Training Component of the Project
"Environmentally Sound Management of Medical Wastes in India"
Endeavour of GEF, UNIDO, MoEFCC and State Governments of Gujarat,
Karnataka, Maharashtra, Odisha and Punjab

TRAINING MANUAL ON BIO-MEDICAL WASTE MANAGEMENT FOR DOCTORS, NURSES, NODAL OFFICERS AND WASTE MANAGERS

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This document has been prepared for the United Nations Industrial Development Organization (UNIDO) on behalf of the training component of the project "Environmentally Sound Management of Medical Wastes in India" by the Department of Community Medicine, M.S. Ramaiah Medical College, Bangalore. This document has been reviewed and approved by the Technical Working Group (TWG), Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India.

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DISCLAIMER

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सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANG

सी.के.मिश्रा
C.K.Mishra

FOREWORD

Government of India, Ministry of Environment, Forest and Climate Change (MOEFCC) is the nodal agency for the India's environmental and forestry policies and programmes. Guided by the mandates of sustainable development inclusive of Industrial growth, Govt. of India, signed the Stockholm Convention on POPs in 2001 and ratified it in 2006. Post ratification of the Convention, as per Article 7 of the convention, National Implementation Plan (NIP) was formulated which identified " Environmentally Sound Management of Medical Wastes" as one of the priority areas.

In compliance to the obligations to be met under Stockholm Convention and ensuring sustainable and a pollution free environment, MoEFCC in collaboration with United Nations Industrial Development Organization (UNIDO) has been implementing a pilot project entitled "Environmentally Sound Management of Medical Waste in India" in the five states of India viz. Gujarat, Maharashtra, Karnataka, Odisha and Punjab.

Amongst many other, two of the major objectives of the project includes capacity building in terms of skilled and trained medical professionals with knowledge and sensitivity towards safe handling, treatment and disposal of medical waste in an environmentally sound manner and; establishment of BAT and BEP across the domain of medical fraternity including the waste handlers and the Medical Waste Treatment Facility operators.

To achieve the above objectives, extensive trainings are being conducted at all levels of medical personnel including administrators, Doctors, Nurses, Para-medical Staff, Waste handlers and CTF operators. Trainings manuals and SOPs developed in 7 languages with pictorial representations for ready understanding is anticipated to enable even the root level workers and feebly educated class to readily understand the medical waste management protocols and practices; thereby helping in percolation of the knowledge to the lowest stratum and upshot of effective implementation of New BMW Rules, 2016.

As a part of project sub-contract, the training documents and SOPs has been developed Dept. of Community Medicines, M. S. Ramaiah Medical College in consultation with the MoEFCC, UNIDO, Central Pollution Control Board (CPCB) and the experts from Technical Working Group and Steering Committee of the project appointed by MoEFCC. These documents are first of its kind and use of these documents are recommended for a more strengthened management of BMW with community of skilled manpower capable of replicating the knowledge further down the line.

The above objectives when accomplished will involuntarily help achieving the prime commitments of a) reduction and ultimate elimination of releases of Unintentionally Produced Persistent Organic Pollutants (UP-POPs) under Stockholm Convention and b) ground level implementation of the Biomedical Waste Management Rules, 2016.

I congratulate M. S. Ramaiah Medical College for their endeavour in developing the training documents and SOPs and recommend the use of these documents for ESM of BMW.

(C. K. Mishra)

Date: 25/10/2017
Place: Delhi

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The United Nations Industrial Development Organization (UNIDO) is mandated to promote and facilitate industrial development for poverty reduction, inclusive globalization and environmental sustainability. This is embedded in the 2030 Agenda for Sustainable Development, the transformative agenda towards the future we want, unanimously agreed upon by the leaders of 193 Member States of the United Nations in 2015. In particular, its Sustainable Development Goal (SDG) 9, calls to "build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation".

Equally, the 2013 Agenda targets good health and well-being, under SDG3 "ensure healthy lives and promote well-being for all at all ages". Amongst others, this requires access to modern health services, provided in hospitals and other health care facilities, that as a consequence of their activities, produce a variety of wastes. These wastes need to be managed properly from source, through collection and transport to final treatment and disposal, to avoid posing threats to health and wellbeing, directly, due to infectious and/or toxic nature, or, indirectly, through the unintended creation of hazardous substances from incorrect treatment, particularly burning. The Stockholm Convention on Persistent Organic Pollutants and the Minamata Convention on Mercury, multilateral environmental agreements ratified by India, amongst others apply to the management of health care waste. UNIDO therefore implements a project with support from the Global Environment Facility (GEF) to develop scalable and replicable models for environmentally sound management of health care waste for different types of health care facilities, and demonstrate these in collaboration with hospitals across five States (Gujarat, Karnataka, Maharashtra, Odisha and Punjab).

Environmentally sound management of heath care waste starts with awareness of risks and adherence to standard operating practices by medical, nursing, administrative and general staff at all levels in the institutions. The M S Ramaiah Medical College and Hospitals in Bangalore therefore developed this set of training manuals and accompanying set of Standard Operating Practices. These are fully consistent with the National Bio-Medical Waste Management Rules of 2016. The Ministry of Environment, Forests and Climate Change (MoEFCC), Ministry of Health and Family Welfare (MoHFW), Central Pollution Control Board (CPCB) and other members of the Technical Advisory Committee all contributed to the review of these manuals.

I am pleased to recommend these manuals as the basis for practical and hands-on training for all involved in the health care waste management chain. Doing so will certainly contribute to protecting health and well-being of patients, staff, visitors and community at large, whilst also protecting the environment in a cost-effective manner.

René Van Berkel, PhD
UNIDO Representative
UNIDO Regional Office in India

CONTENTS

LIST OF ABBREVIATIONS

AERB	....	Atomic Energy Regulatory Board
BAT	....	Best Available Technology
BEP	....	Best Environmental Practices
BMW	....	Bio-Medical Waste
BMWM	....	Bio-Medical Waste Management
CBWTF	....	Common Bio-Medical Waste Treatment Facility
DLMC	....	District Level Monitoring Committee
ESM	....	Environmentally Sound Management
ESMWI	....	Environmentally Sound Management of Medical Wastes in India
ETP	....	Effluent Treatment Plant
GEF	....	Global Environment Facility
GOI	....	Government of India
HCFs	....	Healthcare Facilities
HCW	....	Health care Waste
HCWM	....	Health care Waste Management
Hg	....	Mercury
HICC	....	Hospital Infection Control Committee
HIV	....	Human Immunodeficiency Virus
HWTSDF	....	Hazardous Waste Treatment Storage & Disposal Facilities
IMA	....	Indian Medical Association
MoEFCC	....	Ministry of Environment, Forest and Climate Change
MOU	....	Memorandum of Understanding
MSRMC	....	M.S. Ramaiah Medical College
NACO	....	National AIDS Control Organisation
NSC	....	National Steering Committee
PCC	....	Pollution Control Committee
PCDD	....	Polychlorinated Dibenzodioxins (Dioxins)
PCDF	....	Polychlorinated Dibenzofurans (Furans)
PEP	....	Post Exposure Prophylaxis
POPs	....	Persistent Organic Pollutants
PPE	....	Personal Protective Equipment
PPP	....	Public Private Partnership
SLF	....	Sanitary Land fill
SOP	....	Standard Operating Procedure

SPCB	....	State Pollution Control Board
SPMU	....	State Project Management Unit
TEQ	....	Toxic Equivalency Factor
TNA	....	Training Needs Assessment
ToTs	....	Training of Trainers
TSDF	....	Treatment, Storage & Disposal Facilities
UNEP	....	United Nations Environmental Programme
UNIDO	....	United Nations Industrial Development Organization
WHO	....	World Health Organization

LIST OF TABLES

LIST OF FIGURES

CHAPTERS

Learning objectives

1. To know the importance of sound management of bio-medical waste.
2. To understand what is bio-medical waste and its hazards

Contents

1. Introduction
2. Classification of bio-medical waste
3. Hazards of improper bio-medical waste management

Frequently asked questions

INTRODUCTION

Stockholm convention, a global treaty that aims at protection of human health and environment from persistent organic pollutants (POPs). POPs tend to remain unharmed in the environment for long periods, can spread widely to large geographical areas and has the tendency to add up in the fatty tissue.[1]

The International Agency for Research on Cancer identifies most of the 12 POPs targeted by the Stockholm Convention which pose a potential carcinogenic risk to humans. Reproductive, developmental, behavioural, neurologic, endocrine, and immunologic adverse health effects have been linked to POPs. POPs work their way through the food chain by accumulating in the body fat of living organisms and becoming more concentrated as they move from one creature to another. This process is known as "Biomagnification". When contaminants found in small amounts at the bottom of the food chain magnify, they can pose a significant hazard to predators that feed at the top of the food chain. This means that even small release of POPs can have significant impact on human health.

