of diseases is also now being linked with ICT. Record linkage may also become a reality through ICT use. Tracking of patients' information will help the doctors in managing their patients in a better way, through use of standardised protocols. Even patients' rights will be protected in a better way. They will be able to access their health-related information on anytime, anywhere basis.

Thus, ICT can both be a boon or a bane for healthcare delivery system in India. It has a definite potential to improve the efficiency of hospital and healthcare services, if used properly.

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Use of Multiagent System in Efficient Healthcare Services

61

Mr Jatinder Kumar

“The question of whether computers can think is like the question of whether submarines can swim.”

— Edsger W Dijkstra

LEARNING OBJECTIVES

After reading this chapter, the reader should be able to:

- understand the role of agent and multiagent system (MAS) in efficient healthcare services.
- get an overview of proposed multiagent-based laboratory management system (LMS) in hospital settings.

INTRODUCTION

Healthcare service is the diagnosis, treatment and prevention of disease, illness, injury, and other physical and mental impairments in humans. Healthcare service is delivered by practitioners in medicine, dentistry, nursing, pharmacy, allied health and other care providers. The patient involvement in the healthcare service providing process is very important to enhance the healthcare service quality.

ISSUES IN HEALTHCARE DOMAIN

The healthcare system, in general, is characterised by being a multiactor, widely distributed and extremely complex system. The various problems faced by the healthcare provider in providing efficient healthcare are classified as¹:

- Wide distribution of service-providing units.
- Poor coordination between healthcare providers.
- Extremely complex system.
- Availability of huge amount of information.

Wide Distribution of Service-providing Units

Service-providing units are distributed at different locations. For instance, the problem of patient scheduling consists in scheduling the different tasks to be performed on an admitted patient (e.g. a number of different analysis and tests).²⁻⁴ Normally, each unit of the hospital keeps its own information about the patients hospitalised in that unit and about the schedule of the activities with the unit's equipment.

There are units that provide services to all the other units of the hospital, such as X-rays or blood tests. It is significant to coordinate the schedule of different tests to be performed in different units, especially if, apart from the temporal restrictions derived from the separate location of different units, there are also medical restrictions among the tests (e.g. one test has to be performed at least 2 hours after another test, after taking a medicine for a specific period).

Poor Coordination Between Healthcare Providers

The solution of a problem in healthcare service involves the coordination and the effort of different individuals with different skills and functions, usually without the supervision of a single centralised coordinator. The provision of healthcare typically involves a number of patients, physicians, nurses, social workers, managers, receptionists, etc., located in many different places within the healthcare setup. Patients could be at home, at work, in hospital or on vacation, while the healthcare providers are often at a number of institutions or locations within institutions, providing services such as diagnosis, laboratory testing, radiography treatment, surgery and so on. All these people must coordinate their activities to provide the best-possible treatment to the patient.

Extremely Complex System

Healthcare problems are quite complex and finding standard software engineering solutions for them is not

straightforward. For instance, coordinating the process of eye donation and its transplant in a country like India is not an easy task.⁴ When a new donor is available, it is necessary to very quickly find the most appropriate receptor for the organ, which may be located in a medical centre hundreds of miles away from the donor's location. Furthermore, each hospital keeps the data of the patients of that hospital who are in the waiting list for a certain type of organ. It would be quite difficult to design and implement a centralised complex system to solve this coordination problem.

Availability of Huge Amount of Information

There is large amount of medical information available on the Internet and even from the medical professionals. This vital information is very important—both for medical practitioners and for the patients. Presently, there is no way to access the most relevant information at the desired time by medical practitioners because either they lack the time to search for all this information or filter the way one exactly needs. All these problems may be tackled by the use of multiagent system (MAS).

AGENTS

It is not hard to notice that well-known computer programs such as the Google Search Engine and Microsoft Office Assistant are agents or exhibit some form of agent behaviour. They are used frequently, provide satisfying results to the user and perform other additional functions. For example, Microsoft Office Assistant does more than just providing help. It monitors a users' typing pattern and if the user uses the same pattern repeatedly, the programme copies that pattern so that if a user begins typing on a new line, the agent programme presents the pattern for the user to reuse.

There is no standard definition of agents.

SodaBot definition of an agent: Software agents are programmes that engage in dialogues, negotiate and coordinate transfer of information.⁵ SodaBot is a development environment for software agents supervised by Michael Coen. According to the definition, agents communicate with one another about information when perceiving and acting upon the environment. This definition rules out most standard programs as agents.

