Manual on Healthcare Waste Management in Khyber Pakhtunkhwa

Khyber Pakhtunkhwa-Human Capital Investment Project (KPHCIP)

Message from Minister Health

It is with great pride that I introduce the **Manual on Healthcare Waste Management** for Khyber Pakhtunkhwa. This manual is a critical step forward in our ongoing commitment to enhancing public health and ensuring environmental safety throughout our province.

In recent years, the healthcare landscape in Khyber Pakhtunkhwa has experienced significant growth. With the expansion of healthcare facilities comes the urgent responsibility of managing healthcare waste effectively. The safe handling, treatment, and disposal of this waste are not only essential for protecting the health of our communities but also for preserving the environment for future generations. This manual serves as an essential resource, offering practical guidance and standardized procedures that align with both national and international best practices.

The creation of this manual has been made possible through the collaborative efforts of a diverse group of stakeholders, including the dedicated team from the Khyber Pakhtunkhwa Human Capital Investment Project (KP-HCIP), environmental specialists, healthcare professionals, and policymakers. I would like to extend my heartfelt appreciation to each of you for your commitment and expertise, which have been crucial in developing this invaluable resource.

I encourage all healthcare facilities across the province to implement the guidelines set forth in this manual diligently. By prioritizing proper waste management practices, we can safeguard our communities and promote a healthier environment. Together, we have the power to make a significant impact on public health outcomes and to lead by example in responsible healthcare management.

As we move forward, let us reaffirm our collective commitment to protecting public health and the environment. I am confident that this manual will serve as a cornerstone in our efforts to achieve these vital goals.

Mr. Ihtesham Ali

Minister Health
Khyber Pakhtunkhwa

Message from Secretary Health

As the Secretary of Health for Khyber Pakhtunkhwa, I am pleased to present the **Manual on Healthcare Waste Management**, a vital resource that underscores our commitment to improving public health and environmental safety across our province.

The management of healthcare waste is a critical aspect of our health infrastructure, especially as we witness rapid expansion in healthcare facilities. Proper waste management practices are essential not only to protect the health of our communities but also to safeguard our environment for future generations. This manual has been meticulously developed to provide healthcare professionals, administrators, and waste management personnel with practical guidance and standardized procedures for the safe handling, treatment, and disposal of healthcare waste.

The development of this manual is the result of extensive collaboration among various stakeholders, including experts from the Khyber Pakhtunkhwa Human Capital Investment Project (KP-HCIP), healthcare professionals, environmental specialists, and policymakers. Their dedication and commitment have been instrumental in shaping this resource, ensuring that it aligns with national and international best practices.

I would like to extend my sincere gratitude to everyone who contributed to this initiative, particularly the project team and the World Bank Task Team. Your hard work and expertise have been invaluable in bringing this manual to fruition.

As we implement the guidelines outlined in this manual, I urge all healthcare facilities to prioritize the safe management of healthcare waste. Together, we can create a healthier environment, protect public health, and set a precedent for responsible healthcare practices in Khyber Pakhtunkhwa.

Let us work collectively towards a future where public health and environmental stewardship go hand in hand.

Mr. Adeel Shah

Secretary Health Department
Khyber Pakhtunkhwa

Foreword

Effective healthcare waste management is essential for protecting public health, safeguarding our environment, and ensuring the well-being of our communities. As the Project Director of the Khyber Pakhtunkhwa Health Care Improvement Project (KP-HCIP), I am honored to present this comprehensive manual on Healthcare Waste Management.

This manual is the culmination of extensive research, collaboration, and commitment from a diverse group of experts in the field. It provides practical guidance on the safe handling, treatment, and disposal of healthcare waste, tailored for our target districts. Our aim is to empower healthcare professionals, administrators, and waste management personnel with the knowledge and tools necessary to implement best practices consistently.

In Khyber Pakhtunkhwa, where healthcare facilities are expanding rapidly, the importance of a robust waste management system cannot be overstated. The challenges we face—from inadequate disposal methods to potential health hazards—require immediate attention. This manual addresses these challenges and offers sustainable solutions aligned with national and international standards.

Effective healthcare waste management necessitates a collaborative approach involving healthcare providers, policymakers, and waste management personnel. By fostering a culture of accountability and best practices, we can create a safer and healthier environment for all.

I extend my heartfelt gratitude to all contributors and stakeholders who have played a pivotal role in developing this manual. Your dedication to improving healthcare waste management in our region is truly commendable and reflects our shared vision for a healthier future.

I am confident that this manual will be instrumental in enhancing our healthcare services, protecting our environment, and promoting public health. Together, let us ensure that our waste management practices meet today's needs and safeguard the well-being of future generations.

Dr. Ikram Ullah Khan

Project Director
KPHCIP (Khyber Pakhtunkhwa Human Capital Investment project)

Acknowledgements

The completion of the Manual on Healthcare Waste Management in Khyber Pakhtunkhwa represents a significant milestone in our ongoing efforts to enhance public health and environmental safety throughout the province. This manual could not have been realized without the dedication, collaboration, and contributions of key team members, including the Environmental Specialist, Public Health Specialist, and Procurement Specialist of the Project.

I extend my deepest gratitude to the entire team at the Khyber Pakhtunkhwa Human Capital Investment Project (KP-HCIP), along with the World Bank Task Team Lead and their dedicated team members, for their relentless efforts and expertise in developing this vital resource. Special thanks go to our healthcare professionals, environmental experts, the public health section of the Directorate General Health Services, and policymakers whose insights and recommendations have been invaluable in shaping the content of this manual.

I would also like to acknowledge the leadership and guidance of our Honourable Secretary of Health and the Project Director of KP-HCIP Health. Their vision and support have been instrumental in steering this initiative to its successful completion.

This manual stands as a testament to our collective efforts and shared commitment to safeguarding public health and protecting our environment. I am confident that it will serve as a crucial tool for healthcare facilities across Khyber Pakhtunkhwa, contributing to a safer and healthier future for all.

Dr. Qadir Shah
Deputy Project Director
KP-HCIP Health
Khyber Pakhtunkhwa

List of Abbreviations/ Acronyms

DoH	**Department of Health**	**PEP**	**Post Exposure Prophylaxis**
EHS	Environment, Health, and Safety	ClO_2	Chlorine Oxide
EIAs	Environmental Impact Assessments	Hep-C	Hepatitis-C
EPA	Environmental Protection Agency	Hep-B	Hepatitis-B
ESF	Environment and Social Framework	PEPA	Pakistan Environmental Protection Act
ESS	Environment and Social Standards	PPEs	Personal Protective Equipment
HCWM	Healthcare Waste Management	O_3	Ozone
IEEs	Initial Environmental Examination	OT	Operation Theatre
KPHCIP	Khyber Pakhtunkhwa Human Capital Investment Project	NaOCl	Sodium Hypochlorite
PD	Project Director	pH	Power of Hydrogen ion
POPs	Persistent Organic Pollutants	IPC	Infection Prevention & Control
PVC	Polyvinyl chloride	HEPA	High Efficiency Particulate Air
UNEP	United Nations Environment Programme	HIV	Human Immunodeficiency Virus
WB	World Bank	BOD	Biochemical Oxygen Demand
WHO	World Health Organization	PTC	Positive Temperature Coefficient

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Chapter 1: Introduction to Health Care Waste

1.1 Situation Analysis (Global, National and Provincial)

1.1.1 Global Situation analysis of Healthcare waste

Healthcare waste management is a significant global concern, particularly in low-income countries where waste is often not properly segregated. High-income countries generate an average of 0.5 kg of hazardous waste per hospital bed per day, while low-income countries produce approximately 0.2 kg. However, inadequate segregation in many low-income settings means that the actual volume of hazardous waste could be much higher (WHO, 2014)[1].

Key facts about healthcare waste include:

- Approximately 85% of waste generated by healthcare activities is classified as general, non-hazardous waste, similar to everyday domestic waste (WHO, 2015).
- The remaining 15% consists of hazardous materials, which may be infectious, toxic, or radioactive (WHO, 2016)[2].
- Each year, an estimated 16 billion injections are administered worldwide, but not all needles and syringes are disposed of safely (Hossain & Khan, 2020).
- Open burning and incineration of healthcare waste can emit harmful substances, such as dioxins, furans, and particulate matter (Zhang & Wang, 2019).

Effective management of healthcare waste is crucial to preventing adverse health and environmental impacts, including the unintended release of chemical and biological hazards, such as drug-resistant microorganisms, which can jeopardize the health of patients, healthcare workers, and the general public (UNICEF, 2015).

Health Risks Healthcare waste presents various health risks, including:

- **Infectious Microorganisms:** Waste can harbor harmful microorganisms that can infect hospital patients, healthcare workers, and the public. Drug-resistant microorganisms can spread from healthcare facilities into the environment (WHO, 2018).
- **Toxic Exposure:** There is a risk of exposure to pharmaceutical products, especially antibiotics and cytotoxic drugs, which may be released into the

1. [1] World Health Organization. (2014). Safe management of wastes from health care activities. Retrieved from WHO
2. 2 World Health Organization. (2016). Infection prevention and control in health care settings. Retrieved from WHO

surrounding environment. Additionally, substances like mercury and dioxins can pose hazards during handling or incineration (WHO, 2016).

- **Unsafe Injections:** Although efforts have reduced unsafe injection practices in recent years, in 2010, unsafe injections were still responsible for approximately 33,800 new HIV infections, 1.7 million hepatitis B infections, and 315,000 hepatitis C infections (WHO, 2010)[3].
- **Needle-Stick Injuries:** A person who experiences a needle-stick injury from a contaminated needle has a 30%, 1.8%, and 0.3% risk of contracting hepatitis B, hepatitis C, and HIV, respectively (WHO, 2018).

Additional hazards arise from scavenging activities at waste disposal sites, where waste handlers face significant risks of needle-stick injuries and exposure to toxic or infectious materials. A joint assessment by WHO and UNICEF in 2015 revealed that only 58% of sampled healthcare facilities across 24 countries had adequate systems for the safe disposal of healthcare waste (UNICEF, 2015).

Environmental Impacts The treatment and disposal of healthcare waste can pose indirect health risks through the release of pathogens and toxic pollutants into the environment. Key environmental concerns include:

- **Contamination of Water Sources:** Untreated healthcare waste disposed of in landfills can contaminate drinking water, surface, and groundwater, particularly if landfills are not properly constructed (Zhang & Wang, 2019)[4].
- **Release of Toxic Substances:** The treatment of healthcare waste with chemical disinfectants can result in harmful substances being released into the environment if they are not handled, stored, and disposed of properly (Hossain & Khan, 2020)[5].
- **Air Pollution:** While incineration is a common waste treatment method, inadequate practices can lead to the release of harmful pollutants, including dioxins and furans, known carcinogens (WHO, 2016).

3. [3] World Health Organization. (2010). Global report on the epidemiology and burden of sepsis: Current evidence, identifying gaps and future directions. Retrieved from WHO

4. [4] Zhang, Y., & Wang, W. (2019). Environmental impacts of healthcare waste management in developing countries. Environmental Science and Pollution Research, 26(12), 11434-11445. doi:10.1007/s11356-019-04453-2

5. [5] Hossain, M., & Khan, M. S. (2020). Healthcare waste management: A review of practices and challenges in developing countries. Waste Management & Research, 38(1), 1-10. doi:10.1177/0734242X19877425

Only modern incinerators operating between 850-1100 °C and equipped with specialized gas-cleaning technology can meet international emission standards for dioxins and furans. Alternatives to incineration, such as autoclaving, microwaving, and steam treatment, should be considered where resources allow, as they can minimize hazardous emissions (WHO, 2015)[6].

1.1.2 National Situation analysis of Pakistan

The healthcare waste management (HCWM) situation in Pakistan faces several critical challenges, exacerbated by rapid urbanization, population growth, and inadequate infrastructure for waste segregation and disposal. Poor HCWM practices pose significant public health and environmental risks, particularly regarding the improper handling of infectious waste, exposure to hazardous materials, and environmental contamination.

Key Issues in Healthcare Waste Management in Pakistan

- **Volume of Healthcare Waste:** Pakistan generates around 250,000 tons of healthcare waste annually, with a significant portion classified as hazardous. This includes infectious materials, sharps, pathological waste, and toxic chemicals. Hospitals in urban areas such as Karachi, Lahore, and Islamabad collectively produce over 100,000 kg of healthcare waste per day, but less than 25% of this waste is disposed of properly (WHO, 2016).
- **Lack of Segregation:** In many healthcare facilities, there is minimal segregation between hazardous and non-hazardous waste. Infectious waste, sharps, and general waste are often mixed, increasing the risk of disease transmission, particularly among waste handlers and scavengers. The WHO recommends that at least 10-25% of hospital waste is hazardous; however, due to poor segregation practices in Pakistan, much of the waste becomes hazardous through contamination (UNICEF, 2015)[7].
- **Inadequate Infrastructure:** There are limited functional incinerators across the country, with only a small percentage of hospitals and healthcare centers equipped with modern, compliant incineration units. Much of the healthcare waste is either burned in low-temperature incinerators, dumped in municipal landfills, or improperly disposed of through open burning, contributing to air pollution. The Pakistan Environmental Protection Agency (Pak-EPA) has

6. [6] World Health Organization. (2015). Health-care waste: Guidelines for the development of national health-care waste management plans. Retrieved from WHO

7. [7] United Nations Children's Fund (UNICEF). (2015). Joint WHO/UNICEF assessment of health care waste management in selected countries. Retrieved from UNICEF

reported that less than 50% of public hospitals have incinerators or sterilization facilities, and private healthcare facilities fare even worse (Hossain & Khan, 2020).

- **Regulatory Gaps:** The Hospital Waste Management Rules (2005), introduced under the Pakistan Environmental Protection Act (1997), outline HCWM responsibilities for healthcare institutions. However, enforcement has been weak, with many facilities failing to comply with these regulations due to a lack of monitoring and technical expertise. Public awareness of these rules among healthcare workers is often limited, and there is a lack of dedicated training programs on HCWM (WHO, 2016).
- **Public Health and Environmental Impact:** Improper disposal of healthcare waste, especially sharps and infectious materials, has been linked to increased cases of hepatitis B and C, HIV, and other blood-borne infections. Scavengers who collect recyclable materials from healthcare waste dumpsites are particularly at risk. Unregulated incineration or burning of medical waste produces harmful emissions, including dioxins and furans, which are known carcinogens (Zhang & Wang, 2019).

1.1.3 Provincial Situation analysis of KP

Currently, healthcare waste management practices in Khyber Pakhtunkhwa are not in accordance with the Hospital Waste Management Rules 2005 established by the Environmental Protection Agency and WHO guidelines. The province has 142 public sector hospitals with a total of 13,529 beds according to the District Health Information System. The average infectious waste generated in these government hospitals is approximately 2,000 kg per day, which is not being safely collected, transported, or incinerated. There is no traceability mechanism in place to ensure transparent waste collection, transportation, and incineration, resulting in no manual or digital records of waste generation and disposal.

Key Issues in Khyber Pakhtunkhwa:

- **Lack of Awareness:** Hospital staff, including doctors, nurses, paramedics, and other healthcare workers, are often unaware of proper infectious waste handling and management practices. The few incinerators installed at various healthcare facilities are of substandard quality and lack pollution control mechanisms, failing to comply with the legislative requirements set by the Environmental Protection Agency of Khyber Pakhtunkhwa (WHO, 2018).
- **Research Findings:** A study published by WHO in 2018 aimed to assess adherence to the Hospital Waste Management 2005 Rules in tertiary care teaching hospitals of Peshawar District. The methodology involved pretested

structured questionnaires based on WHO recommendations. Key findings included:

- 70% of surveyed hospitals lacked formal healthcare waste management plans.
- 80% did not have written procedures or related job descriptions.
- 90% lacked proper record-keeping for waste management.
- 56% of hospitals had no trained healthcare waste management supervisors.
- 40% did not provide formal training for new staff.

This study highlights the lack of adherence to national Hospital Waste Management 2005 Rules by all tertiary care teaching hospitals in Peshawar District. The conclusion of the research reveals an urgent need for implementing the Hospital Waste Management 2005 Rules in hospitals and other healthcare facilities. Government support is essential in developing hospital waste management teams and plans, creating standardized training modules, and establishing frequent monitoring of practices.

Findings of KP-HCIP Health Facility Assessment & Interventions

Health Hazards Baseline (Situational Analysis)	1. Pathogen Exposure 2. Hazards for staff and communities (Public health Risks) 3. Open burning Risks
Environmental Hazards	1. Soil and Water Contamination 2. Air Quality Deterioration 3. Chemical Waste
Interventions of KP – HCIP in Target Districts	1. Outsourced Janitorial Services at all 195 Healthcare Facilities in targeted Districts 2. Provision of 3 Bins system along with banners for awareness on color coding system for waste segregation 3. Development of HCWM Manual and Modules. 4. Trainings of Healthcare providers on HCWM
Upcoming Interventions of KP - HCIP	1. Provision of Autoclave with Shredders to target health facilities 2. Construction of Yellow Rooms in target health facilities 3. Capacity building/Orientation on operation and maintenance of Autoclave with shredder

1.2 Overview

Health Care Waste Management (HCWM) is a critical component of public health and environmental protection. It encompasses all the activities and processes involved in managing waste generated by health care facilities, including hospitals, clinics, laboratories, and other medical institutions. Effective HCWM ensures that waste is managed in a manner that minimizes risks to health care workers, patients, the public, and the environment.

1.3 Importance of Healthcare Waste Management (HCWM)

Proper HCWM is essential for several reasons:

Infection Control: Health care waste, particularly infectious waste, can be a source of infection if not properly handled and disposed of. This can lead to outbreaks of diseases within the community and among health care workers.

Environmental Protection: Improper disposal of health care waste can lead to environmental contamination, affecting soil, water, and air quality. Hazardous chemicals and pharmaceuticals can cause significant harm to ecosystems.

Occupational Safety: Health care workers are at risk of exposure to hazardous waste. Proper HCWM practices help in preventing injuries and illnesses caused by needle sticks, chemical exposures, and other hazards.

Legal and Regulatory Compliance: Compliance with local, national, and international regulations on waste management is mandatory. Effective HCWM ensures adherence to these laws, avoiding legal penalties and promoting best practices.

1.4 Legal and Regulatory Framework (International, National & Provincial)

1.4.1 International Guidelines and Conventions

a) World Health Organization (WHO) Guidelines & Strategies

i. WHO Guiding Principles on HCWM

- Prevent health risks to health workers and public
- Support efforts to reduce disease from noxious emissions
- Support the Stockholm and Basel Conventions
- Promote practices to reduce exposure to toxic pollutants from incineration.

ii. WHO Core Principles on HCWM

- Safe and sustainable management of healthcare waste is a public health

imperative and a responsibility of all.