Healthcare services which aim at reducing health problems and treatment of diseases, generate bio-medical waste (may also be called as regulated infectious waste or healthcare waste or clinical waste) as a by-product of medical care services. Inadequate and inappropriate handling and disposal of bio-medical waste, may have serious public health consequences and a significant impact on the environment. Incineration of bio-medical waste is one major contributor to POPs – Dioxins and Furans into the environment. Therefore, sound management of bio-medical waste is a crucial component of environmental health protection.

India being signatory to the Stockholm convention in 2002, the country is obliged to comply with requirements of the convention and is therefore bound to reduce the release of POPs to the environment. Improper management of medical waste result in release of Dioxins and Furans into the environment. It is in this context that the project on "Environmentally Sound Management of Medical Waste in India" (ESMWI) has been approved by Global Environment Facility (GEF) where the Ministry of Environment, Forests and Climate Change, Government of India, is the national executing agency and the United Nations Industrial Development Organization (UNIDO) is the implementing agency. The project aims to assist the country in safe and sound management and disposal of 180,000 tons of health care wastes generated annually which is approximately 484 tons per day.

Ample progress has been made regarding segregation at source; however there is scope for further improvement. The Ministry of Environment, Forest and Climate Change, Government of India, had formulated the Bio-medical Waste Management and handling Rules in 1998 which has been amended to Bio-medical Waste Management Rules in 2016 which will help achieve the objective of Stockholm Convention.

Actions involved in implementing effective biomedical waste management require, a systematic approach, many-layered framework, multi- sectoral cooperation, and should be an integral part of health care services. Community participation is also vital in the implementing policies and programmes for biomedical waste management. Community participation in

implementing policies and programmes can be improved by enhancing the awareness of the community towards safe management of biomedical waste. Actions involved in implementing effective bio-medical waste management programmes require multi-sectoral and interaction at all levels.[1]

Knowledge on potential harm from biomedical waste is evident to governments of many countries, civil societies and medical practitioners. In the recent times it is perceived that improper and haphazard management of waste within the health care facilities is equivalent to poor standards of care and an avoidable source of infections and injuries. Hence, health care providers and allied health care professionals are expected to take responsibility for the waste generated by their activities of health care.[1]

DEFINITION AND CHARACTERISTICS OF BIO-MEDICAL WASTE

The term 'Bio-medical waste' includes any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or research activities pertaining there on, or in the production or testing of biologicals or in health camps, including the categories mentioned in Schedule 1 of the Bio-medical Waste Management Rules, 2016. In addition, biomedical waste include similar kind of waste that are generated at household level, due to health care offered at household level eg dialysis at home, self administration of insulin injections and restorative care.[1]

General waste or non–hazardous waste constitutes to 75 to 90% of waste generated at health care facilities. Administrative, house keeping, packaging, kitchen and maintenance activities of the facilities contribute to the general waste or non hazardous waste. The remaining 10 - 25% of waste is considered hazardous and can pose threat to human and environmental health.[1]

FIGURE 1: FIG SHOWING PROPORTION OF INFECTIOUS AND HAZARDOUS WASTE

CLASSIFICATION OF BIO-MEDICAL WASTE

TABLE 1: CLASSIFICATION OF BIO-MEDICAL WASTE AS PER BMWM RULES 2016

COLOUR CODING	TYPE OF WASTE	EXAMPLES
Yellow	a. Human anatomical waste	Human tissues, organs, body parts, fetus
	b. Animal anatomical waste	Experimental animal carcasses
	c. Soiled waste	Cotton contaminated with blood and other body fluids, plaster casts
	d. Expired or discarded medicines	Discarded tablets and capsules
	e. Chemical waste	Used or discarded disinfectants, chemicals used in biologicals
	f. Chemical liquid waste	Laboratory reagents, X ray film developer, disinfectants, floor washings, formalin
	g. Discarded linen, mattresses, beddings contaminated with blood or body fluid	Bedsheets, blankets, mattresses contaminated with blood or body fluids
	h. Microbiology, biotechnology and other clinical laboratory waste	Culture plates, blood bags, vaccines
Red	i. Contaminated waste (recyclable)	Plastic tubings, urine bags, vacutainers, gloves, catheters, Ryle's tube
White	j. Waste sharps including metals	Hypodermic needles, auto-disabled syringes, syringes with fixed needles, scalpels, knives, blades, lumbar puncture needles and intravenous needles.[1]
Blue	k. Glassware	Used glass bottles
	l. Metallic body implants	Body implants, Plates and screws

Source: Bio-medical waste Management Rules, 2016, Ministry of Environment, Forest and Climate Change, Government of India

Bio-medical waste and its management is a comprehensive issue, encompassing occupational health and safety, environmental health and safety, and injury and incident prevention.

Training healthcare personnel to adopt 'Good Work Practices' will go a long way in promoting the safe management of bio-medical waste so that the environment is protected.

HAZARDS OF IMPROPER BIO-MEDICAL WASTE MANAGEMENT

Who are at risk?

Individuals who would be at risk would include anyone working in proximity with biomedical waste, that would be

Generators - all individuals working in health care facilities who generate biomedical waste

Handlers - who handle biomedical waste at health care facilities or at treatment and disposal facilities

Exposed group - who are exposed to hazardous biomedical waste due to consequence of careless actions of generators and handlers.[1]

Main groups at risk are:

- Nurses, doctors, allied health care personnel(laboratory technicians)
- Patients receiving care either at hospital or at home
- visitors to health care facilities
- General public if biomedical waste is managed improperly
- Personnel in support services like; cleaners, laundry services,
- Personnel working in waste treatment / management or disposal facilities
- Personnel involved in transporting biomedical waste.[1]

TABLE 2: HAZARDS FROM VARIOUS CATEGORIES OF BIO-MEDICAL WASTE

SL. NO.	TYPE OF WASTE	HAZARD FROM THE WASTE	IMPACT FROM THE WASTE
1	Infectious waste and sharps	•Cuts • Abrasions • Infections	• Percutaneous infections with Hepatitis B, Hepatitis C, HIV
2	Chemical and pharmaceutical waste	• Intoxication by acute or chronic exposure • Physical injury • Chemical burns • Injury to skin • Injury to eye • Injury to mucous membrane of airways • Respiratory disease • Skin disease	• Harmful to wildlife[1] • Evolution of antibiotic resistance in bacteria[1] • The chemicals can also cause contamination of water bodies and soil. • When large quantities of disinfectants are released into sewers they can bring down the efficiency of the sewage treatment plant.
3	Genotoxic waste	• Irritant • Dizziness • Nausea • Headache • Dermatitis	• Spontaneous abortions
4	Radioactive waste	• Headache • Dizziness • Vomiting • Fatal	• Can expose the public as well as healthcare workers to the risk of loss of foetus in the first three months of pregnancy • Death
5	Healthcare waste-treatment methods	• Flue gases from improperly functioning waste incinerators • Physical injuries • Leachate release into water • Burning leads to heavy metal release	• Flue gases released • Water pollution • Air pollution • Release of pathogens and toxic pollutants into the environment.
6	Public sensitivity	• Sensitivity to vision of anatomical parts	• Disposal of anatomical waste inappropriately, such as dumping in a landfill is unacceptable.

INFECTION AMONG HEALTH CARE PROVIDERS

Infection of Patients

Poor aesthetics, stray dogs, rodent menace

HAZARDS OF HEALTH CARE WASTE

Infection and injuries to waste handlers

Air pollution

Water pollution

Infection to rag pickers and injuries

FREQUENTLY ASKED QUESTIONS

1. Define Bio-medical Waste

The term 'Bio-medical Waste' includes any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or research activities pertaining thereto, or in the production or testing of biologicals or in health camps, including the categories mentioned in Schedule 1 of the Bio-medical Waste Management Rules, 2016.