Pattie Maes' definition of an agent: Autonomous agents are computational systems that inhabit some complex dynamic environment, sense and act autonomously in this environment, and by doing so realise a set of goals or tasks for which they are designed.⁶ According to Maes, agents are *autonomous*, i.e. they can act without being told or without explicit instruction. The environment in which agents operate as strictly complex and dynamic is also explicitly defined.

Characteristics

The characteristics of an agent distinguish it from a typical software program. The following are the main characteristics of an agent⁷⁻⁹:

- *Autonomy*: An agent can act on its own without direct human intervention, and controls its own actions and internal state.
- *Reactive*: An agent is able to perceive and respond to a changing environment without delay or within a short period of time.
- *Social ability*: An agent is capable of communicating with humans or other agents using an agent communication language.
- *Proactive*: An agent is goal oriented and able to accomplish goals without prompting the user or other agents. It is also able to adapt to change in the environment.
- *Persistence*: The agent keeps running a process continually till it achieves the desired result.
- *Mobility*: The agent has the capability to move from one platform to another.
- *Reasoning*: The agent reasons about its actions before deciding on an outcome.
- *Personality*: The agent has the capability of manifesting characteristics of a human nature.
- *Rational*: An agent selects a particular action that maximises its own performance measure, given the sequence of percepts and whatever built-in knowledge the agent has.

An agent that exhibits the characteristics defined above is deemed an *autonomous agent*, and hence the terms *agent* and *autonomous agent* are used interchangeably.^{6,9}

Classifications

When agents behave similarly or in a related way, they are grouped together according to their similar behaviour into different *classes*. This kind of grouping is referred to as agent *taxonomy*. Several approaches have been used to classify agents. Figure 61.1 depicts the agent taxonomy proposed by Hyacinth Nwana.¹⁰ It also shows that intelligent agents have some or all of the following capabilities: Cooperation, learning and autonomy.

- *Autonomy* means that the agent can act on its own without human guidance or intervention.
- *Cooperation* means the ability of an agent to communicate with other agents and users using a communication language, i.e. agents must have the ability to be social.
- *Learning* means interacting with the external environment, which includes studying the environment and understanding it.
- *Collaborative* means focusing on autonomy and being collaborative with other agents. *Collaborative learning* means the agent is focused on learning and cooperating with other agents (or humans).

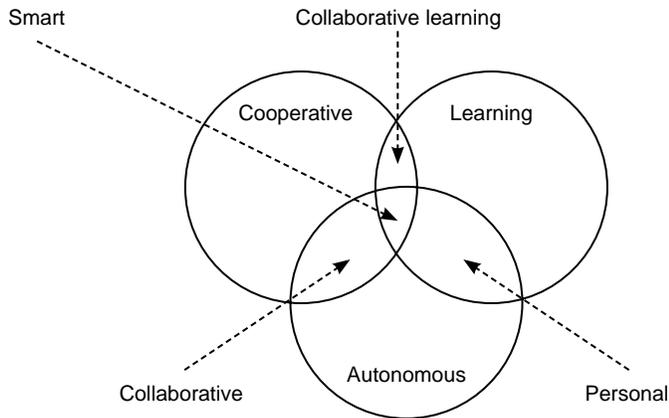


Figure 61.1 Agent taxonomy.

- *Personal* means that the agent is focused on autonomy and learning.
- *Smart* means that the agent is focused on all three attributes: Cooperative, autonomous and ability to learn.^{10,11}

The second agent taxonomy identifies agents according to the tasks they perform.¹⁰ These include *information (or Internet) agents*, *mobile agents*, *reactive agents* and *hybrid agents*. Information agents are agents that help users or other agents to manage large amounts of information on wide area networks (WANs) such as the Internet. *Mobile agents* are those agents that move around some network. *Hybrid agents* are a combination of two or more agent philosophies into one agent. *Reactive agents* are those agents that react to an environment in response to what they perceive.^{10,11}

MULTIAGENT SYSTEM

A multiagent system (MAS) consists of many individual agents focused on interacting with one another.⁹ The interaction can be *cooperative* in the sense that the individual agents contribute towards a common goal or selfish in that individual agents pursue their own interests. The individual agents can also be *coordinative* in that there is coherence of orchestrated actions through anticipation from other actions, while trying to provide global resolution coherently or through *negotiation*. Negotiation means that agents come to a consensus regarding the appointment of tasks or matters of common interest.^{12,13}

The primary goal of MASs is to work together towards finding solutions to problems that are beyond the capabilities of an individual agent. This means that MASs must have the following characteristics^{12,14}:

- Individual agents with incomplete information used to solve a problem.
- There is no universal control of the system.

