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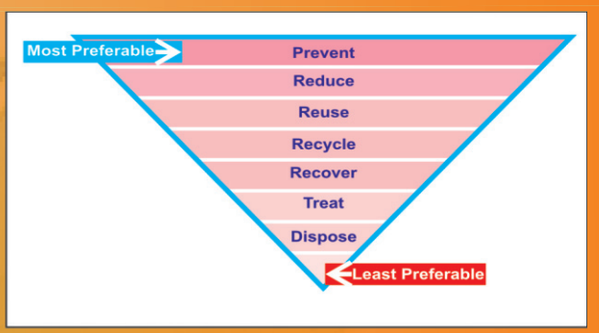
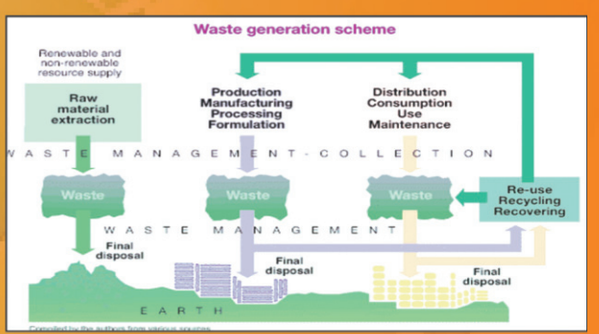
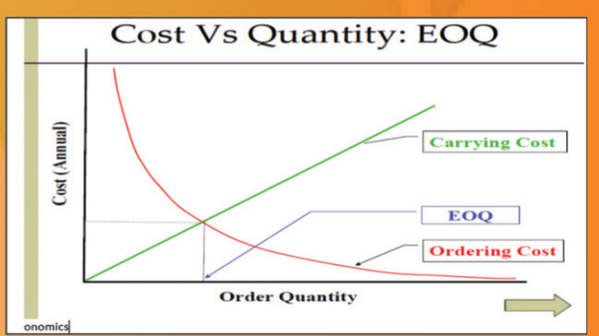
BHME-104
MANAGERIAL AND SYSTEMS APPROACH







"Education is a liberating force, and in our age it is also a democratising force, cutting across the barriers of caste and class, smoothing out inequalities imposed by birth and other circumstances."

—Indira Gandhi

''शिक्षा मानव को बन्धनों से मुक्त करती है और आज के युग में तो यह लोकतंत्र की भावना का आधार भी है। जन्म तथा अन्य कारणों से उत्पन्न जाति एवं वर्गगत विषमताओं को दूर करते हुए मनुष्य को इन सबसे ऊपर उठाती है।''

–इन्दिरा गांधी

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BHME-104
Managerial and Systems Approach

Block

1

MANAGERIAL AND SYSTEMS APPROACH

CURRICULUM DESIGN COMMITTEE (Pre-revised)

Prof. A.K.Agarwal
Director
SOHS, IGNOU
New Delhi

Prof. Santosh Panda
STRIDE, IGNOU
New Delhi

Mr. Alexander Von Hildebrand
Regional Advisor
Regional Office for South-East Asia
World Health Organisation
New Delhi

Dr. Megha K. Rathi
Sr. Consultant
SOHS, IGNOU,
New Delhi

EXPERT COMMITTEE

Dr. Bina Sawhney
Additional DDG BRS (Retd.)
MoHFW, New Delhi

Mr. J Chandra Babu
Sr. Environmental Engineer, CPCB
Parivesh Bhawan, CBD-cum-Office Complex,
East Arjun Nagar, Shahdara, Delhi

Prof. T Hemanth
Head,
Department of Community Medicine
M S Ramaiah Medical College,
Bangalore

Dr. Shyamla Mani
Professor (Retd.),
National Institute of Urban Affairs,
India Habitat Centre
Lodhi Road, New Delhi

Dr. Vijay Rai
Sr. CMO (SAG) &
Chairman Legal Cell,
Dr. RML Hospital, New Delhi

Prof. Reema Kumari
Dept. of Community Medicine and
Public Health, King George's
Medical University, Lucknow

Prof. Vidhya Venugopal
Certified Industrial Hygienist (BOHS)
Department of Environmental Health Engineering
Sri Ramachandra University
Porur, Chennai

Ms. Payden
Regional Advisor, WSH,
WHO - Regional Office for South-East Asia, World Health House
Indraprastha Estate Mahatama Gandhi Marg, New Delhi

Dr. Sunita Singal
Former Sr. CMO, Dept of Obs. &
Gynae, Incharge of Dept of Hospital Waste Management,
VMMC & Safdarjung Hospital
New Delhi

Prof. S B Arora
Director,
School of Health Sciences
IGNOU, New Delhi

Prof. T K Jena
School of Health Sciences
IGNOU, New Delhi

Prof. Ruchika Kuba
Programme Coordinator
School of Health Sciences
IGNOU, New Delhi

Dr. Biplab Jamatia
Assistant Professor (Sr. Scale)
School of Health Sciences
IGNOU, New Delhi

BLOCK PREPARATION TEAM

Writers

Unit 1
Dr. Vijay Rai
Sr. CMO (SAG) &
Chairman Legal Cell,
Dr. RML Hospital, New Delhi

Unit 2
Dr. K.S. Baghotia
State Leprosy Officer &
State Programme Officer
Directorate of Health Services
Govt. of NCT of Delhi
F-17, Karkardooma, Delhi

Dr. Manipadma Rabha
Sr. Medical Officer
MHS,DGHS,GNCT Delhi
PT,DCSS Bhawan, Dwarka
New Delhi

Unit 3
Dr. Priyank Tyagi, Director
Healthrays Medicare LLP, Delhi

Editorial Team

Mr. J Chandra Babu
Sr. Environmental Engineer,
CPCB Parivesh Bhawan,
CBD-cum-Office Complex,
East Arjun Nagar, Shahdara, Delhi

Ms. Anu Agrawal
Senior Consultant, Toxics Link,
H2 (Ground Floor), Jungpura Extension,
New delhi-110014

Dr. Jyotsana Dikshit
Dy. Director, NCIDE, IGNOU, New Delhi

Prof. Ruchika Kuba
Programme Coordinator
School of Health Sciences
IGNOU, New Delhi

Creative Inputs
Dr. Jyotsana Dikshit
Dy. Director, NCIDE, IGNOU, New Delhi

Prof. Ruchika Kuba
Programme Coordinator, SOHS, IGNOU

Vetting Team

Ms. Payden
Regional Advisor, WSH,
WHO - Regional Office Office
for South-East Asia, World Health House, Indraprastha Estate Mahatama Gandhi Marg, New Delhi

Dr. Ute Pieper
WHO Consultant
Hampshire Residence,
B-3A-3, 2A Persiaran Hampshire. 5050
Kuala Lumpur, Malaysia

Mr. J Chandra Babu
Sr. Environmental Engineer, CPCB
Parivesh Bhawan, CBD-cum-

Complex, East Arjun Nagar,
Shahdara, Delhi

Dr. Sunita Singal
Former Sr. CMO, Dept of Obs.
& Gynae, Incharge of Dept of.
Hospital Waste Management,
VMMC & Safdarjung Hospital
New Delhi

Dr. Chhavi Pant Joshi
DADG (Environment Health),
Directorate General of Health Services, Ministry of Health & Family Welfare
Government of India
New Delhi

CO-ORDINATION TEAM

Director
School of Health Sciences
IGNOU, New Delhi

Prof. Ruchika Kuba
Programme Coordinator
School of Health Sciences, IGNOU, New Delhi

PRODUCTION

Mr. Ajit Kumar — Section Officer (P) — SOHS, IGNOU, New Delhid

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COURSE INTRODUCTION

This block covers the basic principles of managerial and systems approach with respect to health care waste management.

Unit 1 describes hospitals as complex organisations and elaborates the managerial activities in the health care facilities. It brings out the concepts, tools and techniques applied in hospital settings. Some macro considerations of the health care waste management have also been covered.

Unit 2 outlines the objectives and components of a waste management system. It differentiates between the off-site and on-site management, treatment and disposal of health care waste. It also helps you to know the various options available for management of health care waste and the criteria which can help you decide which option to take.

Unit 3 talks about waste economics. Our experience has shown that people do not always understand the importance of environment conservation. But economics and financial implications are well understood and acknowledged everywhere. Sometimes transitions happen faster when people understand the economic gain of doing a particular exercise. Segregation for example decreases the financial and environmental burden of the institution. Needle prick injury can have a big financial burden on an institution. Thus investing in training is economical. It is important for everyone involved in waste management to work out the economics of the process so as to maximise gains and minimise losses while preserving the most precious of all things- our environment. This unit explains you the various concepts of waste economics like source reduction, recycling, benefits and costing.

UNIT 1 MANAGERIAL ASPECTS

Structure

1.0 OBJECTIVES

After studying this unit, you should be able to:

- describe the managerial processes and principles of management as applicable in bio-medical waste management
- list the management tools with the managers of bio-medical waste
- explain the system approach to bio-medical waste management and its benefits
- describe the quality issues in bio-medical waste management and role of training, monitoringand evaluation

1.1 INTRODUCTION

All of us are familiar with the term 'Waste'.We see 'waste' being generated all around us in our houses, markets, institutions or Industry. 'Waste' is a by-product of human activity and yet it has propensity to jeopardise the same. 'Waste' has no apparent meaningful value but if not managed properly, it can be a source of nuisance, cause of environmental degradation and can incur health impacts on the community.

In rural settings, population density is low and so is the quantum of general waste generated. Consequently, waste-management is not a problem in rural areas as natural cleansing processes can cope. In urban settings, however waste management is a challenge due to higher quantum of waste generation. It becomes obligatory on the community or its organised groups or the local civic bodies to deploy proper waste management systems. Most people, especially those in remote areas continue to be ignorant and oblivious of the impacts of poorly managed waste. It is not surprising that 'Waste' and 'Pollution' seem to have become constant companions and hall-mark of most cities especially in the developing and under-developed countries.

Health-service delivery outlets like hospitals, dispensaries, polyclinics, laboratories, diagnostic centres etc. generate 'bio-medical waste'or in short BMW that poses a much more serious threat. You have already learned about this in previous units and that managing BMW is serious issue. If not done properly it can have disastrous impact on public health by increasing chances of outbreak of deadly diseases and environmental degradation. It is therefore important that BMW is managed efficiently and efficaciously using appropriate technology. Harmful effects of improper waste management are becoming known not only to the health professionals, health service providers, policy makers and people linked to environmental issues but also to the general public. **In India, Hon'ble Supreme Court has been instrumental in bringing up legislation to protect the environment and to manage the Bio-Medical Waste. This has made it obligatory for the elected governments to undertake health care waste management as their statutory function and earmark sufficient resources for the purpose**.

If one were to see the modern cities and the kind of civic mess they are in, none would disagree that an efficient Bio-Medical Waste Management System cannot be implemented simply by wishing or by legislating. There have to be sound planning and matching managerial systems in place to achieve this. Such systems would have to deploy appropriate technology and the available resources judiciously so as to ensure a defined level of quality and efficiency while trying to achieve the desired goals.There would however always be a mismatch between the goals and the actual ground realties. Such a situation would keep the managers and the doers strive harder and harder, compelling them to deploy sound managerial tools and techniques to make the BMWM operations efficient and cost-effective. This unit is designed to give you an insight into these managerial aspects of health care waste management. In this unit you will learn about the managerial concepts and princeples as applied to health care waste management.

1.2 LEGAL ACTIVISM AND BIO-MEDICAL WASTE MANAGEMENT

Health Care Facilities are created as a necessity for the community, but the waste generated from these health care facilities is an evil and a threat. Improper management of BMW impacts health of the communityas a whole and degrades the environment. It is ironical that most stakeholders continue to be unaware of the seriousness of the issue; the consequence is an unscientific, indiscriminate and unregulated disposal of hospital waste and a matter of concern for the public health authorities.

In USA in 1987 several beaches of New Jersey and New York had to be closed due to a "30-mile garbage slick" consisting mainly of medical and

Did you know?

The incident because of which several beaches of New Jersey and New York had to be closed due to a "30-mile garbage slick" drew the required attention and awareness that ensued finally led to promulgation of 'Medical Waste Tracking Act of 1988' in the USA.

common household wastes. Concerned authority of the New Jersey, Department of Environmental Protection after investigation reported that its cause was not accidental. The waste had been thrown on the beaches with intention to let it disperse in the sea.

In India too, the problems of solid waste management and that of BMW Management came to the attention of Hon'ble courts. Noteworthy in this regard was a Public Interest Litigation (PIL) filed in the Apex Court under Article 32 of the Constitution of India by Dr. B.L. Wadhera, a practicing Supreme Court lawyer. The petitioner sought directions against the concerned authorities to perform their statutory duties properly viz. collection, removal and disposal of garbage and other waste lest there is adverse effect on the environment and on public health.

During the course of hearing, major shortcomings were noticed on the part of local civic bodies and court came up heavily upon them for failing to perform their duties properly. The Hon'ble Supreme Court also called upon the Union of India (UoI) and Government of Delhi (then Delhi Administration) through their Secretaries of Health & Family Welfare to file affidavits on the points raised by the petitioner in 1995-96. Directorate of Health Services (DHS), Delhi was also called upon to carry out a surveyof larger private hospitals of Delhi in reference to their practice of bio-medical waste management. Similar exercise was carried out for public hospitals of DHS. These surveys revealed that most hospitals were not managing their waste properly. They were mostly dumping their waste in the municipal garbage bins without treatment of any kind. Only a few hospitals had old single-chamber incinerators run without proper monitoring and most were not achieving appropriate temperatures.

In B.L.Wadhera vs. UOI case, the Apex Court also directed Central Pollution Control Board (CPCB) to monitor the implementation of its directives. The draft of Bio-Medical Waste (Management & Handling) Rules was published in 1995 by the UOI. under the Environmental (Protection) Act 1986 seeking comments from the stakeholders. In exercise of the powers conferred by Sections 6, 8 and 25 of the Environment (Protection) Act, 1986, the UOI published the Bio-Medical Waste (Management & Handling) Rules in the year 1998 which were later amended in 2000 and 2003. The Rules were further vised in 2016 and the Bio-Medical Waste Management Rules, 2016 were notified indicating that the process of learning and improvement was continued.

These historical facts draw attention to the complexities involved in Bio-Medical Waste Management besides highlighting the proactive role played by the judiciary. Finally all this measures have further strengthened the Environmental (Protection) Act 1986 and promulgation of Bio-Medical Waste (Management and Handling) Act, but the challenges remain. Legislation needs to be enforced and that can be done by applying the principles of management to this important mission. The capital state of Delhi has issues despite the legislation due to the complexities that it has to deal but there are some good examples like the state of Sikkim. This tiny Himalayan state that has achieved complete ban on plastics and burning of waste. It has been able to check environmental pollution through effective solid-waste and bio-medical waste management and is an example of role of effective political leadership. Success of the Chief Minister of Sikkim is not a coincidence. He foresaw an opportunity by knowing his people and their love for their environment. Sikkimese way of life generates relatively low volumes of waste and the chief minister launched the programme as a campaign and linked it to the pride of Sikkimese people.

Did you know?

After Bhopal Gas Leak tragedy, there was another case that primed the Apex Court towards environmental issues. This case "M.C. Mehta vs. Union of India" was filed in the aftermath of Oleum gas leak in Dec. 1985 in west Delhi from the chemical plant of Shriram Food and Fertilizers Ltd. The judiciary concerned with the larger public interest did not hesitate in issuing appropriate directions to the parties concerned and to the state

He put his best men as in-charge of the project and let this team himself to implement the plan. Extensive planning, effective strategy and efficient implementation supported by sufficient resources led to success.

In Sikkim, speaking managerially, the leader made realistic plans, involved all stake holders, prepared a strategy, allocated sufficient resources and deployed simple techniques and achieved success in a manner that it became the success of the people at large. These, in essence, are the salient features of a project management approach to solving difficult problems. Legislation can be empowering and coercive but this is not enough to ensure success unless principles of management are put to effective use.

Check Your Progress 1

1. What was the outcome of B.L. Wadhera vs. UOI case ?

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1.3 HOSPITALS MANAGEMENT AND ITS COMPLEXITIES

Hospitals or Health Care Facilities are most important not only from BMWMpoint of view but also because they are one of the most studied and most challenging from management point of view. Let's learn something more about their structure and complexities as an organisation. This would help you understand the complexities of BMWM therein and the challenges that must be overcome.

1.3.1 Hospitals as Complex Organisations

Hospitals are designed and equipped to keep the sick for providing comprehensive health care services. In addition, hospitals are training centers for health care service providers and research in medical, nursing and other disciplines. Complexity in hospitals also arise due to relationships among three major power centers therein viz. Board of Directors, the CMO/CEO/ Medical Superintendent and the Hospital Staff. Hospitals function as hierarchical systems for imparting a gamut of services through its outdoor, indoor or emergency departments and a variety of support services. Hospitals function within the framework of State Health Policy in accordance to its own organisational policy. Hospitals are complex because the managerial principles of line of authority and unity of command are violated in view of its specific needs. For example, most nurses and paramedical staff would follow orders from their professional supervisors and also from the doctors who issue orders during the course of treating the patients. This makes the managerial structure of hospitals as a **Matrix Organisation**.

Did you know?

A matrix organisation is the complex practice of managing individuals with more than one reporting line and is also commonly used to describe managing cross functional, cross business group and other forms of working that cross the traditional vertical business units of function and geography.

Hospitals deal with life and death situations, deploy sophisticated technologies and equipment with high obsolescence and have to cope with heavy demand on its services with high expectations from the patients, government and the society. Hospital services have legal and social implications and are often called upon to assist the state and the courts of law especially in medico-legal matters. There are several Acts and Laws in addition to Bio-Medical Waste (Management and Handling) Rules that hospitals have to deal with.

Examples are Environment (Protection) Act, 1986, Consumer Protection Act, Right to Information Act, Labour Laws and liabilities under relevant sections of Indian Penal Code, Code of Criminal Procedure and matters covered under the Law of Torts that concern the hospitals directly. You have read about these laws in the Unit 14, Block 4, BHM-101.

Profile of modern hospitals is changing in India. They are coming up generally as super-specialty hospitals, have foreign tie-ups with international affiliations to draw business what is often called as **Medical Tourism. As mentioned in Wikipedia Medical tourism** refers to people travelling to a country other than their own to obtain medical treatment. In the past this usually referred to those who travelled from less-developed countries to major medical centers in highly developed countries for treatment unavailable at home.

Newer Indian hospitals are looking for a global market for their services that match with the best in the world and yet at fees that are much lower than the prevailing rates around the world for similar treatment.

Sophistication of hospital services influences the generation of hospital waste. BMW is generated from various patient-service areas as shown in **Fig 1.1**.

Fig. 1.1: Generation of BMW in various patient-service areas

Hospitals also use cytotoxic agents, radioactive isotopes for their research activities and animal experiments thus adding to more dangerous category of BMW.

The quantum of waste generated is linked directly to the number of hospital beds, number and sophistication of specialty services, average bed occupancy and utilisation of its OPD, OT, Delivery room and diagnostic services. Efficiency and effectiveness of BMWM in a health care facility would also depend on the system of waste segregation, pre-treatment at source, safe-

Watch this video on medical tourism in India.
https://youtu.be/k2f9owU-EH4

Source: https://en.wikipedia.org/wiki/Medical_tourism#cite_note-1

Did you know?

There is economic reason for medical tourism in India. According to industry estimates, the size of medical tourism varies from Rs. 1200 to 1500 crore growing annually at a rate of 30%.

collection, storage, quantity measurement, maintenance of records and movement within and outside hospital, safe transportation, proper treatment and final disposal are important steps from environmentally sound management point of view.

1.3.2 Managerial Activities in a Health Care Facility/ Hospital

The heads of hospitals are generally designated as Chief Executive Officer (CEO), Medical Superintendent (MS) or Director (Medical) etc. Managing these complex institutions almost always involves partnership with medical, nursing and paramedical staff apart from the governing board. There are situations where medical personnel are required to take important decisions that affect operations; there are other situations especially related to finances and materials management where non-medical managers appear to perform better. There is however an increasing realisation that the medical personnel with training in management and hospital administration tend to perform better provided they are freed of their clinical functions.

The hospital managers have to ensure efficient and effective hospital services at all times and of an acceptable quality at affordable costs in compliance to the various provisions and rules. To achieve this, the hospital managers they have to work with the staff as enabler, problem solver, motivator, team builder and facilitator for decision-making. He has to deal with new technologies and establish a climate where people learn, improve their skills and evolve. He is also an evaluator, communicator with a commitment to his organisation and its objectives that have a social cause as well. The activities to be undertaken by hospital managers are mentioned in **Box 1.1**.

The hospital managers have to undertake following activities:

a. **Determination of goals and objectives:** Consists primarily with policy making.

b. **Planning of New Services and Facility Management:** This refers to activities related to improvement of existing services and adding new ones.

c. **Financial management:** This relates to financial affairs of the hospital and includes budgeting and costing.

d. **Human Resource (HR) Management:** This category relates to the selection, motivation, and guidance of employees. It includes wage and salary administration.

e. **Coordinating departmental operations:** This category includes interdependent activities dealing with the internal functioning of all hospital departments. Frequent meetings with departmental heads would one example.

f. **Programme review and evaluation:** This relates to functioning of the clinical services and programmes and is a continuous process.

g. **Public and Community Activities:** This concerns activities related to development and maintenance of Interaction with other health institutions including shared service arrangements with other hospitals.

h. **Health Industry Activities:** Refers to activities that are external to the hospital; It includes participation in hospital associations, third party payers (insurance companies, employers, service suppliers).