In addition, biomedical waste includes similar kind of waste that are generated at household level, due to health care offered at household level eg dialysis at home, self administration of insulin injections and restorative care.[1]

2. What is the importance of managing Bio-medical Waste?

Healthcare services aims to reduce potential risks to health and reduce health problems in humans. Activities undertaken to achieve this aim generate biomedical waste that in itself is hazardous to health and has a potential to cause injuries and spread infections. Therefore to minimize risks to human and environmental health it is important that safe methods of handling, disposal and treatment are instituted.[1]

3. What are the different types of Bio-medical Waste?

A: Yellow

- Human anatomical waste
- Animal anatomical waste
- Soiled waste
- Expired or discarded medicines
- Chemical waste
- Chemical liquid waste
- Discarded linen, mattresses, beddings contaminated with blood or body fluid
- Microbiology, biotechnology and other clinical laboratory waste

B: Red

- Contaminated waste (recyclable)- Plastic and Rubber

C: White

- Waste sharps- (metallic sharps)

D: Blue

- Glassware
- Metallic body implants

TAKE HOME MESSAGES:

- Bio-medical waste is any waste generated during the diagnosis, treatment or immunisation of human beings or animals or research activity
- Majority of health care waste is general waste (≈85%) and very small quantity of waste is hazardous health care waste.

Learning objectives

1. To know the important milestones of BMWM Rules, and other rules concerned with waste management
2. To understand the salient features of application, definitions, duties of the healthcare provider
3. To know the segregation, packaging, transportation, storage, treatment and disposal options prescribed under the new BMWM Rules, 2016
4. To know the salient differences between BMWM and Handling rules 1998 and BMWM Rules, 2016

Contents

INTRODUCTION

Waste management rules in India are founded on the principles of "sustainable development", "precaution" and "polluter pays". Various rules are framed under the broader umbrella of "Environment Protection Act' by Ministry of Environment and Forests (MOEF) in 1986.

KEY PRINCIPLES GOVERNING SAFE MANAGEMENT OF BMW

1. **"Sustainable development" principle** is the organizing principle for sustaining finite resources necessary to provide the needs of future generations of life on the planet.
2. **The "Polluter Pays" principle** – Section 9 (3) of the Act embodies the "Polluter Pays Principle" which states that any expense which has been incurred to restore the environment to its natural state shall be paid by the person who is responsible for such degradation" (Polluter must bear costs for damages and harm caused to environment by his own acts).
3. **The "Precautionary principle"** – states that when the magnitude of a particular risk is uncertain, it should be assumed that this risk is significant and all measures should be taken to protect health and to avoid environmental degradation and hazards.
4. **The "Duty of care" principle** stipulates that any person handling or managing hazardous substances or related equipment is ethically responsible for using the utmost care in that task.
5. **The "Proximity" principle** recommends that treatment and disposal of hazardous waste should take place at the closest possible location to its source in order to minimize the risks involved in its transport.
6. **The "Prior informed consent"** principle as embodied in various international treaties necessitates that stakeholders and affected communities be aware of the risks and hazards associated with waste management. Hence their consent be obtained for establishment of the same. In the context of BMW this principle would apply to transportation, establishment and operation of biomedical waste treatment and disposal facilities.

IMPORTANT MILESTONES

1. International laws:

i. Basel Convention- An agreement on control of transboundary movement of hazardous wastes and their disposal, 1989.

ii. Stockholm Convention- An agreement on Persistant Organic Pollutants, Stockholm, 2001

iii. Minamata Convention - on Mercury, Minamata 2013

2. Indian laws :

i. Environment Protection Act 1986

ii. New Solid Waste Management Rules (SWM), 2016.

iii. Plastic Waste Management Rules, 2016

iv. e-waste (Management) Rules, 2016

v. Bio-Medical Waste Management Rules,2016

vi. Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016

BIOMEDICAL WASTE MNAGEMENT RULES _2016

1. **Introduction:** Under the Environment (Protection) Act 1986, Bio-Medical Waste Management Rules, 2016, came into force from 28th March, 2016 superseding Bio-Medical Waste (Management and Handling) Rules, 1998.

2. **Application:** The rules apply to all persons who **generate, collect, receive, store, transport, treat, dispose,** or **handle bio-medical waste** in any form including:

- Hospital
- Nursing homes
- Clinics
- Dispensaries
- AYUSH hospitals

- Veterinary institutions
- Animal house

- Pathological laboratories
- Blood banks
- Clinical establishments, research or educational institutions
- Forensic laboratories
- Research labs

- Health camps
- Medical/ surgical camps
- Vaccination camps
- Blood donation camps
- First aid rooms of schools

3. **BMWM Rules, 2016 shall not apply to the following types of waste**

Sl. No.	Type of waste	Covered under
1	Radioactive wastes	The provisions of the **Atomic Energy Act, 1962** (33 of 1962) and the rules made there under
2	Hazardous chemicals	The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 made under the Act
3	Solid wastes	Delete the highlighted portion and replace with Solid Waste Management Rules, 2016 made under the Act
4	The lead acid batteries	Covered under the Batteries (Management and Handling) Rules, 2001 made under the Act
5	Hazardous wastes	Delete the highlighted portion and replace with Solid Waste Management Rules, 2016 made under the Act
6	e- waste	The Delete the highlighted portion and replace it with "E-Waste (Management) Rules, 2016", made under the Act
7	Hazardous microorganisms, genetically engineered microorganisms and cells	The Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms, Genetically Engineered Microorganisms or Cells Rules, 1989 made under the Act.

IMPORTANT DEFINITIONS

1. **"Act"** means the Environment (Protection) Act, 1986 (29 of 1986)
2. **"Animal house"** means a place where animals are reared or kept for the purpose of experiments or testing
3. **"Authorization"** means permission granted by the prescribed authority for the generation, collection, reception, storage, transportation, treatment, processing, disposal or any other form of handling of bio-medical waste in accordance with these rules and guidelines issued by the Central Government or Central Pollution Control Board as the case may be
4. **"Authorised person"** means an occupier or operator authorized by the prescribed authority to generate, collect, receive, store, transport, treat, process, dispose or handle bio-medical waste in accordance with these rules and the guidelines issued by the Central Government or the Central Pollution Control Board, as the case may be
5. **"Biological"** means any preparation made from organisms or micro-organisms or product of metabolism and biochemical reactions intended for use in the diagnosis, immunisation or the treatment of human beings or animals or in research activities pertaining thereto

6. **"Bio-medical waste"** means any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or research activities pertaining thereto or in the production or testing of biological or in health camps, including the categories mentioned in Schedule I appended to these rules

7. **"Bio-medical waste treatment and disposal facility"** means any facility wherein treatment, disposal of bio-medical waste or processes incidental to such treatment and disposal is carried out, and includes common bio-medical waste treatment facilities

8. **"Form"** means the Form appended to these rules

9. **"Handling"** in relation to bio-medical waste includes the generation, sorting, segregation, collection, use, storage, packaging, loading, transportation, unloading, processing, treatment, destruction, conversion, or offering for sale, transfer, disposal of such waste

10. **"Healthcare facility"** means a place where diagnosis, treatment or immunisation of human beings or animals is provided irrespective of type and size of health treatment system, and research activity pertaining thereto

11. **"Major accident"** means accident occurring while handling of bio-medical waste having potential to affect large masses of public and includes toppling of the truck carrying bio-medical waste, accidental release of bio-medical waste in any water body, but exclude accidents like needle prick injuries, mercury spills

12. **"Management"** includes all steps required to ensure that bio-medical waste is managed in such a manner as to protect health and environment against any adverse effects due to handling of such waste

13. **"Occupier"** means a person having administrative control over the institution and the premises generating bio-medical waste, which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank, healthcare facility and clinical establishment, irrespective of their system of medicine and by whatever name they are called

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

15. **"Prescribed authority"** means the State Pollution Control Board in respect of a State and Pollution Control Committees in respect of an Union territory;

16. **"Schedule"** means the Schedule appended to these rules.[2]

DUTIES OF THE OCCUPIER
IT SHALL BE THE DUTY OF EVERY OCCUPIER TO

1. Take all necessary steps to ensure that **bio-medical waste is handled without any adverse effect to human health and the environment** and in accordance with these rules

2. Make a provision within the premises for a **safe, ventilated and secured location for storage of segregated bio-medical waste in** coloured bags or containers in the manner as specified in Schedule I

3. To ensure that there shall be no secondary handling, pilferage of recyclables or inadvertent scattering or spillage by animals

4. To ensure that waste from such place or premises shall be directly transported in the manner as prescribed in these rules to the common bio-medical waste treatment facility or for the appropriate treatment and disposal, as the case may be, in the manner as prescribed in Schedule I

5. Pre-treat the laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilisation on-site in the manner as prescribed by the World Health Organisation (WHO) guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and then sent to the CBWTF for final disposal

6. Phase out use of chlorinated plastic bags, gloves (excluding blood bags) and gloves by the 27th March, 2019.

7. Dispose of solid waste other than BMW in accordance with the provisions of respective waste management rules made under the relevant laws and amended from time to time

8. Not to give treated bio-medical waste with municipal solid waste

9. Provide training to all its healthcare workers and others, involved in handling of bio medical waste at the time of induction and there after at least once every year and the details of training programmes conducted, number of personnel trained and number of personnel not undergone any training shall be provided in the annual report.[2]

NOTE: IN THIS DOCUMENT BMWM RULES 2016 REFERS TO THE PROVISON UNDER THE BMWM RULES 2016 AND AMENDMENTS MADE IN 2018.