- Decentralised data, i.e. data resides in different or remote locations in the environment.
- Asynchronous communication.

The increasing popularity of the Internet encourages more research on MASs. This interest is caused by the following MAS abilities¹²:

- *Computational efficiency*: Concurrency in computation is used to send high-level information and results. This provided that the communication between agents is kept at a minimum.
- *Reliability*: Ability to recover from system failures.
- *Extensibility*: Number and capabilities of an agent can be changed.
- *Robustness*: The system's ability to tolerate uncertainty.
- *Maintainability*: A system made up of agent components is easier to maintain because the individual agent components can be maintained separately.
- *Responsiveness*: An individual agent can handle anomalies locally to prevent them from propagating to the entire system.
- *Flexibility*: Agents with diverse capabilities can adapt to find solutions to the current problems.
- *Reuse*: Agents can be used repeatedly to find solutions to diverse problems.

PROVISION OF HEALTHCARE SERVICES USING MULTIAGENT SYSTEM (MAS)

Use of Spatially Distributed Knowledge

Multiagent system provides a powerful framework to help patients, doctors, laboratory clinicians and specialists to interact and collaborate effectively. The patient-related information is widely distributed in different departments/units within a hospital or in a clinic, in insurance company or in government office/organisation. The various agents of the MASs may be running in different computers/machines located at different places (either in hospital or at the residence of a patient) with different knowledge/information required to provide the efficient healthcare services. Therefore, MASs offer an effective way of providing solution for the problems that are distributed.

Coordination of Tasks Among Several Autonomous Entities

One of the main properties of an intelligent agent is sociability. Agents are able to communicate between themselves using some kind of agent communication language in order to exchange any kind of information. In this way, agents can engage in complex dialogues, can negotiate, coordinate their actions and collaborate in the solution of a problem (e.g. different units of a hospital may collaborate in the process of patient scheduling).²⁻⁴

Solution to Complex Problems by Decomposing them into Subproblems

One way to solve a complex problem is to decompose the problem into subproblems, then find the solution for those subproblems and then combine the solutions of subproblems to get the overall solution. In MAS, there are techniques of distributed problem solving in which a group of agents may negotiate how to partition a problem and distribute the different subtasks to different agents.¹⁵ Thus, MAS can handle the complexity of a solution through decompositions, modelling and organising the interrelationships between components.

Providing Personalised Information to Doctors and Patients

Agents can also be used to provide information to doctors and patients. There are information agents (also called Internet agents) that are specialised in retrieving information from different sources,¹⁶ analysing the obtained data, selecting the information in which a user is especially interested, filtering redundant or irrelevant information and presenting it to the user with an interface adapted to the user's preferences.

Thus, the basic properties of the intelligent agents (autonomy, reactivity, proactivity, social ability) and the features of MASs (management of distributed information, communication and coordination between separate autonomous entities) can be used to solve problems in the healthcare domain.

APPLICATION OF MULTIAGENT SYSTEM IN HEALTHCARE

Currently, most of healthcare providers use paper-based records to record a patient's receipt of healthcare services. Unfortunately, the use of such records leads to the inadequate documentation of the caregiving process, a severe disruption in the flow of patient-related information and a substantial delay in the delivery of healthcare services. Advanced information technologies have the ability to restructure the healthcare industry's data collection mode from a 'collect many times, use once' system to that of a 'collect once, use many times' arrangement. Some of the leading information technology developments will assist healthcare organisations in achieving their objectives in the following areas:

- *Computer-based patient records*: A digitised compilation of all clinical and administrative information relating to the care of a single patient is termed electronic health records (EHR) or electronic medical records (EMR). Such e-records are convenient for patients and doctors alike, and can significantly reduce medical errors and help to track public health problems.
- *Data warehousing*: Storing of vast amounts of clinical, financial and operational information in an integrated

decision support database provides immediate easy access to healthcare practitioners.