- Improper management of healthcare waste poses a significant risk to patients, healthcare workers, the community and the environment.
- The right investment of resources and commitment will result in a substantive reduction of the disease burden and corresponding savings in health expenditures.

iii. WHO Strategies on HCWM

- **Short Term**
  - Develop recycling options where possible
  - Use PVC-free materials
  - Promote small-scale non-incineration alternatives
- **Medium-Term**
  - Reduce the number of unnecessary injections to reduce sharps waste.
  - Assess the health risks associated with incineration and exposure to healthcare waste.

b) World Bank Policies on Environment and Social impacts

- The World Bank has established policies and guidelines on healthcare waste management (HCWM) to ensure that waste generated by healthcare activities is managed safely and sustainably. These policies are designed to protect human health and the environment from the potentially harmful effects of healthcare waste. Key aspects of the World Bank's policies on healthcare waste management include:

- Health Care Waste Management Guidance Note
- Environment, Health, and Safety (EHS) Guidelines prepared by International Finance Corporation and World Bank in 1997
- Pollution Prevention and Abatement Handbook 1998: Towards Cleaner Production
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross Sectoral Issues.
- Social Analysis Sourcebook.
- Environmental and Social Framework (ESF).

The World Bank's ESF, particularly its Environmental and Social Standards (ESS), provides comprehensive guidelines on managing environmental and social risks, including healthcare waste management.

Table 1.1 General EHS Guidelines

The **General EHS Guidelines** are organized as follows:

(https://documents1.worldbank.org/curated/en/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf)

c) Stockholm Convention-October-2012

- A global treaty to protect human health and the environment from persistent organic pollutants (POPs).

POPs are chemicals that:
– remain intact in the environment for long periods
– become widely distributed geographically
– accumulate in the fatty tissue of living organisms
– are toxic to humans and wildlife
http://chm.pops.int/Implementation/BATBEP/Guideline

- Article 5: Countries have to take measures to further reduce releases of POPs from unintended production “with the goal of their continuing minimization and, where feasible, ultimate elimination.”
- Annex C: – Medical Waste Incinerators have “the potential for comparatively high formation and release” of dioxins & furans – “Priority consideration” should be given to alternative technologies that avoid formation of dioxins & furans.

d) Basel Convention, 1989

- Coordinated by the United Nations Environment Programme (UNEP)
- Controls transboundary movements of hazardous waste including
    - medical and pharmaceutical waste
    - Hazardous waste exports from most developed countries to t world are banned by this convention.

http://www.basel.int/TheConvention/Publications/

e) Minamata Convention on Mercury-2013

- The Minamata Convention on Mercury is the most recent global agreement on environment and health, adopted in 2013. It is named after the bay in Japan where, in the mid-20th century, mercury- tainted industrial wastewater poisoned thousands of people, leading to severe health damage that became known as the "Minamata disease.”
- Since it entered into force on 16 August 2017, Parties have been working together to control the mercury supply and trade, reduce the use, emission and release of mercury, raise public awareness, and build the necessary institutional capacity.

https://minamataconvention.org/sites/default/files/documents/information_document/Minamata-Convention-booklet-Oct2023-EN.pdf

2.3.2 National & Provincial Rules, Regulations & Policies

In Pakistan, the legal framework for healthcare waste management is comprised of various laws, regulations, and guidelines that address the generation, segregation, collection, transportation, treatment, and disposal of healthcare waste.

a) Pakistan Environmental Protection Act, 1997 (PEPA 1997)

The Pakistan Environmental Protection Act, 1997, is the basic framework of the environmental regulatory regime in Pakistan. It protects, conserves, rehabilitates, and improves the environment and controls pollution, promoting sustainable development.

Key Provisions:

i. ***Establishment of Environmental Protection Agencies (EPAs):*** PEPA 1997 provided for a federal level agency, the Pakistan Environmental Protection Agency

(Pak-EPA), and canvassed provisions regarding provincial EPAs in terms of environmental regulations and control.

ii. ***Environmental Impact Assessment and Initial Environment Examination:*** Every development project, including a health facility, has to carry out an environment impact assessment or initial environment examination to evaluate its impacts on the environment.

iii. ***Control of Hazardous Waste:*** Provisions under the Act exist for controlling and managing hazardous wastes, including healthcare wastes, generated during various processes through proper handling, storage, treatment, and safe disposal.

iv. ***Penalties and Enforcement:*** The various penalties for violating environmental regulations have been spelt out under PEPA 1997 and they include fines as well as imprisonment.

b) Hospital Waste Management Rules, 2005

Under the authority of PEPA 1997, the Hospital Waste Management Rules, 2005, were framed. Specifically, the provisions under these rules for healthcare facilities regulate their waste management system. Rules require each healthcare facility to constitute a waste management team, and to prepare and implement a waste management plan.

The objective is to see that the healthcare waste is handled in a manner that does not pose risks to public health and the environment.

Key Provisions:

i. ***Segregation:*** In healthcare facilities, wastes must be compulsorily segregated at the point of generation into infectious, sharps, pharmaceutical and general wastes.

ii. ***Transportation:*** Safe transportation of healthcare waste from the point of generation to treatment and disposal sites is governed by guidelines, including transport in labeled and secure containers.

iii. ***Treatment and Disposal:*** The regulations detail the acceptable methods of treatment and disposal for healthcare wastes, such as incineration, autoclaving, or secure landfilling.

iv. ***Training and Awareness:*** The healthcare facilities are supposed to provide training about proper waste management practices to the staff and raise awareness regarding the hazards of healthcare waste.

v. ***Record Keeping and Reporting:*** All the facilities are obligated to maintain a record of waste generation, treatment, and disposal, as well as report the information to the concerned regulatory authorities.

c) National Environmental Quality Standards (NEQS)

The NEQSs have defined the permissible limits of pollutants in air, water, and soil, besides standards for discharge of effluents and emissions from all sources, including the

healthcare facilities.

Key Provisions:

i. ***Effluent Standards:*** Under NEQS, the maximum allowable concentrations of different pollutants in the effluent discharged from healthcare facilities to the receiving water bodies will be specified.

ii. ***Emission Standards:*** The standards also contain acceptable emission limits to air of healthcare facilities including emissions from incinerators used for treatment of waste.

iii. ***Monitoring and Compliance:*** Healthcare Facilities must monitor their effluents and emissions on a regular basis to meet the NEQS. Non-compliance would lead to penalties demanding legal action.

d) National Guidelines Infection Prevention & Control 2020

Section 7 (Management of Healthcare Waste) deals with Healthcare Waste Management and states that the waste generated by any healthcare facility (esp. hospital) is a specialized type of waste. This may pose a threat not only to healthcare workers, patients and visitors, but also to the public and the environment. Healthcare waste not only contains pathogenic microorganisms, but also sharp items and appropriate treatment of these items must be made mandatory. Therefore, it is essential that the management of clinical and related wastes conform to the appropriate national and international guidelines. The waste generated by a healthcare facility should be dealt with by a waste management team. The team should develop a written waste management plan or if it is a small setup, a person or persons should be appointed to manage the health facility's waste. Team members should be appraised in writing of their roles and responsibilities and should meet at least twice a month. Waste management should be conducted in coordination with the Infection Prevention and Control Team. The overall responsibility rests with the medical superintendent/chief of the hospital who has to manage the subsequent team composition, its responsibilities and arranging for the resources and finances for the plan.

e) National Hazardous Waste Management Policy 2022.

The policy focuses on the Environmentally Sound Management of Hazardous Waste in Pakistan, in line with the provisions of the relevant MEAs (Multilateral Environmental Agreements), to safeguard public health and the environment.

Policy Objectives -

- To facilitate the implementation of the relevant provisions of the Basel Convention, the Stockholm Convention and the Minamata Convention at national level.
- To prevent, minimize and control hazardous waste being generated in the country.

- To control the transboundary movements of hazardous waste.
- To create an enforcement mechanism through effective regulatory framework and monitoring, inspection & verification system.
- To build capacity of all relevant stakeholders for Environmentally Sound Management of hazardous waste in Pakistan.

Guiding Principles

- ***The Source Reduction Principle-*** generation of waste shall be minimized in terms of its quantity and its potential to cause pollution in conformity with Article 4, paragraph 2 (a) of the Basel Convention.
- ***The Proximity Principle –*** ensuring the availability of adequate disposal facilities as close to the place of production as possible.
- ***The Precautionary Principle –*** considering the costs and benefits, preventive measures shall be taken to control those releases to the environment of substances, waste or energy which are likely to cause harm to human health or the environment.
- ***The Standardization Principle -*** which requires the provision of standards for the ESM of hazardous waste at all stages of their processing, treatment, recovery, and disposal.
- ***The Least Transboundary Movement Principle –*** Transboundary movements of hazardous waste shall be reduced to a minimum consistent with efficient and ESM of hazardous waste in conformity with Article 4, paragraphs 2 (b) and 2 (d) of the Basel Convention.
- ***The Principle of Sovereignty -*** the import of hazardous waste will be banned into Pakistan for disposal purposes.
- ***The Polluter Pays Principle -*** the potential polluter must act to prevent pollution and those who cause pollution pay for remedying the consequences of that pollution.
- **The Principle of Public Participation -** in all stages, waste management options are considered in consultation with the public as appropriate, and that the public has access to information concerning the management of hazardous waste.

f) Khyber Pakhtunkhwa Environmental Protection Act, 2014

The Khyber Pakhtunkhwa Environmental Protection Act, 2014, is a comprehensive legal framework aimed at protecting, conserving, and improving the environment in the province of Khyber Pakhtunkhwa. It builds upon the principles of the Pakistan Environmental Protection Act, 1997, with specific adaptations for provincial needs following the devolution of environmental responsibilities under the 18th Amendment to the Constitution of Pakistan.

Under the Act, the Khyber Pakhtunkhwa Environmental Protection Council and the KP-EPA were established in the province and tasked with monitoring environmental protection. It mandates EIAs and IEEs for projects, regulates hazardous substances, and sets pollution control standards. The Act also encourages public participation, enforces penalties for non-compliance, and provides for environmental tribunals to address grievances. Furthermore, it emphasizes efficient waste management to protect public health and the environment in Khyber Pakhtunkhwa.

- ***Section15 of EPA Act 2014:*** ***Handling of hazardous substances***.--- Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle, deal in and use or import any hazardous substance except--- (a) under a license issued by the Agency and in such manner as may be prescribed; or (b) in accordance with the provisions of any other law for the time being in force, or of any International Treaty, Convention, Protocol, Code, Standard, Agreement or other instrument to which Pakistan or the Province of the Khyber Pakhtunkhwa is a party.

g) Health Policy 2018 Khyber Pakhtunkhwa

- ***Section 4 (Health Policy Outcomes and Policy Actions), Para 31*** recommends implementation of Effective infection control measures in all public and private sector hospitals, including hospital waste disposal. According to the para, Waste Management services/Incinerators will be made functional at least at the district level, with arrangements for collection and disposal of waste from BHUs/RHCs in the districts.

h) Khyber Pakhtunkhwa Hospital Waste Management Rules, 2022 (Finalized and will be notified soon).

1.5 Definition of Healthcare Waste

1.5.1 What is healthcare waste?

"Total waste stream from major healthcare establishments and from minor scattered healthcare activities". (WHO)

1.5.2 General Characteristics of Healthcare Waste

• Total waste generated in hospitals: ¬ 2 - 4 kg per bed per day

• Infectious waste generated in hospitals with good segregation: ¬ 0.2 - 0.4 kg per bed per day

• Average bulk density of healthcare waste: ¬ About 100 - 200 kg per cubic meter

1.5.3 Examples of Healthcare waste

Department	Sharps	Infectious and pathological waste	Chemical, pharmaceutical and cytotoxic waste	Non-hazardous or general Waste
Medical ward	Hypodermic needles, intravenous set needles; broken vials and ampoules	Dressings, bandages, gauze, and cotton contaminated with blood or body fluids; gloves and masks contaminated with blood of body fluids	Broken thermometers and blood pressure gauges; split medicines; spend disinfectants	Packaging, food scraps, paper, flowers, empty saline bottles, non-bloody diapers; non-bloody IV tubing and bags
Operating theatre	Needles, IV sets, scalpels, blades, saws	Blood and other body fluids; suction canisters; gowns, gloves, masks, gauze, and other waste contaminated with blood and body fluids; tissues, organs, fetuses, body parts	Spent disinfectants	Packaging, uncontaminated gowns, gloves, masks, hats and shoe covers
Laboratory	Needles; broken glass, Petri dishes, slides and cover slips;	Blood and body fluids; microbiological cultures and stocks; tissue;	Fixatives; formalin; xylene, toluene, methanol, methylene	Packaging; paper, plastic containers

	broken pipettes	infected animal carcasses; tubes and containers contaminated with blood or body fluid	chloride, and other solvents; broken lab thermometers	
Pharmacy store	Broken bottles, broken thermometers		Expired drugs, Spilled drugs Empty containers	Packaging; paper, empty containers
Radiology			Silver; fixing and developing solutions; acetic acid; glutaraldehyde	Packaging, paper
Chemotherapy	Needles and syringes		Bulk chemotherapeutic waste; vials, gloves and other material contaminated with cytotoxic agents; contaminated excreta and urine. IV sets containing chemotherapy drugs are cytotoxic waste	Packaging, paper
Vaccination campaigns	Needles and syringes Broken glass		Bulk vaccine waste; vials, gloves	Packing
Cleaning Services	Broken glass		Disinfectants (glutaraldehyde, phenols, etc.), cleaners, spilled mercury, pesticides	Packaging, flowers, newspapers, magazines, cardboard, plastic and glass

				containers, yard waste
Engineering			Cleaning solvents, oils, lubricants, thinners, asbestos, broken mercury devices, batteries	Packaging, construction or demolition waste, wood, metal
Food services				Food scraps; plastic, metal and glass containers; packaging
Other Sources:				
Physicians' offices	Needles and syringes, broken ampoules and vials	Cotton, gauze, dressing, gloves, masks and other materials contaminated with blood or other body fluids	Broken thermometers and blood pressure gauges; expired drugs; spent disinfectants	Packaging, office paper, newspapers, magazines, uncontaminated gloves and masks
Dental offices	Needles and syringes, broken ampoules	Cotton, gauze, gloves, masks and other materials contaminated with blood	Dental amalgam; spent disinfectants	Packaging, office paper, newspapers, magazines, uncontaminated gloves and masks
Home health care	Lancets and insulin injection needles	Bandages and other material contaminated with blood or other body fluids	Broken thermometers	Domestic waste

1.5.4 Categories of Healthcare Waste

- Sharps waste
- Infectious waste
- Pathological waste

- Pharmaceutical or cytotoxic waste
- Chemical waste
- Radioactive waste
- Non-hazardous/general waste

1.5.5 Why Segregate Healthcare Waste?

- To reduce the amount of waste that must be treated as hazardous waste
- To reduce the risks of exposure to hazardous healthcare waste for workers
- To lower the cost of treatment and disposal of healthcare waste
- To make possible the recycling of non-hazardous general waste

General Principles

- When properly segregated, 85% or more of healthcare waste is general waste with the same risk as domestic solid waste.
- Sharps waste poses the highest risk of disease transmission of all waste categories
- Blood and body fluids are also a significant source of disease transmission.

1.4.6 Types of Healthcare Waste/ Classification

- **Non-hazardous general wastes** comparable to domestic waste (75-90% of healthcare waste in a health facility)
- **Potentially hazardous waste** or waste that is associated with some health risks (10-25% of healthcare waste in a health facility)

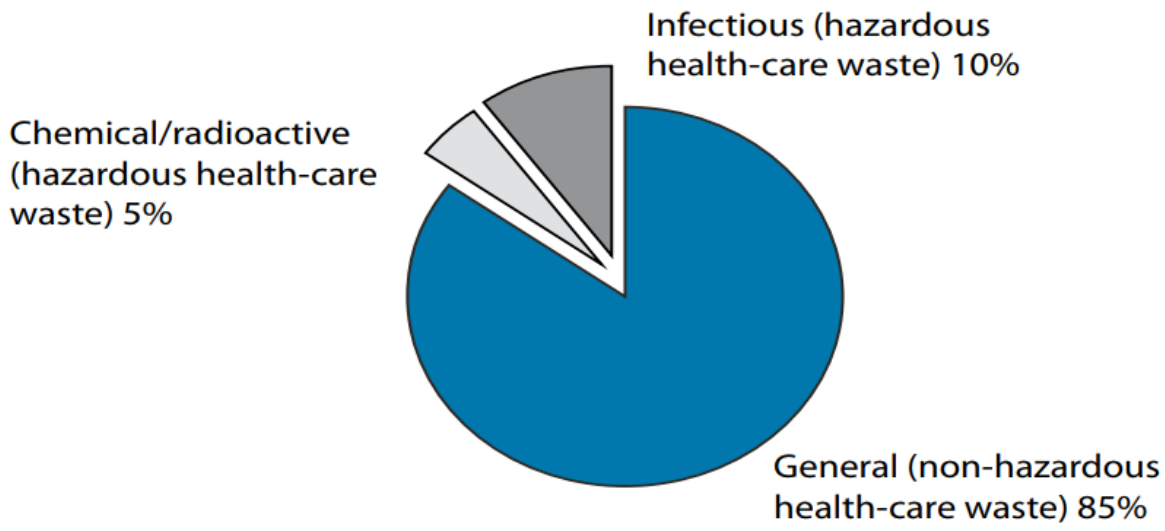


Figure 1: Typical Waste composition in healthcare facilities (WHO)

a) Health Care Waste classifications are based on:

- National Regulations
- International guidelines, if national regulations do not exist Types of risk associated with waste

b) Types of risk associated with waste

- Infectious disease transmission
  - Waste contaminated with blood and body fluids
- Physical injury
  - All sharps waste
- Chemical exposure
  - Cleaning solvents

c) Classifications are useful for deciding treatment approaches:

- Steam disinfection – infectious waste, blood or body fluids,
- microbiological waste
- Burial – anatomical waste, human tissues
- Incineration with pollution control – cytotoxic waste

- Waste minimization options
- Recycling – paper, glass, aluminum
- Composting – kitchen waste, yard waste
- Materials recovery – silver from x-ray waste

d) Waste Color coding- WHO Recommendations

Types of Waste	Color Code
Highly infectious	Red
Infectious, Pathological, Anatomical	Yellow
Sharp	Yellow colored Box
Chemicals, Pharmaceuticals	Brown
Radioactive	Silver
General Waste	Black

1.4.7 World Health Organization Waste Classification

Biological (infectious) risks			Chemical risks			Low risk
Sharps Waste Needles Blades Broken glass	**Infectious Waste** Waste contaminated with blood Cultures Isolation waste	**Pathological Waste** Body parts Human tissue Animal carcasses	**Pharmaceutical Waste** Expired drugs Expired vaccines Cytotoxic waste	**Chemical Waste** Chemical solvents Mercury Cleaners Batteries	**Radioactive Waste** Radionuclides Vials with radioactive residues	**Non-Hazardous General Waste** Recyclable and compost-able waste Non-recyclable waste

a) Hazardous Waste:

i. Infectious waste

Healthcare wastes that are suspected to contain pathogens (or their toxins) in sufficient concentration to cause diseases to a potential host after exposure

Sub-Categories of infectious waste

- Waste contaminated with blood or other body fluids
- Cultures and stocks of infectious agents from laboratory work
- Wastes from infected patients in isolation wards

- (Sharps and pathological waste are given their own classifications because of special methods needed to handle and treat them)

Waste contaminated with blood/body fluids

Examples:

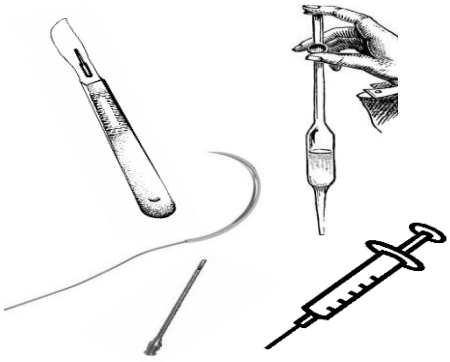
- Liquid waste blood
- Cotton, gauze, or dressings saturated with blood or body
- Gloves, gowns, or face masks covered in blood
- Body fluids considered infectious
- Blood, blood products (e.g., plasma, red blood cells), semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, and body fluids that cannot be differentiated from the above-mentioned fluids.