THE MAJOR SALIENT FEATURES OF BMW MANAGEMENT RULES, 2016 INCLUDE THE FOLLOWING:

1. **The ambit of the rules has been expanded to include** camps such as vaccination camps, blood donation camps, surgical camps or any other health care activity
2. **Phase-out the use of chlorinated plastic bags, gloves (excluding blood bags) and gloves by the 27th March, 2019.**
3. **Microbiological waste, blood samples, blood bags and laboratory waste have to be disinfected at the health care facility before disposal to CBWTF or disposed off in a manner as prescribed by guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 or WHO.**[10]
4. **Regular training has to be provided to all the personnel regarding Biomedical waste management. All personnel handling biomedical waste have to be immunized regularly.**[10]
5. **Bar code system have to be established for bags and containers containing biomedical waste before disposal to CBWTF.**[10]
6. **Report major accidents.**[10]
7. **Existing incinerators to achieve the standards for retention time in secondary chamber and dioxin and furans within two years**
8. **Classification of biomedical waste has been reduced to 4 categories, that was hitherto 10. This may enhance the segregation efficiency.**[10]
9. **Simplified procedure for authorization by the regulatory authority. The period of validity of authorization is matched with the validity period of consent orders. One time authorization for non bedded HCFs.**[10]
10. **The new rules prescribe more stringent standards for incinerator to reduce the emission of pollutants in environment.**
11. **Emission limits for dioxins and furans have been included.**
12. **Land for setting up common biomedical waste treatment and disposal facility would be provided by respective state Governments.**
13. **Establishment of on-site treatment and disposal facility by the occupier is discouraged, if a common biomedical waste treatment facility is available within a radius of 75 kms.**[10]
14. **Operator of a common bio-medical waste treatment and disposal facility to ensure the timely collection of bio-medical waste from the HCFs and assist the HCFs in conduct of training.**
15. **Non-bedded occupiers shall dispose infectious liquid wastes only after treatment by disinfection as per schedule – II (6) of the principal rules.".**

MAJOR CHANGES PROPOSED IN THE BIO-MEDICAL WASTE MANAGEMENT RULES, 2016 AND ITS LIKELY IMPLICATION

TABLE 3: DIFFERENCE BETWEEN NEW AND OLD RULES

BMW (Management and Handling) Rules, 1998 & revised in 2011	Bio-Medical Waste Management Rules, 2016	Reasons and likely implications
Title		
Bio-Medical Waste (Management and Handling) Rules, 2011	Bio-Medical Waste Management Rules, 2016.	The word 'Management' includes Handling.
Application		
These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form.	These rules shall apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio-medical waste in any form and shall not apply to: • Radioactive wastes • Municipal solid wastes • Lead acid batteries • Hazardous wastes • e-waste • Hazardous microorganisms.	Modified to bring more clarity in the application. Clarified that vaccination camps, blood donation camps, surgical camps or any other health care activity undertaken outside the health care facility, will be covered.
Duties of the Health care facilities including CBWTF		
Every occupier of an institution generating bio-medical waste which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment.	**Additions:** Healthcare facilities (HCF) shall make a provision within the premises for a safe, ventilated and secured location for storage of segregated bio-medical waste.[2]	To ensure that there shall be no secondary handling, pilferage of recyclables or inadvertent scattering or spillage by animals and the BMW from such place or premises can be directly transported in to the CBWTF.[2]
	Pre-treat the lab/ microbiological waste, blood samples and blood bags through disinfection or sterilization on-site in the manner as prescribed by WHO guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and then sent to the CBWTF for final disposal	This is to prevent the possible microbial contamination.
	Phase out use of chlorinated plastic bags, gloves within two years from the date of notification of these rules	Will eliminate the emission of dioxin and furans from burning of such wastes.

	Provide training to all its healthcare workers and others involved in handling of BMW at the time of induction and thereafter at least once every year	Will improve the management of BMW including collection, segregation.
	Immunize all its healthcare workers and others involved in handling of BMW for protection against diseases including Hepatitis B and Tetanus	To protect the health of workers
	Establish a Bar-Code System for bags or containers containing BMW to be sent out of the premises.[2]	Will improve the segregation, transportation and disposal system. Also will eliminate pilferage on the way of BMW to disposal facility.
	Report all major accidents including accidents caused by fire hazards, blasts during handling of BMW and the remedial action taken to SPCB.[2]	Help to monitor and improve the management
	Existing incinerators shall achieve the standards for retention time in secondary chamber and Dioxin and Furans within two years from the date of this notification.[2]	Will improve the environment in the vicinity of treatment facility.
Duties of the operator of a CBWTF		
Nil	Same as the duties of HCFs and additionally they shall ensure timely collection of bio-medical waste from the HCFs, assist the HCFs in conduct of training	Specific responsibility on the operator of a common bio-medical waste treatment and disposal facility will be make them clear to their duties.[2]

SCHEDULE

TABLE 4: LIST OF SCHEDULES IN BMWM RULES

Schedule I	Bio-medical wastes categories and their segregation, collection, treatment, processing and disposal options
Schedule II	1. Standards for incinerators A. Operating Standards B. Emission Standards C. Stack Height
	2. Operating and Emission Standards for Disposal by Plasma Pyrolysis or Gasification A. Operating Standards B. Air Emission Standards and Air Pollution Control Measures C. Disposal of Ash Vitrified Material
	3. Standards for autoclaving of bio-medical waste
	4. Standards of microwaving
	5. Standards for deep burial
	6. Standards for efficacy of chemical disinfection
	7. Standards for dry heat sterilization
	8. Standards for liquid waste
Schedule III	List of prescribed authorities and the corresponding duties
Schedule IV Part A	Label for bio-medical waste containers or bags
Schedule IV Part B	Label for transporting bio-medical waste bags or containers

TABLE 5: LIST OF FORMS IN BMWM RULES

Form I	Accident reporting
Form II	Application for authorisation or renewal of authorisation
Form III	Authorisation
Form IV	Annual report
Form V	Application for filing appeal against order passed by the prescribed authority

TABLE 6: SEGREGATION CHART (BMW RULES 2016)[2]

Category	Type of Waste	Type of Bag/ Container to be used	Treatment and Disposal options
Yellow	(a) Human Anatomical Waste • Human tissues • Organs • Body parts • Foetus below the viability period	Yellow coloured non-chlorinated plastic bags	Incineration or Plasma Pyrolysis or deep burial*
	(b)Animal Anatomical Waste • Experimental animal carcasses • Body parts • Organs • Tissues • Waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.		
	(c) Soiled Waste • Items contaminated with blood, body fluids like dressings • Plaster casts • Cotton swabs • Bags containing residual or discarded blood and blood components		Incineration or Plasma Pyrolysis or deep burial* In absence of above facilities, autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding.
	(d) Expired or Discarded Medicines • Pharmaceutical waste like antibiotics • Cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.	Yellow coloured non-chlorinated plastic bags or containers	<u>Expired cytotoxic drugs and items contaminated with cytotoxic drugs</u> • To be returned back to the manufacturer or supplier for incineration at temperature >12000C OR • To CBWTF or HWTSDF for incineration at >12000C Or Encapsulation Or Plasma Pyrolysis at >12000C <u>All other discarded medicines shall</u> • Be either sent back to manufacturer OR • Disposed by incineration