Think and reflect

Can you think of the activities specifically related to management of health care waste which could be categorised as the activities that are expected to be undertaken by the hospital managers ?

i. **Government related activities:** Concerned with legal problems of hospitals and dealing with local, state or central agencies.

j. **Education Development:** This includes all teaching responsibilities, continuing education of hospital personnel, and participation in professional conferences and CME.

k. **Marketing:** Image management of the HCF for potential customers and the public.

Box 1.1: Activities to be undertaken by the hospital managers

1.3.3 Hospitals as Organisation and as Systems

Hospitals as organisation and as systems are explained in **Box 1.2**.

a. Hospitals are bureaucratic organisations where individual positions and clusters of positions are made into a hierarchy or in form of a pyramid. They use a consistent system of rules that become the official boundaries of actions within. These rules are often circulated among the staff in form of circulars or as handbook containing the stated policies of the HR department, written protocols for medical and nursing care etc.

b. Hospitals also use the principle of **Span of Control** that means that a manager can supervise effectively only a limited number of people. A usual span of control of a manager or a supervisor would cover 5 to 10 people under him/her to achieve operational effectiveness. This is especially true in case of service areas like housekeeping, dietary and nursing etc. There is also a division and specialisation of labour in the hospitals. Specific tasks and job descriptions are assigned to each staff of the hospital.

c. **Structure of the Hospitals** (Line and Staff Function): Traditionally hospital structure is pyramidal or hierarchical. In this arrangement, individuals near the top have a specified authority range that goes down to employees at lower levels. Through this 'Chain of Command', the authority is distributed through the hospital.

d. Another type of organisational scheme in hospitals is to form groups that are organised for specific projects with a specified time-frame. For example, this scheme is used while starting a new service or a new department or undertaking modernisation or expansion of the hospital.

e. The hospital deploy various types of professionals at different levels to carry out some defined functions. Those who are directly responsible for running the hospital and to take decisions are the 'Line' functionaries. Those in line-authority control the resources of the organisation and its system. The staff functionaries on the other hand provide support to the line-authorities in carrying out their line function.

f. Hospitals irrespective of their geographical location tend to have almost similar work-flow in reference to patient-care. Conceptually, they have entry points, service areas, supporting services and exit points. The Out Patient Department (OPD), Casualty/Emergency and In-patient Department(IPD) are the usual entry points. These are run and managed by respective clinical specialty departments that are responsible for providing health care services through various service areas like operation theaters, delivery room, ICU, CCU, physiotherapy and special clinics for specific age groups like Geriatrics, Newborn Health, Cancer, Diabetes, Hypertension, Endocrinology etc.

g. The medical services are supported by nursing and ancillary services like Laboratory (Pathology, Biochemistry, Microbiology), Imaging/ Radiology, Anesthesiology, Respiratory lab, ECG, EEG, Rehabilitation Center, Occupational Therapy, Speech Therapy and Pharmacy etc.

h. In addition there are other support Patient Support Services like Dietary, Social Service, Hospital Transport, Laundry, CSSD, Maintenance, Biomedical Engineering, Security, Parking, Fire safety, Disaster Planning. It is common to manage several of these services through contract and the hospital administration has to depute managers for contract management. The hospital administration under the Medical Superintendent or the Director is responsible for the overall management including policy formulation but directly takes care of departments dealing with Finances, Budget and Plan, Human resource, Materials management, Quality assurance, Accreditation and licensing, Estate and Infrastructure, Medical Record Department (MRD), Hospital Infection Control and BMW Management and Patient safety etc.

i. It is clear that hospitals are complex management units that are tuned to meet all possible demands from the patients, community and governments, some stated and some unstated. They have to follow the laws of the land whether or not they are related to health. It is not easy to convince the hospital authorities to change their priorities from patients to other areas like BMWM; even though this appears to be changing. Nevertheless all managerial interventions would have to take cognizance of the situation above before a change or improvement can be brought about in the ways BMW is treated in these important organisations.

Box 1.2: Hospitals as organisation and as systems

Check Your Progress 2

1. Define Medical Tourism and give one example to support your definition.

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2. List various patient-service where BMW is generated.

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1.4 MANAGEMENT CONCEPTS AND SYSTEMS APPROACH

"A dream is just a dream. A goal is a dream with a plan and a deadline. And that goal will remain a dream unless you create and execute a plan of action to accomplish it. Every goal that gets accomplished has a good plan behind of it."

— Harvey Mackay*

Managers deal with other's dreams. They fulfill the goals set by the top management within the constraints. The words of Harvey Mackay quoted above are very apt in the context of any management. Challenge must be overcome for attaining the stated goals lest they remain dreams. The questions,'How','by Who', 'at What Cost' and 'in how much Time' are the usual answers expected to be answered by the managers. As they attempt to find the answers, a plan evolves and principles of management come into play. It may sound difficult but it is easy for a manager who possesses the leadership and communication skills and has mastered the art of management. Meeting the challenges gives him/her same satisfaction like that of a football player who scores a goal; both celebrate in the end and get rewarded.

1.4.1 Understanding Management

Management relates to some predetermined goals and objectives. It is customary that top management comes out initially with a Vision Statement followed by Mission Statement that highlights the vision and the goals.

A sample Vision and Mission statement is given in **Box 1.3.**

Vision Statement

"This Hospital will distinguish itself as a leader in redefining health care delivery and will be recognised for providing quality, innovative care to the patients it serves throughout the country."

OR

"This Hospital will be an innovative, leading regional health system dedicated to advancing the health and transforming the lives of the people we serve through excellent clinical quality; accessible, patient-centered, caring service; and unmatched physician and employee commitment."

Sample Mission Statement

"To provide affordable, holistic quality healthcare appropriate to the needs of our clients by a team of committed, caring professionals striving through a research driven environment."

OR

"The Mission of this Hospital is to provide compassionate, accessible, high quality, cost effective health care to the community; to promote health; to educate health care professionals; and to participate in appropriate clinical research."

Box 1.3: Sample Mission Statement

In India, it is estimated that around 500 Tons per Day (TPD) of BMW is generated from around 1.7 lakh Health Care Facilities (HCFs). Out of this, only about 15% is infectious and rest 85% is non-hazardous, but mixing of the two makes the entire waste infectious. Segregation of infectious bio-medical waste from non-hazardous waste at source is a simple technique to reduce the infectious bio-medical waste generation . Although critical, this aspect is mostly ignored. Thus the cost of not managing BMW properly is very high as its improper management increases the risk of hospital acquired infections, outbreaks of life-threatening infections and degradation of environment.

Watch a video on vision statement.
https://youtu.be/Mk11 80NXQ

Watch a video on the importance of a mission system.
https://youtu.be/sKBIHAZu-LM

Think and reflect

Try to make the vision statement of your hospital. You may like to get in touch with your hospital administrators to explore the vision statement.

Consequently, Government of India (GOI) is determined to contain the problem of improper BMW management in next five years through education of the BMW handlers, enforcing good practices, using appropriate technology for safe disposal and allocating sufficient resources to achieve this goal. The Central Pollution Control Board (CPCB) functioning under Ministry of Environment is identified as the nodal agency to assist GOI in this regard. If GOI, Ministry of Health were to issue a mission statement, it can be worded as shown in **Box 1.4**.

Sample of a Mission Statement

"To recommend effective and affordable technologies, evolve and implement Standard Operating Procedures (SOP), implement and monitor them in all Health Care Facilities in association with the Pollution Control Boards of States and Union Territories. Bring out the policies from time to time and support all the government hospitals to ensure that generated BMW are managed in an environmentally sound manner and also to facilitate gradual elimination of hazards associated with the BMW completely over next ten years."

Box 1.4: Sample Mission Statement

As part of the mission, hospitals are often also defining the Core Values of the HCF like:

a. Compassion
b. A Commitment to Quality
c. Working Together
d. Respect for the Individual

It is clear from above, that an agency is authorised and empowered to play a leadership role and that it would have to identify an experienced full time project-team under a leader and allocate sufficient resources. The PLAN would be the vehicle, RESOURCES, the constraints, PROJECT-TEAM the implementer as well as the monitor. Plan reviews, coarse corrections and further assessment and evaluation would determine the outcomes.

Cornell in 1947 stated that work of management is to plan, direct and control the organisation and to weave together its various components so that all things function properly and all persons cooperate. According to him the objective of the management is that all workers work together, efficiently and for a common purpose. In his definition Cornell tried to spell out key elements of management and their relationship to the organisation, its working and its goals. Later in 1973, Druckere laborated further by emphasising the importance of human resource. He said that Management is about human beings. Its task is to take people capable of joint performance, to make their strengths effective and their weaknesses irrelevant. Management thus is the process of organising, planning, leading and controlling the tasks of an organisation and of using all the resources available for achieving the stated organisational goal. It is important that some terms are understood with clarity.

1.4.2 Functions of Management

In its simplest definition, management means the art of getting things done. Managers can be classified into two groups based on their role in the organisation viz. Staff and Line. In contrast to the Staff or Support function, the managers in the 'Line function' carry out the main or statutory function of

the organisation. Examples of line function are CEO of a company, IPS officer in police department, Engineers in engineering departments like Railways or Public Works Department and so on. Similarly doctors and nurses carry out line function in hospitals; while accounts officers, administrative officers or labour officers work as staff functionaries. The latter support and assist the line functionaries in decision-making while performing line function of the organisation.

Management of any health organisation or a hospital is organised into several departments that carry out activities in consonance to their goal or objectives. The departments function more or less like various organ systems of human body i.e. they carry out their respective function in a well-coordinated manner keeping in mind the needs of other related departments within the framework of the defined goals or objectives .

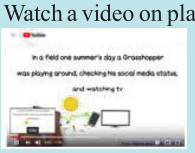
The functions of management are, Planning, Organising, Staffing, Controlling, Directing, Coordinating and Representing which are explained in **Box 1.4**.

1. **Planning:** It is one of the most important core functions of management. It involves activities associated with setting of objectives, making policy, developing strategies for attaining the set objectives within organisational framework. Objective setting requires good understanding of vision of the governing board of the organisation, an in-depth knowledge and understanding of the working of organisation, its resources, of the factors that are likely to influence the outcomes, the opportunities and the threats etc. The manager doing the planning has to peep into the future, has to be in touch with the reality and intricately weave the planning with strengths and weaknesses of the organisation keeping in mind the time and money available. For any plan to be successful, all the key people who would be required to implement the plan must be included. The annual plan or five-year plan or the strategic plans are the usual outcome of this function.
2. **Organising:** This function determines what activities will have to be carried out in the organisation. This includes how the organisation would be divided and subdivided into departments to carry out specified functions and how they would be grouped and inter-linked to ensure smooth operations. Organising involves identification of people to man specified duties and responsibilities, defining the authority attached to their jobs for carrying out these activities. Such relationships in a structured form are depicted in form of an Organisational Chart.
3. **Staffing:** This is perhaps the most critical of all management functions for it requires putting the 'right person' for the 'right job'. It is easier said than done; but if done effectively, by skilled managers, it is recipe for sure success. Good staffing is necessary for effective operations, better use of resources, for improving productivity and profits and for faster attainment of objectives. This function uses personnel management tools including job description, job specifications etc. Effectiveness of this function is reflected in ability of the organisation to recruit and retain good workers and to keep them motivated and willing to take higher responsibility. This is likely if the job-design is such that it does not remain a mere designation but combines work with responsibility and helps a person grow in the organisation.

Did you know?

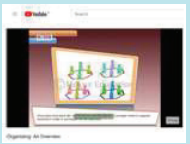
Management functions are carried out in hospitals by people who function in various capacities starting from the CEO, Medical or Nursing Directors, heads of departments, managers, supervisors and team-leaders besides carrying out technical and supportive roles as professionals.

Watch a video on planning.



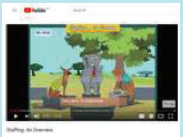
https://youtu.be/SVXKkFGPSxE

Watch a video on overview of organising.



https://youtu.be/M1AHBHmDRbk

Watch a video on 'an overview' of staffing.

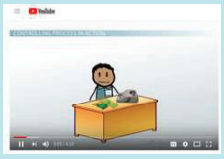


https://youtu.be/jT8N6nXG6Co

4. **Directing:** Managers are most commonly seen performing this function in day to day affairs of the organisation. A layman would perceive the manager as one sitting in his/her office and issuing orders to his/her subordinates. But this is mostly not true. Managers might think themselves as captains but their word may not be the law any longer. Managers must use their leadership position to guide, help, persuade or coach their team members who report to him/her. The tool that managers use for performing this function is not their organisational position but their ability to lead and to motivate.
5. **Controlling** is a function concerned with measurement of performance of employees against a predetermined standard or identified norm. For control to be effective there should be defined standards. In addition there should be an Information Systems that would monitor compliance in relation to those standards and the level to which these standards are attained. The tools that help the manager are a mix of reward and punishment. The wages and the ego also play an important role. It is common to measure control in terms of outcomes or turnover but this alone might mask several shortcomings.
6. **Coordinating** is necessary for ensuring that various teams and departments work together in a manner that they relate to one another's needs and achieve the slated objectives within the constraints of time. Traditionally a coordinator has plenty of responsibility but little authority. Most successful coordinators are the ones who have real or apparent authority, total commitment to the programme with extraordinary skills in persuasion.
7. **Representing** is a function that is often ignored by managers but it is one of the functions that would enhance team spirit make the managers more effective. Representing in context of management means being the spokes person for the team or the unit or the organisation on the outside. It may be time and energy consuming for the managers but it generates bonding, trust, better association and team spirit. The manager should be sensitive towards the needs of the team as well as those who the team stands for. It requires communication skills like presentation, debate, analysis and articulation. The managers would need both substance and theatre for representing his/her team well.

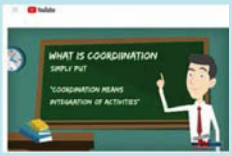
Box 1.4: Seven functions of management

Watch a video on controlling.



https://youtu.be/Xaf4iNOKRyU

Watch a video on coordination



https://youtu.be/EtPvAPulMZg

Think and reflect

Keeping the seven functions of management write down the functions taking examples from the management of Health Care Waste.

1.4.3 Management Principles

Management Principles can also be called as guidelines or the commandments for a manager. These were enunciated first by the French industrialist 'Henry Fayol' in the early twenties. Their real importance and implications were recognised only in the forties but they are so true that they hold good even today. The management principles described in **Box 1.5** are flexible and mostly applicable to most organisations in most situations, most of the times.

1. **Division of work:** The work assigned to each worker should be clearly defined and activities of the organisations precisely clarified. All work thus gets performed efficiently and gradual development of competence and skills. Big tasks require that work is divided amongst many and they work in coordination.

2. **Authority and responsibility:** These are inseparable, with the latter arising from the former. Without authority one cannot discharge responsibility. However, authority should be commensurate with responsibility.
3. **Discipline:** Considering discipline as respect for agreements that are directed at achieving obedience, discipline requires good supervisors at all levels. Manager and administrators hold set the good example through their actions and behaviour.
4. **Unity of Command:** This means that employees should receive orders from one superior only. Each employee must know who his immediate boss is and be responsible to him for his work.
5. **Unity of Direction:** Each group of activities with same objectives should have one head and one plan. As opposed to unity of command this relates to the organisation as a whole. There should be teamwork and unity in the organisation. If people are divided about objectives there will be waste of organisational resources.
6. **Centralisation of authority:** There refers to the extent to which authority is concentrated or dispersed. It should be clear in the organisation as to who is to issue orders and what are the areas of his/her authority. Otherwise conflicting orders will create confusion.
7. **Scalar chain:** Chain of supervisors from higher to lower ranks should not be bypassed unnecessarily.
8. **Order:** This is "a place for everything and everything in place". As a principle in organisation this will result in optimisation of resources.
9. **Remuneration:** Equal pay for equal work. Each person should be paid according to his contribution. The remuneration and method of payment should be fair and afford maximum possible satisfaction to employees and employer.
10. **Stability of tenure:** Unnecessary turnovers or transfers of employees are both the cause and effect of bad management. The employees want assurance about permanent nature of the hob resulting in a feeling of security and involvement in work.
11. **Delegation of authority:** Because managers manage through the work of others, there should be delegation of authority. Through delegation the subordinates get prepared for higher responsibility. They needs training and motivation of the delegator and delegate must match.
12. **Initiative:** This is the thinking out and execution of a plan. Employee should be given opportunity for use of creative ideas in their work, It is a means to job involvement and commitment to organisational goals.
13. **Subordination of Individual interest to the Organisational Interest:** When the two differ, management must reconcile them was the organisation is set up to meet the needs of society the individual must sacrifice some selfish interests in the overall interest of the organisation and society.
14. **Equity:** Loyalty and devotion should be elicited form personnel by a combination of impartiality kindness and justice on the part of managers when dealing with subordinates. They must be treated without any bias for race, religion sex and class.

Box 1.5: Management principles

Watch a video on management principles.

https://youtu.be/RIozYN_rhkA

The above management principles as propounded by the classical school of management are still in use but attempts to apply them blindly especially in health care service organisations may be counter-productive due to highly personal nature of these services and the professional needs of the technical service providers.

Check Your Progress 3

1. What is the importance of a vision statement?

   .....

   .....

   .....

2. Identify the functions of management in the word search given below.

G	K	J	X	Y	Y	C	X	Q	J	U	H	K	G	H
G	N	J	S	W	F	D	X	Y	E	X	A	N	P	L
N	O	I	Z	H	T	T	I	W	N	A	I	Y	V	M
I	B	M	T	N	L	B	T	Z	N	Z	T	J	S	G
L	D	Q	G	N	I	T	A	N	I	D	R	O	O	C
L	P	U	S	J	E	Y	A	N	K	M	C	J	I	G
O	L	L	T	P	X	S	A	R	U	W	G	R	G	N
R	K	W	A	P	T	G	E	H	V	D	D	J	E	S
T	T	V	F	N	R	D	I	R	E	C	T	I	N	G
N	I	Z	F	O	N	E	B	F	P	W	e	f	k	k
O	G	D	I	N	S	I	P	L	R	E	H	K	B	H
C	K	D	N	P	J	C	N	N	P	Q	R	Z	C	H
E	P	W	G	J	G	Y	K	G	G	J	G	R	I	T
V	B	T	Q	Q	N	F	J	N	W	F	I	D	V	E
H	Y	Q	N	B	I	M	C	G	J	W	S	I	K	G

3. Identify some of the Henry Fayol's management principles.

1. Employees should receive orders from one superior only	
2. Without authority one cannot discharge responsibility. However authority should be commensurate with responsibility.	
3. The work assigned to each worker should be clearly defined and activities of the organisations precisely clarified.	
4. Each group of activities with same objectives should have one head and one plan.	
5. There refers to the extent to which authority is concentrated or dispersed.	
6. Requires good supervisors at all levels.	
7. This is "a place for everything and everything in place".	
8. This is the thinking out and execution of a plan.	

1.4.4 Planning as a Management Function and Technique

Planning is an important managerial functions as well as a management technique. As a function, it is a way of finding out where an organisation stands in the present and where it intends to be at some given time in future. It incorporates techniques like 'Forecasting' that in essence means 'predicting future' in terms of some defined parameters. It is integral to planning and requires assumptions about internal resource-needs and also about external or environmental factors. Health organisations need forecasting for assessment of demand on their services and for assessing utilisation of its resources.

Forecasting involves understanding the reasons behind the changes that have occurred in the past, what aspects of the plan activity must be measured and studied. It involves collection of data as a measuring device and draws conclusions through analysis of data. There are several forecasting techniques that are used selectively depending on the situation to be forecasted. Some such methods are, time series analysis, extrapolation, visionary forecast, panel consensus, market research, Delphi method, moving average method, correlation analysis, regression model, economic model, opinion polling etc. just to name a few.

Planning can be Strategic or Operational as explained in **Box 1.6**.

Strategic Planning covers the organisation as a whole including its mission. It develops broad objectives like details of services required and means for their fulfillment.

Operational Planning on the other hand looks at relatively lower levels in the organisation. Essentially it implements the Strategic Plan and focuses mainly on specific programmes and their implementation.

Box 1.6 : Strategic and Operational planning

Box 1.7 jots down the major components that all the plans should have.