Cultures and stocks

– Laboratory cultures used for growing microbiological agents
– Culture dishes and devices used to transfer, inoculate and m
– Stocks of infectious agents
– Discarded live and attenuated vaccines

ii. Sharps waste

- Items that could cause cuts or puncture wounds whether or not they are infected
- Needles, hypodermic needles, syringes
- Scalpels and other blades
- Knives
- Infusion sets
- Saws
- Broken glass, pipettes



iii. Chemical waste

Discarded solid, liquid and gaseous chemicals from diagnostic and experimental work and from cleaning and disinfection. Hazardous chemical waste are chemicals with at least one of the following properties:

- Toxic
- Corrosive

(e.g. acids of pH < 2 and bases of pH > 12)

- Flammable
- Reactive (explosive, water-reactive, shock-sensitive)
- Oxidizing

Examples of Hazardous Chemical Waste

- –Formaldehyde, glutaraldehyde
- –Photographic fixing and developing solutions
- –Laboratory solvents
- –Pesticides
- –Mercury in thermometers and sphygmomanometers
- –Disinfectants (phenols and bleach)
- –Toxic cleaners, degreasers

Non-hazardous chemical wastes do not have any of the above properties.

Examples of Non-Hazardous Chemical Waste

–Saline solution, glucose, amino acids, vitamins.

iv. Pharmaceutical wastes

• Waste that consists of expired, unused, split, and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer used

• Discarded items used in the handling of pharmaceuticals, such as bottle or

boxes with residues, gloves, masks, connecting tubing, and drug vials

• Cytotoxic (chemotherapeutic or antineoplastic) drug waste.

v. Radioactive Waste

• Solid, liquid, and gaseous materials contaminated with radionuclides

• Includes sealed radioactive sources, low-level waste (swabs, vials, etc.), residues, excreta from patients treated or tested with unsealed radionuclides, low-level radioactive wastewater from washing

• Body fluids of patients undergoing radiation therapy.

b) Non-Hazardous waste

• Waste that has not been in contact with infectious agents, hazardous chemicals, or radioactive substances, and that does not pose a sharps hazard

• Typically, more than half of non-hazardous general waste is paper, cardboard, and plastics.

General Waste

Recyclable waste

- Mixing recyclables at the point of generation with other wastes prevents recyclables from being recovered.
- Collected, segregated and stored away from infectious and hazardous wastes to prevent cross-contamination.

Biodegradable waste

- Kitchen waste, food scraps, yard trimmings

1.4.8 Sources of healthcare waste

a) Major sources of Health Care Waste are as under:

Hospitals
Clinics
Laboratories
Research activities
Nursing homes
Acupuncturist
Paramedic and ambulance services
Animal research
Blood banks
Mortuaries
Autopsy centers

Physicians' offices
Dental clinics
Chiropractors
Psychiatric hospitals
Cosmetic piercing and tattooing
Institutions for disabled persons
Funeral services
Home healthcare
hysicians' offices

b) Sources of Healthcare waste within Hospital

Department	Sharps	Infectious and pathological waste	Chemical, pharmaceutical and cytotoxic waste	Non-hazardous or general waste
Medical Ward	Hypodermic needles, intravenous set needles; broken vials and ampoules	Dressings, bandages, gauze, and cotton contaminated with blood or body fluids; gloves and masks contaminated with blood of body fluids	Broken thermometers and blood pressure gauges; split medicines; spend disinfectants	Packaging, food scraps, paper, flowers, empty saline bottles, non-bloody diapers; non-bloody IV tubing and bags
Operating theatre	Needles, IV sets, scalpels, blades, saws	Blood and other body fluids; suction canisters; gowns, gloves, masks, gauze, and other waste contaminated with blood and body fluids; tissues, organs, fetuses, body parts	Spent disinfectants	Packaging, uncontaminated gowns, gloves, masks, hats and shoe covers
Laboratory	Needles; broken glass, Petri dishes, slides and cover slips; broken pipettes	Blood and body fluids; microbiological cultures and stocks; tissue; infected animal carcasses; tubes and containers contaminated with blood or body fluid	Fixatives; formalin; xylene, toluene, methanol, methylene chloride, and other solvents; broken lab thermometers	Packaging; paper, plastic Containers

Pharmacy store	Broken bottles, broken thermometers		Expired drugs, Spilled drugs Empty containers	Packaging; paper, empty Containers
Radiology			Silver; fixing and developing solutions; acetic acid; glutaraldehyde	Packaging, paper
Chemotherapy	Needles and syringes		Bulk chemotherapeutic waste; vials, gloves and other material contaminated with cytotoxic agents; contaminated excreta and urine. IV sets containing chemotherapy drugs are cytotoxic waste	Packaging, paper
Vaccination campaigns	Needles and syringes		Bulk vaccine waste; vials, gloves	Packing
Cleaning services	Broken glass		Disinfectants (glutaraldehyde, phenols, etc.), cleaners, spilled mercury, pesticides	Packaging, flowers, newspapers, magazines, cardboard, plastic and glass containers, yard waste
Engineering			Cleaning solvents, oils, lubricants, thinners, asbestos, broken mercury devices, batteries	Packaging, construction or demolition waste, wood, metal
Food services				Food scraps; plastic, metal and glass containers; packaging
Physicians'	Needles and syringes, broken ampoules and vials	Cotton, gauze, dressing, gloves, masks and other materials contaminated with blood or	Broken thermometers and blood pressure gauges; expired drugs; spent disinfectants	Packaging, office paper, newspapers, magazines, uncontaminated gloves and masks

		other body fluids		
offices Dental offices	Needles and syringes, broken ampoules	Cotton, gauze, gloves, masks and other materials contaminated with blood	Dental amalgam; spent disinfectants	Packaging, office paper, newspapers, magazines, uncontaminated gloves and masks
Home health care	Lancets and insulin injection needles	Bandages and other material contaminated with blood or other body fluids	Broken thermometers	Domestic waste

c) Different waste categories generated by health-care facilities in Pakistan

Type of health-care facility	Total health-care waste generation	Infectious waste generation
Hospitals	2.07 kg/bed/day (range: 1.28–3.47)	
Clinics and dispensaries	0.075 kg/patient-day	0.06 kg/patient-day
Basic health units	0.04 kg/patient-day	0.03 kg/patient-day
Consulting clinics	0.025 kg/patient-day	0.002 kg/patient-day
Nursing homes	0.3 kg/patient-day	
Maternity homes	4.1 kg/patient-day	2.9 kg/patient-day

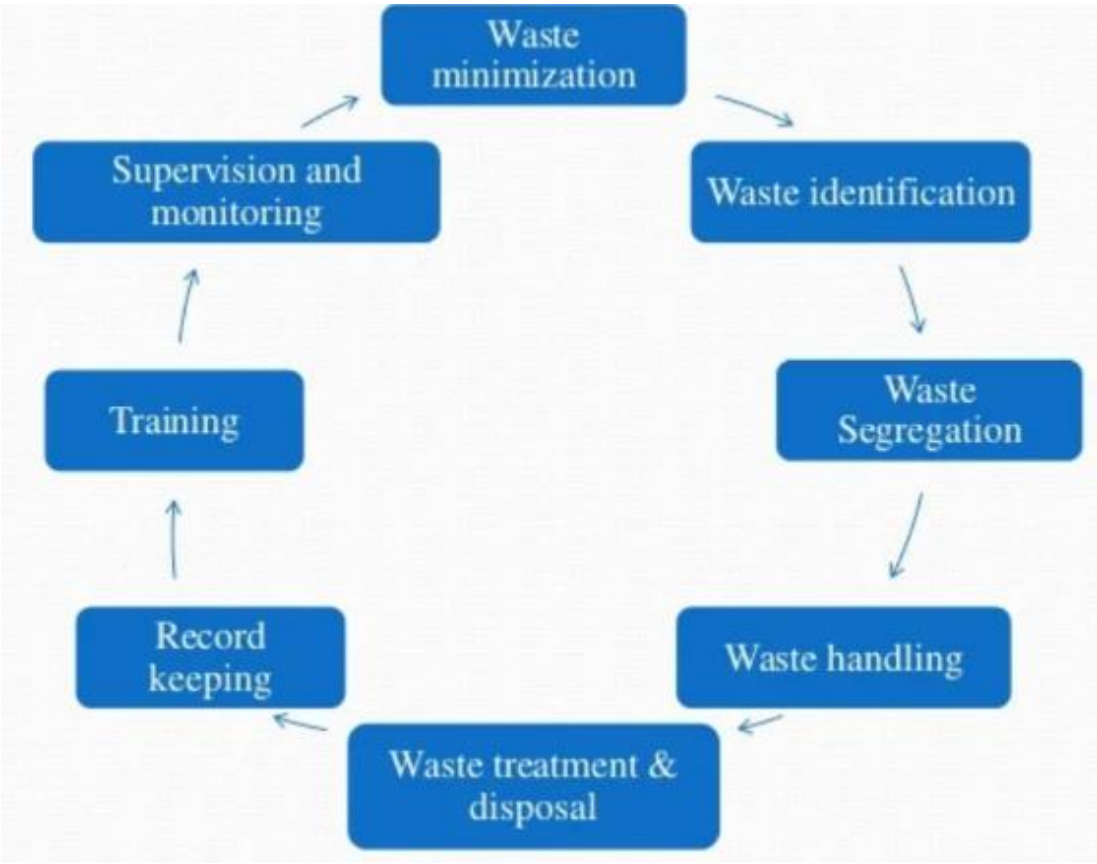
Source: https://link.springer.com/chapter/10.1007/978-3-030-96989-9_4/tables/2

Chapter 2: Segregation, Collection and Labelling of Healthcare Waste

This chapter focuses on:

- Step in healthcare waste management and plan for minimization.
- Segregation system
- Segregation within the hospital
- Waste labelling
- Waste collection
- In-site transportation
- Storage

2.1. Waste Management Cycle (WHO)



2.2. Describing plan for minimization of Healthcare waste

- Best practice waste management aims to avoid (waste prevention) or recover as much of the waste as possible in or around a health-care facility, rather than disposing of it by burning or burial
- Waste management Hierarchy is based on 3Rs, i.e.
    - Reduce (at Source)
        - Use of physical rather than chemical cleaning methods (Steam instead of chemicals)
        - Purchasing Reduction
        - Efficient Stock Management
    - Reuse
        - Reuse may involve a combination or all of the following steps: cleaning, decontamination, reconditioning, disinfection and sterilization
    - Recycle
        - From an environmental perspective, recycling is less desirable than reusing a waste item, because it frequently requires substantial energy input and transport to offsite recycling centers
- Composting
    - composting hospital food waste is also beneficial to reduce the volume of waste before disposal.
- Bio digestion
- Energy recovery

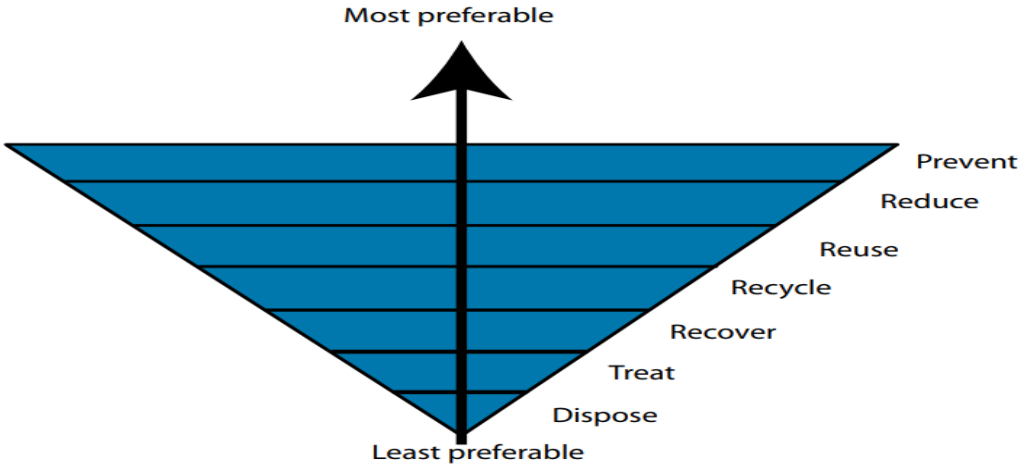


Figure. 2 Waste Management Hierarchy – WHO

(https://courses.lumenlearning.com/suny-monroe-environmentalbiology/chapter/15-2-waste-management-strategies/)

2.3. Segregation systems

- Responsibility of person who produces
- As close as possible to place of generation
- 3 Color Coded bin system
- Further types of containers can be used to other types of waste
- Uniform coding system throughout the country
- Color coding make it easier to put waste in correct container

a) Guiding Principles

General waste generated in medical area is of low risk

Blanket approach: In case of known communicable infection all waste used in and around the patient is infectious. Poorly segregated waste should never be resorted.

Corrective action is ensuring proper segregation in future.

Waste audit data can be used to indicate type, size & No of containers.

b) Technical Approach

Segregation within the hospital

Yellow bins are used for removal of infectious waste, including contaminated materials. White bins hold non-infectious general waste, which can be paper and packaging. Needles and sharp objects like surgical blades are disposed of in impervious containers or red bins.

3 Color Coded Bins at Ward Level

Sharp Container

Segregation with in the hospital- White Bin

Syringes

Human Anatomical Waste

Infusion Set

Bandage

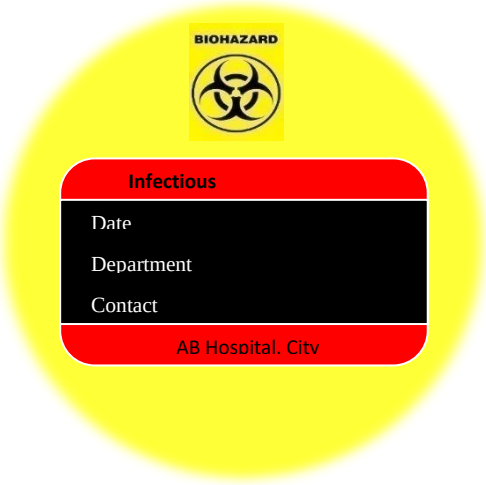
Cotton swab

Used Gloves

Yellow Bin
Infectious Waste

2.4. Waste Labeling

- A routine program for infectious waste labeling should be established as part of a healthcare waste management plan.
- Ideally, waste bags and containers should be labelled with the date, type of waste and point of generation to allow it to be tracked through to disposal. Where possible, weight should also be routinely recorded. Anomalies between departments with similar medical services or over time at one location can show up differences in recycling opportunities or problems such as poor segregation and diversion of waste for unauthorized reuse.



- Should be established as part of a healthcare waste management plan
- Recommended waste label content:
- Date
- Type of waste
- Point of generation
  (to allow tracking)
- Weight should be routinely recorded, where possible.

2.5. Waste Collection

- A routine program for infectious waste collection should be established as part of a healthcare waste management plan.
- General, non-hazardous wastes should not be collected at the same time or in the same trolley as infectious or other hazardous wastes
- Should be established as part of a healthcare waste management plan
- Waste to be collected from each area at least daily (except for sharps)
- Should ensure that containers are not overfilled
- Should ensure segregation is maintained at each stage
- Sharp waste should be collected when the box is 3/4th filled

2.5.1 Steps for Developing a Waste Collection System

- The first step towards effective waste management is identification of sources producing the waste within hospital premises. This is required both at the macro level, where the community of regulating bodies identify institutions that generate healthcare waste, and within the institutions, where the administration identifies activities and points that generate such waste. This identification helps the managers to focus their resources and efforts for effective waste management.
- Within the healthcare organization, waste may be produced in the wards, laboratories, procedure rooms, outpatient departments, offices of the medical practitioners, pharmacy, radiology department and any other place where any diagnostic, therapeutic or research activity are undertaken.
- Appropriate containers or bag holders should be placed in all locations where particular categories of waste may be generated. Collection should be daily for most wastes with collection timed to fit with the pattern of waste generation at each location. Instructions on waste segregation and identification should be posted at each waste collection point to remind staff of the procedures.
- Identify the points of generation of different types of wastes within the healthcare facility
- Quantify the amounts of wastes and calculate optimum container sizes for each area
- Evaluate how quickly the containers fill
- Set up fixed collection times so infectious waste containers are removed when 3/4th full
- set up a notification procedure for whenever waste needs to be removed

sooner

- Resupply bags or containers during removal
- Conduct continuous monitoring and improvement

2.5.2 Some Considerations When Scheduling Collection Times

- Match collection times with the regular pattern of waste generation during the day
- Examples:
  - In medical areas where the morning routine begins with the changing of dressings – collect infectious waste mid-morning to prevent accumulation of soiled bandages
  - In facilities with set visiting hours – collect general and recyclable waste after visitors have departed
  - Collect infectious waste from surgical theaters according to the schedule of operations

a) Infectious Waste Containers

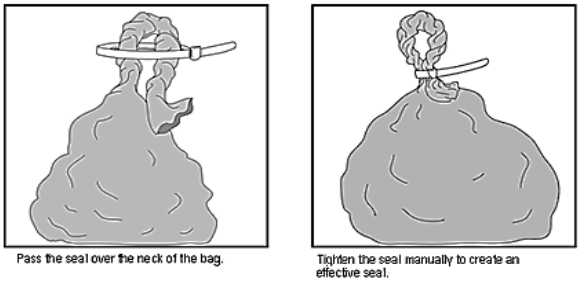
- Ideal infectious waste containers are those that have
  - Lids that remain closed except when waste is discarded
  - Pedal-operated devices to open the lids
  - Color-coded bags inside the containers

2.5.3 Infectious Waste Collection

- Where possible, waste generated on the wards should be stored in dirty utility rooms, which are designated for cleaning equipment, dirty linen, and waste. From here the waste can be collected and transported to the central storage facility. If dirty utility rooms are not available, then the waste can be stored in the wards at designated and labeled areas in the ward.
- Wastes should be transported to the designated central or interim storage area (Yellow Room)
- Waste bags and containers should be labeled with the date, type of waste, and point of generation so that it can be correctly and easily tracked through to disposal
- Do not redistribute the waste contents by shaking the bag as this could cause liquids or aerosols to be released.

a) Proper Bag Closure

- Staff should ensure that waste bags are tightly closed or sealed when they are about ¾ full
- Bags should *not be* closed by stapling (which can cause tears)
- A plastic tag or tie can be used
- Light-gauge bags can be closed by tying the neck
- Heavy-gauge bags may require a plastic sealing tag of the self-locking type.
- Examples of bag tying methods
- Simple knot
- Goose-neck or swan-neck method
- Self-locking tag



- Self-locking or twist ties: Seal tightly when using self-locking twist ties. Be careful of loose twist ties which can slide off when the bag is carried.
- Twist the open end and tie the end into one knot. (Do not tie alternate corners into knots. This will not appropriately close the bag.)
- Swan-neck method: Twist the open end and then fold it over into a “gooseneck” or swan-neck, and then seal over the neck using a twist-tie or tape.
- Source: http://www.biosch.hku.hk/clinicalwaste/clinicalwaste.html

b) Bag Removal and Replacement

- The bags or containers should be replaced immediately with new ones of the same type
- A supply of fresh collection bags or containers should be readily available at all locations where waste is produced

2.5.4 Collection of Sharps

- Safety boxes should not be more than ¾ full when closing and sealing them.
- Overfilling increases, the risk of needle-stick injuries.
- If a cardboard safety box has a broken handle, check all sides and bottom to make sure there are no protruding needles before removing the container.
- Heavy-duty gloves should be used when handling sharps containers.