	(e) Chemical Waste • Chemicals used in production of biologicals • Used or discarded disinfectants.	Yellow coloured containers or non-chlorinated plastic bags	Incineration or Plasma Pyrolysis or Encapsulation in HWTSDF
	(f) Chemical Liquid Waste • Liquid waste generated due to use of chemicals in production of biologicals • Used or discarded disinfectants • Silver X-ray film developing liquid • Discarded Formalin • Infected secretions • Aspirated body fluids • Liquid from laboratories • Floor washings, cleaning, house-keeping and disinfecting activities etc.	Separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste • Shall be pre-treated before mixing with other waste water. • The combined discharge shall conform to the discharge norms given in Schedule II.
	(g) Discarded linen, mattresses, beddings contaminated with blood or body fluid routine mask and gown.	Non-chlorinated yellow plastic bags or suitable packing material	• Non-chlorinated chemical disinfection followed by incineration or Plasma Pyrolysis or for energy recovery. • In absence of above facilities, shredding or mutilation or combination of sterilization and shredding.
	(h) Microbiology, Biotechnology and other clinical laboratory waste • Blood bags • Laboratory cultures • Stocks or specimens of microorganisms • Live or attenuated vaccines • Human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures	Autoclave or Microwave or Hydroclave safe plastic bags or containers	• Pre-treat to sterilize with non-chlorinated chemicals on-site as per NACO or WHO guidelines • Autoclaving / microwaving / Hydroclaving And thereafter for incineration

Red	Contaminated Waste (Recyclable) • Tubing • IV bottles • IV tubes and sets • Catheters • Urine bags • Syringes (without needles and fixed needle syringes) • Vacutainers with their needles cut • Gloves	Red coloured non-chlorinated plastic bags or containers	Autoclaving/ micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible **PLASTIC WASTE SHOULD NOT BE SENT TO LANDFILL SITE**
White translucent	Waste sharps including metals (both used, discarded and contaminated) Needles Syringes with fixed needles, needles from needle tip cutter or burner Scalpels Blades Any other contaminated sharp object that may cause puncture and cuts	Puncture proof, leak proof, tamper proof containers	Autoclaving followed by Shredding or mutilation or encapsulation in metal container or cement concrete
Blue	(a) Glassware: Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes. (b) Metallic body implants	puncture proof and leak proof box or container with blue mark with blue coloured marking	Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling

**Disposal by deep burial is permitted only in rural or remote areas where there is no access to CBWTF within 75 Km. this will be carried out with prior approval from the prescribed authority and as per the Standards specified in Schedule-III. The deep burial facility shall be located as per the provisions and guidelines issued by Central Pollution Control Board from time to time.*[2]

TAKE HOME MESSAGES:

- It is the duty of the occupier to ensure Bio-medical waste management rules, 2016, are implemented in their respective health care facilities
- Non-compliance with the rules may involve punitive action

CHAPTER 3 - LIFE CYCLE APPROACH IN BIO-MEDICAL WASTE MANAGEMENT

Learning objectives

1. To understand the biomedical waste management flow
2. To understand the hierarchy in health care waste management system
3. To know 4 Rs in waste minimization

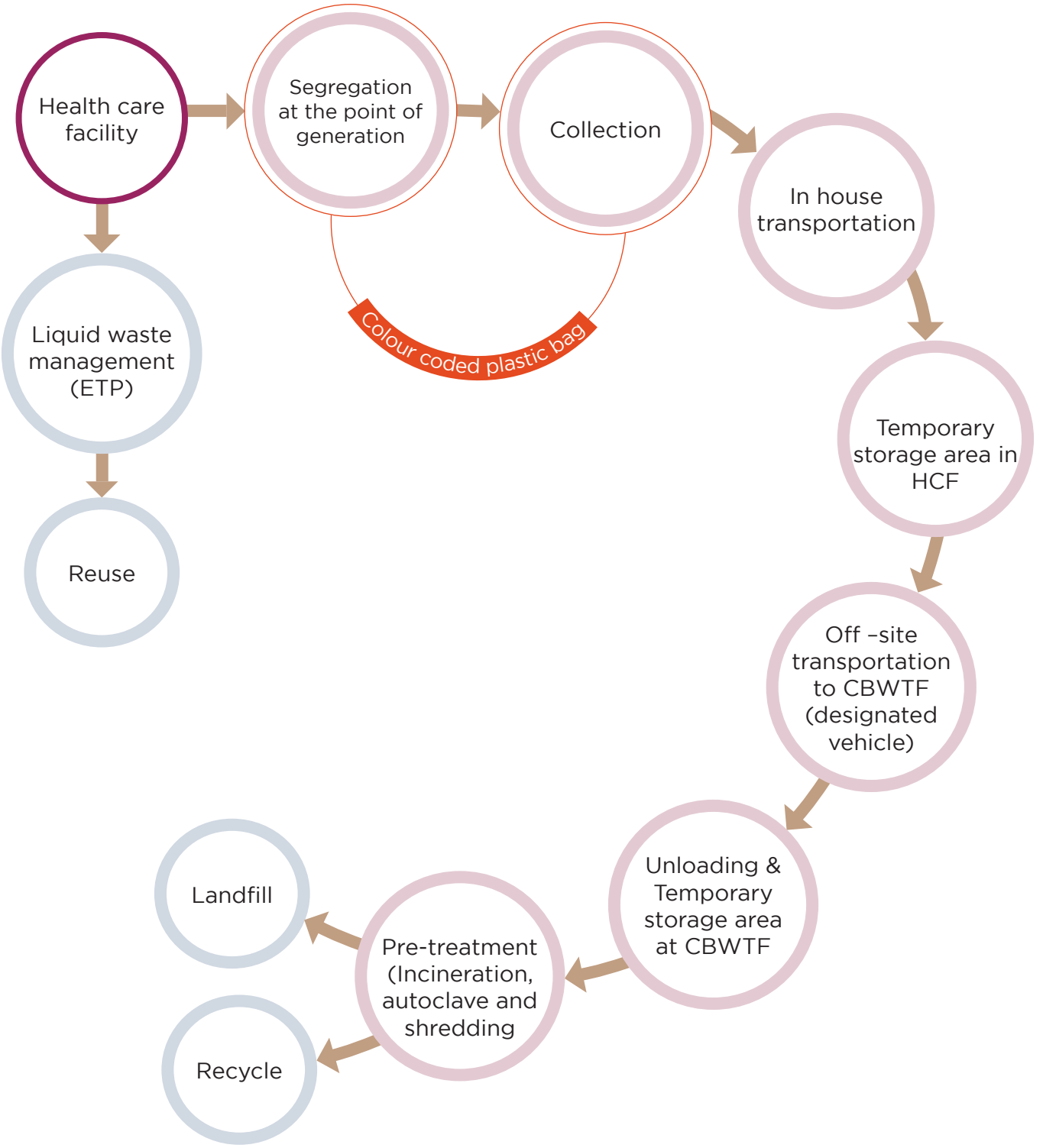
Contents

1. Introduction
2. Biomedical waste management flow
3. Waste minimization
4. 4 Rs in waste minimization
5. Synopsis of HCWM stream

INTRODUCTION

Bio-medical waste management should be approached in a lifecycle manner. The management of waste starts form waste minimization, Segregation at source till its final treatment and disposal options. The important component that should be kept in mind throughout the life cycle approach is that of Worker safety, Patient safety and Environment safety.