All Plans should be,

i. based on study of expected end results
ii. broad based and flexible
iii. involve all stake holders as far as possible
iv. comprehensive
v. continually reviewed and updated
vi. realistic
vii. time-phased

Box 1.7: Major components that all the plans should have

Step by step approach to planning: If Planning were to be used as a technique, it is important to do it in a structured manner in the steps as aoutherised in **Box 1.8**. But this can be subject to some variations depending on demands on the plan and the manager who is planning:

1. **Situational Analysis:** Core problem and the Opportunities are assessed by involving all stake holders and including all opinions
2. **Identification** of Problems and prioritisation

3. **Establishing Goals and Setting Objectives** that are realistic, relevant, feasible, achievable and measureable.
4. **Review of risks/ limitation/constraints and elaboration of mitigation measures**
5. **Defining Operational Policy and establishing Systems:** Operational policy is a statement of objectives. It is one of the main functions of each department. The Operational policy leads to operational plans and systems to be followed at respective levels in the organisation.
6. **Systems are made operational** so that they fit within the constraints of operational policy. This would determine how things would finally take shape. For example, the operational system would look into procedures for procuring equipment printing of forms and/or deployment of different category of staff.
7. The outcome of the planning process is the Plan-document that is required to be presented to and approved by the governing body of the organisation.

Box 1.8: Step by step approach to planning

Think and reflect

Consider the problem of sharp injuries and outline the step by step approach to planning the prevention of sharp injuries in your hospital or health care institution.

1.4.5 Management Tools and Techniques

At times one may treat management tools and techniques and one, but in fact, tool is a model and technique refers to the method or the procedure of using that tool. Considering the limited scope of this unit, only those techniques that are relevant to health institutions and hospitals are discussed.

Systems Approach

A system is an integrated assembly of interacting elements designed to carry out cooperatively a pre-determined functional.

There are five major elements in systems approach selecting objectives, designing alternatives, building models, weighing cost against effectiveness and the application of suitable criterion. It can be represented with a diagram. See **Box 1.9**. on system analysis.

System Analysis provides for,

i. Consideration of all variables over and above the biological and technical that affect health intervention programmes
ii. A planning approach that relates input to output
iii. Emphasis on quantification and analytical methods
iv. Orientation towards health problems rather than towards the categories of services
v. Communication with key governmental decision making centers
vi. Early attention to planning and priority setting
vii. Improved inter-disciplinary collaboration and
viii. Use of wide range of analytical models and methods

Box 1.9: System analysis

The world of modern managers is changing rapidly. They face challenges due to the complexities of the organisations where they work and problems that

they have to face due to growing demands, both internal and external. They thus need to enhance their capabilities through newer management techniques. They help them carrying out their managerial functions better especially in decision-making.

There are several management techniques that are used by hospital managers as mentioned in **Box 1.10**.

i. Operational Research (OR) Techniques

a. Those used for inventory control viz. Economic Order Quantity (EOQ), ABC Analysis, Just in Time (JIT) technique,

b. Queuing Theory

c. Linear Programming

d. Sequencing

e. Network Analysis like Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM)

ii. Work study

iii. Work simplification

iv. Quality Circle (QC)

v. Computer Aided Designs

vi. Budgeting

vii. Management by Objectives (MBO)

viii. Techniques based on Analysis (SWOT, Quantitative factors in evaluating alternatives(Cost Effective, Cost Benefit, Break-even) etc.)

ix. Decision Tree

x. Forecasting

Box 1.10: Management techniques used by hospital managers

i. Operational Research (OR)

Operational Research (OR) is a scientific method that was developed by mathematicians to aid the military during second world-war for managing the logistics. It follows the Systems Approach and provides a quantitative basis for decisions about operations under the managers. In this, mathematical models are developed and outcomes are calculated for all possible options.

OR is an interdisciplinary team approach solving economic physical, psychological, biological, sociological and engineering aspects of any problem through involvement of mathematicians, statisticians, engineers, economists, computer experts and managers. This team tries to analyse the cause and effect relationship among various parameters and evaluates outcome of various alternative strategies.

OR increases the creativity of decision making and OR models have been commonly used in solving problems, various financial and administrative problems. Other OR techniques include Probability theory, Queuing theory, Linear programming, risk analysis, decision trees, preference theory etc.

The various steps in application of OR methods are mentioned in **Box 1.11**.

a. Problem Formulation: This involves
   - Precise description of the goal/objectives of the study
   - Identification of the controllable and uncontrollable variables involved in the system
   - Recognition of restrictions and constraints on the identified variables

b. Mathematical Model:The OR groups makes assumptions and develops a model that gives a perspective picture of the problem.

c. Identification of the possible solution: Solutions are derived with the help of mathematical techniques like linear programming simulation or experimentation.

d. Testing the solution: The model is then tested for measuring its effectiveness and efficiency. The model is considered valid if it repeats past performance under identical conditions using historical data.

e. Establishing controls: The controls are established to mark the limits within which the model and the derived solutions is considered reliable.

f. Implementation and maintenance of model: The optimal solution derived through OR method is then implemented. The OR group initiates this process of implementation. If the model isused more than once in the analysis of the decision related problems, then each time it would have to be reviewed and revised.

Box 1.11: Various steps in application of OR methods

OR Techniques

a. ECONOMIC ORDER QUANTITY (EOQ):

The cost of inventory is related to its purchase cost and inventory carrying cost. There is always one quantity at which these two costs are equal and total of the two is the minimum. This is the EOQ and is calculated by the following formula:

$$EOQ = \sqrt{\frac{2AOc}{Ic}}$$

EOQ = Economic order quantity
A = Annual demand for the item
Oc = Ordering cost
Ic = Carrying cost per unit

$$\text{Frequency for placing order} = \frac{\text{Annual consumption}}{\text{Order quantity}}$$

Look at **Fig.1.2** which maps the cost and quantity to graphically show the concept of EOQ.

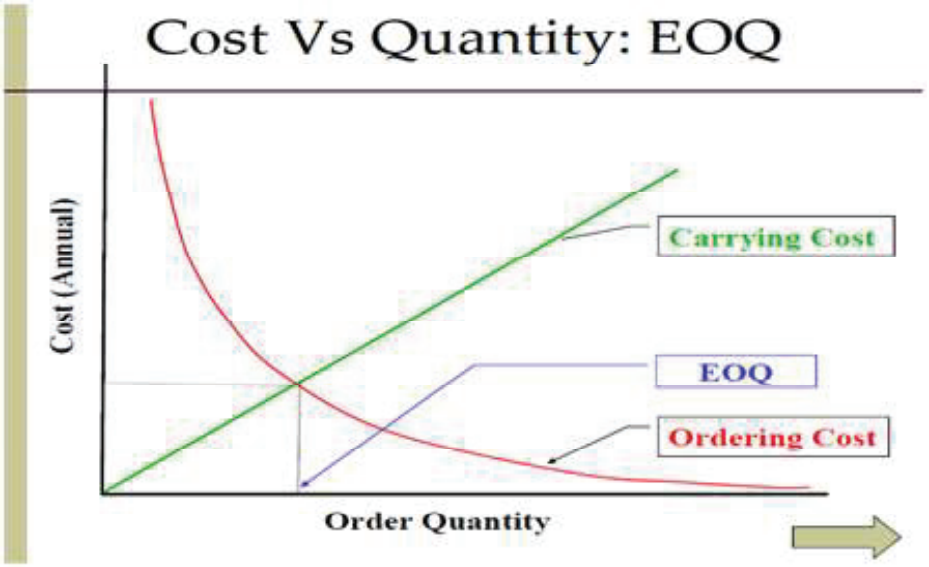


Fig.1.2: Costs and quantity to graphically show the concept of EOQ

https://youtu.be/qgvH2Eo6_gY

b. ABC ANALYSIS:

It has been observed that some inventory items cost more than others and thus inventory follows the Pareto's law. Lord Pareto was an economist and he observed that wealth of a country is held in the hands of a few. Later this phenomenon was observed in other walks of life as well. If all items of any inventory are arranged in descending order according to their total cost per annum, it is common to see that 20% of the items consume almost 70-80% of the total budget of those items. Thus it makes sense managerially that controls are observed on these items to observe economy. These items are called category A items. **Box 1.12** mentions the steps of ABC analysis.

Steps of doing the ABC Analysis:
i. The cost of each items of the inventory is multiplied by the total quantity used during the given time, usually annual usage.
ii. The items are arranged in descending order of the numeric value.
iii. The cumulative value of the items written against each in the next column.
iv. The cut off points are drawn at various levels depending on the purpose and need of the analysis and they are shown in the graph below it.

Box 1.12: Steps of ABC analysis

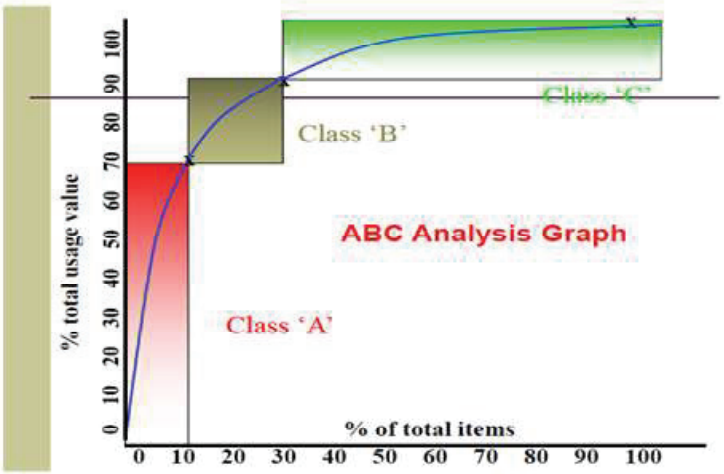


Fig. 1.3: ABC Analysis Graph

Watch this video to understand ABC Analysis.
https://youtu.be/XDrpfL1TkP0

Watch this video to understand JIT Technique
https://youtu.be/7tchKZiIwIU

Watch this video to understand the basic of Queuing Theory.
https://youtu.be/Yo7LG_JeJos

Watch this video to understand what is linear programming.
https://youtu.be/kGDMtU6z1uU

From **Fig. 1.3** it can be observed that about 10% of items consume around 70% of the budget. These are category 'A' items in ABC Analysis. On the other hand, around 70% items in lowest part of the list consume about 10% of the budget (Category C) and middle 20% fall in category 'B'.Please remember that these cut off points are arbitrary depending on how pressing the need is to control the inventory cost. The category 'A' items are costlier, lock the capital and are prone to pilferage and it is cost-effective to keep a check on them as they consume lesser resources and dividends are higher. Besides the quantity ordered for category 'A' items would be lower and re-orders more frequent. Higher management prefers to keep the purchase of these items directly under its control with better record-keeping and monitoring .

c. JUST IN TIME (JIT) TECHNIQUE:

This is a Japanese technique that allows almost zero inventory for some items and is gaining importance all over the world. This is also known as zero inventory or stockless purchases. It requires a dependable relationship, excellent communication and perfect level of coordination between the user department and the supplier firm. This method requires that the lead time is near zero i.e. the items are ordered just in time that the supplies reach just before the inventory for that item is exhausted.

d. QUEUING THEORY/WAITING LINE MODEL:

Long queues for seeking service are common problem in the public health system. Long queues are the common cause of dissatisfaction of patients and chaos. It is classically due to mismatch between the demand and supply of the service, arrival pattern of patients and space available for waiting. Since health care service providers are scarce and costly, it is a waste if they remain idle for some time and overworked at others. Besides, their number cannot be increased indefinitely to match the demands of those in the queue .

In 'waiting line models' one observes the length of the queue, traffic density, arrival pattern of patients, time for which services remain idle, time during which the services are overburdened i.e. peak hours, average waiting time and average service time. With the help of these parameters, the one can determine mathematically the ideal number of service points, space and facilities for waiting patients, number of queues, and arrangement for more doctors/service providers during peak hours and appointment system to regulate the arrival of patients.

e. LINEAR PROGRAMMING:

This is one of the most successful technique for OR. It assumes that a linear relationship exists between variables and that the limits of variations can be determined. This technique is used for optimum utilisation of the resources . This is a mathematical technique for the purpose of optimal allocation of resources. Requirements of linear programming are mentioned in **Box 1.13**.

LP requires,

- Clear Objectives
- Defined constraints or restrictions
- Non-negative conditions: LP requires that the value of variables must be zero or more but never negative.
- Linear relationship: There is a proportional relationship between two or more variables. For example, if one worker can lift 50 waste bags in two hours then more workers should be able to lift more bags in the same proportion. Same can hold for the capacity of waste autoclaves or the incinerators.

Box 1.13: Requirements of Linear Programming

f. SEQUENCING:

Managers are often confronted with a situation where they have to decide the sequence in which they have to carry out multiple tasks for maximum returns or output. Such problems are termed Sequencing problems. Let's say the BMW has to undergo sequential tasks viz. segregation, collection in bags that are colour coded, sealed, numbered, weighed and then sent to autoclave and then to a shredder or transported to incinerator. Mathematically one can determine a sequence that would be able to maximise the output of the machines and reduce the idle time.

Watch this video to understand what is sequencing.
https://youtu.be/GTXQMjRx28M

g. NETWORK ANALYSIS:

Programme Evaluation and Review Technique(PERT):

A project manager who is overseeing a large scale, non-repetitive project has to track the planning activities required to complete it and to review the plan to ensure that it gets completed on time. Such a project can be construction of a building or development of a software application or commissioning an incinerator plant in a large teaching hospital for BMW management. The manager has to evaluate the effectiveness of their plan and the actions taken, and also to review their plans from time to time. PERT is a widely used technique. Requirements for PERT is mentioned in **Box 1.14**.

PERT requires preparation in form of several steps as below:

i. List all activities required for completion of the project

ii. Link these activities with each other in as realistic a fashion as possible.

iii. Estimate the expected time (T^e required to complete each activity,

- Optimistic time (O): shortest time for the activity
- Pessimistic time (P): time taken if everything required in that activity goes wrong
- Most probable time (M) or a realistic estimate of the time that the activity would take.

$$\text{Expected time } T^e = (O + 4M + P)/6$$

iv. Calculation of Critical Path: PERT is also called as the critical path method (CPM) as the network activities and their linkage allows deduction of a Critical Path that is the longest path to complete the Project. If this is delayed the entire project would get delayed. Besides the abbreviations O, P, M and T^e as above, PERT uses other abbreviations like, 'TE' for earliest start time; TL Latest start time. Only one arrow represents a defined activity. Start or termination of an activity is represented as a circle. Critical path is shown in bold arrows and events are distinguished by numbers, no two events have same numbers.

Box 1.14: Requirements of PERT

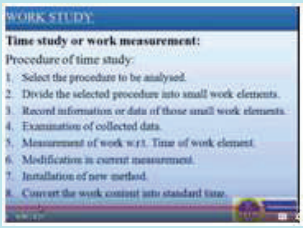
There are user-friendly software Project Management Tools available that are very handy for preparing PERT and monitor the projects.

ii. Work Study

Work study is a useful technique in Human Resource Planning. It is used for finding out better ways of performing jobs (Method Study); and for exercising control over the output by setting standards for outputs and/or for outputs in reference to time (Time Study).

Objectives for **Work Study** are to assess labor utilisation, reducing fatigue, increase satisfaction, standardisation of work, machine utilisation etc. It is carried out by collecting relevant information about ongoing method of working, making a flow chart and critically examining the information to see if improvement can be made. This is followed by checking the acceptability and implementing.

https://youtu.be/K-t5bTLU6rc



The time study sets time standards for work and/or outputs and is done by methods such as Stop Watch time study and Work/activity sampling. Stop watch time study is done by direct observation of time and records if the prescribed method is being used. A worker is selected and asked to perform the task in a repetitive fashion and time recorded. It is useful for repetitive works.

Work Sampling estimates the delays or stoppage of work in operational areas, non-productive time in relation to the productive time for workers, managers and machines etc. The technique consists of taking a number of spot observations at random intervals over sufficient period of time. It then estimates the normal time for an activity per unit of output. For example, it is common in hospitals that nurses are used for maintaining a number of registers and almost 60-70% of their professional time is lost in non-professional work of record keeping. Since wage of a professional nurse are high, it makes sense if that work can be allocated to a non-professional multipurpose worker with some training.

iii. Work Simplification is also a technique in which workers are trained in techniques of work flow analysis etc. and encouraged to simplify their works.

iv. Quality Circles (QC):

'Quality Control Circles' consists of a group of staff members who meet regularly to discuss and solve the common problems that they face in their work area. This is a voluntary action but encouraged by the organisation through recognition but generally not monetarily. QC generally consists of workers but may also include supervisors. They are encouraged to receive training in statistical quality control (SQC) techniques and of working in groups. Though the concept originated in USA but it became more popular in Japan and is credited with having a significant impact on quality of Japanese products.

https://youtu.be/WwtsXEvRO6I

v. Computer Aided Design

Computer Aided Design is a part of engineering dealing with the designing 3D computer objects or models by using specialised software. Examples in the medical field are the 3D Computer modelling of replacements organs and other body parts, used for teaching and simulations .

vi. Budgeting

a. Zero Base Budget (ZBB)

In this type of budget the manager are asked to justify their demand for funds independent of the past estimates. Thus they are asked to give detailed justification starting from zero. Though it increases paperwork and requires more time but it shifts the burden of giving justification for the demand on the manager. The estimates tend to be more realistic and managers justifying tend to become responsible in their demands. This is superior to the usual increment budgeting resorted in most Indian establishments even though the trend is changing.

ZBB is presented in a manner that the top management can evaluate and compare it with other activities competing for same or similar resources. For example, out of several alternative ways of carrying out same activity one best can be selected for funding. Alternatively a method can be identified that shows better outcomes for the funds deployed amongst several many other avenues.

https://youtu.be/t0KLvsvShsk

b. Performance Budgeting

In this type of budgeting, which is supported by planning commission in the public sector, the budget identifies activities that are needed to achieve a specific objective. The funding agencies allocate funds to the activities and not to the departments; the performance budget monitors utilisation of the budget in reference to these activities through achievement of identified physical targets vis-à-vis financial allocations in every quarter. This encourages periodic reviews, makes performance audit more effective and provides better controls to the top management.

https://youtu.be/yqejmZrtmNg

vii. Management by Objectives (MBO)

MBO is a process wherein senior managers and workers in a unit identify common objectives, outcomes and contribution by each member of the team in a manner that the resources are utilised in the best possible manner.

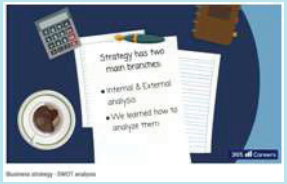
MBO is a participative approach that integrates several managerial activities systematically with a view to achieve the organisational objectives in a result oriented manner. Periodic review of performance and contribution of every stake-holder in achieving the desired objectives is one of the hallmarks of MBO.

viii. Techniques Based on Analysis

a. SWOT Analysis:

In short SWOT means 'Strength-Weakness-Opportunity-Threats'. Like individuals, organisations too have their strengths and weaknesses and this relates to the internal environment of the organisation. These qualities of the organisation depend on its resources like manpower, technology, financial resources, assets, machines, its experience and goodwill etc. Opportunities and Threats on the other hand relate to the external environment. It comprises of the geographical location, sanitation, political climate, presence of competitive institutions, socio-economic status of the people, law and order situation, availability of technology and markets, presence of banking and insurance sector etc.

https://youtu.be/9-NWhwskTO



The management of the health care facility or hospitals has to constantly be aware of its strengths, weaknesses, opportunity and threats while making important changes or taking decisions that are likely to affect its future. SWOT Analysis can also be used to evaluate best among the alternatives while solving a problem. SWOT is indispensable while doing strategic planning. It is not uncommon to see that something that may appear to be a threat to begin with, turns out to be an opportunity in the long run and vice versa. The key is to keep open-mind and indulge in frank brain-storming among the key managers and an out of the box thinking. When combined with some risk-taking, SWOT can be rewarding and is a hallmark of aggressive institutions.

b. Quantitative Factors in Evaluating Alternatives

i. Cost Effectiveness Analysis: This is the technique of weighing alternatives where optimum solution cannot be conveniently reduced in quantifiable form such as to rupee or some other measurable form to identify a preferred choice. This method is used in evaluating health programmes where outcomes are not quantifiable in money terms directly. The outputs are thus measured in terms of the effectiveness of an intervention. In this technique costing details of each alternative are worked out and effectiveness of each is analysed in terms of attainment of programme objectives and of the relationship between cost and effectiveness. This helps in selecting the best alternative.

ii. Cost Benefit Analysis: This technique is used for health planning. The inputs and outputs are both measured in monitory terms to decide if a particular alternative is worth-accepting. It begins with detailed description of the alternative to be tested, followed by estimation of the value/cost of all resources in monitory terms. Then it identifies the outcomes and estimates their benefits, also in monitory terms. The impact of time delay, if any, is to be factored in as well. It is important to apply a decision rule in reference to the priority and focus of the intervention especially with reference to the target population of the area. This analysis incorporates a sensitivity analysis wherein the criticality of the assumptions in working out the monitory estimates is analysed.

iii. Break-even Analysis and Break-even Point: This is a very common tool for evaluating the economic feasibility of a new enterprise or a product. It identifies a point at which revenue is exactly equal to cost called as the 'Break-even Point' or a point at which there is no loss or profit. In other words this indicates the level of sale that covers the costs. Sale of units above this number would lead to profit and below it to a loss. This analysis is based on two types of costs viz. Fixed costs and variable costs. Fixed costs as the name suggests are constant and an outcome of overhead costs or the establishment costs that would incurred even if there is no production.

The **Fig. 1.4** depicts the break-even point graphically as the point at which the total revenue is equal to the total cost. The triangle to the left of the break-even point is loss and the one to its right denotes the profit.