2.5.5 Chemical Waste Collection

- Chemical wastes should never be mixed or disposed of down the drain but stored in strong leak-proof containers
- All chemicals should be clearly labeled

- type of waste
- name of the major chemicals
- any necessary hazard labels, e.g. corrosive, flammable, explosive, or toxic

a) Characteristics of Chemical Waste

- Characteristics of chemicals to be stored and disposed must considered
- Spillage kits, protective equipment and first aid kit need to be available
- Good lighting and ventilation must be ensured
- Separate storage zones should be available.

Some examples of Chemical Wastes are:

• explosive waste • corrosive acid waste • corrosive alkali waste (bases) • toxic waste • flammable waste	• oxidative waste • halogenated solvents (containing chlorine, bromine, iodine or fluorine) • non-halogenated solvents

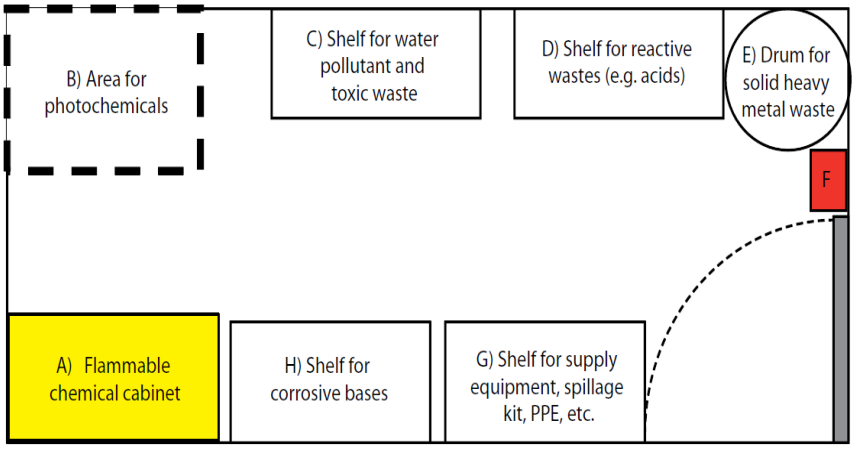
b) Transportation within the hospital

- Safe transportation to the central storage point within the health facility will be ensured by using specially designed waste collection trolley.
- The waste collectors will be provided with proper PPEs for transportation of waste.

- The waste bags will be loaded in trolley after sealing and weighing.
- The shortest route will be used for transportation of waste from wards to yellow room.
- The doors of trolley shall remain closed to ensure that no one gets exposed to the hazardous waste during its transportation.
- The trollies will be cleaned and disinfected on daily basis.

Figure 1 Transportation of Healthcare Waste within Hospital

2.5.6 Chemical Storage Room (WHO Design)



2.5.7 Pharmaceutical Waste Collection & Storage

- Unused pharmaceuticals should go back to the pharmacy for return to the manufacturers or dispatched to the vendors
- Spilled and contaminated pharmaceuticals should go directly from the point of generation to the facility waste storage area
- Pharmaceuticals should be kept in their original packaging to aid identification and prevent reaction between incompatible chemicals.

- Should be separated from other waste

Hazardous includes

- controlled drugs (should be stored under government supervision);
- disinfectants and antiseptics;
- anti-infective drugs (e.g. antibiotics);
- genotoxic drugs (genotoxic waste);
- ampoules with, for example, antibiotics.

Non-Hazardous

- ampoules with non-hazardous content.
- fluids with non-hazardous contents, such as vitamins, salts (sodium chloride)
- solids or semi-solids, such as tablets, capsules, granules, powders for injection,
- aerosol cans

2.5.8 Radioactive Waste Collection

- Where specialist disposal services exist, they should collect and handle radioactive wastes.
- Otherwise, waste may be stored in radiation-proof repositories (leak-proof, lead-lined, and clearly labeled with name of radionuclide and date of deposition) where it can decay naturally

Chapter 3: Transportation and Storage of Healthcare Waste

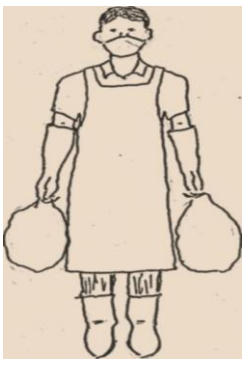
This chapter focuses on:

- Training of waste transporters
- On site Transportation
- Routing
- Health facility map with site plan for waste collection
- General requirement for storage area/yellow room
- Storage time for infectious waste
- Pathological waste storage
- Waste Yard
- Documentation record keeping

3.1 Training of healthcare Waste Transporters

- Waste transport staff should be trained on the following:
  - Relevant legal regulations, policies & guidelines
  - Risks of hazardous healthcare waste
  - Waste classifications
  - Safe handling of healthcare waste
  - Labeling and documentation
  - Emergency and spillage management procedures
  - Emergency contact numbers and details of emergency services

3.1.1 Requires the use of proper PPEs





3.1.2 Onsite transportation:

- Less busy time
- Already set and designated routes should be used.
- Transport staff wear proper PPEs
- Waste Transportation trolley: color coded and labelled with type of waste e.g.
- Infectious Waste Trolley: Yellow and Labelled “Infectious Waste”
- Municipal Waste Trolley: White and Labelled “General Waste”
- Sharps to be transported in Sharp Containers
- Chemicals and pharmaceuticals should be transported separately.

a) Onsite transport: Transport Trolley’s

- Be easy to load and unload
- No sharp edges
- Easy to clean, drainage holes
- Easy to push and pull
- Not too high
- Lockable
- Sized according to generated waste in the facility.
- Color coded
- Spare trolley should be available.

b) Cleaning Transport Equipment

- Transport equipment should be cleaned and disinfected daily with an appropriate disinfectant.

i. Example of a Cart Cleaning Station

This cart cleaning station at a hospital uses sodium hypochlorite solution for disinfection followed by rinsing with a pressure hose to clean infectious waste wheeled bins.

The station has a local exhaust vent and sewer drain. It is located next to the central storage area where infectious waste is picked up by an external transporter for treatment at an off-site autoclave treatment plan.

ii. Onsite transport: Routing

- Separate hazardous and nonhazardous routes should be planned.
- Clean to Dirty Principle
- Frequency of collection should be adjusted --- no overflowing of containers.
- Routing plan would be influenced by:
    - waste volume and number of waste bags or containers
    - waste types
    - capacity of the waste storage within medical areas and at interim storage areas
    - capacity of the transportation trolleys
    - transport distances and journey times between the collection points.

3.2 General Requirements for Storage Areas/ Yellow Room

3.2.1 The storage area Specifications:

- have an impermeable, hard-standing floor with good drainage
- be easy to clean and disinfect (a tiled floor and walls are recommended)
- have facility to keep general waste separated from infectious and other hazardous waste

- have a water supply for cleaning purposes.
- have easy access for staff in charge of handling the waste
- have a lock to prevent access by unauthorized persons
- have easy access for waste-collection vehicles
- be protected from the sun, rain or snow
- The storage area should:
- have good lighting and at least passive ventilation
- Temperature Regulation for Infectious/ Pathological Waste (2°C to 8°C)
- not be situated near fresh food stores and food preparation areas
- have a supply of cleaning equipment, protective clothing, and waste bags or containers
- have a washing basin with running tap water and soap for the staff
- be cleaned regularly at least once a week
- have a capacity appropriate to the volumes of waste generated
- be labelled in accordance with the hazardous level of the stored waste

3.2.2 Labels for Central Storage Areas/ Yellow Room

		
No entry for unauthorized persons for all storage areas	Biohazard sign for infectious and sharps waste	Toxic sign for chemical and hazardous pharmaceutical waste
		
No eating or drinking	No smoking	

3.2.3 Storage of Infectious Waste and Sharps

- The storage area should have a biohazard sign
- Regular inspection and cleanup (at least weekly) of storage areas should be part of HCWM plans (Health care waste Management)
- Workers should be trained in site spillage procedures
- Sharps can be stored without problems, but other infectious wastes must be kept cool if storage times are exceeded or refrigerated at a temperature of 2°C to 8°C if stored for more than a week.

3.2.4 Storage Times for Infectious Waste

- Storage times for infectious waste (e.g. the time gap between generation and treatment) should not exceed the following if the storage area is not cooled:

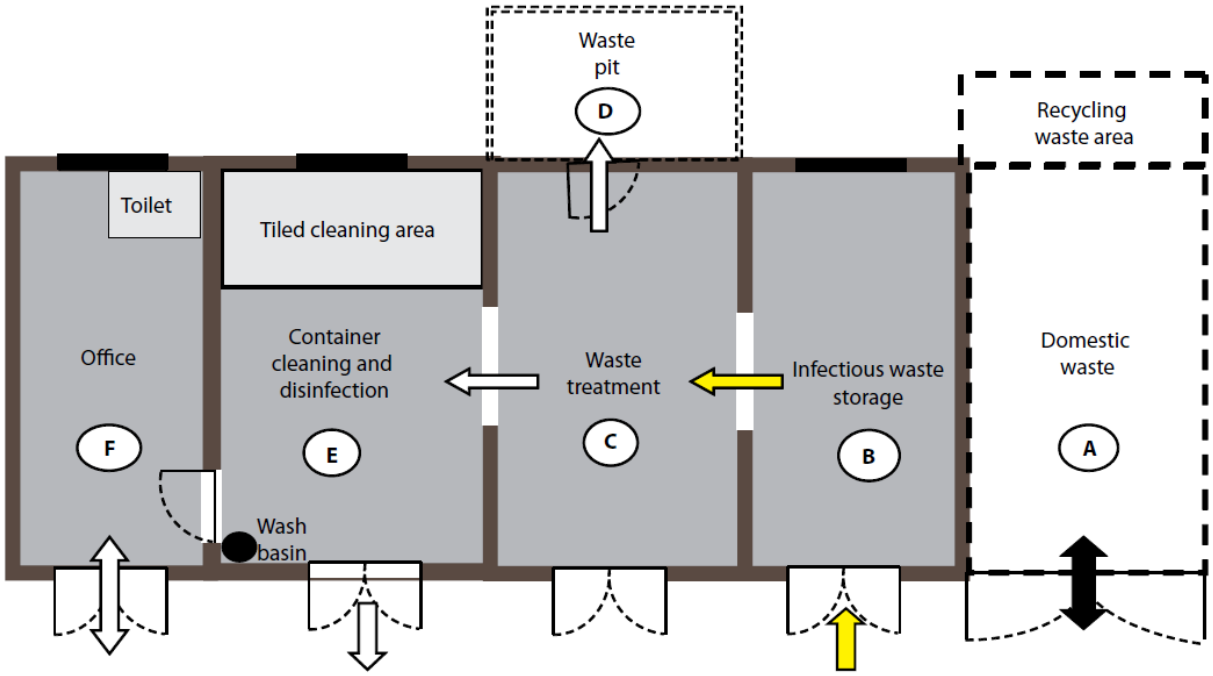
Temperate climate:	**Warm climate:**
72 hours in winter	48 hours during the cool season
48 hours in summer	24 hours during the hot season

Completely enclosed, separate and have Loading Documents

3.2.5 Pathological Wastes Storage

- Considered as biologically active waste
- Expect gas formation and pathogen growth
- Storage should be air-conditioned or refrigerated (e.g. in the morgue) and should be stored at a temperature of 2°C to 8°C
- In some cultures, body parts are given to the family for ritual procedures or are buried in designated places.

3.3 Waste Yard (WHO Model)



3.4 Examples of healthcare waste transport vehicles

Chapter 4: Cytotoxic waste management

This chapter focuses on:

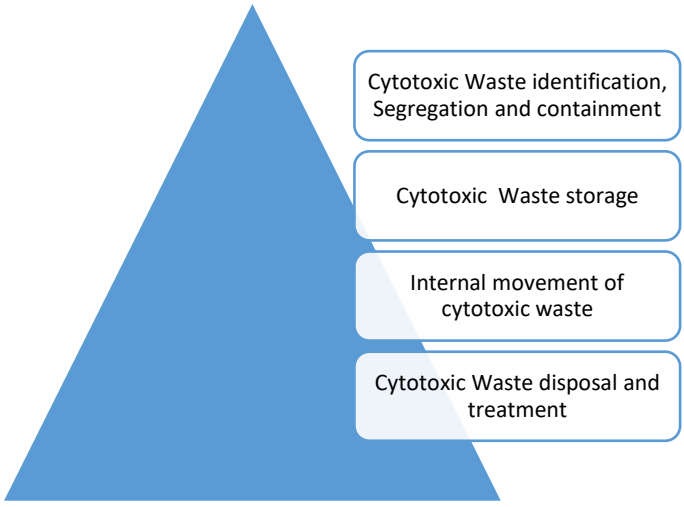
- Introduction to Cytotoxic Waste
- Process for Cytotoxic Waste Management
- Conclusion

4.1 Cytotoxic Waste

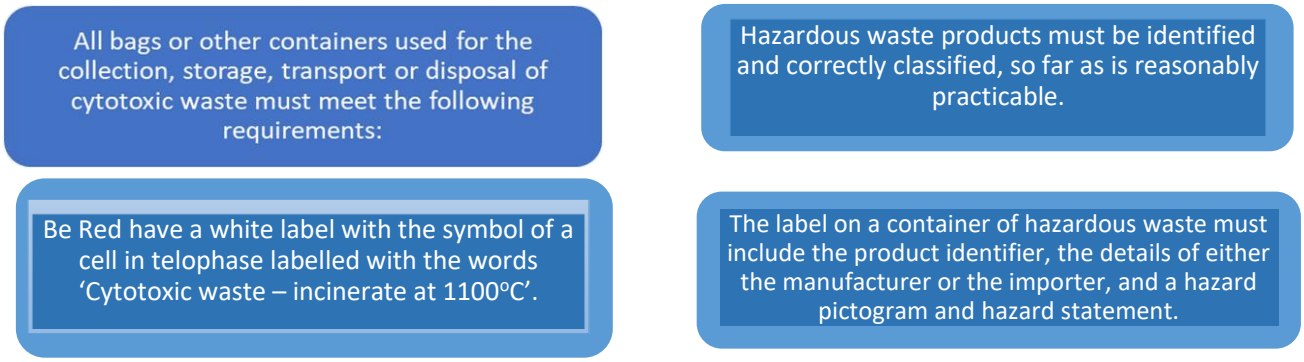
Cytotoxic waste includes any residual cytotoxic drug following patient treatment, and the materials or equipment associated with the preparation, transport or administration of cytotoxic drug therapy. Cytotoxic Waste includes.

- Cytotoxic pharmaceuticals past their recommended shelf life, unused or remaining drugs in all forms, contaminated stock, and cytotoxic drugs returned from patients
- Contaminated waste from preparation processes
- Sharps and syringes, ampoules and vials
- Intravenous infusion sets and containers
- Empty cytotoxic drug bottles

4.2 Cytotoxic Waste Management



a) Identification of Cytotoxic waste



4.2.1 Waste segregation

- Cytotoxic waste must be segregated from any other waste streams such as pharmaceutical or chemical waste.
- Control measures should be implemented to ensure segregation of cytotoxic waste at the point of generation
- During internal transport and storage, in consultation with workers, cytotoxic waste segregations must be ensured
- Personnel involved in support services should be properly oriented on segregation of cytotoxic waste
- Incorporation of efficient waste disposal methods into patient care procedures
- Appropriate signage at all collection and storage areas must be ensured .

Color	Description
Red	For Cytotoxic Wastes
Yellow	For Infectious Wastes
Sharp containers	For Needles, Vials
White	General wastes

4.2.2 Internal movement/ Transportation of cytotoxic waste

- Do not overfill cytotoxic waste containers
- Locate cytotoxic waste collection bins as close as practicable to the site of generation and to transport corridors
- Use dedicated, rigid-walled, puncture-resistant containers such as wheelie bins, handcarts and trolleys to move cytotoxic waste around the facility

- Schedule frequent waste collection rounds. Movement should be planned to avoid peak activity times (e.g. visiting hours, mealtimes and changes of shift)
- Avoid movement of cytotoxic waste through public areas or general staff thoroughfares
- Develop a cytotoxic spill management plan for spills occurring during transport

4.2.3 Cytotoxic Waste storage

- Cytotoxic waste must be stored in a designated area for storing waste that is not accessible to
- Un-authorized persons.
- All stored cytotoxic waste must not cause environmental nuisance.
- Ways to eliminate environmental nuisance generation include:
- Sealing or securing cytotoxic waste bins prior to waste collection and not re-opening on-site once they have been secured
- Using a storage area with adequate lighting and ventilation
- Locating the storage area away from storm water drains and other sensitive areas
- Designing the storage area for ease of cleaning, decontamination and maintenance of hygiene Standard.