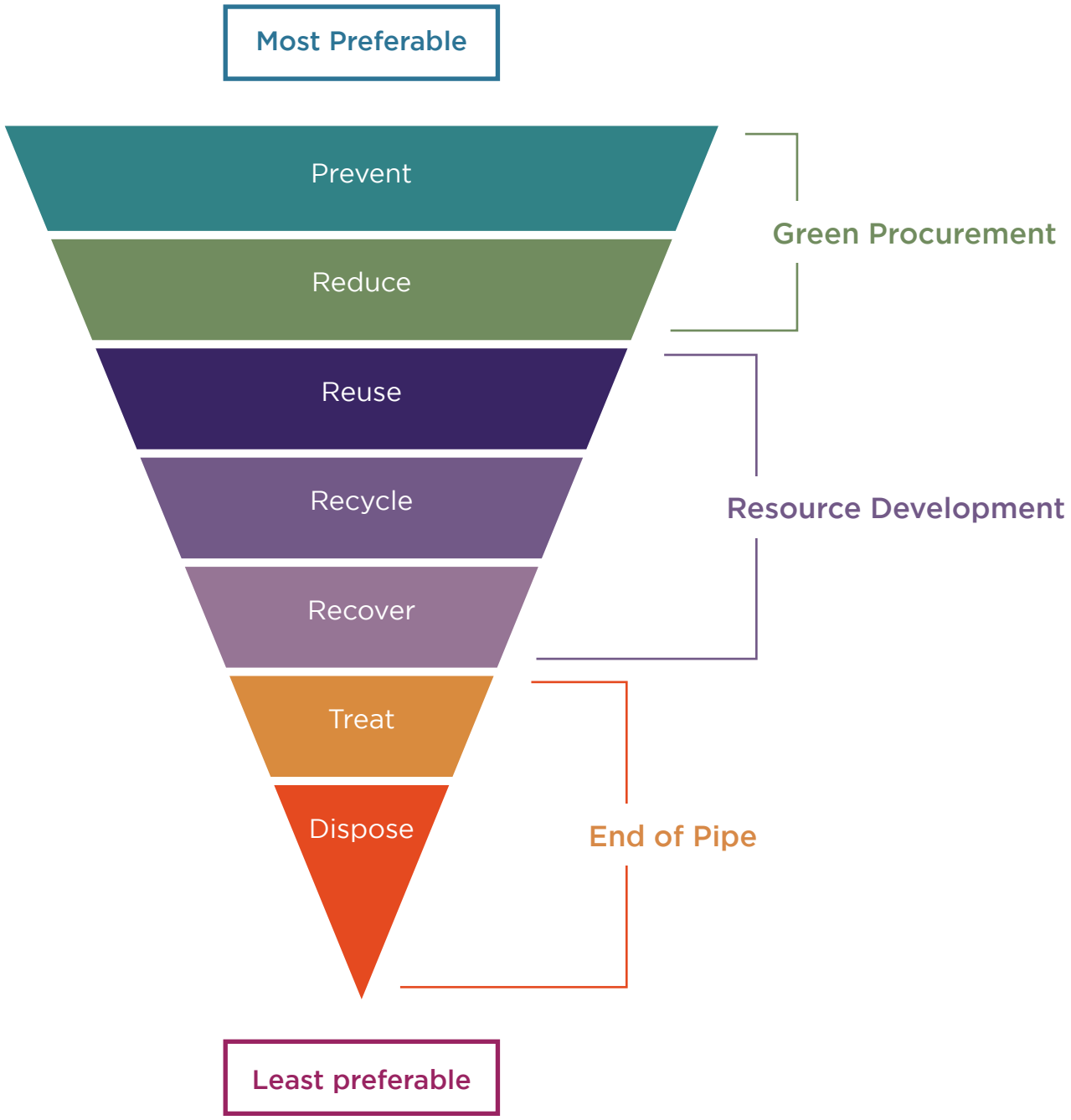
FIGURE 2: DEPICTION OF BIO-MEDICAL WASTE MANAGEMENT FLOW



Health care waste management hierarchy depicts the application of waste minimization technique. The below mentioned techniques have been applied:

- **Green Procurement:** Purchase of materials that have definite and safe method of disposal. It refers to reduction at source
- **Resource Development (3R's)** - Reuse, Recycle and Recovery
- **End of Pipe:** Final treatment and disposal

FIGURE 3: HEALTH CARE WASTE MANAGEMENT HIERARCHY

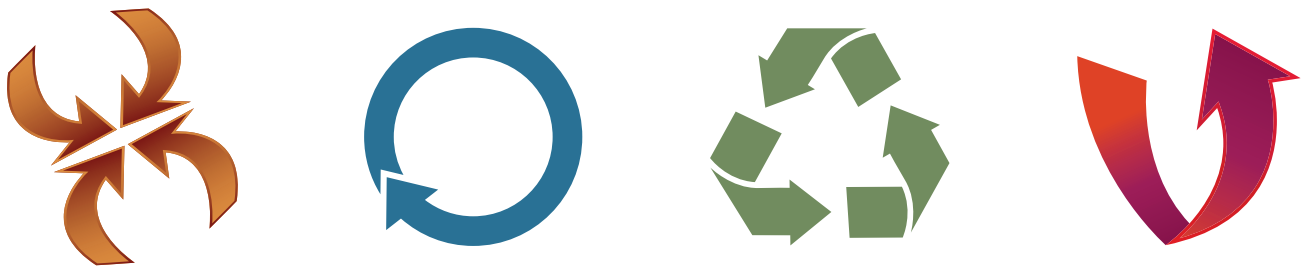


Source: WHO Blue Book & http://www.wpro.who.int/philippines/publications/health_care_waste_management_manual_3rd_ed.pdf

Waste minimization can be done at two points in HCFs

- Firstly, at Procurement stage referred to as Step Zero (step 0) by adopting purchasing environmentally friendly products.
- Secondly, during the process of segregation by applying the 4 R principle

FIGURE 4: FOUR 'R'S IN WASTE MINIMIZATION



Source: Source: http://csrno.ca/en/solid-waste/the-4rs/

4 'R's help in environmentally sound and safe management of medical waste by minimising and managing the waste and waste streams effectively.

REDUCE

Reducing the waste is a simple and primary step in minimising the waste generation. This can be achieved by

1. Environmentally preferable purchasing
   - Products or services whose environmental impacts have been assessed and found to be not harmful to human health and environment
   - Also called "green purchasing"
   - Includes everything from recycled paper at the simplest level to medical equipment at higher levels
   - Employs a 'life-cycle' approach to reduce overall environmental impact
2. Inventory control in pharmacy and store room
3. Employing reusable and recyclable products

REUSE

Re-use is reusing the product over and over again for a given function intended as well as finding another use for a product.

1. Reuse as a principle of waste management demands selection of such materials that can be reused rather than those that have to be disposed after single use. This principle can be applied whenever possible.
2. Standards for disinfection and sterilization have to be strictly followed if equipments and materials have to be reused.
3. A combination of or all sterilization processes as autoclaving,disinfection, cleaning, reconditioning and decontamination methods should be used for the devices such that they are safe for reuse.
4. Items not directly used for healthcare can be used for reuse - paper, cardboard, glass, metal containers, plastic wrappings etc.
5. Devices such as syringes and hypodermic needles that are meant for single use must not be reused as the risk of cross infection is high.

RECOVER

Resource recovery can be achieved by selective extraction of disposed materials from waste stream for a specific next use by diverting it to resource recovery stream.

1. Solvent recovery in the hospital laboratory
2. Silver recovery in Radiology Department
3. Mercury recovery

RECYCLE

Recycling is reprocessing of a used item into a new raw material. Often reduce and reuse terminologies often used synonymously. While Reuse refers to use of the product or item in the original form either for same purpose or for different purpose, Recycling refers to when the product will lose its original form and shape and may be used for different purpose. Recycling office paper, newspapers, aluminium cans, glass bottles, construction debris, etc.

FIGURE 5: SYNOPSIS OF THE HCW STREAM

Step	Location	Healthcare waste stream	Key points
0		Waste Minimization	Purchasing policy; Stock management; Recycling of certain types of waste
1	In Medical unit	Generation	Colour coded containers/ bags; Proper waste segregation
2		Segregation at source	One of the most important steps to reduce risks and amount of hazardous waste
3	In-Health facility	Collection+ On-site transport	Protective equipment; sealed containers; specific easy to wash trolleys
4		On-site storage	Lockable easy to clean storage rooms; limited storage time of 24-48 hours
5		On-site treatment/ disposal	Adequate storage room; limited time of maximum of 48 hours
6	Outside of Health Facility	Off-site transport	Appropriate vehicle and consignment note; HCF is informed about final destination
7		Off-site treatment/ disposal	Appropriate vehicle and consignment note to be ensured

Source: WHO Blue Book

The principle of Reduce, Reuse, Recycle and Recover should be adopted in the safe management of bio-medical waste in order to protect human health and minimize its impact on the environment.

TAKE HOME MESSAGES:

- 4 R principles to be adopted wherever feasible – REDUCE, REUSE, RECYCLE & RECOVER
- Segregation is one of the keys to reduce the cost for disposal and increases materials for recycling

CHAPTER 4 - SEGREGATION OF BIO-MEDICAL WASTE

Learning objectives

1. To explain the importance of segregation and containment
2. To know about colour coding, labelling and placement of bins
3. To demonstrate the segregation of various bio-medical waste into different colour coded bins in accordance with BMWM Rules, 2016

Contents

Frequently asked questions

INTRODUCTION

As mentioned in the BMWM Rules, 2016,

- No untreated bio-medical waste shall be mixed with other wastes.
- The bio-medical waste shall be segregated into containers or bags at the point of generation in accordance with Schedule I prior to its storage, transportation, treatment and disposal.[2]

Segregation is the primary step and the "HEART" of safe management of biomedical waste management. Simply put across segregation means collection and separation of different types of waste right from the point of generation to final disposal.