- *Document imaging*: The process of scanning and storing images. The electronic image has the ability to be shared and accessed more readily by clinicians and administrators at various geographic locations.
- *Internet solutions*: Internet and intranet developments allow healthcare service providers to integrate clinical and financial information from numerous sites without having to invest in enterprise-wide systems.
- *Expert information systems*: Every healthcare organisation has a series of rules that are instrumental to the delivery of care for that particular enterprise. Clinical decision support systems apply these rules in order to assist physicians in the administration of healthcare services.
- *Telemedicine*: The use of information technology to deliver medical services and information from one location to another.

MAS Used in Healthcare Services

There are many agent-based systems being applied for healthcare services such as supporting the expert's decision-making, accessing distributed data sources or the coordination of the execution of healthcare activities.

Moreno et al. developed a system where both the information and communication technologies (ICT) and multiagent technology are used to design, build and deploy a computerised system for improving the management of the data stored in the palliative care unit (PCU) of a big hospital.¹⁷ This unit is specialised in dealing patients with terminal illnesses and its aim is to ease their pain in the final phase of their lives. Depending on the initial medical diagnosis, the patient can be treated in the PCU, in another unit of the hospital or at home.

Becker et al. developed a MAS for highly distributed applications in healthcare that provides different interfaces to integrate existing information systems.¹⁸ The framework contains numerous healthcare actors and consists of detailed partial models of the healthcare domain. It enables the examination of modelling methods, configuration problems, agent-based negotiation strategies and coordination algorithms. This system consists of various facilities, which include a directory of agents (with the services they offer), management of events, an ontology repository, a knowledge base of medical terms, a generic *Actor Agent* that can be customised depending on the role of an actor, a repository of source files of services and a simulation environment.

Huang et al. designed MAS for distributed medical care, facing challenges regarding the distribution of data and control, information uncertainty and environment dynamism.¹⁹ The coordination mechanism is based on commitments and conventions between different types of agents. The task allocation and coordination is done by managing

agents that manage the execution of tasks and by contractor agents that execute the task.

Decker et al. modelled a MAS for hospital patient scheduling with complex medical procedures.^{20,21} A function-centred view is taken and nursing wards are modelled as autonomous agents. They developed a generalised partial global planning (GPGP) approach as a constraint-based coordination mechanism. It is constructed to avoid resource conflicts and patients are treated as exclusive resources that are handled by a special mechanism.

Hashmi et al. proposed a healthcare knowledge procurement system based on the use of multiagent technologies.²² The most important features in this system are autonomous knowledge gathering, filtering, adaptation and acquisition from some healthcare enterprise/organisational memories with the goal of providing assistance to nonexpert healthcare practitioners. This system is based on five different agent types. These types are:

- *User interface agent*: An agent to convert the search result into a viable format for passing to the user interface agent.
- *Query optimising agent*: An agent that optimises the query.
- *Knowledge retrieval agent*: An agent that performs the query.
- *Knowledge adaptation agent*: An agent to adapt the knowledge to the current circumstances.
- *Knowledge procurement agent*: An agent, which if all else fails, searches the web for the knowledge.

Hadzic et al. developed a multiagent-based system that supports the doctors in the diagnosis, treatment and supervision processes of the evolution of new epidemics, based on the exploration of all data pertinent to each case and on the scientific data contained in various professional databases.²³ This system combines the advantages of the holonic paradigm with MAS technology and ontology design for the organisation of unstructured biomedical research into structured disease information. A fuzzy mechanism ruled by intelligent agents is used for integrating dispersed heterogeneous knowledge available on the web and so for automatically structuring the information in the adequate ontology template as per the user requirement.

Gao et al. designed and developed a MAS whose aim is to efficiently gather and distribute information on the vital signs and locations of patients in an extremely fault-tolerant manner.²⁴ This system consist of (i) a central server, which medical doctors use to verify the overall conditions of patients and (ii) portable clients—one for each patient—that patients use to send information about their condition. Such instruments delegate the task of providing relevant data obtained from classical sensors to the patient. The monitoring devices are not normally capable of proactively operating to autonomously detect anomalies in the conditions of patients.

Laleci et al. developed a multiagent-based system for the monitoring of chronic diseases both at home and at hospital using a semantic infrastructure.²⁵ The system is capable of deploying and executing clinical guidelines in a care environment, including sparse care providers having heterogeneous information systems. This MAS addresses such challenges through an enabling semantic interoperability environment.