4.2.4 Waste disposal and treatment Incineration

- Currently, incineration is the only acceptable technology for treating cytotoxic waste.
- If the waste consists of a mixture of cytotoxic and other waste it should be incinerated at the temperature recommended for cytotoxic waste which is 1100^{o}C.

Chapter 5: Liquid waste management

This chapter focuses on:

- What are the risks from health-care wastewater?
- Hazardous and non-hazardous liquid health-care wastes?
- When is it possible to discharge liquid health-care waste into a sewerage system and when is it not advisable?
- How should liquid health-care waste be handled in the absence of a sewerage system?
- How should a sewerage system be designed?
- What are primary, secondary and tertiary wastewater treatments?
- What are new developments in the treatment of liquid health-care waste?

5.1 Characteristics and Estimation of Healthcare Liquid Waste

a) Estimation (WHO)

- small–medium-sized hospitals: 300–500 Liters per inpatient per day
- large health-care settings: 400–700 Liters per inpatient per day
- university hospitals: 500–>900 Liters per inpatient per day.

b) Characteristics

- organic particles (feces, hairs, food, vomit, paper, fibers)
- Soluble organic material (urea, proteins, pharmaceuticals)
- inorganic particles (sand, grit, metal particles)
- soluble inorganic material (ammonia, cyanide)

5.2 Healthcare Wastewater

- Health-care wastewater is any water that has been adversely affected in quality during the provision of health-care services.

a) Blackwater

- (sewage) is heavily polluted wastewater that contains high concentrations of fecal matter and urine.

b) Greywater

- (sullage) contains more dilute residues from washing, bathing, laboratory processes, laundry and technical processes

c) Storm water

d) Rain Fall

5.3 Health Hazards

A proportion of the generated wastewater from health-care facilities will pose a higher risk than domestic wastewater. Depending on the service level and tasks of the health-care facility

a) Wastewater Related Diseases

- Campylocacteriolosis, Cholera, Hep A & Hep E, Schistosomiasis, Typhoid

b) Liquid Chemicals

- Anesthetics, disinfectants, chemicals from laboratory activities, developer and fixer solutions from photographic film processing, and iodinated X-ray contrast media, Glutaraldehyde, Formaldehyde, Dental amalgam

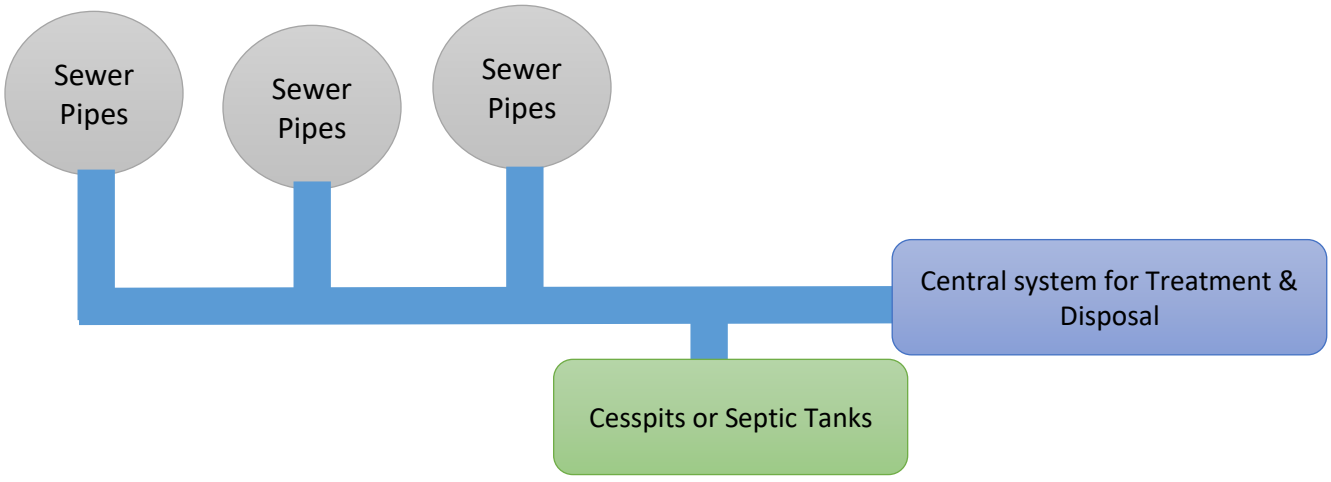
c) Pharmaceuticals in wastewater

- Antibiotics and other drugs

d) Radioactive substances

5.4 Collection and Pre-Treatment

- A decentralized collection and treatment system is not the preferred method approach for healthcare facilities, however can be adapted where no main sewerage system exists



5.4.1 Pre Treatment

Pre Treatment could include:

- Acid base neutralization
- Filtering to remove sediments
- Autoclaving
- Non-hazardous chemicals such as syrups, vitamins or eye drops can be discharged in the main sewer system without pre-treatment.
- A grease trap can be installed to remove grease, oil and other floating materials from kitchen wastewater and then can be discharged to the sewer without pretreatment. The trap and collected grease should be removed every 2–4 weeks.
- Body fluids, small quantities of blood and rinsing liquids from theatres and intensive care can be discharged in the sewer without pre-treatment.
- Note that 5% sodium hypochlorite (NaOCl – bleach) is not effective for disinfecting liquids with a high organic content such as blood and stools
- Lime milk (calcium oxide) can be used to destroy microorganisms in liquid wastes with high organic content requiring disinfection (e.g. stool or vomit during a cholera outbreak). In these cases, faeces and vomit should be mixed with the lime milk in a ratio of 1:2, with a minimum contact time of six hours. Urine can be mixed 1:1, with a minimum contact time of two hours.
- Wastewater from the dental department should be pretreated by installing an amalgam separator in sinks.
- Radioactive wastewater from radiotherapy (e.g. urine of patients undergoing thyroid treatment) should be collected separately and stored in a secured place until the levels of radioactivity have decreased to background concentrations. After the required storage time, the wastewater can be disposed of into a sewer.

5.4.2 Discharging Waste Water

Discharging wastewater generated from a health-care facility into the municipal sewage system, after adequate pretreatment is a preferred method if the municipal sewage-treatment plant fulfils the local regulatory requirements.

5.4.3 Onsite wastewater treatment

This could include physical, chemical and biological processes to remove contaminants from the raw sewage. The objective is to produce a treated effluent that is suitable for reuse or discharge back into the environment, usually surface watercourses.

a) Primary treatment: (prevent damage or clogging)

- The first stage is the removal of solids that are separated by sedimentation

b) Secondary treatment:

- Dissolved biological matter is progressively converted into a solid mass using indigenous waterborne bacteria.

c) Tertiary treatment (effluent polishing)

- Further treated to remove suspended solids, phosphates or other chemical contaminants, or maybe disinfected.

d) Disinfection of wastewater (tertiary treatment)

- Chlorination of residual organic material may generate chlorinated organic compounds that may be carcinogenic and harmful to the environment. Therefore, disinfection by chlorine is only recommended if it can be ensured that the organic matter is below 10 mg/l.
- Ozone (O3) is another option that can oxidize most organic material.
- The effectiveness of disinfection depends heavily on
    - Turbidity, pH, the type of disinfectant (concentration and time). Short contact times, low doses, high organic contents and high flows all reduce effective disinfection.
- Common methods and agents for disinfection include
    - NaOCl, chlorine dioxide (**ClO2)**.
    - Ultraviolet (UV) light
    - **Ozone** (O3): *less susceptible to changes in pH, and it can destroy specific chemical contaminants (such as some pharmaceuticals) in the wastewater.*

5.4.4 Disposal of Sludge

- Onsite treatment of hospital sewage will produce a sludge that contains high concentrations of helminths and other pathogens
- should be treated before disposal. The most common treatment options include
    - anaerobic digestion

- aerobic digestion and
- composting.

- For composting, sludge is mixed with a carbon source such as sawdust, straw or wood chips. In the presence of oxygen, bacteria digest the sludge and the carbon source, and create heat that will pasteurize the sludge.

5.4.5 Reuse of wastewater and sludge

- Generally, not recommended with standard wastewater-treatment plants,
- Reuse for agricultural purposes, (per Gram Solids)
  - Less than one helminth egg
  - Less than 1000 fecal coliforms

5.5 Monitoring of wastewater systems

- Losses of 10–30% of the wastewater due to broken sewer pipes, non-watertight access holes and leakages at pipe connections are common
- The inflow of wastewater and the outflowing treated effluent should be tested regularly to monitor how efficiently the treatment plant reduces the concentration of contaminants.
- The most common parameters for monitoring the effluent quality are:

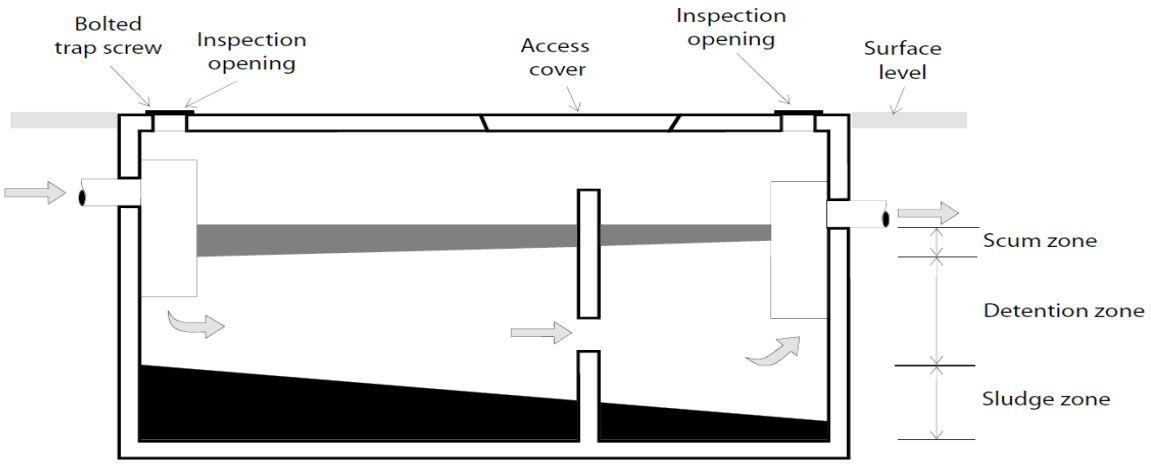
  - temperature;
  - pH;
  - BOD5
  - chemical oxygen demand;
  - nitrate;
  - total phosphorus;
  - total suspended solids;
  - presence and concentration of *Escherichia coli*

5.6 Wastewater Management

5.6.1 Septic Tanks

- The minimum treatment method for wastewater is the septic tank,
- separation of solid and liquid components of wastewater
- digestion of organic matter in an anaerobic environment.
- A septic tank also takes on the functions of storing solids and allowing clarified liquid to outflow for further treatment or discharge.

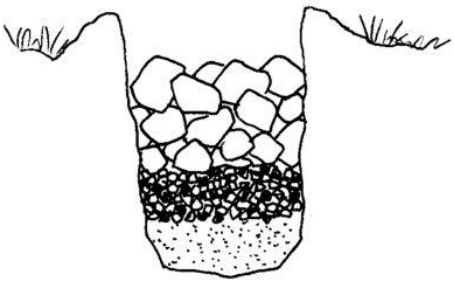
- The capacity of the septic tank – 2 days



***Sample Septic Tank*, Source: South Australian Health Commission (1995)**

5.6.2 Soakaway pits

- Effluents from the treatment plant are collected and allowed to infiltrate into the ground.
- The pit may be filled with stones, broken bricks or similar material or may be lined with open-jointed masonry.
- The top 0.5 m of the pit should be lined solidly, to provide firm support for a reinforced concrete cover.
- Planting trees adjacent to or over a soakaway pit can improve liquid removal through transpiration and increased soil permeability.



5.7 Important considerations

- Body fluids, contents of suction systems from non-infectious patients from OT should be discharged via the drain by staff wearing PPEs
- Stool, vomit and mucus from highly infectious patients
  - thermally treated
  - Lime milk (calcium oxide) can be used during emergencies for disinfection
- Blood
  - can be emptied into a septic or sewerage system (PPEs)
  - disposal at a controlled land-disposal site,
  - treatment in a high-temperature incinerator (1100 °C) / autoclave

- If no other disposal option is available, expired blood bags unopened into a protected pit.

- Solid health-care waste, especially solid hazardous waste (pharmaceuticals, chemicals), should not be mixed into wastewater.
- Liquid laboratory hazardous waste (colorants, formalin)
  - Adsorbent (e.g. sawdust) > solid mass > rendered immobile or encapsulated.

- Chlorine-based disinfectant
  - concentration of <0.5% active
  - disposed directly in a soakaway pit.
  - should not be disposed of in a septic tank, because it will harm the biodegradation process.

- Liquid pharmaceuticals in vials (but not cytotoxic materials) can be crushed in a closed bucket, mixed with sawdust, and the solid mass incinerated or encapsulated.
- Glutaraldehyde > neutralized by Glycine > soakaway pit

Chapter 6: Occupational health & Safety (Healthcare waste management)

This Chapter Focuses on:

- How hazardous is healthcare waste
- Who is at risk
- What are the hazards
- What is the procedure that should be set up to reduce the risk of accidents.
- What equipment and supplies are needed to protect workers.
- How can exposure be prevented or limited
- What education is needed for those who are at risk.

Workers represent half the world's population and are the major contributors to economic and social development. All workers have the right to a safe and healthy environment at work.

6.1 Aim

- promotion and maintenance of the highest degree of physical, mental and social well-being of workers
- the prevention amongst workers of departures from health caused by their working conditions
- the protection of workers in their employment from risks resulting from factors adverse to health
- the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities.

6.2 Management Role

- Identify Hazards and infection risks they encounter, prevention and control of exposure
- Continuous monitoring of worker's health and safety
- Ensure correct handling, treatment storage and disposal procedures are being followed.
- Standardized Rules and Procedures for Healthcare waste.
- Inform and train (to perform duties properly and safely)
- Involve them in identification of hazards and recommendation in prevention and control
- Provide proper PPE
- Establish an occupational health program.

6.3 Role of the workers

- Take care of your own health and safety
- Make correct use of machinery tools etc
- Make correct use of PPE
- Immediately inform the concerned /supervisor for any health related hazard.

6.4 Role of IPC

- Primary health screening of all staff, by questionnaire, medical examination and review of vaccinations

- Keeping up to date staff health record
- Regular training of all staff in IPC, sharp management, hand hygiene, personal hygiene, exposure to blood and body fluid
- Administering immunization to all staff
- Contact listing
- Sharp injury record keeping.

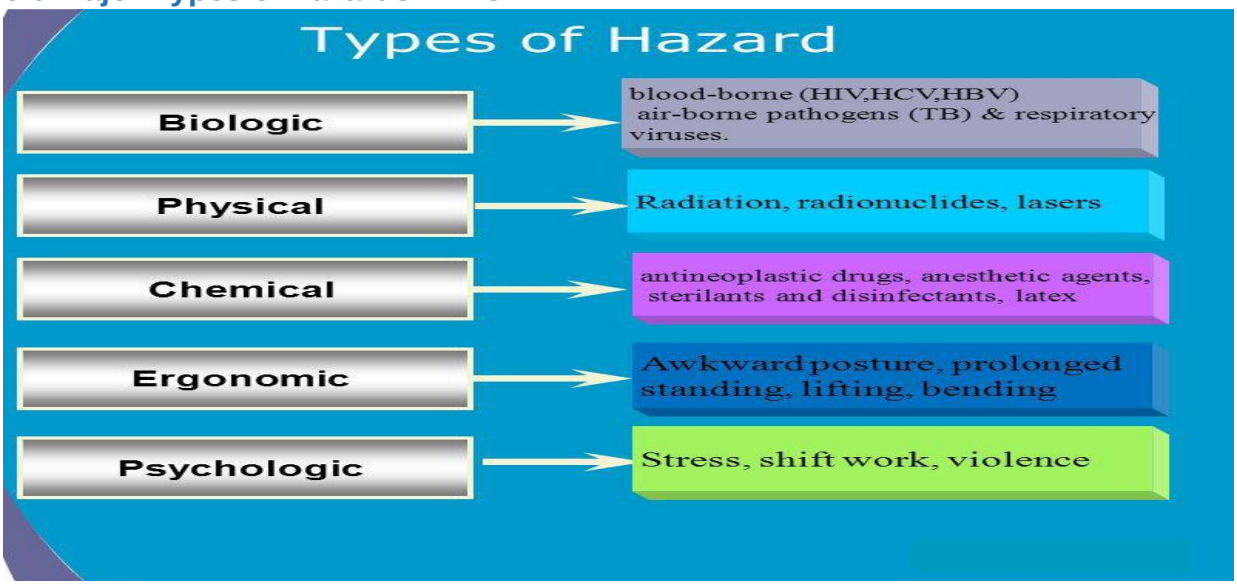
6.5 Who is at risk

- Health care providers
- Hospital cleaners/ janitors
- Maintenance workers, operator of waste treatment equipment
- All personnel involved in waste handling and disposal

Risk can be minimized through

- Training (knowledge and understanding of associated risk, rules and procedures)
- Emergency response: training, availability of necessary equipment, written procedures for different type of emergencies drawn up. (spill infectious, chemical)
- One person should be designated responsible for handling emergencies, coordination of actions, reporting to managers and regulators liaising with emergency services.