Bio-medical waste which is segregated at the point of generation should continue to remain in the same waste category during storage, transportation till final disposal. Only 10- 25% of waste generated at health care facilities is hazardous and requires appropriate management. Nearly 75-90% of waste generated at health care facilities is non hazardous or general waste in nature. Hence, a sizable portion of waste generated is recyclable. Segregation, as a system in place will help separate hazardous and non-hazardous waste and contribute to minimizing the quantum of hazardous waste.[1]

BENEFITS OF SEGREGATION

- Minimizes the quantity of infectious / hazardous waste that needs special handling and treatment
- Prevents the mixture of medical waste like sharps with the general municipal waste
- Reduces the risks of exposure to hazardous health care waste for workers and hence reduce the chance of spread of infection/ injuries
- Reduces the cost of treatment of waste and its disposal as a result segregation helps in saving resources.
- Segregation prolongs the operational life of the disposal facility
- Prevents pilferage of certain waste like used syringes, needles and other plastics.
- Plastic waste if recycled after appropriate treatment can be used for non-food grade applications
- Hospital aesthetics will be maintained.

GENERAL PRINCIPLES OF WASTE SEGREGATION

• Waste segregation should happen at the point of generation. Generators of waste eg. - doctors, nurses, laboratory technicians are responsible for segregation of waste as soon and as close as possible to the point of generation. Hence, segregation has to be carried out at bedside, at the operation table, at the workstation in a laboratory. [1]

• Different hazardous waste should be separated in different containers with bags and bar codes as per BMWM Rules, 2016 as mentioned in the schedule I.

• To improve segregation efficiency proper placement, labelling of colour coded bins and use of colour coded bags with bar codes, as per BMWM Rules, 2016 must be strictly implemented.

• Segregation of waste should be maintained throughout the life cycle till its final disposal- i.e. wastes should not be mixed during collection, transport or storage.

COLOR CODING AND LABELING OF WASTE BINS

Containers for waste collection:

- Should be of the appropriate material for the type of waste with correct colour and symbol
    1. For Infectious waste, the containers should be leak-proof plastic or metal or steel containers and yellow coloured with biohazard symbol
    2. For Sharp waste, the container should be white translucent puncture proof, leak proof, tamper proof container with biohazard symbol
    3. For Recyclable contaminated waste, the containers should be leak-proof plastic or metal or steel containers, red coloured with bio hazard symbol For Cytotoxic waste, the containers should be leak-proof plastic or metal or steel containers and Yellow coloured with cytotoxic symbol
    4. For Glassware and metallic body implants, puncture proof and leak proof box or container with blue coloured marking with bio hazard symbol should be used.
- Should be of adequate size depending on the quantum of waste generated at the point of generation
- Should have a plastic bags of not less than 50µ thickness. The plastic bag and the bin should have the 'biohazard' symbol or cytotoxic symbol as appropriate and prominently displayed
- Should be covered and preferably foot operated
- As per BMWM (Amendment) Rules, 2018 microbiology, biotechnology and other clinical laboratory waste including the blood bags, should be pre-treated on site either through disinfection or sterilisation as per World Health Organization guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014" and then send to CBWTF or deep burial for final disposal Liquid chemical waste should be segregated at source and pre-treated or neutralised prior to mixing with other effluent generated from HCFs.[2]

COLOUR CODING
(NON-CHLORINATED, MORE THAN OR EQUAL TO 50µ THICK PLASTIC BAG)

- Helps health care personnel to segregate waste items into correct color coded waste bins.
- Color coding helps health care personnel who are less literate to retain segregated waste during the process of transportation, storage and final disposal.
- Color code provides a visual hint of the potential risk of the contained waste.[2]

FIGURE 6: COLOUR CODED BAGS/CONTAINERS

PLACEMENT OF BINS:

- Infectious waste containers should not be placed in areas where no infectious waste is generated (such as visitor's waiting areas, visitors' toilets, reception, administrative offices, medical records department, etc.)
- In areas where both infectious and non-infectious wastes are generated, both containers should be strategically placed near each other so as to facilitate segregation.
- Sharps container should be within arm's length of the healthcare professionals giving the injections. Placing waste containers too far away can increase the risk of needle-stick injuries.
- Sharps container to be either wall mounted or placed on a table.
- Infectious and sharps bins should not generally be placed by the patient beds except for isolation wards
- The nurse's trolley should have provision for the yellow bin (for contaminated swabs or dressings), red bin (syringes, etc.) and a sharps container (needle) and hub cutters in case they are used
- Location of the waste bins should be in the nurses' station, treatment room, or in other areas that patients and visitors cannot access
- If the Healthcare facility recycles non-hazardous general waste, marked containers for recyclables such as paper, packaging, plastic bottles and aluminium cans should be strategically located

- Chemical waste containers should be in areas where chemical waste is generated, such as pharmacy, laboratory and engineering
- Container for Expired drugs can be placed in Pharmacy as a central storage area from where it can be returned to the manufacturers or handed over to CBWTF, whichever is the policy of the HCF
- Any colour other than that used for BMW and according to the state policy, appropriate bins should be used for general waste

FIGURE 7: WASTE THAT SHOULD GO INTO YELLOW BIN

Human organs, Placenta, Soiled waste - Items contaminated with blood/ body fluids Experimental animal & its organs, blood bags & expired or discarded drugs into Yellow Bin.[2]

Blood soiled cotton swab

Bandaid[1]

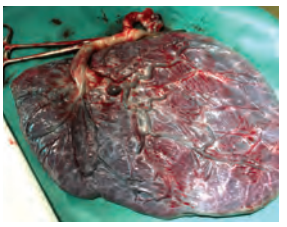
Head Cap[2]

Empty blood bags

Expired blood bag

Expired or Discarded Medicines[3]

Experimental animal[4]



Placenta[5]

Mask

Plaster cast

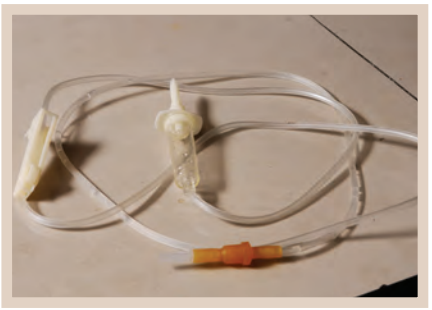
Yellow bin with yellow non-chlorinated plastic bag (≥ 50 µ)

FIGURE 8: WASTE THAT SHOULD GO INTO RED BIN

All Contaminated (Recyclable) Waste into RED BIN

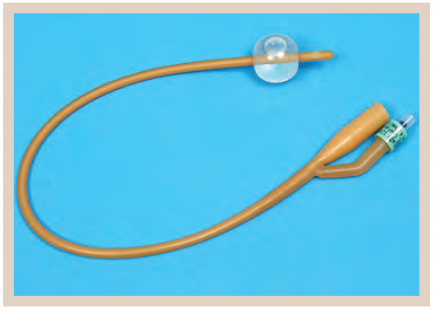
Heavy duty rubber gloves

Latex gloves



Infusion / IV set

Vacutainers[6]



Rubber tubing

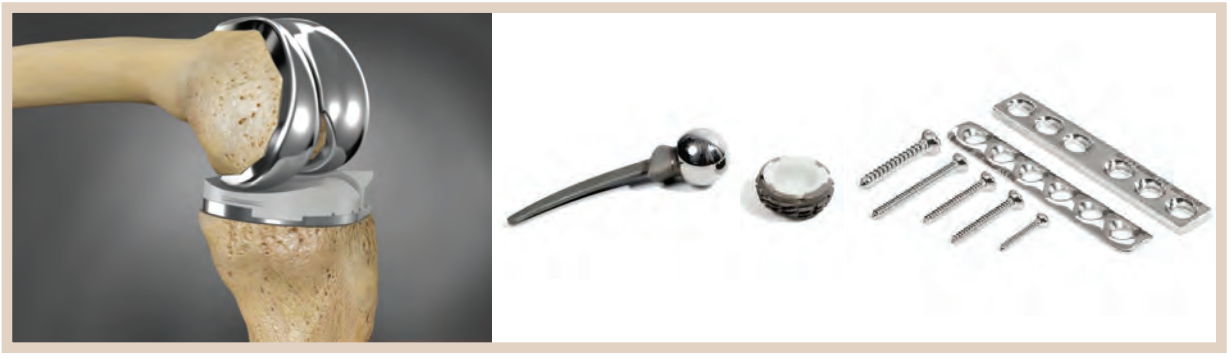
Urine bag

Plastic syringe

Red bin with red non-chlorinated plastic bag (≥ 50 µ)

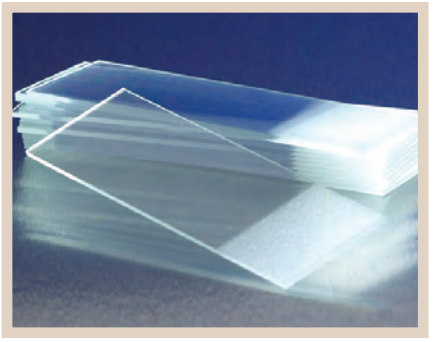
FIGURE 9: WASTE THAT SHOULD GO INTO THE BLUE BOX

Glass waste and metallic body implants into puncture proof and leak proof box or container with Blue coloured marking.