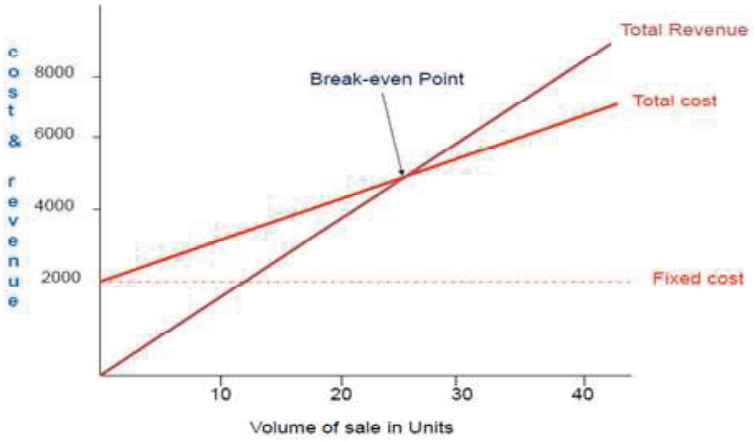


Fig. 1.4 : Graphical depiction of the break-even point

ix. Decision tree

A decision tree is a graphical representation of possible solutions to a decision based on certain conditions Trees are an excellent way to deal with these types of complex decisions, which always involve many different factors and usually involve some degree of uncertainty.

Presented below is an example. Let us take the example of a needlestick injury. While dealing with sharps there is a possibility of getting a needlestick injury or not getting the injury. If you do happen to prick yourself, the needle could be contaminated with blood which is infected. If it is not infected, you are safe. However, if it is infected, and you have taken a post exposure prophylaxis, your chances of contacting infection is low whereas if you do not take a PEP, then the chances of being infected increases. Once the decision tree has been mapped out with its corresponding outcomes, values (utilities) and probabilities, the best health care choice can be identified.

x. Forecasting

Forecasting is basically a management tool which is used for planning. It relies on data from the past and present, involves the analysis of trends and helps to cope up with the uncertainties of the future.

Health forecasting is a tool for predicting future health events or situations such as demands for health services and health care needs. By using forecasting, the health service providers are able to plan and take appropriate mitigating actions to minimise risks and prevent damage.

Various methods have often been adopted to forecast aggregate or specific health conditions. Demand forecasting for example can be used to access the need for resources like manpower, medicines, equipment etc .

https://youtu.be/fp-1_9mLlbc

Check Your Progress 4

1. What is SWOT analysis?

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2. Explain zero base budgeting.

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1.5 BIO-MEDICAL WASTE MANAGEMENT PROGRAMMES: SOME MACRO CONSIDERATIONS

Bio-medical waste-management operations should not be piecemeal. The top management or the government should have the broad picture with clear goals. Decentralised decision making, good project teams under a good leadership and sufficient resources supplemented with good plan would always yield the desired results. A well-thought plan spells out the actions to be taken, resources to be deployed and the time frame in which the project is to be implemented and is the blue-print for success.

World Health Organisation (WHO) has spelt out some core principles for achieving safe and sustainable management of health care waste. First among them is that there should be clearly defined guidelines, defined responsibilities for the managers at various levels and sufficient funds to be made available **(Box 1.15)** mentions the objectives of health care waste management plan.

At a national level, such a plan should cover the following objectives (WHO, Basel Convention & UNEP, 2005):

a. Develop the legal and regulatory framework for bio-medical waste management
b. Rationalise the waste-management practices within bio-medical facilities
c. Develop specific financial investment and operational resources dedicated to waste management
d. Launch capacity building and training measures
e. Set up a monitoring plan
f. Reduce the pollution associated with waste management

Box 1.15: Objectives of healthcare waste management plan

WHO recommends periodic reviews of policies on BMW management depending on realties at the ground level and on the available technologies. At the national and state level things are to be seen at a macro level or in a broad perspective while local plans need to have good micro-plans to take care of need-assessment, required materials, available skills, proper costing and best practices for waste-handling and waste-treatment. The cost benefit and feasibility of commissioning a larger bio-medical waste treatment facility in view of future needs by using forecasting and other OR techniques would be cost-beneficial in the long term.

It is important that maximum time and attention is given to planning especially with reference to strategic issues like involvement of various stake-holders including the private sector and scope of a public-private partnership.

A national waste-management plan based on assessment of existing bio-medical waste management facilities and the unmet demand would yield valuable data for evolving a consensus on actions to be implemented across the country. A supportive national policy and a national programme for BMW management can speed things up and derive benefits to public health faster. Such a policy would attract the industry and the private sector to invest in appropriate technology with better designs of the waste-treatment and disposal facilities. Good practices of one state can be replicated in other states and thus a framework.

In India a policy and legal framework for BMW management already exists and now its challenge is in bringing about a change in the outlook of the health institutions and health care service providers and universal application of the good practices for BMW management and their monitoring. This can only be achieved through application of principles of management and allocating sufficient resources to sustain the BMW Programme perpetually.

It is important that the entire programme is properly monitored and supervised through institutional and legal mechanisms. As things mature it is likely that both environmental engineers and medical personnel can take up BMW management as a profession. They can play a proactive role on lines similar to what we have in finance and audit as Chartered Accountants. They would have appropriate skills and knowledge about all aspects of BMW and its management. Presently such professionals do not exist and this important task is left on the shoulders of lowest rung of workers who are neither trained nor motivated not empowered to play a proactive role. There is a need for such effective workers and for Quality Circles in hospitals/institutions that are major generators of BMW.

Most urban hospitals in India have a Hospital Infection Control Committee (HICC), headed generally by the head of the hospital and assisted by the microbiologist. After promulgation of the Bio-Medical Waste (Management and Handling) Rules most such hospitals have a nodal officer for BMW who is also a member of the HICC. Presently these nodal officers are mostly doctors or nurses who have undergone training as trainers. Such an institutional arrangement has long term implications and is likely to encourage health personnel to specialise and move in had BMW professionals.

Waste-management in a Bio-Medical Waste Treatment Facility is of critical importance as inefficiency or carelessness can play havoc with lives of the people. There is a strong case for a regulator for their continuous and effective monitoring. The State Pollution Control Boards need to be strengthened through involvement of eminent citizen and empowered to deal with offenders effectively.

Under provisions of the BMW Act the heads of hospitals or the facility that generates BMW is responsible for proper and safe disposal of the BMW. He should formally nominate the members of waste-management team specifying their duties and responsibilities. There should be a full time waste-management officer to have an overall responsibility for looking after bio-medical waste-management plan and its day-to-day operations.

Considering the public health importance of the BMW management the error-prone nature of human beings, there is a strong case for use of Information Technology and automation in BMW management. Most of the modern hospitals are getting computerised and using Hospital Management Information System

(HMIS) Software in a manner that most of their work-flow is becoming online. Most HMIS Software have modules that cater to every department of the hospital. However few have functionality to take care of BMW Management. The Centre for Development of Advance Computing (CDAC) is a society under Ministry of Electronics and Information Technology GOI that developed an HMIS solution for Delhi Government hospitals. The system is presently operational in one hospital in west Delhi. As part of its memorandum of understanding with Delhi Government CDAC has conceptualised a BMW Management module that provides for printing of a RFID (Radio-frequency Identification) tag that has a unique ID for each waste bag and its weight. This system through RFID readers placed strategically within the hospital, is capable of ensuring that each waste-bag is accounted for and travels through a defined route only. The solution is feasible, cost effective and reduces the human interface and the dependence on health personnel.

Check Your Progress 5

1. Write down the objectives of BMWM programme.

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2. What is the HMIS system developed by CDAC for GOI?

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1.6 LET US SUM UP

Understanding the scientific basis of good BMW management or choosing the best technology for the same may not be enough to implement a good and efficient Bio-Medical Waste Management Programme at the grass-root level. It is imperative that the entire process of bio-medical waste management is seen as a system and understood in terms of criticality of the processes involved. As resources are always limited, it is necessary that ground realties are properly assessed through surveys and studies before-hand followed by prioritisation of the challenges for bringing around a change. A clear vision, well-defined goals and mobilisation of sufficient resources would finally set the ball in motion and a project would emerge. Next comes selection of a project-team under an experienced leader who follows the principles of management, creates a good plan and then achieves the project objectives using various managerial tools and techniques.

Such a methodology is the recipe for success and one success in a given health care facility or a hospital can then be replicated in a larger way to cover bigger institutions or bigger areas be it municipal ward or a district or a state. You would appreciate that within the framework of management policies, goals, objectives and managerial techniques there is always a scope for the managers

to be creative through an innovative strategic plan, using appropriate leadership style to turn any dream into realty using a team approach. The success of the project and consequent changes are the reward that the managers aspire for. This is the reason that celebration is the final event before a management project is considered complete. The concepts covered in this unit are summarised in the Mind Map (**Fig. 1.5**).

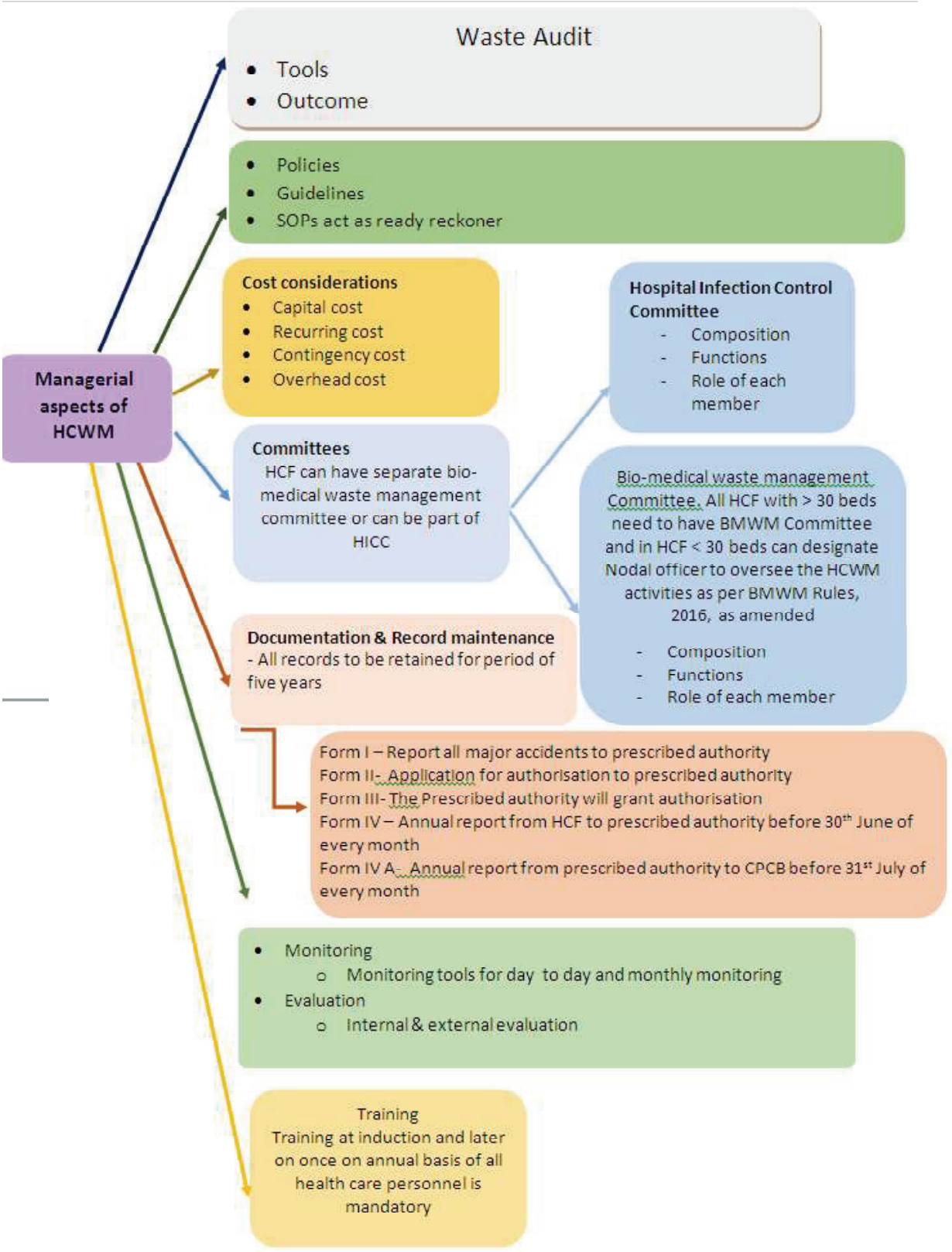

Fig. 1.5 : Mind Map

1.7 GLOSSARY

BMW	:	Bio-medical Waste
CDAC	:	Centre for Development of Advance Computing
CMO	:	Chief Medical Officer
CEO	:	Chief Executive Officer
DHS	:	Directorate of Health Services
EOQ	:	Economic Order Quantity
GoI	:	Govt. of India
HCF	:	Health Care Facility
HICC	:	Hospital Infection Control Committee
IPD	:	In-patient Department
HIMS	:	Himalayan Institute of Medical Sciences, Dehradun
MS	:	Medical Superintendent
OPD	:	Out Patient Department
OT	:	Operation Theatre
PERT	:	Program Evaluation and Review Technique
PIL	:	Public Interest Litigation
QC	:	Quality Control Circles
RFID	:	Radio-frequency Identification
SQC	:	Statistical Quality Control
SWOT	:	Strength-Weakness-Opportunity-Threats
UoI	:	Union of India
WHO	:	World Health Organisation
ZBB	:	Zero Base Budget

Glossary of Terms related to Management

System in an organisation or in any work area refers to functions and activities that are carried out together so as to fulfill a defined objective and/or purpose of the organisation.

Management System is the mechanism through which an organisation manages its assets both human and physical to achieve its objectives within the constraints.

Health Systems comprise of the organisations, institutions and resources that produce health-actions, i.e. an effort for providing health care and public health services and/or initiatives in related sectors whose prime objective is to improve health.

A Systems Approach views the organisation as a unified, well-directed system of interrelated parts that are aligned towards a stated goal.

System Flexibility is the outcome of the ability of the organisation to manage diversity, increase its adaptability and be flexibility with a view of achieving the stated objectives with least possible resources in the shortest time.

Management, on one hand deals with well-defined areas such as productivity and efficiency that are best exemplified by operations research or a management science approach to problem solving. On the other hand, management deals in more diffuse areas such as leadership and motivation where there are no defined methods. Rightly so management can be viewed both as an art and a science. It is solely on the manager as to how he/she constructs or reconstructs the organisations so as to maximise efficiency, productivity and effectiveness, and minimise the stress and unhappiness of the people who work for him/her.

1.8 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1. The Apex Court directed Central Pollution Control Board (CPCB) to monitor the implementation of its directives. The draft of Bio-Medical Waste (Management & Handling) Rules was circulated in 1995 by UOI. This also improved awareness of the state and the general public about environmental issues and led to strengthening of the Environmental (Protection) Act 1986.

Check Your Progress 2

1. Medical tourism refers to people travelling to a country other than their own to obtain medical treatment. In the past this usually referred to those who travelled from less-developed countries to major medical centers in highly developed countries for treatment unavailable at home. Example: Chennai is the most popular destination for medical treatment in India. Nearly, 40% of the country's medical tourists arrives in Chennai for medical treatment, a study conducted by Confederation of Indian Industries (CII). Latest reports showing that Chennai receives up to 200 foreign patients daily due to high quality medical treatment, low cost and best experience. Apollo Hospital is the most popular private hospital in the city.

Source:
https://traveljee.com/destination/asia/india-asia/medical-tourism-destinations-in-india/

2. BMW is generated from various patient-service areas -

   Out Patient Department (OPD), In-patient Department (IPD, Day-care centers, Operation Theaters, Delivery Rooms, Intensive Care Units (ICU),Coronary Care (CCU), Pediatric ICU, Neonatal ICU. In addition, support service like Laboratory, Radiology/imaging, Pharmacy, Radiotherapy, Laundry, CSSD etc. also contribute to their share of BMW.

Check Your Progress 3

1. Vision statement attracts commitment and energizes human resources and people, while creating meaning in workers' lives. It bridges the present with the future while establishing a standard for excellence.

2. Planning, Organising, Staffing, Controlling, Directing, Coordinating and Representing.

3. Unity of Command, Authority and responsibility, Division of work, Unity of Direction, Centralisation of authority, Discipline, Order, Initiative.

Check Your Progress 4

1. SWOT analysis (strengths, weaknesses, opportunities and threats analysis) is a framework for identifying and analysing the internal and external factors that can have an impact on the viability of a project, product, place or person.

   A SWOT analysis is often used at the start of or as part of a strategic planning exercise. The framework is considered a powerful support for decision-making because it enables an entity to uncover opportunities for success that were previously unarticulated or to highlight threats before they become overly burdensome. For example, this exercise can identify a market nichè in which a business has a competitive advantage or help individuals plot career success by pinpointing a path that maximises their strengths while alerting them to threats that can thwart achievement.

2. Zero-based budgeting (ZBB) is a method of budgeting in which all expenses must be justified for each new period. The process of zero-based budgeting starts from a "zero base" and every function within an organisation is analysed for its needs and costs. In this type of budget the manager are asked to justify their demand for funds independent of the past estimates. Thus they are asked to give detailed justification starting from zero. Though it increases paperwork and requires more time but it shifts the burden of giving justification for the demand on the manager. The estimates tend to be more realistic and managers justifying tend to become responsible in their demands. This is superior to the usual increment budgeting resorted in most Indian establishments even though the trend is changing.

Check Your Progress 5

The objectives of BMWM programme are to:

1. a. Develop the legal and regulatory framework for Bio-medical waste management

   b. Rationalise the waste-management practices within Bio-medical facilities

   c. Develop specific financial investment and operational resources dedicated to waste management

   d. Launch capacity building and training measures

   e. Set up a monitoring plan

   f. Reduce the pollution associated with waste management.

2. The Centre for Development of Advance Computing (CDAC) has developed an HMIS solution for Delhi Government hospitals. The system is presently operational in one hospital in west Delhi. As part of its memorandum of understanding with Delhi Government CDAC has conceptualised a BMW Management module that provides for printing of a RFID (Radio-frequency Identification) tag that has a unique ID for each waste bag and its weight. This system through RFID readers placed strategically within the hospital, is capable of ensuring that each waste-bag is accounted for and travels through a defined route only. The solution is feasible, cost effective and reduces the human interface and the dependence on health personnel.

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UNIT 2 SYSTEMS OPTIONS

Structure

2.0 OBJECTIVES

After studying this unit, you will be able to:

- explain the objectives and components of a waste management system
- enumerate the systems available for waste management
- identify the need for setting up on-site Bio-Medical Waste Treatment Facility
- differentiate between the single option and multi option approach

2.1 INTRODUCTION

You have already read about the principles of management in general and in relation to the management of waste in the first unit of this course. It needs to be understood that the term "Management of Waste"a comprehensive term, is preferable to disposal of waste. Management encompasses the entire gamut of activities and endeavours related to the handling of waste-segregation, storage, collection, transportation, treatment and disposal of waste till the wastes is of no more use and are rendered relatively harmless. It takes into consideration the overall impact of individual activities and not merely the immediate objective of removal, discarding or disposal of waste. Otherwise, these wastes may be dangerous as they pose chemical and biological hazards apart from physical hazard. You have already read about the principles of waste management in Unit 6, Block 2 of BHM-101 and the impact of both infectious and chemical waste in Unit 9 and Unit 10 respectively of Block 3, BHM-10.

Any system designed for proper waste management should address all these risks equally and thus will need to employ a variety of approaches and technologies. You have also learnt about the various treatment technologies in the Units 21 to 24, Block 2, BHM-102.

A key learning from observation of waste management systems is that the issue is best approached as human management and training issue and not merely as a technology issue. However, it is also to be understood that without properly appreciating the technology concerns any system built will itself go to waste. The selection of a technology is not a simple one of choosing something available in the market, but requires careful evaluation, taking into account not only the costs but also the current and projected waste generation rates, waste composition, existing practices, ease of application, training needs, technical requirements as well as environmental and occupational safety.

The Bio-Medical Waste Management Rules, 2016, as amended restrict occupier (or Health Care Facility) for establishment of on-site or captive bio-medical waste treatment facility, if a service of common bio- medical waste treatment and disposal facility (CBMWTF) is available within a distance of seventy-five kilometers, as installation of individual treatment facility by health care facility (HCF) requires comparatively high capital investment. In addition, it requires separate dedicated and trained skilled manpower and infrastructure development for proper operation and maintenance of treatment systems. The concept of CBMWTF not only addresses such problems but also prevents proliferation of treatment technologies in a particular town or city. In turn, it reduces the monitoring pressure on regulatory agencies. In the area where CBMWTF is not available, then only there is a choice for on-site treatment and disposal of generated waste, in accordance with the Bio-Medical Waste Mangement Rules, 2016, as amended.

In this unit you shall learn the various system options available in the management of health care waste. You will learn the various factors which decide how to choose the particular system over another. Many times it is not an individual choice but mandatory as per certain criteria drawn out be governments. We shall take the example of the system options as envisaged by the BMWM Rules 2016, as amended for India.

2.2 WASTE MANAGEMENT SYSTEM

Let us learn more about the objective and the components of a waste management system.