6.6 Major Types of hazards in HCWM



6.6.1 Physical hazards

- Noise
- Projectiles
- Heating devices
- Moving machinery accidents
- Slipping

6.6.2 Cytotoxic hazards

- Cytotoxic drugs -antineoplastic drugs, aerosolized medications, anesthetic gases)
- Anesthetic gases
- surface disinfectants
- Laundry disinfectants
- Equipment disinfectants -phenolic, quaternary ammonium compounds, bleach, ethylene oxide, glutaraldehyde
- Inhalational exposure
- Dermal exposure
- Mucosal exposure

6.6.3 Bio-hazards

- Human blood and blood products. This includes items that have been affected by blood and other body fluids or tissues that contain visible blood.
- Animal waste
- Human body fluids
- Microbiological wastes
- Pathological waste.
- Sharps waste

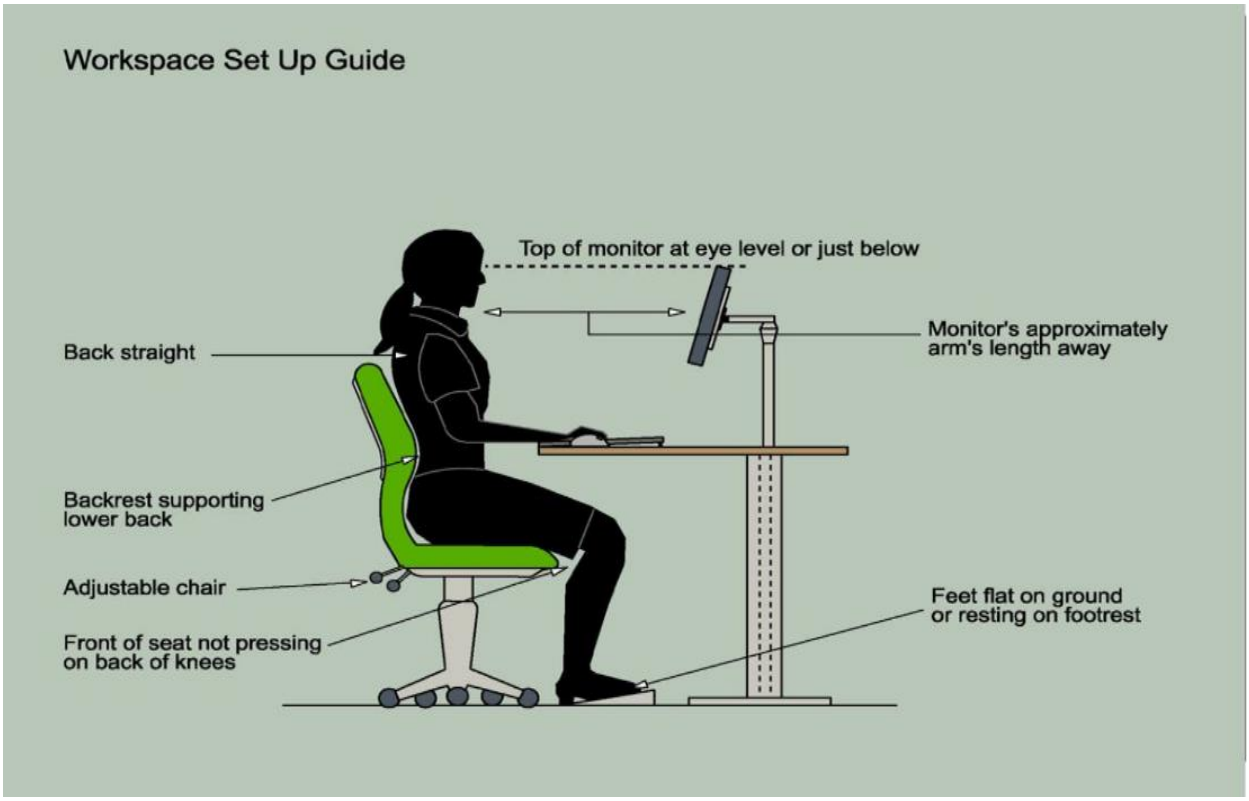
6.6.4 Activities with potential risk of infection

- Clinical examination of humans
- Taking specimens of blood, body fluids or other clinical specimens e. g. smears
- Surgical procedures

- Dressing/treatment of wounds
- Care of patients incapable of looking after themselves
- Attending humans or animals at risk from others or themselves
- Working with animals.

6.6.5 Ergonomic Hazards

Hospital employees are exposed to injuries such as muscle and ligament strain and tears, joint and tendon inflammation, pinched nerves, herniated discs and other injuries from ergonomic stressors during handling, transferring, and repositioning of patients.



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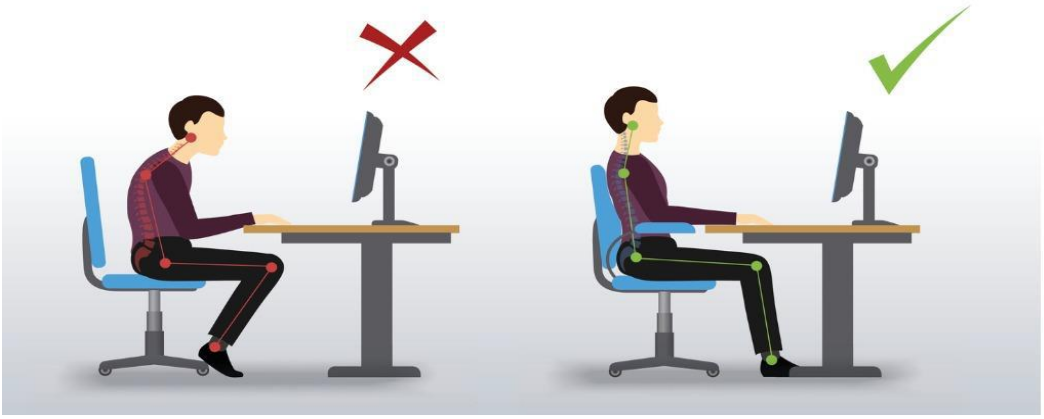


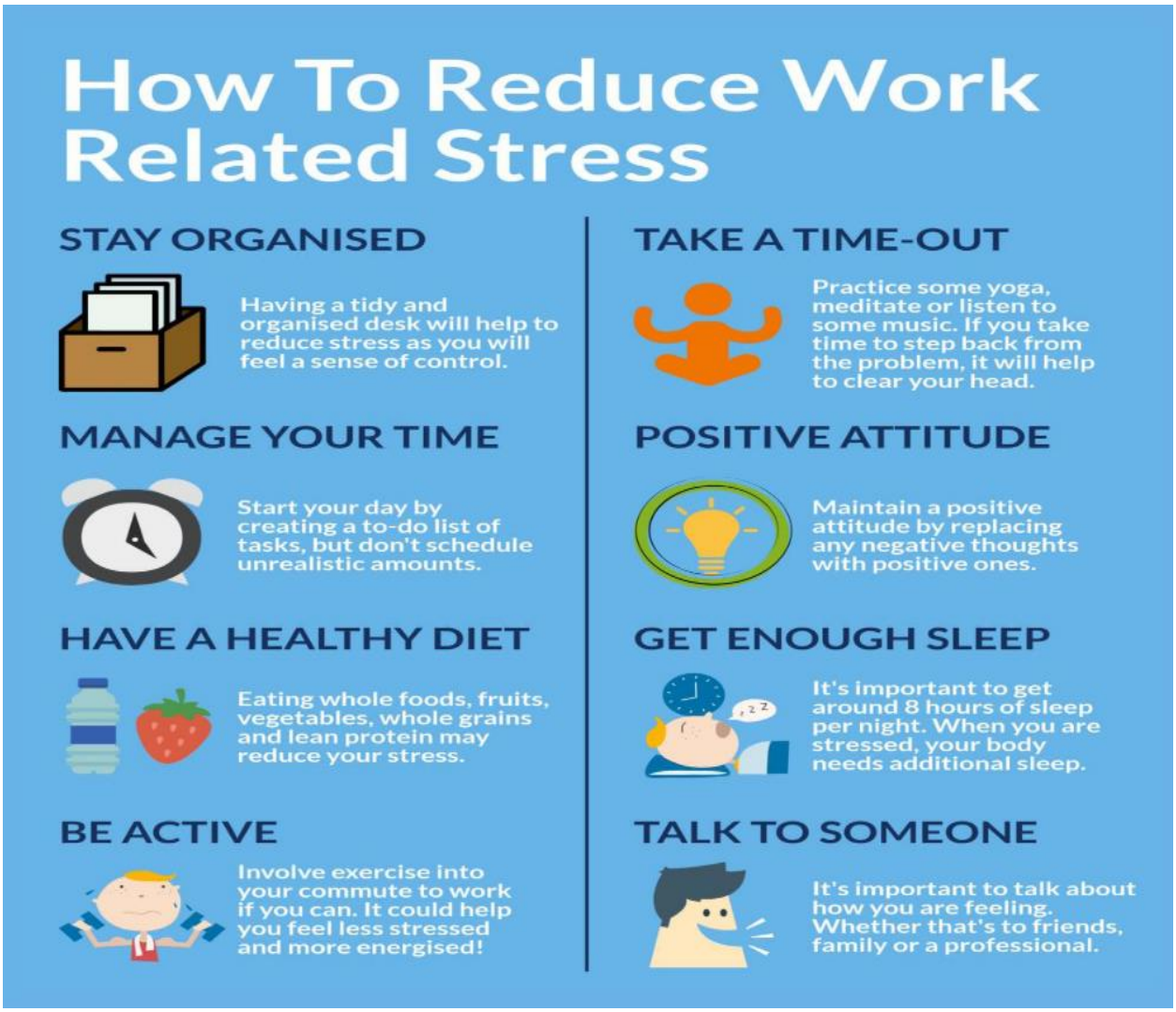
6.6.6 Psychological hazards

high work overload, poor interpersonal relationships, assault by patients' relatives and job dissatisfaction as the psychosocial hazards experienced by health care workers.

a) Stress...

- (the situation is ‘stressful’)
- (I feel ‘stressed’)
- (this is what happens to me when I’m under ‘stress’).

- Stress can be taken to mean an intensive, unpleasant state of tension in a heavily aversive, threatening, subjectively long-lasting situation whose avoidance is subjectively crucial.
- The (stress) conditions mentioned to date not only relate to ‘major’, rare events, but primarily also to smaller, everyday inconveniences.

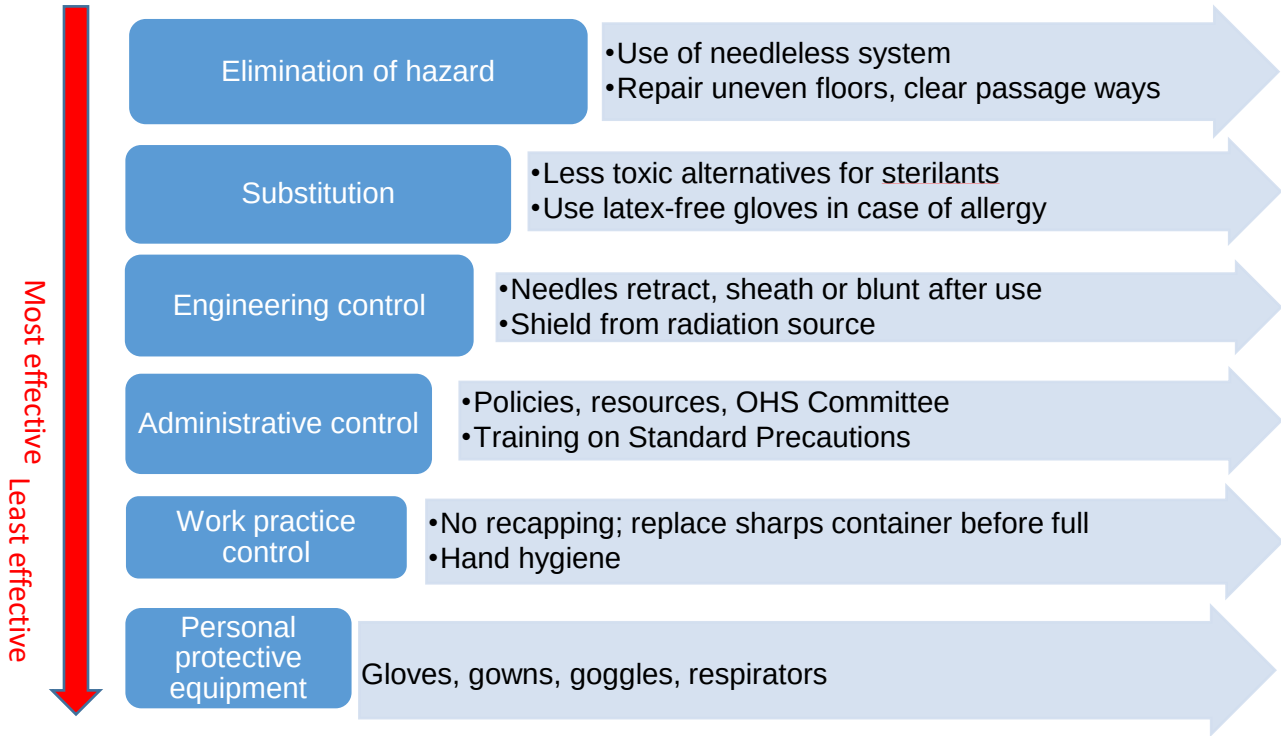


6.7 Hazards to Health Care Waste Workers

Hazards	Health effects	Control measures
Sharps injuries and resulting exposure to bloodborne pathogens	Infections with hepatitis B or C, HIV, malaria or other bloodborne infections (Prüss-Ustün, Rapiti & Hutin, 2005)	Immunization against hepatitis B virus (WHO, 2009a) Appropriate disposal of sharps at site of use into a puncture-resistant container without recapping (Hutin et al., 2003; WHO, 2010)Use of engineered needles that automatically retract, blunt resheath, or disable the sharp (CDC, 1997; Lamontagne et al., 2007)
Other biological hazards	SARS (WHO, 2007a, 2009b) Tuberculosis, Influenza	Exhaust ventilation (natural or mechanical (WHO, 2009c, 2009d)Standard precautions (WHO, 2007b)Respiratory protection with N95, FFP3 respirators for high-risk cough-inducing procedures (Jefferson et al., 2008; WHO, 2009c)Autoclaving laboratory waste in the laboratory before disposal (Weber, Boudreau & Mortimer, 1998)
Chemicals Chlorine disinfectants (sodium hypochlorite)	Skin and respiratory sensitization (International Programme on Chemical Safety, 1999; Zock et al., 2007) Eye and skin irritation, weakness, exhaustion, drowsiness, dizziness, numbness and nausea	Substitute soap and water for cleaning chemicals Avoid soaking of sharps in chlorine when they will receive autoclaving or incineration before disposal Dilute chemicals appropriately according to manufacturer for less toxic exposure (Zock, Vizcaya & Le Moual, 2010)
High-level disinfectant glutaraldehyde	Irritation of the eyes, nose and throat Skin sensitization Occupational asthma where the symptoms in affected individuals include chest tightness and difficulty in breathing (Mirabelli et al., 2007)	Substitute steam sterilization except for pressure sensitive instruments (Harrison, 2000; Pechter et al., 2005) Ensure appropriate dilution and use in closed, ventilated system
Sterilants: ethylene oxide (International Programme in Chemical Safety, 2003)	Eye and skin irritation, difficulty breathing, nausea, vomiting, and neurological problems such as headache and dizziness Reproductive hazard, linked to nerve and genetic damage, spontaneous abortion and muscle weakness Carcinogen (IARC, 1999)	Substitute steam sterilization for ethylene oxide except for pressure-sensitive instruments (EPA, 2002) Use only in a closed and ventilated system

Heavy lifting Handling heavy loads over long periods	Back injuries and musculoskeletal disorders (Schneider & Irastorza, 2010) Degenerative diseases of the lumbar spine	Reduce mass of objects or number of loads carried per day (Nelson, 2003) Use waste carts with wheels, automated waste transfer from cart to truck and treatment Use lifts and pulleys to assist in transferring loads
Ionizing radiation	Irreversible damage of cells, anaemia, leukaemia, lung cancer from inhalation (Niu, Deboodt & Zeeb, 2010)	Safe waste management, in full compliance with all relevant regulations, must be considered and planned for at the early stages of any projects involving radioactive material should be established from the outset that the waste can be properly handled, treated and ultimately disposed off. See International Atomic Energy Agency for national regulatory standards and safety guidance (IAEA, 1995)

6.8 Hierarchy of controls



6.8.1 Exposure Prevention and Control

- Needle Stick Injury Prevention
- **Spill Management**

- Require cleanup of the area contaminated.
- Type of infectious agent.
- Most hazardous spillage occurs in labs rather than in medical care departments.
- Procedure require safe handling and proper PPE
- Exposed person should be immediately removed for decontamination.
- Special attention should be paid to eyes and open wounds.

- **Reporting accidents and incidents**

- Should be trained in emergency response and reporting.
- The causes should be investigated, and recurrence should be prevented.

- **PPE:**

- The type of PPE depends upon the extent of risk associated with healthcare waste.
- Industrial boots and heavy-duty gloves are particularly important

- **Occupational Post Exposure Prophylaxis**

- PEP – HIV
- Immunization --- Hep B

6.8.2 Work Restrictions post-exposure / infection

- Work restrictions may be imposed on HCW following an exposure or infections
- Restrictions may range from re-assignment from taking care of high risk patients or
- Complete work restriction depending on the type of exposure or communicable infection.

b) Guidelines of personnel restriction because of infectious illnesses or special conditions

i. Well-defined policies which govern;

- personnel responsibility in reporting illness
- when to make work restrictions
- when to return to work after clearance of an illness that required work restriction.

ii. Identify the persons with authority to restrict the HCW from work or

patient contact.

iii. ***3. Develop policies that encourage personnel to report their illnesses or exposures and that do not penalize them with loss of wages, benefits, or job status.***

iv. ***4. Educate and encourage personnel who have signs and symptoms of a transmissible infectious disease to report their condition promptly to their supervisor and occupational health.***

v. ***5. Provide appropriate education for personnel on the importance of good hygienic practices, especially handwashing and covering the nose and mouth when coughing and sneezing.***

6.9 Suggested work restrictions for health care personnel exposed to or infected with infectious diseases of importance in health care settings

Disease	Work restriction	Duration
Conjunctivitis	Restrict from patient contact and contact with the patient's environment	Until discharge ceases
Cytomegalovirus infections	No restrictions	
Diarrheal diseases ▪ Acute stage (diarrhea with other symptoms) ▪ Convalescent stage, Salmonella spp.	Restrict from patient contact, contact with the patient's environment, or food handling Restrict from care of high-risk patients	Until symptoms resolve Until symptoms resolve
Diphtheria	Exclude from duty	Until antimicrobial therapy completed and 2 cultures obtained ≥ 24 hours apart are negative
Enteroviral infections	Restrict from care of infants, neonates, and immunocompromised patients and their environments	Until symptoms resolve
Hepatitis A	Restrict from patient contact, contact with patient's environment, and food handling	Until 7 days after onset of jaundice

Hepatitis B ▪ Personnel with acute or chronic HBs Ag +ve who do not perform exposure-prone procedures ▪ Personnel with acute or chronic Hbe Ag +ve who perform exposure-prone procedures	No restriction Do not perform exposure-prone invasive procedures until counsel from an expert review panel has been sought; panel should review and recommend procedures the worker can perform, taking into account specific procedure as well as skill and technique of worker	Until HBe Ag is -ve
Hepatitis C	No recommendation (unresolved issue)	
Herpes simplex Genital Hands (herpetic whitlow) Orofacial	No restriction Restrict from patient contact and contact with the patient's environment Evaluate for need to restrict from care of high-risk patients	Until lesions heal
Human immunodeficiency virus	Do not perform exposure-prone invasive procedures until counsel from an expert review panel has been sought; panel should review and recommend procedures the worker can perform, taking into account specific procedure as well as skill and technique of the worker; standard precautions should always be observed	
Measles ▪ Active ▪ Post exposure (susceptible personnel)	Exclude from duty Exclude from duty	Until 7 days after the rash appears From 5th day after 1st exposure through 21st day after last exposure and/or 4 days after rash appears
Meningococcal infections	Exclude from duty	Until 24 hours after start of effective therapy
Pediculosis	Restrict from patient contact	Until treated and observed to be free of adult and immature lice
Mumps ▪ Active ▪ Post exposure (susceptible personnel)	Exclude from duty Exclude from duty	Until 9 days after onset of parotitis From 12th day after 1st exposure through 26th day after last exposure or until 9 days after onset of parotitis