Mabry et al. developed a MAS whose purpose is to provide meaningful diagnoses and intervention suggestions to the healthcare personnel acting on behalf of the patient in the cases of emergency trauma with particular emphasis on types of shock.²⁶ This system consists of a set of agents that act as a collaborative team of specialists to realise the monitoring and diagnostic infrastructure for dynamically collecting, filtering, and integrating data and reasoning about them through a hybrid approach of fuzzy logic, causal Bayesian networks, trend analysis and qualitative logic.

Schumacher et al. developed an agent based on e-health system.²⁷ This system is a technology-driven project that brings together three notable new technologies: MASs, semantic web services and peer-to-peer middleware in the scope of mobile and context-aware environments. The system finds its motivations in a healthcare scenario that runs at many occasions throughout the world.

Vieira-Marques et al. developed a virtual electronic patient record system, which consists of a collection of agents that integrate documents from multiple-legacy departmental information systems within one institution.²⁸ The system includes three main components: MAS for integration of data, the visualisation modules and the central repository. All agents act in an asynchronous and autonomous way. The system collects all the information retrieved by various agents, including information about patients and their reports. As soon as this information is available, practitioners can access it through the visualisation module. This module allows a secure and authorised access to the medical data using a web-based platform.

PROPOSED MULTIAGENT-BASED LABORATORY MANAGEMENT SYSTEM (LMS)

Overview of Hospital Information System

The objective of hospital information system (HIS) is to help its users to handle the patient and multitude of other details. The system will allow simultaneous users to access the information. Patient management will include all processes between checking-in and checking-out of patients to and from the hospital. The HIS will also support automatic backup and protection of data. Hospital information system is an enterprise-wide tool that is made up of a number of modules. These modules help to organise the data in a manner that will allow the seamless flow of information in the hospital environment.

The functions of HIS are broadly classified into three groups, namely:

- Clinical services
- Support services
- Back office services

Clinical services

The clinical services consist of following modules:

- Registration
- Outpatient department (OPD)
- Inpatient department (IPD)
- Emergency
- Laboratory
- Central sterile supply department (CSSD)
- Blood bank
- Diet and kitchen
- Patient billing
- Duty roster, and appointment and scheduling

Support services

The following modules constitute the support services:

- General patient enquiry
- Transport
- Security
- Sanitation
- Laundry

Overview of Laboratory Module

Laboratory module is designed specially to streamline the diverse activities of laboratories in the areas of haematology, microbiology, histology/cytology, biochemistry, virology, etc. It also covers radiological functions and investigative procedures. It allows for flexibility in the interfacing of laboratory equipment and the ease of accessing information from a number of different database types. Laboratory module captures information related to various investigations required for the routine functioning of the hospital. Conducting number of investigative tests and making the results available promptly is a crucial step for accessing the patient's medical status and for further course of action. The main functions of laboratory module are:

- Accept test requisitions from departments or outside hospital.
- Specimen collection at collection counters or laboratories.
- Sample reception at laboratories.
- Specimen processing.
- Result entry.
- *Validation of results:* The validation procedure ensures that the test results are correct and ready for test report.
- Dispatch

Other investigative procedures

Besides the tests, there are number of procedures that are conducted and the data pertaining to these procedures should also be captured. Clinical departments undertake procedures in which they have specialisation, e.g. cardiology department undertakes ECG, Holter and catheterisation studies within the hospital. The processing of transactions in the laboratory can be summarised as follows:

- Register a patient (part of registration module)
- Order laboratory tests
 - Order entry
 - Order details
 - Questionnaires and answers
- Specimen collection and reception
- Result processing
- Result display

Software interfaces

The laboratory module communicates with other internal modules of HIS as well as any other external software, which are already running in the hospital through some software interfaces. The laboratory module interfaces with the following modules:

- Registration
- Inpatient department (IPD)
- Emergency
- Patient billing
- Appointment and scheduling
- Outpatient department (OPD)
- Procurement and online inventory
- Hospital equipment maintenance and infrastructure maintenance (HEM/IM)
- Central sterile supply department (CSSD)
- Duty roster

Proposed Multiagent-based Laboratory Management System (LMS)

Each hospital laboratory receives daily number of request with samples, analyses the samples and then delivers final results to the requesters (doctors, hospital departments, etc.). The method of transmission of test results depends on their urgency level. Besides the laboratory equipment for carrying out medical analysis, the personnel of the hospital laboratory are supported in their daily tasks by the laboratory software (LS), coupled with a traditional telephone communication system. These constitute two major components of the current HIS to ensure the availability of medical results in a main database and their transmission.