2.2.1 Objectives of a Waste Management System

The overall aim of any waste management system is to ensure and assure human health and safety of environment. To bring to realities these aims, the individual activities under the waste management system need to be laid out as specific objectives. The **five** objectives of any waste management system are enumerated in **Box 2.1**.

Objectives of Waste Management Systems are as follows:

a. To reduce the infectious/hazardous nature of the waste

b. To reduce the volume of the waste

c. To prevent misuse and/or abuse of the waste

d. Aesthetic considerations

e. To ensure occupational safety and health

Box 2.1: Objectives of waste management system

Let us read more about these objectives

a. Reduce the Infectious/Hazardous Nature of Waste

A major concern with waste from health care institutions is its infectious nature. Its propensity to result in hospital acquired infections; its ability to cause an accelerated transmission of infection in the community is what creates a scary and grim picture.

Box 2.2 lists the ways in which the infectious or hazardous nature of the waste can be reduced.

a. One of the most important objectives of a waste management system is to reduce this infectious nature of health care waste.
b. Proper segregation and containment of waste from the point of generation to final disposal are the most important steps in reducing the quantity of infectious waste in the health care facilities, as proper segregation results in restricting infectious waste generation to 10-20 per cent of total hospital waste.
c. Further the infectious waste is rendered non-infectious by disinfection and sterilisation methods.

Box 2.2: Reducing the infectious or hazardous waste

You may like to recap about pre-treatment already covered in the Unit 19, Block 1, BHM-102 and the treatment technologies in Unit 21 to 24, Block 2, BHM-102.

b. Reduce the Volume of the Waste

Think and reflect

Why do you think we need to reduce the volume of the waste?

The second concern is the volume of waste as mentioned in **Box 2.3**.

a. Large numbers of disposables are being used in health care establishments thus increasing the volume of waste many times.
b. Policies in health care establishments should encourage reduction of waste and ensure health standards simultaneously.
c. Purchases in the institution should aim at bulk purchases and minimise packaging.
d. The policies of reduce, reuse and recycle should be actively in place and followed.

Box 2.3: Mechanisms to reduce the volume of waste

Did you know?

You might have read many newspaper reports about the used and improperly discarded syringes and bandages being collected by rag pickers, washed and again being made available for sale in kilograms for reuse of syringes and mattress filters respectively. One should not be complacent about such reports but should consider that this sort of activity can result in faster spread of infection and many of us can be the 'innocent victims'. In the long run no section of the society is spared of this problem.

You have already read about the minimisation in Unit 6, Block 2, BHM-101 and in the Unit 1 of this block.

c. Prevent Misuse and/or Abuse of the Waste

WHO estimates that nearly 50 per cent[1] of the syringes are reused in developing countries like India. An example of the same is provided in **Box 2.4**.

A study conducted among primitive tribes of Andaman and Nicobar Islands, Union Territory of India found high prevalence (26.3%) of hepatitis B virus infection. Unsafe injections were identified as an independent risk factor for acquiring HBV infection in this population.

Source: Bulletin of World Health Organisation 1999;77(10):789-800.

Box 2.4: Study reflecting the unsafe injection practices in India

Box 2.5 gives you some tips to be followed during use of syringes, needles and tubing to prevent reuse.

a. A used syringe should be either deformed in such a manner that no person can use it subsequently as a syringe again, but can recover the value of the plastic material.

b. A needle cutter destroyer should be used to cut the tip of the syringe and cut the needle or pull it out so that it is no more of use either as a syringe or a needle.

c. The plastic catheter, IV tubing and such other articles should be cut or destroyed so that is not reused but can only be recycled. Recycling of waste is strictly recommended only after proper disinfection/ sterilisation and mutilation.

Box 2.5: Some good practices at site of sharp waste generation

Think and reflect
What do you think could be the reasons to prevent reuse of the waste items? Is it not one of the ways for waste minimisation?

Other important points for preventing misuse or abuse of waste items are mentioned in **Box 2.6**.

Preventing misuse or abuse of waste items are-

a. To ensure that treated waste is handed over to authorised, trusted and reliable agencies/agents only.

b. A detailed record should be maintained of the quantum of waste handed over.

c. Till such time, the waste should be stored in a separate enclosure, which is secure, and accessible only to the designated personnel.

d. Recycling of the used and treated syringes may be recommended by the respective policies or guidelines set by the government of the respective countries.

e. Recycling of used syringes should be channelised only after ensuring disinfection followed shredding in India in accordance with the Bio-Medical Waste Management Rules, 2016, as amended.

Box 2.6: Measures to prevent reuse or misuse of waste items

d. Aesthetic Considerations

In any institution, generally procurement of containers and equipment for waste management is given a low priority. This results in the non-availability or replacement of articles like waste bins and bags, which are vital for the waste management system. In many institutions, the waste container is an old broken drum, which is not of the appropriate size. This invariably results in the container getting full very soon and waste being spilt over to the surrounding areas. A dirty looking, torn waste container will not make people use the bin properly. In resource poor situation, it is to be remembered that for waste management systems, we are not looking at 'highly sophisticated colourful containers' but 'clean-correct size containers'. Many a times, the waste containers are not cleaned properly because it is a waste container. Special care must be taken to keep the containers clean as they are potential source of infections if not washed and cleaned regularly. Some of the aesthetic considerations have been listed in **Box 2.7**.

a. The person who is in-charge of the waste management system should work out the details of the size of containers, their placement, the frequency of cleaning and the ease of cleaning.
b. The containers should preferably be round in shape as it is easy to clean and no waste is left on the edges.
c. There are plenty of types of containers available in the market. Talk to the personnel who maintain and manage the waste containers and they would give better insights into the difficulties or suggestions for better containers.
d. It must be ensured that the particulars of the containers meet the norms as set by the legislative or regulatory guidelines of the country.

Box 2.7: Aesthetic consideration in health care waste management

Proper waste containment is one of the three key steps in waste management at point of generation, collection and storage. The other two being waste segregation and waste decontamination.

e. Ensure Occupational Safety and Health

It is ideal and desirable that occupational safety be a prime consideration for any system of waste management. Occupational safety does not merely mean getting them gloves or providing the staff vaccination. Some of the strategies to be adopted are given in **Box 2.8**.

Think and reflect

Write down the different locations in which a health care worker could be exposed to health hazards. Now write against each category, the type of risks.

The strategies for ensuring occupational safety and health are

a. To ensure that whoever is working in the health care institution is not exposed to the hazards of the waste stream.
b. When such exposure is inevitable in their line of duty, each category of health care personnel are provided with personal protective measures.
c. A key third component is to ensure that practices of one category of personnel do not compromise the safety and health of the waste handlers e.g., not discarding the waste sharps into the puncture proof container but into the general waste would not only result in making general waste infectious but also would induce the hazard for the personnel handling it.
d. All the staff generating, collecting, transporting, storing or treating and disposing the waste should be trained for adopting safe management practices of health care waste management.
e. Immunisation especially against infections like HIV and Hepatits B and C should also be an integral component of the occupational health and safety programme.
f. Health checkup of all employees in the health care facilities also ensures safety of the employees.

Box 2.8: Strategies for occupational safety and health

Did you know?

occupational safety of the health care functionaries is now mandatory under the Bio-Medical Waste Management Rules, 2016, as amended.

2.2.2 Components of a Waste Management System

You might have realised by now that, a systems approach to waste management is the most desirable approach for overall waste management system as it covers all the different aspects of waste management in a very systematic manner **(Box 2.9)**.

The overall activities related to waste management can be broadly divided into the following components:

a. Generation and segregation of waste

b. Decontamination or pre-treatment of waste

c. Collection, transportation and storage of waste

d. Treatment and disposal of waste

Box 2.9: Components of health care waste management system

a. Generation and Segregation of Waste

Generation is the point where the waste is generated in the health care establishment. We should understand that every area of the hospital has got the potential to generate waste **(Box 2.10)**.

The difference is in terms of the quantum and quality of waste generated.

i. A laboratory generates concentrated infectious waste because of the different diagnostic tests being undertaken, but the quantum is relatively less.

ii. An operation theatre generates more waste both in quantity and their infectious nature. A general medical ward generates more waste, which is mostly non-infectious in nature.

iii. A corridor in the hospital also generates waste, which in all probability should be only general waste.

iv. But if waste within the laboratory is not managed well, then swabs after drawing blood could well find its way into the corridor, thus, making the waste in corridor infectious.

Box 2.10: Quantum of waste generated by different locations

Think and reflect

List the types and the volume of waste generated in the Kitchen, ICU, OPD, a medical ward, blood bank, mortuary, school medical room.

Another aspect that we need to understand is the concept of different types of waste. There can be many ways of classifying the waste. The different classifications of waste has already been dealt in Unit 5, Block 2, BHM-101. You will better appreciate after you complete reading this unit that the different proposed classifications are chiefly based on the availability of treatment and disposal options. Whatever classification system is adopted, one needs to answer the question whether the system has been able to satisfy the five objectives of waste management as described in **Box 2.1** above.

The main purpose of segregating the waste is to sort different categories of waste and place the wastes in different containers or bags. By appropriately segregating the waste, the health care establishment not only reduces the total treatment costs for waste management but also reduces the chances of spreading infections among health care workers and community. Different types of waste are separated from the waste streams based on the type of treatment and disposal practice. The waste of each category specified will be discarded into separate containers. The best way of segregation is a colour-coded system, where each receptacle has its own colour. You have also read about the principles of segregation in Unit 2, Block 2, BHM 101.

Did you know ?

Pre-treatment is essentially required to be carried out at the health care institutions to render the waste non-infectious and to reduce the chances of the risks to the health care workers as well as the public from the waste.

b. Decontamination and Pre-treatment of waste

You have read about the pre-treatment of waste in details in the Unit 19, Block 1, BHM-102. The guidelines for the pre-treatment or decontamination of waste

as laid down by the legislative or regulatory authorities of the respective countries must be adhered to. Guidelines for effective management of bio-medical waste in India have been made mandatory under the Bio-Medical Waste Management Rules, 2016, as amended notified under the Environment (Protection) Act, 1986 by the Ministry of Environment, Forest and Climate Change (MoEF &CC).

Think and reflect

What are the different categories of wastes that require pre treatment?

Did you know ?

In India, the guidelines as given in the Bio-Medical Waste Management Rules, 2016, as amended should be followed for ensuring effective management of bio-medical waste.

c. Collection, transportation and storage of waste

The details of collection, transportation and storage of waste has already been studied in the unit 6, Block 2, BHM-101. In case you have opted for the optional course you will learn more about the practical aspects of these activities in the workshop course BHML 101. All the guidelines related to these activities as given by the legislative and regulatory authorities in the respective countries must be adhered to.

d. Treatment and disposal of waste

There are a number of treatment technologies and disposal options that can be adopted for management of the different categories of health care waste. You have already read about these treatment technologies in the Units 21 to 25 in the Block 2 of BHM-102. The treatment technologies and the disposal options that can be adopted depend upon a number of factors given in **Box 2.11**.

Factors deciding the treatment and disposal options are as follows:

a. The legislative and regulatory requirements
b. Technologies available
c. Cost of the treatment and the cost effectiveness of each option
d. Availability of trained or skilled manpower
e. Space for establishing the treatment technologies and disposing the waste
f. Impact of the waste treatment technologies on environment

Box 2.11: Factors deciding the treatment and disposal options

The comparison of various disinfection technologies is given in **Table 2.1**.

Table 2.1: Comparison of different treatment technologies

S. No.	Parameters	Plasma Method	Chemical Method	Micro-wave	Autoclave	Irradia-tion UV Gamma	Remarks
1	Level of Disinfectant	YY	YY	YY	Y	Y	
2	Plastic Fibers Treatment	X	YY	YY	XY	YY	Low molecular plastic in autoclave looses structural integrity/ Crimping
3	Skilled Labour Required	Y	Y	X	Y	Y	Some Microwaves are fully automated therefore

							the only process which does not required skill labour.
4	Oil containing Sample	Y	X	Y	X	X	Since oil does not dissolve in water it forms a protective layer against contact disinfection systems.
5	External Heat Emission	YY	X	X	Y	X	Autoclave & Plasma requires high energy, precaution and addi-tional devices to operate.
6	High Altitudes Hospitals	YY	YY	YY	Y	YY	Autoclave is pressure dependent therefore redundant in high altitude.
7	Infected Trapped Air/ Cycle	X	Y	Y	Y	X	Trapped air reduces efficiency & Operator safely.
8	Energy Required	Very High	N/A	16 amp 10, 1.5 kw/hr	30, 10kW-hr	Very high	Microwave requires less energy in comparison to auto-clave.
9	Odours & Emission	X	Y	X	Y	Y	While in operation unpleasant odour comes out and in some cases may be hazardous
10	Mobility Disinfection/	X	Y	Y	X	X	Mobility can be

							maintained in micro-wave which is essential to maintain point of care disinfection
11	Disinfection Sterilisation Process Time	10 min	15 min	50 min	90 min	20 min	
12	Cost per Installation	80 Lacs	Low Cost but Serious limitations	25 lacs	20 lacs	Low cost but carcino-genic	Low cost equipments not always good as can be Harmful/ hazardous
13	Consumables Required/ Recurring Cost	Very high	Yes	Nil	Very High	Nil	Apart from recurring hassles and processes also involved
14	Internet Hub Connectivity	X	X	Y	X	X	Some microwaves are equipped with latest internet centralised control & Audit.
15	Practical Utilisation in Suburban & Rural Areas	X	Y	Y	X	X	Autoclave & Plasma require very high power which is impractical in suburban & Rural Areas
16	Post Installa-tion Mainte-nance	Very high	Low	Low	Very high	High	
17	Make in India/Indian Patent 2017	X	X	Y	X	X	

Source: –???

The different options that can be adopted for the treatment and disposal is covered in the next section.

Check Your Progress 1

1. What are the five objectives of any waste management given in this unit?

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2. What are the factors deciding the treatment and disposal options ?

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2.3 PLANNING A WASTE MANAGEMENT SYSTEM

The planning for waste management should not happen as an afterthought of major investments in building new health care infrastructure. It needs to be considered as a basic public health concern and should be integrated from the beginning of the planning process of building a health care facility. It is prudent that we remember that waste management is a process of establishing systems of practice and not choosing one or the other technology **(Box 2.12).**

a. The various constituents like

- planning,
- training,
- management systems,
- technology,
- equipments, and
- disposal sites.

need to be given comprehensive attention.

b. The goal ought to be that they are to provide a sustainable and flexible solution for not just today but tomorrow and also the days to come.

c. Waste treatment is just a part of the solution and is a process that changes the character of hazardous waste into less hazardous or non-infectious waste, may or may not reduce the volume of waste and remain non-recognisable.

d. Components of the waste management system that should happen within the premises of the health care institution are:

- segregation at source (point of generation),
- proper containment,
- decontamination,
- secured transportation and
- temporary storage

e. Depending on the facilities available for the institution either within or outside, the remaining components (waste treatment and disposal system) of the waste management system can be organised.

f. On-site systems for waste management may be minimal and could be restricted to only a secured temporary storage system if the area where the health care institution is served by a common waste treatment facility.

g. The facilities that an institution should plan for depends on the facilities that the common waste treatment facility offers. It is desirable that the common bio-medical waste treatment facility provides complete and comprehensive systems so that individual institutions can focus their efforts on ensuring a segregated waste stream from point of generation to temporary storage.

Box 2.12: Planning a waste management system

Did you know?

It may be noted that there is no perfect or ideal method of waste management, each technology has advantages and disadvantages.

2.3.1 Off-site Infectious Waste Management

The health care waste generated in the health care facility is required to be segregated as per the laid down provisions and the guidelines. **In India these are issued by CPCB/Government of India from time to time.** It is collected, transported internally and then stored for an interim period (but not more than 48 hours). The waste is then transported extramurally to a central bio-medical waste treatment facility. You have already read about all these activities in Unit 6, Block 2, BHM-101. You have also read about the offsite treatment and disposal of waste in Unit 20, Block 1, BHM-102. Two important activities that are required to be followed by a health care facility which sends it's waste for off-site treatment is given in **Box 2.13**.

The following two activities are important

a. Pre-treatment of waste before transportation of waste to the CBMWTF

b. Tracking of the waste using bar code system and ensuring that there is no pilferage or tampering with the waste intended for final treatment and disposal only through a CBMWTF

- **In India, this is ensured by a compulsory Bar Coding that has to be put on the waste before it is transported for final treatment and disposal through a Common Bio-Medical Waste Treatment Facility (CBMWTF) as prescribed under the Bio-Medical Waste Management Rules, 2016, as amended. For further details on Bar code system, please refer to the guidelines for bar code system issued by CPCB (www.cpcb.nic.in).**

Box 2.13: Activities to be undertaken by HCF under offsite management of health care waste

Think and reflect

Try to find out the type of option followed in the other countries – on-site or off-site. What are their reasons for this decision.

Under the Bio-Medical Waste Management Rules, 2016, as amended and notified by the Government of India, for all health care facilities (HCFs), the infectious waste is required to be transported and disposed through a CBMWTF located within 75 kilometers. In case of no reach to any CBMWTF, the BMW generated from HCFs should be disposed in captive treatment and disposal facility or by deep burial pit as authorised by the respective SPCB/ PCC and as specified in the Table 2.2.

2.3.2 On-site Management: Treatment and Disposal of Bio-Medical Waste

As discussed above, in situations where the waste cannot be sent to a Central treatment facility, it is required to treat the waste in the health care facilities. These must be done as per the prescribed guidelines by the respective legislation or regulatory authorities of the respective countries. **The guidelines for the treatment and disposal of bio-medical waste under the BMWM Rules, 2016, as amended are given in Box 2.14.**

a. The treatment and disposal options given under Schedule-I as well as the Standards stipulated under Schedule-II of the Bio-Medical Waste Management Rules, 2016 as amended is applicable to both captive and CBMWTF.

b. Only the difference is that wherever CBMWTF is available within 75 km distance in such a case, the Health Care Facility is required to ensure pre-treatment of infectious waste such as

   i. bio-technology,

   ii. microbiology,

   iii. blood bags and

   iv. blood waste is required to be pre-treated prior to its storage in the designated colour coded bag or container and later for disposal through a CBMWTF within 48 hours.

c. The deep burial is not permitted in case of CBMWTFs. In case where the CBMWTF is not available within 75 km of a HCF, in such a case, the HCF is allowed to have captive treatment facilities.

d. In such a case, the guidelines applicable to the CBMWTFs should be complied by the HCFs with the requirement of guidelines for CBMWTFs.

Box 2.14: Options for treatment and disposal of waste under the BMWM Rules, 2016, as amended

Table 2.2 given below shows the treatment and disposal options through a CBMWTF or on-site treatment facilities to be followed as enumerated in BMWM Rules, 2016, and BMWM (Amendment) Rules, 2018 in India.

Table 2.2: Category-wise Infectious Waste Treatment and Disposal Options through a CBMWTF or On-site Treatment Facilities as per BMWM Rules, 2016, as amended.

Part-1

Category	Type of Waste	Type of Bag or Container to be Used	Treatment and Disposal Options
(1)	(2)	(3)	(4)
Yellow	**(a) Human Anatomical Waste**Human tissues, organs, body parts and fetus below the viability period (as per the Medical Termination of Pregnancy Act 1971, amended from time to time).	Yellow coloured non-chlorinated Plastic Bags Note: (i) Chemical waste (yellow-e) comprising of un-used, residual or date expired liquid chemicals including spent hypo of X-Ray, should be stored in yellow container	Incineration or Plasma Pyrolysis or deep burial*
	(b) Animal Anatomical Waste Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.		
	(c) Soiled Waste Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components.		Incineration or Plasma Pyrolysis or deep burial* In absence of above facilities, autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery.
	(d) Discarded or Expired Medicine Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along		Expired 'cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for

	with glass or plastic ampoules, vials etc.		incineration at temperature >1200 0C or to common bio-medical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at >12000C Or Encapsulation or Plasma Pyrolysis at >12000C. All other discarded medicines shall be either sent back to manufacturer or disposed by incineration.
	(e) Chemical Waste Chemicals used in production of biological and used or discarded disinfectants		Disposed of by incineration or Plasma Pyrolysis or Encapsulation in hazardous waste treatment, storage and disposal facility
	(f) Chemical Liquid Waste Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, Silver X - ray film developing liquid, discarded Formalin, infected secretions, aspirated body fluids , liquid from laboratories an d floor washings, cleaning, house - keeping and disinfecting activities etc		After resource recovery, the chemical liquid waste shall be pre-treated before mixing with other wastewater. The combined discharge shall conform to the discharge norms given in Schedule-III.
	(g) Discarded linen, mattresses, beddings contaminated with blood or body fluid, routine mask & gown.		Non- chlorinated chemical disinfection followed by incineration or Plazma Pyrolysis or for energy recovery. In absence of above facilities, shredding

			or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery or incineration or Plazma Pyrolysis.
	(h) Microbiology, Biotechnology and other clinical laboratory waste (Pre-treated) Microbiology, Biotechnology and other clinical laboratory waste: Blood bags, Laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures.	Autoclave or Microwave or Hydroclave safe plastic bags or containers	Pre-treat to sterilize with non-chlorinated chemicals on-site as per World Health Organisation guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and thereafter sent for incineration.
Red	Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes without needles, fixed needle syringes with their needles cut, vaccutainers and gloves	Red Coloured Non Chlorinated Plastic Bags (having thickness equal to more than 50 ì) and Containers	Autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to landfill sites.
	Waste Sharps including metals Needles, syringes	White Coloured	Autoclaving or Dry Heat Sterilization

White	with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and contaminated metal sharps	translucent, puncture proof, leak proof, Temper proof containers	followed by shredding or mutilation or encapsulation in metal container or cement concrete; combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State Pollution Control Boards or Pollution Control Committees) or sanitary landfill or designated concrete waste sharp pit.
Blue	**(a) Glassware:** Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes	Puncture proof, leak proof boxes or containers with blue coloured marking	Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium Hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.
	(b) Metallic Body Implants		

*** Disposal by deep burial is permitted only in rural or remote areas where there is no access to common bio-medical waste treatment facility. This will be carried out with prior approval from the prescribed authority and as per the Standards specified in Schedule-II .The deep burial facility shall be located as per the provisions and guidelines issued by Central Pollution Control Board from time to time.**

Part-2

1. All plastic bags shall be as per BIS standards as and when published, till then the prevailing Plastic Waste Management Rules shall be applicable.
2. Chemical treatment using at least 1 to 2% Sodium Hypochlorite having 30% residual chlorine for twenty minutes or any other equivalent chemical reagent that should demonstrate $Log_{10}4$ reduction efficiency for microorganisms as given in Schedule-III.
3. Mutilation or shredding must be to an extent to prevent unauthorised reuse.
4. There will be no chemical pre-treatment before incineration, except for microbiological, lab and highly infectious waste.
5. Incineration ash (ash from incineration of any bio-medical waste) shall be disposed through hazardous waste treatment, storage and

disposal facility, if toxic or hazardous constituents are present beyond the prescribed limits as given in the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 or as revised from time to time.