Pertussis ▪ Active ▪ Post exposure (asymptomatic personnel) ▪ Post exposure (symptomatic personnel)	Exclude from duty No restriction, prophylaxis recommended Exclude from duty	From beginning of catarrhal stage through 3rd wk after onset of paroxysms or until 5 days after start of effective antimicrobial therapy Until 5 days after start of effective antimicrobial therapy
Rubella ▪ Active ▪ Post exposure (susceptible personnel	Exclude from duty Exclude from duty	Until 5 days after rash appears. From 7th day after 1st exposure through 21st day after last exposure.
Scabies	Restrict from patient contact	Until cleared by medical evaluation
Tuberculosis ▪ active disease ▪ PPD converter	Exclude from duty No restriction	Until completion of a minimum of 14 days of 4 drug therapy with clinical & bacteriological improvement
Varicella ▪ Active ▪ Post exposure (susceptible personnel)	Exclude from duty Exclude from duty	Until all lesions dry and crust From 10th day after 1st exposure through 21st day (28th day if VZIG given) after last exposure
Tuberculosis ▪ active disease ▪ PPD converter	Exclude from duty No restriction	Until completion of a minimum of 14 days of 4 drug therapy with clinical & bacteriological improvement
Zoster ▪ Localized, in healthy person ▪ Generalized or localized in immunosuppressed person ▪ Post exposure (Susceptible personnel)	Cover lesions; restrict from care of high-risk patients Restrict from patient contact Restrict from patient contact	Until all lesions dry and crust Until all lesions dry and crust From 10th day after 1st exposure through 21st day (28th day if VZIG given) after last exposure or, if varicella occurs, until all lesions dry and crust

Viral respiratory infections, acute febrile	Consider excluding from the care of high risk patients or contact with their environment during community outbreak of RSV and influenza	Until acute symptoms resolve
Streptococcal infection group A	Restrict from patient care, contact with patient's environment, or food handling	Until 24 hours after adequate treatment started

6.10 Education and Training

- Healthcare waste workers should be trained before starting work.
- Refresher training on routine basis.
- May Include:

- Awareness about potential hazards
- Purpose of immunization
- Waste handling procedure.
- Reporting of exposure and injuries
- Preventing infections following exposure with PEP and the use of PPE

6.11 Minimum approaches to health and safety practices

- Implementation of standardized management procedures.
- Hepatitis B vaccination
- Provision of sharps boxes where injections are taking place.
- implementation of standard precautions, such as no recapping of needles after use.
- Promotion of proper hand hygiene.
- Availability, as a minimum, of gloves to provide personal protection from patients' body fluids.
- Allocation of an additional role (waste management supervisor) to assume responsibility for promoting better worker safety.

6.12 Desirable Improvements to the Minimum Approach

- Implementation of safer needle devices.

- Establishment of health and safety discussions among staff or committees in the local workplace.
- Establishment of surveillance systems and use of data to prevent further injuries.
- A system for post-exposure prophylaxis.
- Occupational health services formally established at a health-care facility.

Chapter 7: Treatment Methods of Healthcare Waste

This chapter focuses on:

- Selection of treatment methods
- Waste treatment technologies & Final Disposal of waste

7.1 Selection of Treatment Method

- The nature of the waste, regulatory requirements and availability of resources guide the selection of treatment methods for healthcare waste.
- Methods used include incineration of hazardous and infectious wastes that kill pathogens but should be well managed to reduce emissions.
- Autoclaving is done on medical instruments as well as some kinds of waste so that they can be safely disposed of.
- With regards to liquid waste, a chemical disinfection process is applied.
- Alternatively, burial into depth may be the way out where there is no such modern facility like sharps or other dangerous material are involved.
- These measures are put in place to protect public health, safeguard the environment and ensure adherence to national and international standards.

- Selection of Treatment Method depends on;
    - Waste characteristics
    - Technology capabilities and requirements
    - Environmental and safety factors
    - Cost

7.2 Factors to consider

- waste characteristics - quantity of wastes for treatment and disposal - capability of the health-care facility to handle the quantity of waste - types of waste for treatment and disposal	- skills needed for operating the technology - environmental and safety factors - environmental releases - location and surroundings of the treatment site and disposal facility - occupational health and safety considerations

- technology capabilities and requirements - local availability of treatment options and technologies - capacity of the system - treatment efficiency - volume and mass reduction - installation requirements - available space for equipment - infrastructure requirements - operation and maintenance requirements	- public acceptability - options available for final disposal - regulatory requirements - cost considerations, equipment purchase cost - shipping fees and customs duties - installation and commissioning costs - annual operating costs, - cost of transport and disposal of treated waste - decommissioning costs.

7.3 Selection of waste treatment methods

Treatment/Disposal Options	Non-plastic Infectious Waste	Anatomical Waste	Sharps Waste	Pharmaceutical Waste	Chemical Waste
Waste Burial	Yes[1]	Yes[1]	Yes[1]	Small quantities	Small quantities
Sharp pit	No	No	Yes[1]	Small quantities	No
Placenta pit	No	Yes1	No	No	No
Encapsulation	No	No	Yes	Yes	Small quantities
Inertization	No	No	No	Yes	No
Low temp burning (< 800°C)	Yes (interim solution)	Yes (interim solution)	No	No	No
Med temp burning (800 – 1000°C)	Yes	Yes	Yes	No	No
High temp burning (> 1000C°)	Yes	Yes	Yes	Small quantities	Small quantities
Steam autoclave	Yes	No	Yes	No	No
Microwave	Yes	No	Yes	No	No
Chemical	Yes	No	Yes	No	No
Discharge to Sewer	No	No	No	Only non-hazardous	Small quantities
Others				Return expired drugs to supplier	Return unused chemicals to supplier

Note: [1] Waste should be disinfected first
Source: Management of Solid Health-care Waste at Primary Health-Care Centers (WHO, 2005)

7.4 Waste Treatment Technologies

- Thermal processes
- Chemical processes
- Irradiation technologies
- Biological processes
- Mechanical processes

7.4.1 Thermal Process

- Rely on heat to destroy pathogens
- Low Heat and High Heat Designs
- Low-heat thermal processes are those that use thermal energy at elevated temperatures high enough to destroy microorganisms but not sufficient to cause combustion or pyrolysis of the waste.
- In general, low-heat thermal technologies operate between 100 °C and 180 °C.
- Moist (or wet) thermal treatment involves the use of steam to disinfect waste and is commonly performed in an autoclave or steam-based treatment system.

7.4.2 Steam Treatment Technologies

- Autoclaves are capable of treating a range of infectious waste, including cultures and stocks, sharps, materials contaminated with blood and limited amounts of fluids, isolation and surgery waste, laboratory waste (excluding chemical waste) and “soft” waste (including gauze, bandages, drapes, gowns and bedding) from patient care.

- Gravity-displacement autoclaves
- Pre-vacuum or high-vacuum autoclaves
- Pressure pulse autoclaves.

7.4.3 Integrated steam-based treatment systems

- A second generation of steam-based systems has been developed for the purpose of improving the transfer of heat into the waste
- Achieving more uniform heating of the waste
- Rendering the waste unrecognizable
- Making the treatment system a continuous (rather than a batch) process.
- These systems have sometimes been referred to as advanced autoclaves, hybrid autoclaves or advanced steam treatment technologies.

7.4.4 Microwave Treatment Technologies

- Microwave technology is essentially a steam-based process where treatment occurs through the action of moist heat and steam generated by microwave energy.

- A typical semi continuous microwave system consists of an automatic charging system, hopper, shredder, conveyor screw, steam generator, microwave generators, discharge screw, secondary shredder and controls.
- The equipment includes hydraulics, HEPA filter and microprocessor-based controls protected in an all-weather steel enclosure.
- Waste bags are introduced into the hopper.
- To prevent release of airborne pathogens, air is extracted through a HEPA filter as the waste bags are loaded.
- After the hopper lid is closed, waste goes through a shredder.

7.4.5 Medical Waste Autoclave with Shredder Steam Sterilizer Description:

- Medical Autoclave with Shredder is the cost-effective medical waste treatment technology. Unlike incinerators, Autoclave for Waste Disposal technology does not produce any harmful emissions of combustion air pollutants.
- Structure and Characteristics

a) Pressure chamber

- The chamber is vertical pressure vessel with jacket, good for pre-heating, drying and continuous operation.
- Feeding port is on the top of the machine with electric sliding door sealed with gasket. Discharging port is on the bottom with motor driving, lever type promotion and demotion unloading gate which is teflon painted.
- Unloading gate is equipped with PTC heater to ensure sterilized waste dry and germ free. Wheeled cart is for transferring of finished waste.

b) Double axel shredding system

- It is equipped with a single motor reducer, by a pair of gear wheel to drive a pair of knife axles to run simultaneously to shred.

c) Water supply & vacuum system

- Water supply system is composed with pump, level controller, angle valve, non-return valve etc. User connects water to pump, the system start working automatically.
- Vacuum system is composed with vacuum pump, water separator, non-return valve, vacuum valve and water pipe

7.4.6 Chemical Treatment Technologies

- Now being extended to the treatment of health-care waste
- Treating liquid waste such as blood, urine, stools or hospital sewage.
- limitations:
  - Shredding or milling of waste is usually necessary before disinfection.
  - Powerful disinfectants are required, which can be hazardous
  - Adequately protected personnel.
  - Disinfection efficiency depends on the operational conditions within treatment equipment.
  - Only the surface of intact solid waste items will be disinfected.

7.4.7 Alkaline hydrolysis

- Alkaline hydrolysis or alkaline digestion is a process that converts animal carcasses, human body parts and tissues into a decontaminated aqueous solution.
- The alkali also destroys fixatives in tissues and various hazardous chemicals, including formaldehyde, glutaraldehyde and chemotherapeutic agents.
- The technology uses a steam-jacketed, stainless-steel tank and a basket.
    - After the waste is loaded in the basket and into the hermetically sealed tank, alkali in amounts proportional to the quantity of tissue in the tank is added, along with water.
    - The contents are heated to between 110 °C and 127 °C or higher, and stirred.
    - Depending on the amount of alkali and temperature used, digestion times range from six to eight hours.

7.4.8 Incineration

Incineration is a high-temperature, dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter and results in a significant reduction of waste volume and weight.

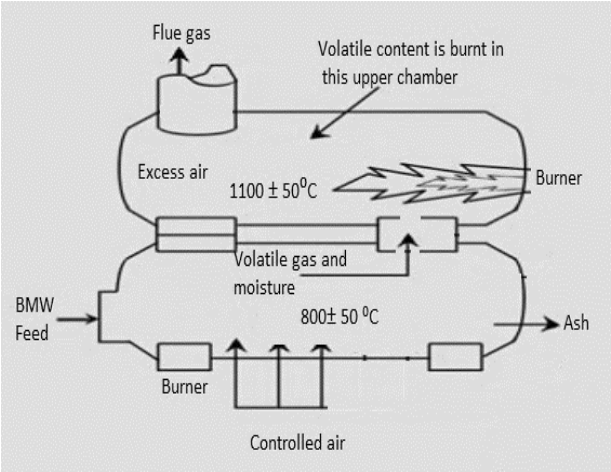
High-heat thermal processes take place at temperatures from about 200 °C to more than 1000 °C.

They involve the chemical and physical breakdown of organic material through the processes of combustion, pyrolysis or gasification.

	Pyrolysis	Gasification	Incineration
Reaction temperature (°C)	250–700	500–1600	800–1450
Pressure (bar)	1	1–45	1

a) Considerations in Incineration

- heating value > 2000 kcal/kg
- content of combustible matter > 60%;
- content of non-combustible solids < 5%;
- moisture content < 30%.



b) Types of Incinerators

Type	Use
Dual-chamber starved-air incinerators	designed to burn infectious health-care waste
Multiple chamber incinerators	used for pathological waste
Rotary kilns	capable of reaching temperatures that break down genotoxic substances and heat-resistant chemicals

7.4.9 Encapsulation

- Involves filling containers with waste, adding an immobilizing material, and sealing the containers.
- The process uses either cubic boxes made of high-density polyethylene or metallic drums, which are three quarters filled with sharps or chemical or pharmaceutical residues.

- The containers or boxes are then filled up with a medium such as plastic foam, bituminous sand, cement mortar, or clay material.

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- The containers or boxes are then filled up with a medium such as plastic foam, bituminous sand, cement mortar, or clay material.
- After the medium has dried, the containers are sealed and placed into landfill sites.

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7.4.10 Inertization

- The process of inertization involves mixing waste with cement and other substances before disposal to minimize the risk of toxic substances contained in the waste migrating into surface water or groundwater
- 65% pharmaceutical waste
- 15% lime
- 15% cement
- 5% water.
- Disposal:
- The inertized waste, now in a stable and less hazardous form, can be safely disposed of in a landfill or other designated disposal sites.
- The solidified mass minimizes the potential for toxic substances to migrate into the environment, thereby protecting surrounding ecosystems and water sources.

7.4.11 Anatomical waste, pathological waste

- The treatment of anatomical, pathological, placenta and fetal remains wastes may be bound by sociocultural, religious and aesthetic norms and practices.
- Two traditional options have been:

- interment (burial) in cemeteries or special burial sites
- burning in crematoria or specially designed incinerators.

- A more recent option is alkaline digestion, especially for contaminated tissues and animal carcasses.

- ***7.4.12 Final disposal of Non-Hazardous waste through municipality***
- Engage Early: Coordination with the local municipality will be established by the Facility in-charge for efficient disposal of municipal waste.

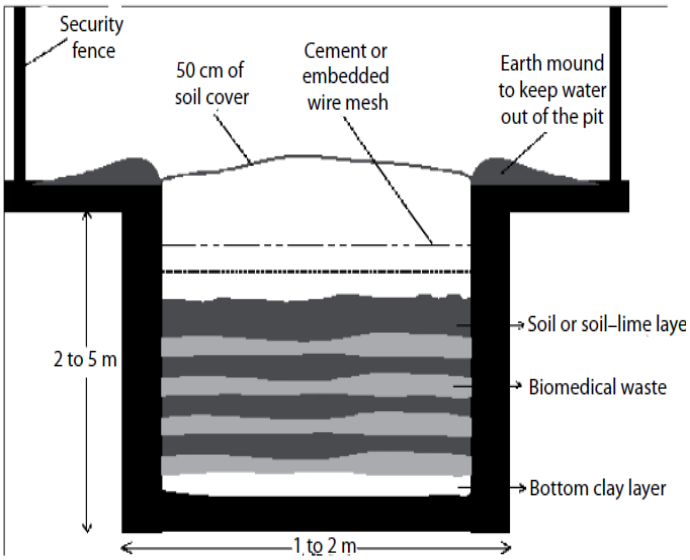
- Develop Agreements: Formalize agreements (MoU) that outline the roles and responsibilities of both the facility and the municipality in the waste management process. The MoU to address following:
  - Identification & Designation of Waste Collection Points: Municipality to identify spots and place Large Waste Collection Bins in/near vicinity of Health Facility for disposal of municipal waste from hospital
  - Establish a Disposal Schedule: Coordination with municipal services to set up a regular collection and disposal schedule that aligns with the facility's waste generation patterns (at least once daily).

- Monitoring Plan: Monitoring plan will be implemented to regularly check the efficiency and effectiveness of the waste collection and disposal process. This could involve routine inspections, documentation of waste disposal activities, and regular reviews of the MoU's implementation.

- Future Coordination: ongoing communication will be maintained with the municipality to address any emerging issues or changes in waste generation. Periodic meetings could be held to update the MoU as needed, ensuring that the waste management system remains responsive and effective.

Treated Solid Hazardous waste including sharps will be dumped in Burial pits

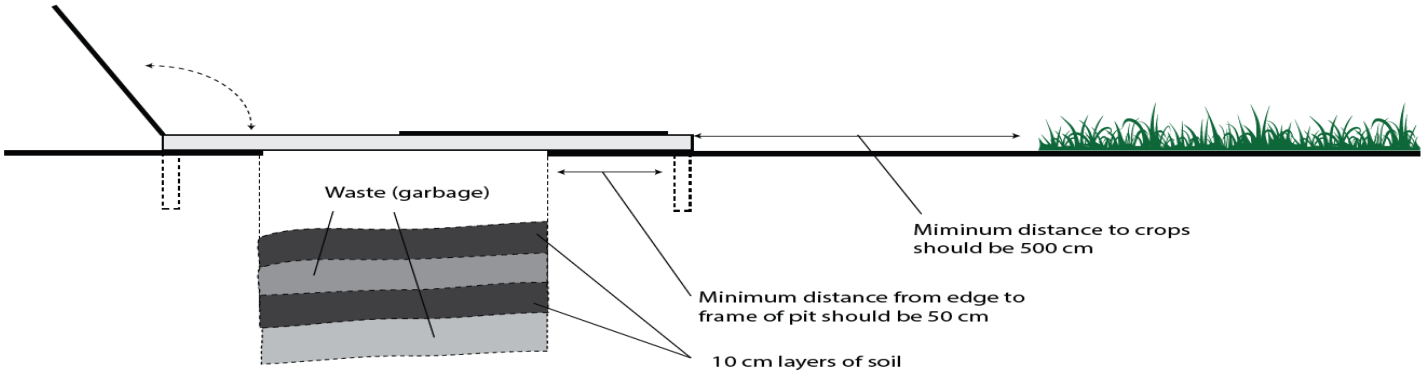
7.5 Burial Pit

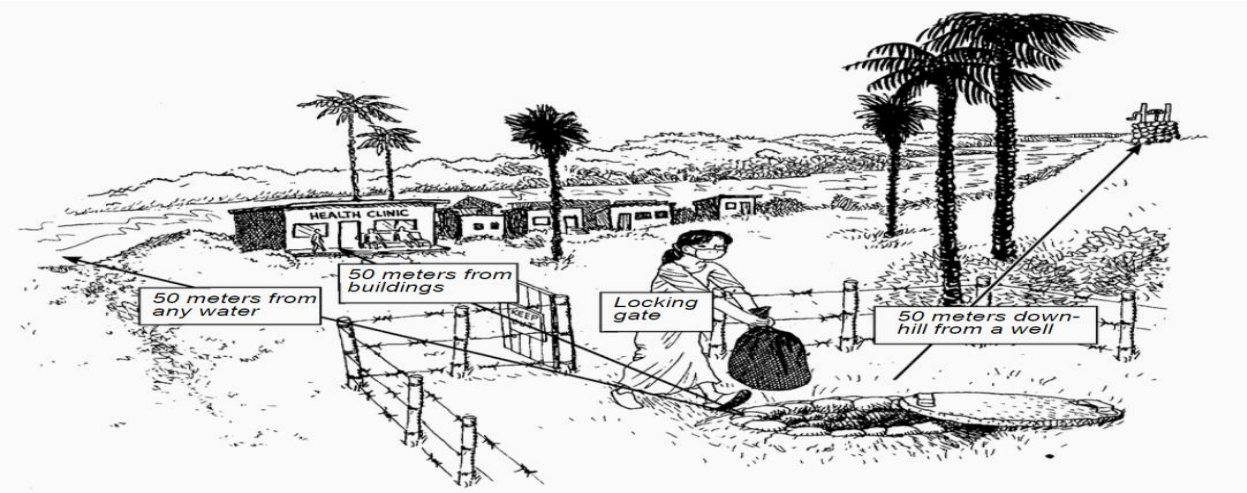


7.5.1 Burial Pit characteristics

Dig a pit 1 to 2 meters wide and 2 to 5 meters deep. The bottom of the pit should be at least 1½ meters above the highest level of groundwater (water table).