Indeed, several scenarios still require the telephone communication system to get things done, e.g. in the following circumstances:

- A doctor calls a technologist to transmit patient's test results.

- A technologist calls the laboratory to obtain the test results over phone.
- A laboratory technologist asks his laboratory senior colleague to make a decision in an emergency situation over phone, and so forth.

One can notice that human actors interact with each other directly or indirectly through the various communication modes.

Major challenges

Hospital information system (HIS) raises a number of issues such as:

- Even though the major part of results are transferred through autoanalysers and LS, the quality of services provided by HIS depends to a more or less extent on human factors, e.g. any mistake of a laboratory technologist in transferring test results to a doctor may cause dramatic consequences on patients.
- Hospital information system does not allow the requesters to know when results become available.
- The processes that take place in the telephone communication system cannot be logged automatically in HIS for monitoring and tracking purposes.
- Consultant who uses HIS spends a lot of time in searching, retrieving, consulting and interchanging the test results.
- To establish a successful phone communication, two actors must be present, therefore, time is wasted if either one cannot reach to the other when needed.
- Because of the time-consuming use of HIS in many scenarios, doctors and laboratory personnel have less time for their real medical activities.

The above-identified problems, caused by human operations, often prevent information to flow smoothly from HIS to actors and vice versa. These problems illustrate the so-called 'automation gap', which leads to the need of a systematic, strategic approach that automates error-prone human processes.

Proposed solutions

The 'automation gap' can be filled using multiagent technology. The objective is to propose a multiagent-based methodology for migrating from the legacy human agent-centred HIS towards an efficient healthcare system. In LMS, the actors (laboratory personnel, laboratory technologist, doctors, etc.) are human agents.

A human agent is a professional characterised by experience, skills, intelligence, reactivity, proactivity and ability to work autonomously and to *cooperate* with other human agents. In other words, the proposed solution delegates daily routine tasks performed by human agents to software agents. In this approach, each actor is assigned a personalised software agent who acts as his personal

assistant. The assistant receives a list of things to do from its owner, performs the assigned tasks in close cooperation with other software agents and delivers the final result to the desired requester. The software agent solution will offer the following significant advantages over LS:

- The features and functionalities of LS multisite are maintained, preserving the investment in the old LS.
- In the proposed agent-based LMS, the delegation of routine tasks from human actor to software agents will allow human actors to focus their attention on analysis of sample, test result interpretation, medical decision-making and so forth.
- The LMS coupled with mobile devices (PDAs, mobile phones, smartphones, pager etc.) will allow the actors to view the test results transmitted by personal assistants anywhere and anytime. All events and actions are systematically logged and centralised to support auditing of the system. Traceability and exceptional investigation, e.g. to answer a patient's complaint will also improve.

Table 61.1 Agents and their roles in laboratory management system (LMS)

Agent name	Agent job
Doctor agent	<ul style="list-style-type: none"> • Gets information about the availability of test results from the laboratory personnel agents. • Gets alerts of unread test results from the alarm manager agent. • Provides information to the doctor that test results are available. • Receives test results' data from the integration agent. • Displays test results' data to the concerned doctor. • Informs the alarm manager agent about the read/unread status of the test results sent to the doctor. • Informs the integration agent before and after each action.
Lab personnel agent	<ul style="list-style-type: none"> • Inform to the alarm manager agent and doctor agent regarding the availability of test results. • Receives alerts from the alarm manager agent signalling the abnormal unread status of a test result. • Acknowledges the alarm manager agent that the laboratory personnel read the alert sent to him. • Informs the integration agent before and after each action.
Alarm manager agent	<ul style="list-style-type: none"> • Alerts the laboratory agent as soon as the abnormal unread status of a given test result is detected. • Receives test results from the lab personnel agent. • Receives from the doctor agent the status that 'test results have been read by doctor'. Receives from the lab personnel agent that 'alert message has been acknowledged by the lab personnel agent'. • Informs the integration agent before and after every action.
Integration agent	<ul style="list-style-type: none"> • Retrieves test results from HIS, based on the query issued by the doctor agent or the lab agent. • Delivers extracted test results to the requester agent. • Informs the integration agent before and after every action. • Logs the actual start/end notifications with their date and time.