6. Dead Foetus below the viability period (as per the Medical Termination of Pregnancy Act, 1971, amended from time to time) can be considered as human anatomical waste. Such waste should be handed over to the operator of common bio-medical waste treatment and disposal facility in yellow bag with a copy of the official Medical Termination of Pregnancy certificate from the Obstetrician or the Medical Superintendent of hospital or health care establishment.
7. Cytotoxic drug vials shall not be handed over to unauthorised person under any circumstances. These shall be sent back to the manufactures for necessary disposal at a single point. As a second option, these may be sent for incineration at common bio-medical waste treatment and disposal facility or TSDFs or plasma pyrolys is at temperature >1200ºC.
8. Residual or discarded chemical wastes, used or discarded disinfectants and chemical sludge can be disposed at hazardous waste treatment, storage and disposal facility. In such case, the waste should be sent to hazardous waste treatment, storage and disposal facility through operator of common bio-medical waste treatment and disposal facility only.
9. On-site pre-treatment of laboratory waste, microbiological waste, blood samples, blood bags should be disinfected or sterilised as per the Guidelines of World Health Organisation or National AIDS Control Organisation and then given to the common bio-medical waste treatment and disposal facility.
10. Installation of in-house incinerator is not allowed. However in case there is no common bio-medical facility nearby, the same may be installed by the occupier after taking authorisation from the State Pollution Control Board.
11. Syringes should be either mutilated or needles should be cut and or stored in tamper proof, leak proof and puncture proof containers for sharps storage. Wherever the occupier is not linked to a disposal facility it shall be the responsibility of the occupier to sterilise and dispose in the manner prescribed.

Bio-medical waste generated in households during health care activities shall be segregated as per these rules and handed over in separate bags or containers to municipal waste collectors. Urban Local Bodies shall have tie up with the common bio-medical waste treatment and disposal facility to pick-up this waste from the Material Recovery Facility (MRF) or from the household directly, for final disposal in the manner as prescribed in this Schedule.

Source: **Bio-Medical Waste Management Rules, 2016, as amended notified by Government of India (www.envfor.nic.in)**

2.4 OPTIONS AVAILABLE FOR WASTE MANAGEMENT SYSTEM

Deciding upon the options to be chosen from those available for health care waste management is given in **Box 2.15**.

a. The selection of a technology requires careful evaluation, taking into account the following factors

   i. Cost of treatment,
   ii. Current and projected waste generation rates,
   iii. Waste composition,
   iv. Existing practices,
   v. Ease of application,
   vi. Technical requirements (utilities, maintenance, sitting, etc.), training needs,
   vii. Environmental and occupational safety issues.

b. The treatment and disposal technology should be

   i. technically achievable,
   ii. economically viable and
   iii. environmentally friendly.

c. The final choice of treatment system and their individual component(s) should be chosen according to

   i. cost,
   ii. feasibility,
   iii. effectiveness, and
   iv. local situation.

d. Multiple options should be chosen to achieve the final objective of ensuring that the waste is rendered safe for all health care providers and the community.

e. The choice for decision makers should not be limited to a low-cost incinerator or a prohibitively expensive high-tech solution.

f. Available cleaner alternatives which safely treat and dispose off medical waste like

   i. use of autoclaves standard or advanced,
   ii. microwave,
   iii. dry heat systems, etc., should be utilised.

g. The list of alternative technologies also include:

   i. cement encasing,
   ii. encapsulation with immobilising agents,
   iii. waste burial pit with concrete cover,
   iv. small portable steam treatment units with traditional grinders,
   v. point-of-use sharps technologies or bigger units to be used in centralised facilities.

h. The health care facility can choose between centralised facility or a on-site waste treatment system basis on the criteria mentioned above and the national legislations and guidelines.

i. The health care facility should always remember that it is the waste producer who is responsible for safe final disposal of its waste.

j. Regular training and monitoring will help in ensuring proper functioning of the waste management within and outside the institution.

Box 2.15: Factors responsible for choosing the options for health care waste management

Preferably, a health care facility should not treat waste within the facility as its main mission is to promote health. At the same time health care provider is responsible for the waste it produces, should not leave the premises of the health care facility, unless waste is sealed with tag and labelled with bio-hazard and bar code liable on the containers as well as highly infectious wastes is pre-treated *in situ*.

During past few years, it has been realised that each nursing home/health care facility in an urban locality may not be able to lay down individual systems of its own. This would add to the cost of treatment/management, which patients have to bear, eventually. Thus, developed the concept of CBMWTF. However it is important to realise that CBMWTF is heavily dependent upon couple of factors such as adequate transportation. Collection of waste from health care facility should follow a laid down pattern, route, and periodicity. Precautions and procedures to be followed for the waste haulers/waste handlers is given in **Box 2.16**.

Generally there is no responsibility assigned to waste haulers, however, the waste haulers may be charged to ensure that:

a. Personal protective clothing and equipment are used by waste handlers.
b. Leak resistant and fully enclosed rigid containers are provided for transportation.
c. Untreated medical waste is not transported with treated waste. If that is done for some reason, untreated and treated waste must be transported in different compartments, which are leak proof.
d. Waste is transported only to registered waste treatment facility.
e. Completed tracing documents are maintained. Such documents are kept for at least a period of three years.
f. Options deployed at a CBMWTF need also to be officially registered. The multi options are eco-friendly and do not pose adverse impact on human health should be a cardinal principle.

Box 2.16: Precautions and procedures to be followed for the waste haulers/waste handlers

2.4.1 Single Option Versus Multi Option Approach

Not all parts of every country will be able to put in place, simultaneously a system of collection transportation and centralised treatment facility. The choice, however, is not between a low-cost incineration or a high-tech centralised facility. A range of options or combination of options is available and each country or district should consider and evaluate the best mix of options to suit different conditions with the goal of protecting the patient, health care workers, the community and their environment.The pros and cons of a single versus multi option is given in **Box 2.17**.

a. Any system designed to adequately address risks from the wastes will need to employ a variety of approaches and technologies.
b. No one technology is appropriate in all settings or adequate to handle all types of wastes.
c. Whether in the context of an urban setting with adequate infrastructure or a rural setting, the key learning from observation of waste management systems is that addressing the threat associated with hazardous health care wastes is best approached as a human management and training issue, not as a technology issue.

d. Systems that have been implemented employing a single technology to handle wastes (such as incinerator) most often do not adequately address the need for.
   i. staff training,
   ii. occupational safety in handling wastes and residues from the incinerator,
   iii. need for maintenance,
   iv. continuing costs of operations,
   v. as well as the environmental costs to the community.
e. Each of the different waste treatment and final disposal options have deficiencies and trade-offs.
f. Single options mostly find a part of the solution of the problem.

Box 2.17: Choosing between single versus multi options

Incineration and waste burning had formerly been the method of choice for treating most hazardous/infectious health care wastes. While it is still widely used, burning waste is rapidly being replaced and has experienced significant decline as a treatment choice globally. The advantages of volume reduction offered by burning, to limit scavenging, comes at a high price in terms of toxic emissions, such as heavy metals like mercury and cadmium, or other toxics such as dioxins from the combustion of chlorine-containing compounds common in health care wastes. Ash residues from burning concentrated toxic material adds to groundwater pollution from the eventual disposal of the ash in non-secure landfills. Operation of incinerators or other combustion technology presents a wide array of occupational hazards that are often overlooked. The approaches with the best results in rendering the wastes safe for disposal have a higher price tag for purchase and operation . The factors deciding the final choice of treatment system is given in **Box 2.18**.

The final choice of any treatment system should be made carefully, on the basis of various factors, many of which depend on local conditions:

a. Disinfection efficiency
b. Volume and mass reduction
c. Occupational health and safety consideration
d. Quantity of waste for treatment and disposal/capacity of the system
e. Types of waste for treatment and disposal
f. Infrastructure requirements
g. Locally available treatment options and technologies
h. Options available for final disposal
i. Training requirements for operation of the method
j. Operation and maintenance considerations
k. Available space
l. Location and surroundings of the treatment site and disposal facility
m. Investment and operating costs
n. Health and environmental considerations
o. Public acceptability
p. Regulatory requirements

Box 2.18: Factors deciding final choice of treatment option

2.4.2 Waste Management as a Systems Option

Waste management needs to be addressed as a systems option and dealt with an integrated approach within the overall health care management system. As annunciated in the Standards of NABH (National Accreditation Board for Hospital and Health Care Providers) and Joint Commission international health care waste management should be included as a key quality control indicator in the health care facilities. Ways in which waste management can be addressed as a systems option is given in **Box 2.19**.

To ensure a sound health care waste management system

a. A waste management committee must be constituted under the supervision of the head of the institution.

b. The committee must not only ensure good waste management practices in the health care facility but also understand the importance and role of health care waste management system in infection control and patient safety.

c. There needs to be a holistic approach for health care waste management as it cuts across various infections like Tuberculosis, AIDS, HBV, HCV and other blood borne diseases.

d. Measures for proper health care waste management must be taken up by one and all within the health care facility and also various ministries and donor agencies.

e. The need for health care waste management, its legislation and guidelines and various principles and steps for proper waste management should be included in the curriculum and orientation programme along with regular training and awareness programmes for the health care personnel.

f. To ensure a sound health care waste management system the basic principles of waste management such as segregation, collection and storage, transportation, treatment and disposal must be addressed along with other important issues like proper supply and maintenance of waste management equipment and consumables, occupational safety, waste minimisation.

g. Use of environment friendly alternatives like mercury free devices, non-burn treatment technologies, reduce use of chemicals and pesticides, waste water treatment and principles of 3Rs must also be followed in the health care facility.

Box 2.19: Waste management as a systems option

Check Your Progress 2

1. Write briefly on single option versus multi option approach in waste management.

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2.5 LET US SUM UP

In this unit you have learnt that the success of waste management system is based much more on planning, good management, proper tools, training (and reinforcement of training) and providing a sustainable system, rather than the choice of an individual treatment technology. Also, the treatment options for waste management by the HCF depends on the availability of a CBMWTF within 75 km distance.

It has been emphasised that health care waste management is not a technology issue but involves a human effort for establishing a systematic waste management programme. While building a system all the different aspects of waste management must be carefully examined. Specially while choosing technologies a cost effective, efficient and environment friendly technology must be selected.

2.6 GLOSSARY

a. "operator of a common bio-medical waste treatment facility"

It means a person who owns or controls a Common Bio-Medical Waste Treatment Facility (CBMWTF) for the collection, reception, storage, transport, treatment, disposal or any other form of handling of bio-medical waste.

b. Decontamination

Decontamination has a larger scope when compared with disinfection. Disinfection refers to removal of the infectious material, while decontamination is also removing the dirt and grime associated with the articles of use.

c. Off-site Management

Components of the waste management system that happens outside the premises of the health care institution and includes external transportation of waste, use of treatment and disposal technologies landfill, management of toxic and hazardous waste, etc.

d. On-site Waste Management

Components of the waste management system that should happen within the premises of the health care institution like segregation at source (point of generation), proper containment, decontamination, secured transportation and temporary storage.

e. System Options

A system designed for proper waste management will need to employ a variety of approaches and technologies. Selection of the right approach and the appropriate technology is choosing system options.

f. Systems for HCWM

Waste management encompasses the entire gamut of activities and endeavours related to the handling of waste: segregation, storage, collection, transportation till the products are no more of use and are rendered relatively harmless. The individual components can be considered as systems and sub-systems for waste management as each of them have a bearing on the other.

2.7 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1. Five Objectives of any Waste Management Systems are as follows:
   a) To reduce the infectious/hazardous nature of the waste
   b) To reduce the volume of the waste
   c) To prevent misuse and/or abuse of the waste
   d) Aesthetic considerations
   e) To ensure occupational safety and health
2. Factors deciding the treatment and disposal options are as follows:
   a. The legislative and regulatory requirements
   b. Technologies available
   c. Cost of the treatment and the cost effectiveness of each option
   d. Availability of Trained or skilled manpower
   e. Space for establishing the treatment technologies and disposing the waste
   f. Impact of the waste treatment technologies on environment

Check Your Progress 2

1. Single option approach generally uses using one system/technology for waste treatment and disposal. Multi option approach emphasises on using different options like training, monitoring, resource allocation and the use of a combination of technologies for waste treatment etc.

2.8 REFERENCES AND FURTHER READINGS

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6. Bulletin of World Health Organisation 1999;77(10):789-800.
7. Draft Report, Assessment of Injection Practices in India (2002-03). An India CLEN Programme Evaluation Network, by India Clinical Epidemiology Network and All India Institute of Medical Sciences.
8. Bio-Medical Waste Management Rules, 2016, as amended notified by the Government of India under the Environment (Protection) Act, 1986 (www.envfor.nic.in)
9. **Guidelines for Bar Code System for Effective Management of Bio-medical Waste issued by** Central Pollution Control Board (CPCB) (Website www.cpcb.nic.in).

UNIT 3 WASTE ECONOMICS

Structure

3.0 OBJECTIVES

After studying this unit, you should be able to:

- define waste generation and management practices
- elaborate the economic factors that govern waste management
- enlist and discuss the costs involved in waste management
- enlist and describe the costs involved in welfare economics of waste management
- undertake the economic assessment methods and economic instruments, which essentially help in policy development and overall control of the waste management system
- provide strategies for waste minimisation

3.1 INTRODUCTION

For most individuals, waste is a waste of time, effort and money. While performing our duties and helping people access health care services, what we don't realise is that waste is not just an unwanted aspect or by-product of any process but it is central component of any process holding immense untapped potential.

Waste Management, fundamentally implies money, directly it turns waste into a resource, which unlocks capital and indirectly it leads to efficiency in the processes, which again saves on costs.

Resources are always limited and scarce, thus understanding economics, helps us understand how the world affects our lives. Managing the variables and applying sound economic principles can optimise processes and help us do more with less.

Understanding this simple science and its principles equips us to handle waste management effectively. The knowledge in this unit, allows us to assess, measure and improve waste cycle related metrics through the specific assessment methods. With ever increasing costs of providing health care, pressure of saving costs and being environmentally responsible, we have to understand the economic instruments available to policy makers at a macro level and how we can apply them in our day to day functioning.

One should further grasp the strategies and methodologies of waste minimisation. This latest approach is now a buzzword in waste management and includes concepts like resource utilisation, zero waste, reuse and recycling. You will also learn more about minimisation in this unit.

3.2 WASTE GENERATION CYCLE

Each stage of product life cycle generates a specific type of waste. Each waste requires a specific management solution for treatment and final disposal. The Life cycle approach gives a more complete picture of the waste and energy associated with a product. You must have realised that if we switch from linen to disposable perioperative textiles, our long-term laundry costs may reduce but the waste generation would increase significantly. Hence, our daily choices determine the amount of waste we produce. As consumers, our relationship to a product happens only during a short phase of its existence and mostly we are oblivious to the waste associated with that product's life cycle. Here, again we should think about the disposable perioperative textiles that may be available in our health care institutions. For us, they may be a more convenient choice but most of us will not know about the final disposal method and environment impact of this choice of product. Let's look at this from another angle, even if for a moment you consider the waste generated to have a similar impact as compared to reusable textiles, the sheer volumes would have a negative impact on the environment.

Rather than just looking at the amount of waste that ends up in a landfill or an incinerator, the life cycle analysis (LCA) is a comprehensive approach: it also measures energy use, material inputs and waste generated from the production until the goods are delivered to the consumer. The life cycle of a product has been depicted in **Fig. 3.1**.

LCA is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. Designers use this process to help critique their products. LCAs can help avoid a narrow outlook on environmental concerns by **adopting the measures as mentioned in Box 3.1**.

a. Compiling an inventory of relevant energy and material inputs and environmental releases;

b. Evaluating the potential impacts associated with identified inputs and releases;

c. Interpreting the results to help make a more informed decision

Box 3.1: Adressing environmental concerns

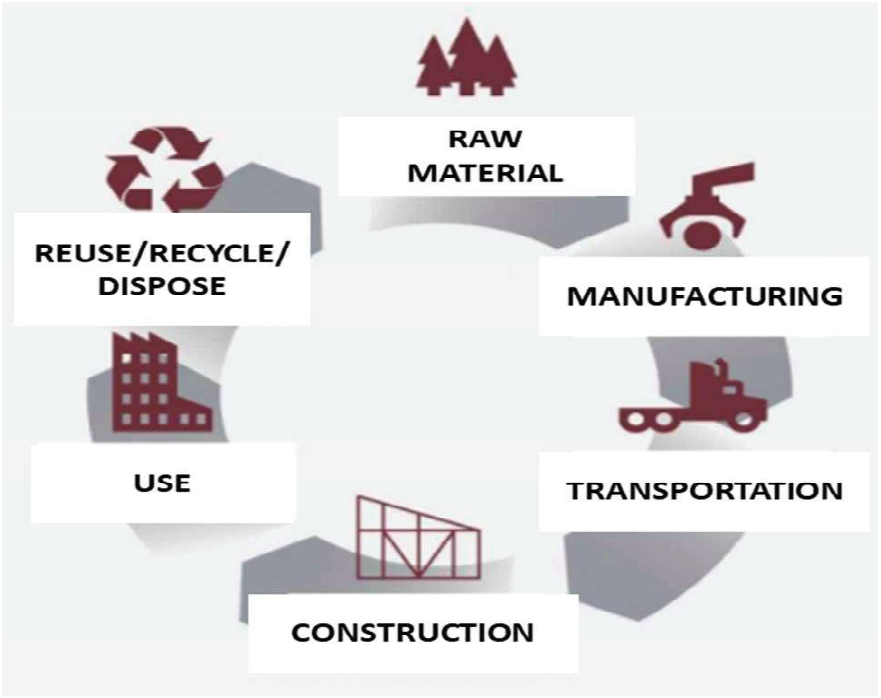


Fig. 3.1: Life circle of a product

Think and reflect

With the help of examples discuss the practices of recycling and reuse which are detrimental to patient safety and those which are not.

LCA approach is useful in many instances, e.g. take a hospital which is using PVC products and now is reconsidering its decision. The purchase officer knows something about the hazards of using PVC. But recently she got her hands on a text which spoke about how polluting PVC is during manufacturing, use and disposal. She was surprised to know that **PVC production is the largest use of chlorine gas in the world**. The use and disposal both are related to release of toxic substances like dioxins and furans and additives like lead and phthalate. Based on these findings the hospital made a conscious decision to cut down use of PVC. What is environmentally taxing is invariably economically burdening in the long run.

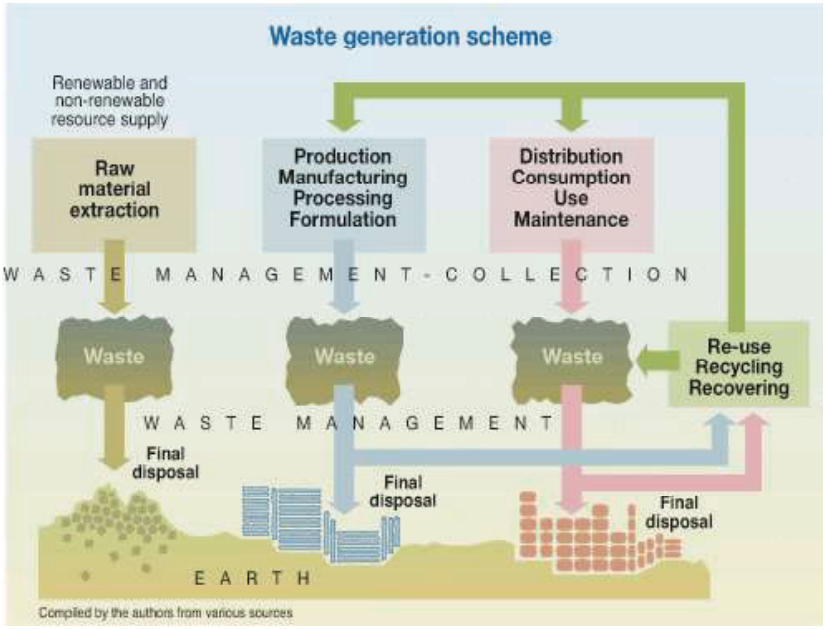
Source: http://www.pulpworksinc.com/environmental-impacts-of-pvc.html

Did you know ?