1. Dig a pit 1 to 2 meters wide and 2 to 5 meters deep. The bottom of the pit should be at least 1½ meters above the highest level of groundwater (water table). 2. Line the bottom of the pit with a layer of clay at least 30 cm thick. 3. Build up a ridge of earth around the top of the pit to prevent surface water from running in. 4. Build a fence around the area where the pit is located to keep children safe and animals out.	5. Each time waste is put in the pit, cover the waste with 10 cm of soil, or a mix of soil and lime. Lime helps disinfect the waste and will also keep animals away. 6. When the pit is within about 50 cm of the ground surface, cover the waste with soil and permanently seal it with cement and embedded wire mesh





Use the 50 meter rule when you dig a pit to bury wastes.

Chapter 8: Healthcare Waste Management Plan

This Chapter Focuses on:

- Waste Management Plan & Its importance
- Present situation (waste-management practices, personnel and equipment involved)
- Assessment of Health Facility Waste
- Possibilities for waste minimization, reuse and recycling; waste segregation; onsite handling, transport and storage practices
- Identification and evaluation of waste-treatment and disposal options (onsite and offsite)
- Identification and evaluation of the options for record keeping and documentation, training and monitoring
- Constitution & Notification of Waste Management Team with defined Roles and Responsibilities for Health Facility

8.1 Waste Management Plan & Its importance

- Planning for HCWM at the facility level should take into consideration the World Health Organization (WHO) core principles for achieving safe and sustainable management of healthcare waste
- The right investment of resources will result in a substantive reduction of disease and corresponding savings in health expenditures.

8.1.1 Effectiveness of healthcare waste management

a) The effective management of health care waste depends on:

– good administration and organization

– adequate legislation and financing

– active participation by trained and informed staff

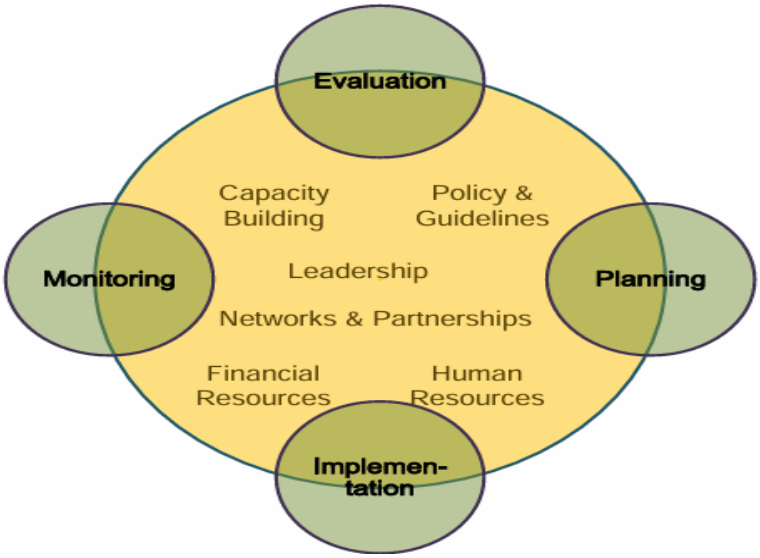
– Monitoring and continuous improvement

b) The end result is to:

– decrease the burden of disease

– reduce the pollution associated with healthcare waste and its attendant effects on healthcare workers and the community

8.1.2 Planning is an Evolving and Adaptive process



8.2 Development of waste management plan

Waste management plan should address the following issues:

• Existing situation (waste management practices, personnel and equipment involved)

• Quantities of waste generated

• Possibilities for waste minimization, reuse, and recycling

• On-site handling, transport, and storage practices

• Training for personnel involved

• Estimation of costs relating to actual situation and proposed options

8.3 Conduct a waste assessment

- A baseline provides information on the initial condition of the facility to:
  - – Determine what best practices and techniques should be introduced
  - – Develop and monitor performance indicators
  - – Be used as the initial reference point
  - – Be used as a starting point for future assessments
  - – Be used as a basis for future evaluations
  - – Collect written and photographic documentation

– Decide what technologies should be used

– Decide what waste storage and treatment capacity is needed

Table 5.1 Sample sheet for assessing waste generation

Name of the health-care facility: ..... Week:															
Waste-collection point: department/ location	Waste category[a] (specify)	Quantity of waste generated per day (weight and volume)													
		Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday	
		kg	litre	kg	litre	kg	litre	kg	litre	kg	litre	kg	litre	kg	litre

a Infectious waste, pathological waste, sharps, pharmaceutical waste, cytotoxic waste, waste with high heavy metal content, radioactive waste
Source: adapted from Christen (1996)

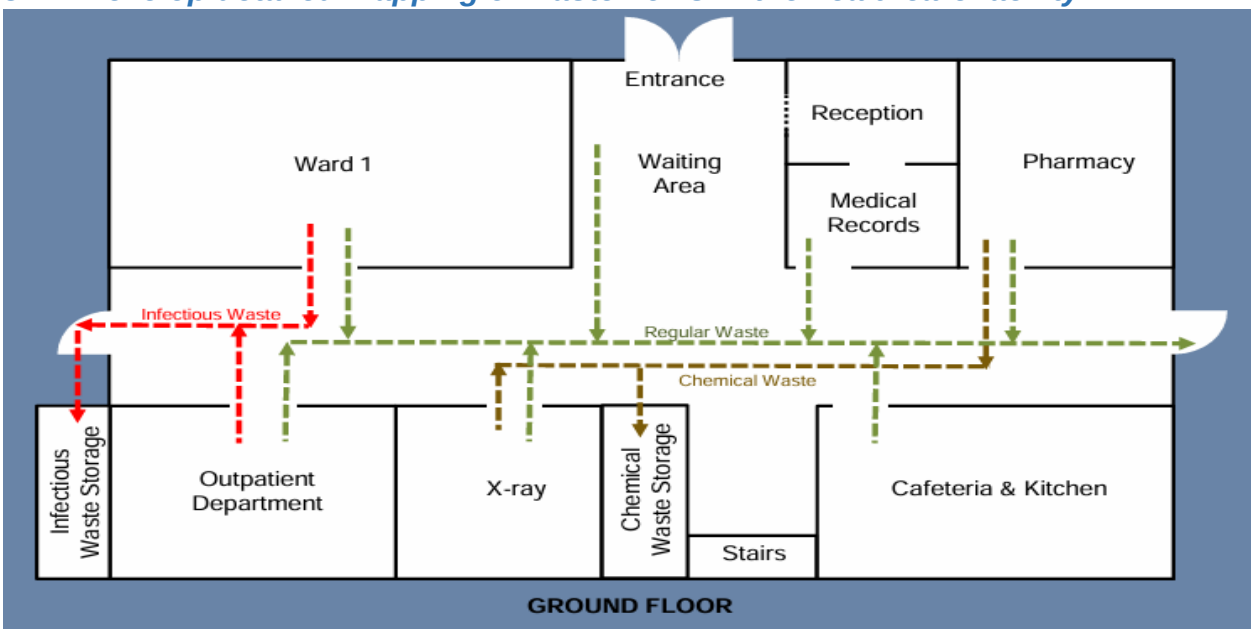
8.4 Waste-management plan

8.4.1 Location and organization of collection and storage facilities

- Drawings of the establishment showing designated bag or disposal container for every ward and department in the hospital
- Drawings showing the central storage site for health-care waste and the separate site for other waste. Details of the type of containers, security equipment, and arrangements for washing and disinfecting waste-collection trolleys (or other transport devices) should be specified. The document should also address eventual needs for refrigerated storage facilities.
- Drawings showing the paths of waste-collection trolleys through the hospital, with clearly marked individual collection routes.
- A collection timetable for each trolley route, the type of waste to be collected, and

the number of wards and departments to be visited on one round.
The central storage point in the facility for that particular waste should be identified.

8.4.2 Develop detailed mapping of waste flows in the healthcare facility



8.4.3 Design specifications

- Drawings showing the type of bag holder to be used in departments.
- Drawings showing the type of trolley or wheeled container to be used for bag collection.
- Drawings of sharps containers, with their specification.

8.4.4 Required material and human resources

- An estimate of the number and cost of bag holders and collection trolleys.
- An estimate of the number of sharps containers and health-care waste drum containers required annually, categorized into different sizes, if appropriate.
- An estimate of the number and cost of color-coded bags or bins to be used annually.
- An estimate of the number of personnel required for waste collection.

8.4.5 Responsibilities

- Definitions of responsibilities, duties and codes of practice for each of the different categories of personnel of the hospital who, through their daily work, will

generate waste and be involved in the segregation, storage and handling of the waste.

- A definition of the responsibilities of hospital attendants and ancillary staff in collecting and handling wastes, for each ward and department; where special practices are required (e.g. for radioactive waste or hazardous chemical waste), the stage at which attendants or ancillary staff become involved in waste handling shall be clearly defined.

8.4.6 Procedures and practices

- Simple diagram (flowchart) showing procedure for waste segregation.
- The procedures for segregation, storage and handling of wastes requiring special arrangements, such as autoclaving.
- Outline of monitoring procedures for waste categories and their destination.
- Contingency plans, containing instructions on storage or evacuation of health-care waste in case of breakdown of the treatment unit or during closure for planned maintenance.
- Emergency procedures.

8.4.7 Training

- Description of the training courses and programs to be set up and the personnel who should participate in each.

8.4.8 Parameters to be Monitored by the Waste Management Officer

- Waste generated each month by waste category in each department
- Maintenance of the treatment technology
- Stock Monitoring of inventory/ commodities required for HCWM
- Waste handled safely and in accordance with the safety operation procedures:
- Occupational safety (e.g. use of PPE)
- Proper segregation at source
- Availability and use of bags, containers, bins and other equipment
- Marking, labeling and signage
- Internal transport and storage
- Treatment and disposal

8.4.9 Occupational safety and public health aspects:

- Incidents resulting in injury, “near misses”, or failures in the handling, separation, storage, transport, or disposal system
- these should be reported to the Infection Control Officer and the Waste Management Officer and will be the basis for measures to prevent recurrences.

8.4.10 Reporting

a) Once the HCWM system is put in place:

- The Waste Management Team reviews the HCWM Plan annually and initiates changes necessary to upgrade the system
- The Waste Management Officer prepares an annual report approved by the head of the hospital and submits the report to the government

Hospital Waste Reporting Proforma (HWRP-01)

	Name of the hospital/health facility				Date	
	Address				Reporting month/year	
	Contact Person				Designation/Section	
	Contact (Mobile/Phone				Email	
	Total No of Beds				Wastewater Treatment (Yes/No)	
Days	**Infectious Waste (kg)**	**Non-Infectious Waste (kg)**	**Waste Incinerated (kg)**	**Radiological Waste (kg)**	**Total Waste (kg)**	**Sharps (kg)**
1						
2						
3						
4						
5						
6						
7						
8						
9						

10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
	Note: (1) Hospital Waste Reporting Proforma must be dully typed and should not be handwritten. (2) Proforma must be dully signed and officially stamped by the administrative in charge. (3) Report should be delivered within the first three days of each month to EPA, Khyber Pakhtunkhwa					
	Signature of Administrative In charge					
	Name of Administrative In charge					
	Contact					
	Email					
	Official Stamp					

8.5 Constitution & Notification of Waste Management Team with defined Roles and Responsibilities at Health Facility

S/No	Responsible person	Role	Responsibilities
1	Administrative In charge	Chairman	•Constitute hospital waste management team •Execute waste management plan after being approved by the hospital waste management committee.

			•Facilitate meetings of the hospital waste management team and ensure the implementation of its decisions •Designate the waste management/Environmental officer • Supervise implementation, monitoring and review of the waste management plan. • Arrange for a waste audit of the hospital by this agency or an external agency/Firm as may be designated for the purposes, involving analysis for the existing waste stream and assessment of existing waste management practices. •Allocate sufficient financial and manpower resources to ensure efficient implementation of the waste management • Ensure adequate training and refresher courses for the concerned hospital staff. • Make provision within the premises for safe storage of segregated waste as per protocols and ensure to avoid secondary handling or pilferage by animals or any others. • Make arrangements for Pre-Treatment, Disinfection if required as per protocols. • Make appropriate arrangements for disposal of municipal waste for which formal agreement with local Government authorities is required. • Ensure safety of staff involved in handling the hospital waste which may include immunization, Regular medical check-ups and provision of

			Personal protection equipment (PPE) etc. •Maintenance of record including the hospital waste management register and documentation of accidents/injuries, if any; • Submission of monthly and annual report to the agency on the Hospital Waste Reporting Proforma (HWRP) • Maintain the record of all incineration, Disinfection, Autoclaving etc. for at least 5 years at the hospital.
2	Chief pharmacist	Member	• The Chief Pharmacist shall be responsible for the sound management of pharmaceutical stores and pharmaceutical wastes as per standard guidelines. • Give Advice regarding formulation of appropriate procedures for management of pharmaceutical waste and coordinate implementation of these with hospital administration, waste management officer/Environmental officer, Nursing superintendent, etc. • Ensure that the concerned hospital staff members receive adequate training in pharmaceutical waste management procedures. • Ensure safe utilization of Genotoxic products and safe disposal of Genotoxic waste.
3	Head of all departments of the hospital	Members	•Ensure that all doctors, nurses, clinical staff in their respective departments, are aware of, and where required, properly training in waste management procedures. •Disseminate all waste related

			procedures and policies in their departments. • Ensure proper reporting on Hospital waste mechanism as per requirement of Hospital administration. • Liaise with the waste management officer/Environmental officer for effective monitoring and reporting of omissions and errors in implementation of the waste management plan; •Arrange a quarterly session for training and refresher courses on safe waste management procedures and management of any accident or spillage, etc. in their respective departments.
4	Head of Sanitation staff	Member	
5	Hospital Engineer	Member	• Installation, maintenance and safe operation of waste storage facilities, waste handling equipment and advise the administrative incharge on identification of appropriate sites for waste storage, and installation of the necessary equipment, e.g incinerator (Dual chambered incinerator with wet or dry scrubber), Autoclave, shredder, microwave, etc. • Ensuring that the concerned hospital staff members are properly trained for these purposes.
6	Infection Control Officer (to be notified by the hospital)	Member	•Giving advice regarding the control of infection and the standards of the waste disposal system; • Identifying training requirements for each category of staff • Organizing training and refresher

			courses on safe waste management procedures. • Documentation of the waste generated on daily and monthly basis. • Make yearly Plans for infection control and identify the right time for taking action against vector control. • Advise the hospital on the disinfection procedure for risk waste.
7	Nursing Superintendent /Senior most nurse	Member	•Ensure training of nursing staff, laboratory staff, medical assistants and sanitary staff and sweepers in waste management procedure and basic personal hygiene and quarterly screening such as HBS, HCV, HIV, etc; • Ensuring Segregation of waste in wards and operation theatres. • Ensure the proper transportation of waste within the hospitals.
8	Radiologist	Member	• Give advice regarding formulation of appropriate procedure for management of radioactive waste and coordinate implementation of the procedure. • Ensure that the concerned hospital staff members receive adequate training in radioactive waste management procedures. • Maintain the record of radioactive waste generated and transferred for final disposal. • Maintain nuclear waste record if facility available.
9	Waste management/Environmental Officer	Member-cum-Secartary	**A) For Waste Collection** • Day to day implementation, monitoring of the waste

			management plan, maintaining documentation and record. • Ensure the availability of necessary equipment as per requirment within the institution. • Ensure internal collection of waste bags and waste containers, and their transportation to central storage facility of the hospital on daily basis. • Liaises with the supplies departments/Storage section of the hospital to ensure that an adequate supply of waste bags, containers, protective clothing and collection trolleys are available all the time;• Ensure that the sanitary staff and sanitary workers immediately replace used bags and containers with the new ones of the same type and where a waste bag is removed from containers, it is properly cleaned before a new bag is fitted therein;• Directly supervise the hospital sanitation staff assigned the duties to collect and transport the waste. **B) For Waste Storage** • Ensure correct use of central storage facility and that it is kept secured from unauthorized access and the waste from cental storage facility shall be transferred to disposal site within twenty four (24) hours;• Prevent unsupervised dumping of waste bags and

			waste containers on the hospital premises even for a short period of time• Maintain the record of waste broght to the central storage facility, type of waste entered, weight of waste, date and time of entrance of waste as well as when it was transferred from central storage facility to disposal site;**C) For Waste disposal**• Coordinates and monitor all waste disposal operations, and for this purpose meet regularly with the concerned representatives of the hospital waste management team;• Ensure that the methods of transportation of waste are used on site to the central storage facility incinerator, if installed and off site by hospital waste management team. • Ensure that the waste not stored on the hospital premises for longer than twenty four hours by coordinating with incinerator operators and hospital waste management team;• Ensure the proper labelling of waste collection bags, the type of waste stored in them, weight of the waste and date of collection;• Ensure a proper written record of the type and quantity of the waste sent for incineration;• Receive a signature from incinerator/treatment operators for the waste sent for disposal. • Staff Training (Doctors, clinical

			Staff, nursing staff, laboratory staff, medical Assistants)• Ensure that sanitary staff and sanitary workers are not involved in waste segregation and they only handle waste bags and containers in the correct manner;**C) For incident management and control**• Ensure that emergency procedures are available at all times that all staff members are aware of the action to be taken. • Investigate, record and review all incidents reports regarding hospital waste management • Record the quantities of waste generated by each department of the hospital on weekly basis.
10	Co-Opt Members		