Various agents in the proposed LMS

The proposed solution, i.e. LMS has following four agent categories:

- Integration agents
- Alarm manager agents
- Doctor agents
- Laboratory personnel agents

The job description of these agents is depicted in Table 61.1.

The information flow between various agents of the laboratory management system (LMS) and their arrangement is shown in Figure 61.2. The proposed systems, i.e. laboratory management system (LMS), and appointments and scheduling system (ASS) can be implemented using any agent development environment (e.g. JADE, Aglets, etc.). Similar kind of detailed study can be carried out to propose multiagent-based solution for the following areas of the healthcare services.

The healthcare system in general is characterised by being a multiactor, widely distributed and extremely complex system. From the patients' point of view, the system is too much segregated. The various problems faced by the healthcare professionals in providing efficient healthcare are widely distributed knowledge, coordinated effort of multiactor required, extremely complex system and availability of huge amount of information.

In this chapter, an intensive study has been made on laboratory module of HIS in order to find how the healthcare services will be made efficient with the use of MAS. In proposed multiagent-based laboratory management system, the delegation of routine tasks from human to software agents allows human actors to focus their attention on specimen analysis, test result interpretation, medical decision making and so forth. The LMS coupled with mobile devices allows the actors to view the test results transmitted by agents anywhere and anytime. All events and actions are systematically logged and centralised to support auditing of the system.

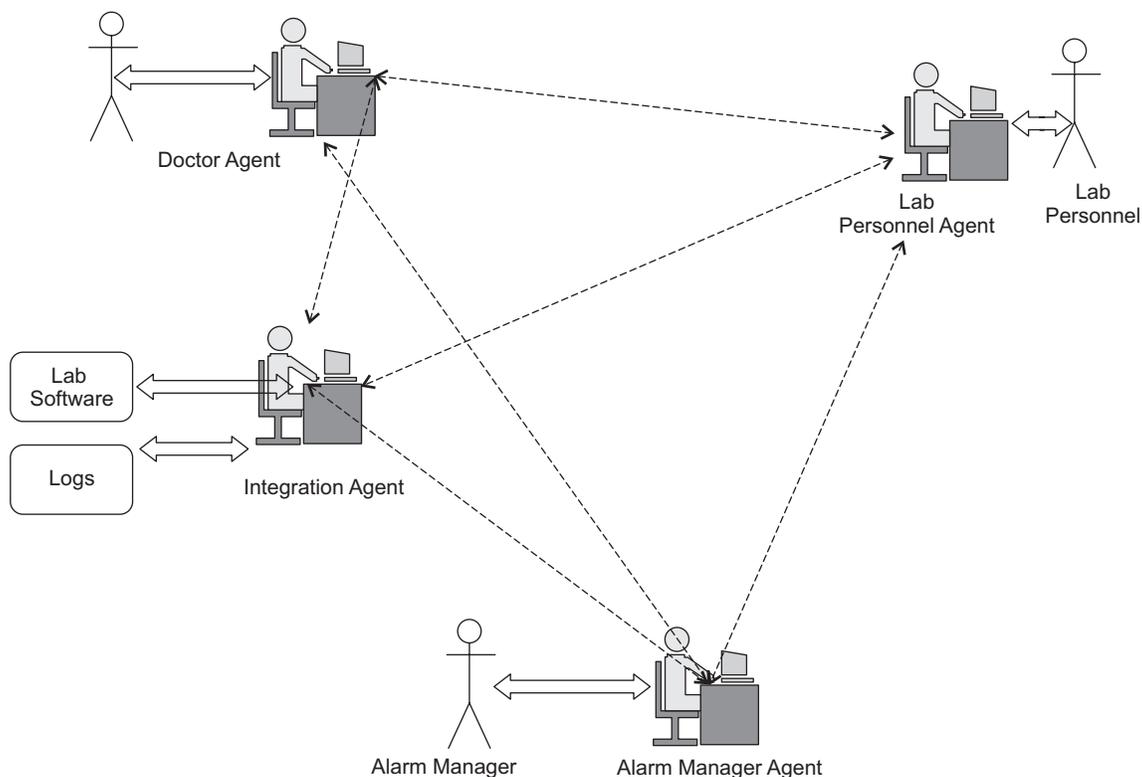


Figure 61.2 Interactions between the agents in proposed approach.

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