PVC consumes about 40 per cent of total chlorine production, or approximately 16 million tons of chlorine per year worldwide.

Source: http://www.pulpworksinc.com/environmental-impacts-of-pvc.html

The waste generation cycle has been explained in the **Fig. 3.2**.



Source: United Nations Environment Programme
http://www.grid.unep.ch/waste/html_file/10-11_waste_cycle.html

Source:
http://www.grid.unep.ch/waste/html_file/10-11_waste_cycle.html

Fig. 3.2: Waste generation cycle

Waste generation and management aspects are given in Box 3.2.

a. **Consumption:** Consumption of any material in the process of diagnosis, immunisation or treatment of human beings or animals or in research activities, directly or indirectly leads to generation of health care waste which can be hazardous (like those syringes infected with blood) or non-hazardous (also known as general /municipal solid wastes like loose packaging material) which can be discarded easily yet contribute to the carbon footprint of any operations.

b. **End-of-Life: Recycling or disposal:** Though patient safety and product effectiveness need to be considered before any approach to waste minimisation, recycling and reuse should be considered wherever possible. You must remember that main aim of bio-medical waste management is to curb unauthorised recycling and reuse. We need to differentiate between which practice or policy is safe and which is detrimental to patient safety or public . The approach which is safe, ethical, economical and environmentally sound should be adopted. Any practice before being implemented under the Recycle and or Reuse category should get the endorsement by the Hospital Infection Control Committee or the clinical microbiology department (if the committee is not available).

Box 3.2: Waste generation and management

Think and reflect

Try to see the policies and procedures followed in your hospital. Are the policies of source reduction, substitution and reuse followed ?

3.3 WASTE MANAGEMENT SYSTEM

Waste management is the "generation, prevention, characterisation, monitoring, treatment, handling, reuse and residual disposition of wastes". There are various types of wastes including municipal or what is now called solid waste (residential, institutional, and commercial), this category includes the general waste. we segregate in to black bags.

According to the Solid Waste Management Rules 2016, Govt of India, need to be segregated into green and white bags. Waste water can also be divided into waste from non-patient or non-clinical areas and special health care, radioactive, hazardous wastes, electrical and electronics waste, lead acid batteries, sewage and sludge.

Waste management is the process of treating wastes and offering variety of solutions for recycling items termed as recyclable wastes. It is about minimising wastes by either reducing their generation or finding ways of converting them to a valuable resource. Waste management is the need of the hour as it disposes waste products and substances that we have used in a safe and efficient manner, and also puts back most of the resource back in the production loop, thus reducing environmental impact as well as promote sustainable way of using natural resources.

Source:
http:/
www.sustainabilityroadmap.org/topics/waste.shtml#.Wfg6LWi0OUk

According to WHO, the waste management system in health care facilities comprises of: Waste Minimisation - Waste Identification - Waste Segregation - Waste Handling - Waste Treatment & Disposal - Record Keeping - Training - Supervision & Monitoring.

Waste management system that may be adopted in case of health care facilities is given in **Fig. 3.3**.

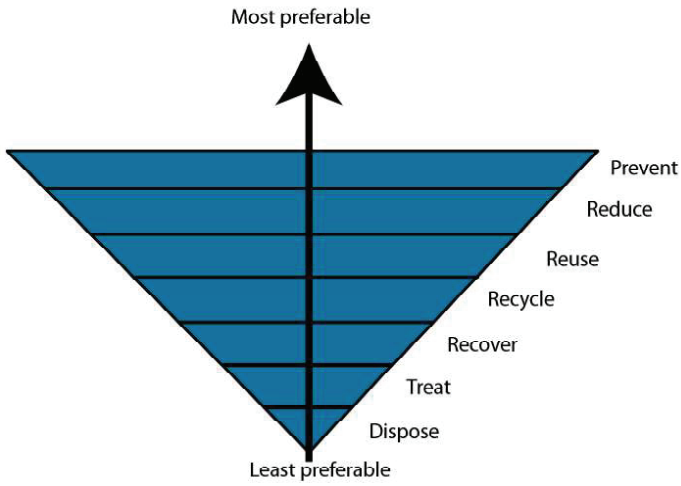
Source: World Health Organisation (WHO)

Fig. 3.3 : Typical Waste management system in a Health Care Facility

3.3.1 Waste Management Hierarchy

According to the US Environmental Protection Agency (USEPA), a no single waste management approach is suitable for managing all materials and waste streams in all circumstances. This is known as 'Waste Management Hierarchy'. This hierarchy is also the backbone of waste segregation, a principle that is embedded in Health Care Waste Management. Waste management hierarchy already discussed in detail in Unit 6, Block 2, BHM-101.

The hierarchy ranks the various management strategies from most to least environmentally preferred and is also known as the 3R's approach to waste management (Reduce, Reuse and Recycle). Waste Management hierarchy is given in the **Fig. 3.4.**



Source: WHO, Safe management of waste in health care settings, 2014

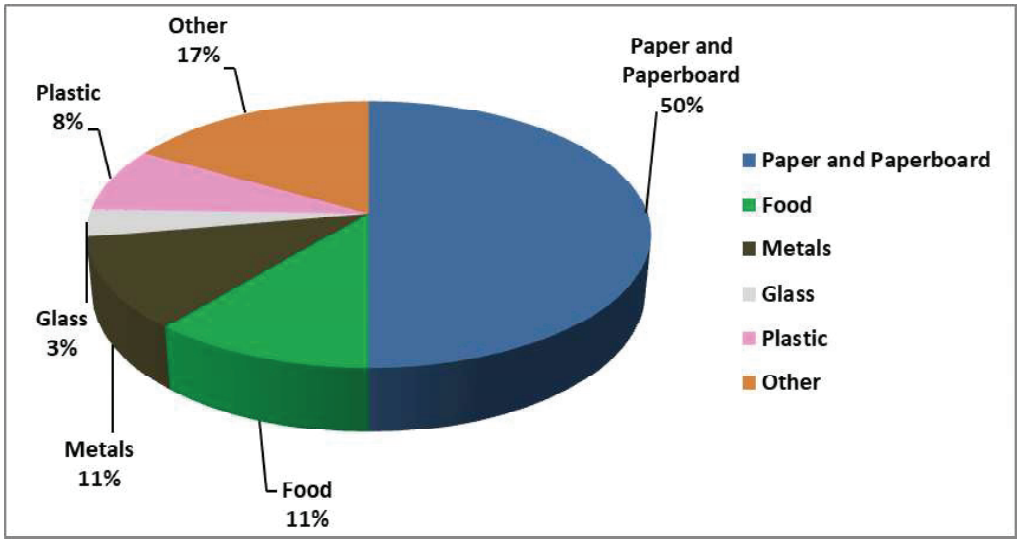
Fig. 3.4: The waste-management hierarchy

3.3.2 Source Reduction, Substitution and Reuse

Source reduction, substitution and reuse also known as waste prevention/ minimisation, means reducing waste at the source, and is the most environmentally preferred strategy. It can take many different forms, including reusing, buying in bulk, reducing packaging, redesigning products, and reducing toxicity. Source reduction also is important in manufacturing. Purchasing products that incorporate these features supports source reduction. In some hierarchies, this is divided into three namely, substitute, reduce and reuse. Mercury containing medical devices can be substituted with mercury free devices and therewith less hazardous waste is generated. For e.g. Cidex (glutaraldehyde) which is used for sterilisation has a recommended shelf life (after which it is changed) but depending upon the clinical load and close monitoring one can reduce the frequency of change and hence reduce amount of waste produced. Reuse of cardiac electrode catheter, electrophysiology (EP) catheters, imaging catheters, ECG leads (& wires), pneumatic tourniquet cuffs, DVT compression sleeves, pulse oximeter sensors, orthopedic bits, orthopaedic blades, orthopedic blurs, renal dialyser, external fixators, laparoscopic trocars, ultrasonic scalpels and multi-clip appliers are common examples which are safe and easily implementable. As mentioned above, one way of setting safe and effective reuse policies to minimise waste generation is to have them validated and endorsed by the Infection Control Committee of a hospital and in line with the regulatory compliances.

3.3.3 Recycling

Recycling is a series of activities that includes collecting used, reused, or unused items that would otherwise be considered waste; sorting and processing the recyclable products into raw materials; and remanufacturing the recycled raw materials into new products. Remember good segregation practices mean more recyclable waste in the hospital and thus more revenue from waste. Research has also shown that recycling reduces certain waste streams and results in overall cost savings and minimises impacts on the environment as recycling of waste material is economically cheaper rather than manufacturing new products from the natural resources. A high proportion of the non-hazardous waste can be recycled. An example of the recyclable or composable waste is given in **Fig. 3.5**.



Source: American Hospital Association,
http://www.sustainabilityroadmap.org/topics/waste.shtml#.Wfg6LWi0OUk

Fig. 3.5: Example of proportion of recyclable/compostable waste

3.3.4 Energy Recovery

Energy Recovery from waste is the conversion of non-recyclable waste materials into useable heat, electricity, or fuel through a variety of environmental friendly waste treatment processes, including combustion, gasification, pyrolysis, anaerobic digestion, and landfill gas (LFG, which is 50% methane) recovery. This process is often called waste-to-energy (WTE).

Think and reflect

Find out if your health care facility is involved in the energy recovery process.

3.3.5 Treatment and Disposal

Prior to ultimate disposal, treatment can help reduction of volume and toxicity of waste. Treatments can be physical (e.g., shredding), chemical (e.g., chemical disinfection /incineration), and biological (e.g., anaerobic digester). Landfills are the most common form of ultimate waste disposal preferred when there is no possibility of reuse/recycling of waste material and are an important component of an integrated waste management system.

Question

How can we reduce the amount of waste that goes into the landfill

Answer

We can do this by source reduction, waste minimisation, proper segregation, reuse/ recycle and proper treatment.

But remember the hierarchy- source reduction and reuse of resources is the best option because it is economically less taxing and environmentally less polluting. Then comes recycling, when we recycle we recover resources and put them back into the production cycle .

Energy recovery is often economically unviable and generally very polluting especially in the absence of effective pollution control systems, which is common in most developing countries. Talking about landfills, remember we do not have adequate and suitable land now, and finding a landfill site is becoming a major problem for most cities. Thus good environmental governance also makes good economic sense in today's world.

3.3.6 Case Studies

Case Study 1- Strategies to Minimise Waste* (New South Wale Waste Management Guidelines, 1998)

Effective waste minimisation strategies include waste avoidance, sound policy framework, effective management, waste segregation, reduction, re-use and recycling.

a. **Avoidance:** The Housekeeping and Purchase policies of the health care facility should be reviewed to avoid excessive waste, without compromising the work standards or environmental outcome. Simple product modifications may include requesting manufacturers, suppliers or Central Sterile Supply Departments to remove unnecessary materials supplied in sterile procedure packs, reducing unnecessary packaging or preplacing polystyrene foam with recyclable or biodegradable fillers.

b. **Reduction:** It can be achieved through product substitutions, product modifications and procedural changes.

(Product Substitution: product assessment should be done prior to finalising items for purchase. This assessment is to quantify or understand their potential to generate problematic waste, result in toxic emissions, or detrimental to the operation and maintenance of treatment facilities. Product assessment can be achieved through:

i. Evaluating product Material Safety Data Sheets (MSDS);

ii. Determine composition of the product and potential waste output

iii. Seeking technical waste disposal advice from consultants or relevant authorities like the Pollution Control Boards

iv. Considering the percentage of recycled materials used in the product's manufacturing

Some practical examples include progressive replacement of polyvinyl chloride (PVC) plastic compounds by products made from ethylene vinyl acetate copolymers. Organic pigments should replace heavy metal pigments, commonly used for coloring waste bags and sharps containers. Essentially the types of substitutes to be considered include biodegradable cleaning compounds and safer chemicals.

l. **Product Modifications:** This aspect of waste minimisation requires strong vendor relations. This may be an easy aspect for large health care providers who have a clout with manufacturers and suppliers alike but may pose a challenge for smaller providers. The aim of the management is to try and get the product changed or modified through during the process of creation or packaging. For e.g. change from solvent based products to water based; lead based paints to less hazardous alternatives, from mercury based sphygmomanometer to an aneroid one.

2. **Procedural Changes:** Simple changes to patient care procedures can be made to minimise the wastes generated, e.g.

Whereever possible minimise use of dressing packs especially for minor procedures like suture removal etc.

When preparing for dressings, clean and sterile procedures, practitioners should critically assess materials required and remove all unwanted materials before the start of the procedure.

Colour coded waste collection bins should be available at all possible sources of waste generation sites to ensure complete segregation.

Review frequency of waste collection and size and location of containers or bags.

c. Re-Use: Though disposable items are a must for highly infective wastes or in cases of isolation, but re-usable items should be preferred whenever it is clinically appropriate, environmentally sound, practical and cost effective. It should be ensured that patient care and infection control practices are not compromised during re-use application. Further, cleaning and reprocessing of all reusable items must be considered and discussed in Infection Control Committees to device sound policies and protocols. Items that may be considered for re-use include washable nappies, pill cups, denture mugs, cutlery, crockery, reusable kidney trays etc. Further, Long-term radionuclides conditioned as pins, needles, or seeds and used for radiotherapy may be reused after sterilisation.

d. Recycling: A large number of recyclable items are generated by Health care facilities and should be separated for recycling. By separating recyclables, quantity of waste going to the landfill is reduced by up to 60%. As disposal volumes decrease, cost savings should increase. The state pollution control board can provide details of Recycling units that can aid in this endeavour.

Practical Methodologies for Waste Minimisation in Hospitals:

1. **Waste Segregation -** At City of Hope hospital in Duarte California (USA), they were able to reduce their landfill costs by 30% by changing their waste pick up process. They did this simply by creating a process to segregate waste streams in a way that would send each stream into the most sustainable, financially beneficial place possible. So essentially segregation for solid wastes is also a strategy to explore.
2. **First-In-First-Out (FIFO) system for pharmaceuticals -** Paying attention to expiry dates and using of the oldest drugs first could prevent a hospital from wasting and having to dispose drugs unnecessarily.
3. **Look for repurposing options -** Finding alternatives is important to the minimisation of waste. This could be anything from wastewater treatment (which could then be used for horticulture and sanitation) to recycling to waste to energy. In terms of regulated medical waste, repurposing options are largely untapped. Keep an eye out for new opportunities as they become more popular.
4. **New Equipment -** There are many options for new medical equipment that will help minimise your waste. Big purchases like this should be thoroughly evaluated first, but should be considered a valid option. An example would be X-ray developers. Switching to a non-toxic x-ray developer using digital technology could reduce mimimisation of wastewater generation.
5. **Eliminate Food Waste -** It's possible to eliminate 100% of food waste and save an institutions money and help it reach its waste reduction goals. Non-perishables and food in good condition can be donated. Scraps, bones and peels can be sent to plants that will convert the waste into energy.

Examples of policies and practices found to minimise quantities of waste are summarised in **Box 3.3**.

a. Source reduction

i. Purchasing reductions: Selecting supplies that are less wasteful where smaller quantities can be used, or that produce a less hazardous waste product. For e.g. procuring non-PVC based blood bags; use of re-usable surgical drapes instead of disposables; use of bio-degradable waste bags.

ii. Use of physical rather than chemical cleaning methods (e.g. steam disinfection instead of chemical disinfection).

iii. Prevention of wastage of products (e.g. in nursing and cleaning activities).

b. Management and control measures at hospital level

i. Centralised purchasing of hazardous chemicals.

ii. Monitoring of chemical use within the organisation from delivery to disposal of hazardous wastes.

c. Stock management of chemical and pharmaceutical products

i. More frequent ordering of relatively small quantities rather than

large amounts at one time, to reduce the quantities used (applicable in particular to unstable products).

ii. First- In First- Out (FIFO): Use of the oldest batch of a product first.

iii. Use of all the contents of each container.

iv. Checking of the expiry date of all products at the time of delivery, and refusal to accept short-dated items from a supplier.

Source: WHO, Safe management of wastes from health-care activities, 2014

Box 3.3: Examples of policies and practices found to minimise quantities of waste

Check Your Progress 1

1. How are economic factors linked to waste management?

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2. What is a life cycle approach to waste management?

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3. What is Waste Management System according to WHO?

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4. What is waste management hierarchy and what are the various levels of this pyramid?

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3.4 ECONOMIC PRINCIPLES OF WASTE MANAGEMENT

Did you know ?

A green economy is characterised where economic value and growth is maximised while managing all natural assets sustainably.

There exists a close relation between economy and environment. An input used in the economic activity not only includes labour and capital but also raw materials. As economic activity increases, the exploitation of natural resources also goes up, leading to their depletion. On the output side, along with the conventional economic goods, pollution is also an output. Economic activity which includes production and consumption requires inputs of natural

resources and releases pollution, which imposes environmental costs. Environmental costs include natural resource depletion, pollution and the breakdown of the life support system of our planet.

Economic efficiency – in the waste context – is attained when the amount of waste generated (and managed at each level of the hierarchy) is optimal, i.e. the costs of reducing waste by one unit is equal to the economic and environmental benefits of having one less unit of waste. There are costs and benefits associated with reducing waste. For example, reducing waste through making production processes more resource-efficient has benefits in terms of greenhouse gas emissions avoided and savings in material costs.

3.5 PRIVATE ECONOMICS IN WASTE MANAGEMENT

The private economics of waste management usually involve: capital costs, running costs (operation, maintenance and repair) revenues (income from sale of products), taxes.

a. Capital Costs

The capital costs are the costs that are invested in fixed capital. Fixed capital is e.g. land, buildings and equipment. The costs of planning and design of the system are often associated with the capital cost.

b. Running Costs (or Operating Costs): Fixed or Semi-fixed or Variable Costs

Running costs, are costs that appear continuously during the lifetime of a waste management system. These costs are necessary for operation, maintenance and repair of the system. The fixed costs include salaries of personnel, rent, depreciation and insurance. The fixed costs are agnostic to the volume of business and don't vary over the economics of scale. The variable costs will include cost of repair of equipment, raw materials, equipment like trolleys, dust bins, bags, weighing balances and spare parts. Semi-variable costs will include utilities like fuel, electricity, water etc.

c. Revenues

In addition to costs, the waste management system may obtain revenues from the sale of different products recovered from the waste. This could be energy, paper, glass, metals, plastics and compost.

d. Taxes

The private economics also include the taxes that are imposed on the system, being general taxes such as value added tax or specific waste taxes, for example, on incineration and landfilling (presently service tax is exempted for the bio-medical waste treatment facility operators). This kind of tax is a means of diverting waste away from landfills and into recycling.

According to the "polluter pays" principle, each health care establishment should be financially liable for the safe management of any waste it generates. The costs of training, personnel, segregation, collection, appropriate packaging, on-site handling and storage are internal to the establishment and paid as labour and supplies costs; the costs of off-site transport, treatment, and final disposal are external and paid to the contractors who provide the service of final waste disposal (Common Bio-Medical Waste Treatment Facility).

Question

What is the Polluter Pays principle ?

Answer

The "polluter pays" principle implies that all producers of waste are legally and financially responsible for the safe and environmentally sound disposal of the waste they produce. This principle also attempts to assign liability to the party that causes damage.

Did you know?

Private cost a person/ organisation pays for any activity, but there are impacts of each action. Thus, if waste management is not done properly and people contract diseases/ rivers get polluted/ there are toxic emissions in the air; then the society pays for it, though indirectly. This is the social cost.

Total cost = private cost + the social cost.

So, in addition to the costs enlisted in the **Fig. 3.6**, there are other social costs involved to arrive at the total cost, and all of us should try and make it negligible.

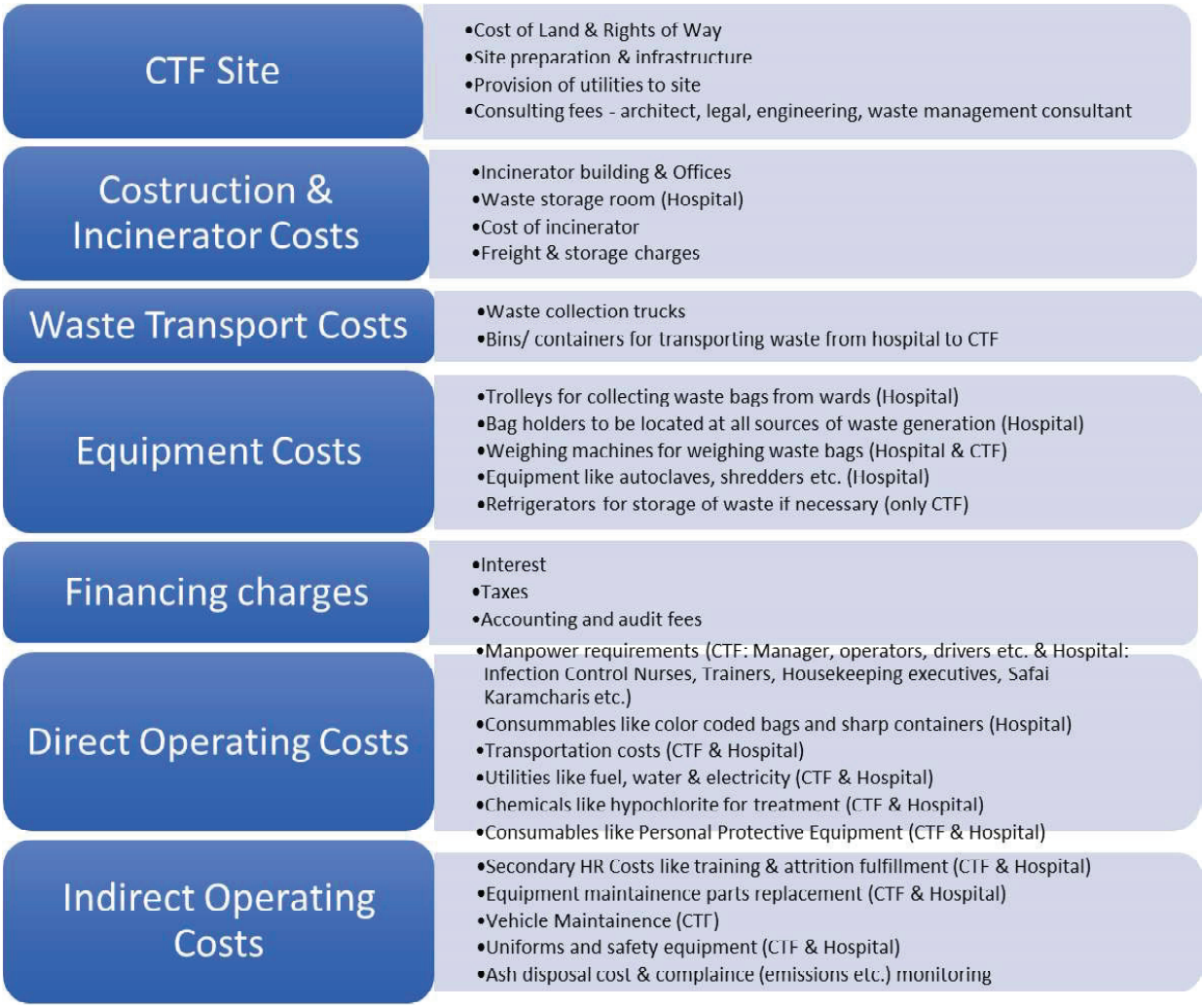

Fig. 3.6: Total costs of a Health Care Waste Management System

Check Your Progress 2

1. What do you mean by environmental costs and a green economy?

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2. What are the components of private economics?

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3.6 BENEFITS OF WASTE MANAGEMENT

With rational and consistent waste management practices there is an opportunity to reap a range of benefits **(Box 3.4)**.

1. **Economic -** The minute a hospital starts investing in people it starts gaining. E.g. money spent on trainings have always ensured better segregation. Better segregation leads to less infectious waste (which costs money to dispose) and more recyclable waste/general waste (which generates revenues). Many hospitals have reported a drop in needlestick injury rate and thus the cost associated with PEP regime

is also reduced. Thus, there is a big economic gain for the hospitals. Though it may seem very distant but one must realise that waste management is directly related to decreased infections. This in turn decreases hospital stay and increases patient safety. Improving economic efficiency through the means of resource use, treatment and disposal and creating markets for recyclables can lead to efficient practices in the production and consumption of products and materials resulting in valuable materials being recovered for reuse and the potential for new jobs and new business opportunities. E.g., e-waste recycling.

2. **Social** - By reducing adverse impacts on health by proper waste management practices, the resulting consequences are more appealing settlements. Better social advantages can lead to new sources of employment and potentially lifting communities out of poverty especially in some of the developing poorer countries and cities. Good waste management leads to increased occupational and patient safety. Mismanaged waste can lead to spread of vector borne and communicable diseases for the community as well as waste handlers. On the contrary, good practices can solve these issues and can have a positive effect on public health and environment.
3. **Environmental** - Reducing or eliminating adverse impacts on the environment through waste prevention/ minimising (reducing, reusing, and recycling); can improve air and water quality and help in the reduction of greenhouse gas emissions.

Box 3.4: Benefits of waste management

Think and reflect

Can you think of some more examples of the economic, social and environmental examples in health care waste management ?

3.7 ENVIRONMENTAL COSTS OF WASTE MANAGEMENT

Unsafe waste management is one source of the global air pollution. WHO reports that in 2012 around 7 million people died – one in eight of total global death – as a result of air pollution exposure. This finding more than doubles previous estimates and confirms that air pollution is now the world's largest single environmental health risk. This results in increasing economic costs for the public. Reducing air pollution could save millions of lives.

See the example as mentioned in **Box 3.5**.

Based on a study published by the WHO Regional Office for Europe and the OECD in 2015, it is possible to estimate the economic cost of air pollution health impact in the countries of the WHO European Region for 2010:

a. the annual economic cost of premature deaths from air pollution across the countries of the WHO European Region stood at US$ 1.431 trillion; and
b. the overall annual economic cost of health impacts and mortality from air pollution, including estimates for morbidity costs, stood at US$ 1.575 trillion.

Box 3.5: Study on air pollution

Source: WHO Regional Office for Europe, OECD (2015). Economic cost of the health impact of air pollution in Europe: Clean air, health and wealth. Copenhagen: WHO Regional Office for Europe.

Disposing of waste improperly has huge environmental impacts and can cause serious problems to the society. When waste is disposed of by deep burial or in landfill sites, it will eventually rot, but not all, and in the process it may emanate bad odour or generate methane gas, which causes fires and also

contributes to the greenhouse effect. Leachate produced as waste decomposes may cause ground water pollution if no proper liners are used. Badly-managed landfill sites may attract vermin or cause litter.

Incinerating waste also causes problems, because plastics tend to produce toxic substances, such as dioxins and furans, when they are burnt under unfavourable conditions or improper and inadequate APCD attached with the incinerators . Gases from incineration may cause air pollution and contribute to acid rain, while the ash from incinerators may contain heavy metals and other toxins may contribute to ground water contamination if not disposed in an environmentally sound manner.

Throwing away things not only causes wastage of useful natural resources but also wastage of raw materials and energy used in making the items. Reducing waste generation means less environmental impact, less use of natural resources and energy and saving money in terms of cheaper production cost.

Check Your Progress 3

1. Enlist and describe some benefits of waste management.

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2. What are the problems associated with- a) landfilling of waste b) incineration of waste.

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3. What are the practical methodologies for waste minimisation?

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3.8 CASE STUDY: WASTE ECONOMICS AT X HOSPITAL, NEW DELHI

COST ESTIMATION FOR SOLID WASTE MANAGEMENT AT X HOSPITAL, NEW DELHI

The hospital has dedicated nearly 80 square meter of its area for the purpose of storage and collection of hospital waste. The solid waste management is done using a partially outsourced model with responsibility of collection and storage being done by the hospital itself whereas transportation, processing/treatment and disposal of waste as per recommended guidelines are outsourced.

The X hospital is chargeda fee of Rs. 35,000/- per month against Blue bags disposal to outsourced agency and receives an amount of Rs. 75,000/- per month for the

Thus, hospital is mainly left with segregation, collection and temporary storage of hospital waste. Table 1 below highlights the annual cost estimation for solid waste management undertaken by X hospital, New Delhi:

Table 1: Annual Cost Estimates for Solid Waste Management undertaken by X HOSPITAL, New Delhi

SN	Head	Rates/unit (Rs)	Qty	Amount in Rs.
I.	**Operating Expenses**			
A.	Consumables and Supplies			
i)	Bags			
	Red	105/- per kg	49800 kg	52,29,000
	White	110/- per kg	5890 kg	6,47,900
	Blue	100/- per kg	5160 kg	5,16,000
	Yellow	100/- per kg	10750 kg	10,75,000
ii)	Big Bins			
	Red	3,900/-	69	2,69,100
	White	3,900/-	50	1,95,000
	Blue	3,900/-	60	2,34,000
	Yellow	3,900/-	48	1,87,200
iv)	Medium pedaled bins (set of 3)	11,250/- for 5 years	35	78,750
v)	Small Bins			
	Red	300/-	980	2,94000
	White	300/-	410	1,23,000
	Yellow	300/-	315	94,500
vi)	Puncture proof container (27 ltr)	500/-	421	2,10,500
vii)	Small container for sharps	85.67	398	34,097
viii)	Needle destroyer	1015.00	248	2,51,720
ix)	5% Sodium hypochlorite solution	41/- per liter	16780	6,87,980
ix)	Domestic gloves	2.20 per pair	6580	14,476
x)	Caps	1.80	4678	8,420
xi)	Heavy duty gloves	350/- per pair	20	7,000
xii)	Gum boots	568/- per pair	7	3,976
xiii)	Masks	2.80 each	6372	17,842
xiv)	Uniform	689/-	12	8,268
	Sub total (A)			**1,01,87,729**

B.	**Salaries and wages**			
xv)	Chief Sanitary Inspector	47000/- p.m.	6 months	2,82,000
xvi)	Sanitary Inspector	32000/- p.m.	6 months	1,92,000
xvii)	Sanitary Supervisor	35,000/- p.m.	2x6 months	4,20,000
xviii)	Sanitary supervisor	15,400/- p.m.	6 months	92,400
xix)	Sanitary Executive	8,200/- p.m.	6 months	49,200
xx)	Sanitary worker	17,210/- p.m.	12 months	2,06,250
xxi)	Sanitary worker	17,340/- p.m.	12 months	2,08,080
xxii)	Sanitary worker	17,990/- p.m.	12 months	2,15,880
	Sub total (B)			**16,65,810**
C.	**Services and Charges**			
xxiii)	Annual License fee	81,000/- for 3 years	-	27,000
xxiv)	Payment to Outsourced gency (Bags disposal)	35,000/- per month	12 months	4,20,000
	Subtotal (C)			**4,47,000**
	Total Operating Expenses (A+B+C)			**1,23,00,539**
II.	**Infrastructural Costs**			
1.	Autoclave Machines1	4,80,000/-	4	1,92,000
2.	Trolleys (660 Ltrs)2	24,860/-	10	49,720
3.	Weighing machine (300 kg Automatic)2	7,200/-	3	4,320
4.	Construction and building@Rs 3200/- per sq. meter p.a.	90 sq.mtr	2,88,000	
1.	**Subtotal (I)**			**5,34,040**
	i) Grand Total (I+II)			**1,28,34,579**
	ii) Add Contingency & Overheads @10%[8]			**12,83,458**
	Total Annual Cost (i+ii)			**1,41,18,037**
	Per bed per day rate at 100% occupancy[3]			**64.46**
	Per bed per day rate at 80% occupancy [4]			**80.58**

1. The life expectancy of Autoclave machines (1 Common utility and 1 each installed at blood bank and Microbiology department) is estimated to be 10 years hence its usage cost has been calculated as 10% of total cost using Straight Line Depreciation Method
2. The life expectancy of Trolleys and Weighing machine is estimated to be 5 years, hence annual usage cost has been calculated as 20% of total cost using Straight Line Depreciation method.
3. Assuming the hospital to be 600 bedded, 100% occupancy means for an year is 600*365
4. Assuming the hospital to be 600 bedded, 80% occupancy means for an year is 480*365

Source: Case study submitted by Dr. Parul Bansal, MBBS, DNB (Health and Hospital Administration), SGRH

Table 2: Annual Cost Estimates for Liquid Waste Management

SN	Head	Rates/unit	Qty	Amount in Rs
I.	**Operating Expenses** **A. Electricity**	Rs 12/KWH	300 Units/ month x 12 months	43,200
B.	**Consumables**			
1.	Chemicals			
	a) 111EM	Rs 26,000/- per month	12 months	3,12,000
	b) Chlorine	Rs 620/- per month	12 months	7,440
2.	Media			
	a) MGF			
	(Multi Grade Filter)	Rs 14,000/- per month	2 Pcs x 12 months	3,36,000
	b) ACF (Activated Carbon filter)	Rs 17,500/-	2Pcs x 12 months	4,20,000
C.	**Maintenance (including manpower)**			
	a) Building	Rs 8,2000/- per month	12 months	98,400
	b) Annual Maintenance Charges for plant and machinery including cost of manpower (11 Nos.) supplied by the AMC provider	Rs 1,60,000/- per month	12 months	19,20,000
	Subtotal (I)			**31,37,040**
II. Infrastructure Costs				
1.	Plant and machinery	127064 p.m.	-	15,24,768
2.	Land, Building and Construction	@Rs 3400/- per sq. meter p.a.	250 sqm	8,50,000
	Subtotal (II)			23,74,768
	i) Total cost (I+II)			55,11,808
	ii) Add contingency	@ 10%		5,51,181
	Grand Total (i+ii)			**60,62,989**
	Per bed/per day Operating cost @100% Bed occupancy rate			**27.68/day/bed**

* Cost per bed/day at 100% bed occupancy rate = Rs 27.68 /day/bed

Source: Case study submitted by Dr. Parul Bansal, MBBS, DNB (Health and Hospital Administration), SGRH

3.3: Proportional Distribution of different cost components of Solid Waste Management

SN	Cost Component	Amount in Rs	Proportion in Total Cost
1.	Infrastructural cost	5,34,040	3.78%
2.	Consumables and supplies	1,10,87,729	78.53%
3.	Salaries and wages + Services and Charges	12,12,810	8.59%
4.	Contingency expenses	12,83,458	9.09%

3.9 LET US SUM UP

In this unit we have learnt that waste is not a by-product without any value. Instead, waste is one of the most important aspects of any process as optimisation of waste production leads to economic, environment and social benefits.

Economics of Waste Management and Waste Production revolve around the fundamentals of demand supply and market dynamics. Rarely, is an equilibrium

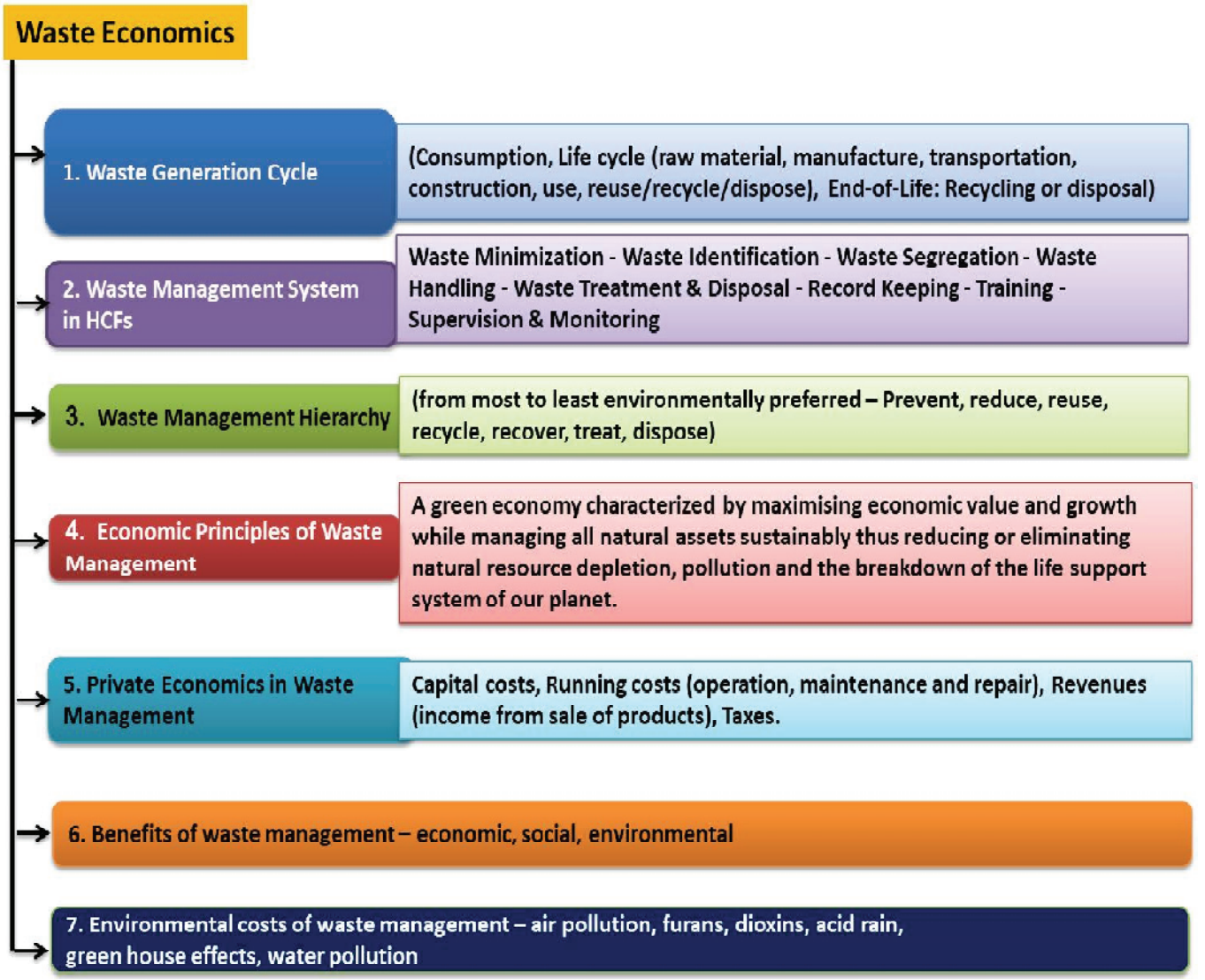

Fig 3.7: Mind Map

found in waste management as it is generally considered without any value but waste itself and the handling of waste up to its final disposal has costs. The costs may be divided in to those borne by the generator of waste within their organisation and external costs (once again borne by the generator) but outside the organisation. The waste economics also considers the social and environmental effects. This has led to newer concepts like zero waste and circle economy, which imply giving back to nature and using the natural resources more responsibly leading to sustainable growth.

Further, Hospitals and health care providers should focus on waste audits, waste segregation and waste minimisation to reduce costs associated with waste management. This would ensure that overall health care provision costs are kept lower. Overall, Health care services will then have a lower environmental, economic and social impact. Adoption of a positive attitude towards waste management reduces the chances of market failures and minimises waste generation.

The concepts covered in this unit have been summarised in **Fig 3.7**.

3.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1. Each stage of product life cycle generates a specific type of waste and each waste requires a specific management solution for final disposal. The Life cycle approach gives a complete picture of the waste and energy associated with a product- it measures energy use, material inputs and waste generated from the production until the goods are delivered to the consumer.
2. According to WHO, the waste management system is a cycle. It starts with Waste Minimisation. For this it is required to Identify Waste. Waste must then be segregated so that it can be propery handled, treated and disposed. Record Keeping, Training, Supervision & Monitoring are important for Waste Minimisation.
3. According to the US Environmental Protection Agency (USEPA), no single waste management approach is suitable for managing all materials and waste streams in all circumstances. According to the suitability of a treatment options they are ranked, this is known as Waste Management Hierarchy. This hierarchy is also the backbone of waste segregation. The various levels of the pyramid are: **(Most preferred to least preferred)- Source reduction and reuse, Recycling, Energy Recovery, Treatment & Disposal.**

Check Your Progress 2

1. Economic activity which includes production and consumption requires inputs of natural resources and releases pollution, which imposes environmental costs. Environmental costs include natural resource depletion, pollution and the breakdown of the life support system of our planet. A green economy is characterised where economic value and growth is maximised while managing all natural assets sustainably.

2. The private economics of waste management usually involve:
   a. Capital costs
   b. Running costs (operation and maintenance)
   c. Revenues (income from sale of products)
   d. Taxes

Check Your Progress 3

1. The benefits can be social, economic and environmental
2. Problems associated with landfilling are
   a. bad odour produced when the waste rots
   b. methane gas is generated, which is explosive and contributes to the greenhouse effect.
   c. Leachate produced as waste decomposes may cause ground water pollution if no proper liners are used.
   d. Badly-managed landfill sites may attract vermin or cause litter.

The problems associated with incineration are-

   a. If the waste contains plastics, it tends to produce toxic substances, such as dioxins and furans, when they are burnt under unfavourable conditions.
   b. Gases from incineration may cause air pollution and contribute to acid rain,
   c. Ash from incinerators having heavy metals and other toxins can cause ground water contamination.

3. The practical methodologies for waste minimisation are:
   - Know your waste streams
   - Waste Segregation
   - Source Reduction
   - First-In-First-Out (FIFO) system for pharmaceuticals
   - New Equipment
   - Eliminate Food Waste
   - Paying attention to expiry dates and using of the oldest drugs first could prevent a hospital from wasting and having to dispose drugs unnecessarily.

3.11 REFERENCES AND FURTHER READINGS

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