Metallic body implants

Broken ampules



Slides

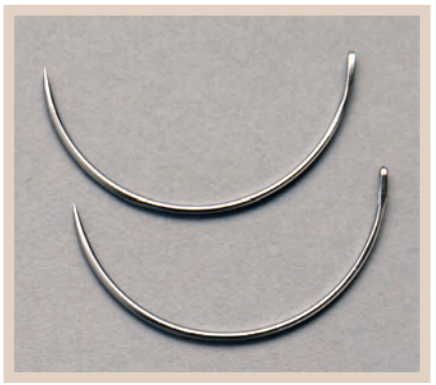
Empty vials

Puncture proof , Leak proof Box/ Container with blue colored marking

FIGURE 10: WASTE THAT SHOULD GO INTO THE WHITE CONTAINER

Sharps into white tamper-proof, puncture-proof, leak proof container

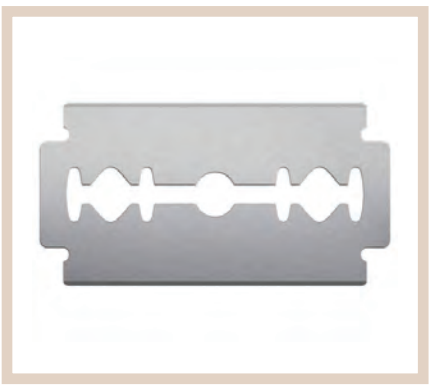
Fixed needle syringe



Surgical Needles

Needles

Scalpel blades



Blade

White Translucent Tamper - Proof / Puncture-Proof / Leak Proof Container

FREQUENTLY ASKED QUESTIONS

1. What is containment?

Containment is the method of treatment where segregated waste is contained in appropriate colour coded containers till its final disposal so that it does not cause any harm to human or environment.

2. How many coloured bins do I need to maintain?

Four colours - Yellow, Red, White and Blue

Yellow	• Human and animal Anatomical Waste
	• Soiled Waste
	• Expired or Discarded Medicines including cytotoxic drug
	• Chemical Waste
	• Chemical Liquid Waste
	• Discarded linen, mattresses, beddings contaminated with blood or body fluid
	• Microbiology, Biotechnology and other clinical laboratory waste
Red	• Contaminated Waste (Recyclable)
White (Translucent)	• Waste sharps including metals
Blue	(a) Glassware: Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes (b) Metallic Body Implants

3. What type of container should I use for sharps?

White (Translucent) Puncture proof, Leak proof, Tamper proof containers

4. Do I need to disinfect Sharps at the HCF?

Under the 2016 rules, chemical disinfection has not been mentioned at the level of HCF. However, at HCF, a disinfectant can be added to ensure safety before sending to CBWTF. But at CBWTF, autoclaving followed by shredding and mutilation is done before sending for encapsulation with cement concrete. As a good practice, it would be better to chemically treat with hypochlorite waste before sending to CBWTF.

5. Should Microbiology, biotechnology and other clinical laboratory waste be pre-treated?

Yes. Microbiology, biotechnology and other clinical laboratory waste needs to be pre-treated at HCF either by Autoclave/ Microwave/ Hydroclave and then sent for Incineration.

TAKE HOME MESSAGES:

- A four colour coded bin system according to BMWM Rules 2016
  i. Yellow – Infectious waste
  ii. Red – recyclable waste
  iii. White – Metallic sharps waste
  iv. Blue – Glassware and metallic body implants
- Ensure segregation of waste at the point of generation

Learning objectives

1. To explain the Principles of Disinfection
2. To demonstrate the preparation of disinfection solution

Contents

1. Definition of disinfection

2. Efficiency of disinfection

3. Differences between Sterilization and Disinfection

4. Different methods of onsite disinfection suggested as per BMW Rule of 2016

    - Autoclave
    - Microwave
    - Chemical Disinfection

5. What are the different categories of waste that needs to be pre-treated?

6. How do we prepare 10% sodium hypochlorite solution?

INTRODUCTION

Disinfection of waste is aimed at killing of pathogenic organisms so as to render the waste incapable of spreading disease to humans. It does not aim at killing all microorganisms and spores.

DEFINITION OF DISINFECTION

Disinfection is defined as destruction of most of the pathogenic agents or their toxins with an exception to bacterial spores on inanimate objects or surfaces by use of chemical substances or physical agents.

EFFICIENCY OF DISINFECTION DEPENDS UPON THE FOLLOWING

- The characteristics of waste and the extent of contamination with organic matter
- Efficiency of the disinfectant
- Strength of the disinfectant
- The period of contact between waste and disinfectant

DIFFERENCES BETWEEN DISINFECTION AND STERILIZATION

Disinfection	Sterilization
Disinfection is the process of eliminating all harmful bacteria and inactivation of viruses from any surface. E.g.: Bed stand, door handle	Sterilization is a process by which all the microorganisms and spores are killed that are present on any surface E.g.: autoclave sterilizes surgical instruments
Disinfection can be achieved by chemical disinfectants, heating, pasteurization	Sterilization can be achieved through Heat, chemicals, irradiation
Disinfection is used mostly to decontaminate surfaces and air	Sterilization is used for medical and surgical instruments

DIFFERENT METHODS OF ONSITE DISINFECTION SUGGESTED AS PER BMWM RULES OF 2016

1. Autoclave
2. Microwave
3. Chemical disinfection with Sodium hypochlorite solution

1. Autoclave

- An autoclave is made of metal vessel, that is designed to tolerate high pressure and temperature. A system of pipes and valves are used to deliver steam and create vacuum in the vessel. A sealed door prevents escape of steam.[1]
- The basic principle of sterilization is that steam under pressure and required temperature is microbicidal and sporicidal.
- The four parameters that are important for autoclave are steam, pressure, temperature and time.
- Items that can be autoclaved: soiled waste, left over samples in the laboratory, any waste contaminated with blood or body fluids,(gauge, bandages,linen,) sharps, microbiological waste like culture media, limited amount of fluids.[1]
- Autoclaving as a method of disinfection is not recommend for anatomical waste as complete penetration of heat is not uniform.[1]

FIGURE 11: AUTOCLAVE

2. Microwave

- Moist heat and steam are generated by microwave energy and microwaving is essentially a steam based process.[1]
- The frequency radio waves that are generated will create friction between molecules that will generate heat which helps in disinfection.
- Items which can be disinfected using microwave: Cultures and stocks, sharps, materials contaminated with blood and body fluids, isolation and laboratory waste (excluding chemical waste) and soft waste (e.g. gauze, bandages, gowns and bedding) from patient care.
- Items not to be put in microwave: Volatile and semi- volatile organic compounds, chemotherapeutic waste, mercury, other hazardous chemical waste and radiological waste

Source: Meteka GmbH, Austria

FIGURE 12: MICROWAVE

1. Sodium hypochlorite solution

- Active against most bacteria, viruses and spores; widely used for treatment of waste water.
- As per BMWM Rules 2016, Sodium hypochlorite solution is the disinfectant to be used
- Chemical disinfection is most suitable for treating liquid waste such as blood, urine, stools or hospital sewage.
- Solid, even highly hazardous, health-care wastes, including microbiological cultures and sharps, may also be disinfected chemically, with the following limitations:
  1. Shredding or milling of waste is usually necessary before disinfection.
  2. Powerful disinfectants are required, which can be hazardous and should be used only by well-trained and adequately protected personnel.
  3. Disinfection of intact solid waste items by chemical disinfectants is limited to only the surface of solid waste.[1]

FIGURE 13:
SODIUM HYPOCHLORITE SOLUTION

DIFFERENT CATEGORIES OF WASTE THAT NEED TO BE PRE-TREATED AT HEALTHCARE FACILITY

FIGURE 14: CATEGORIES OF WASTE THAT NEED TO BE TREATED AT HCFS

Sl. No	Category of Waste	Pre-treatment
1	Microbiological waste Biotechnology waste Other clinical laboratory waste	Autoclave Or Non chlorinated disinfectant to achieve $\log_{10}4$ reduction efficiency of microorganisms
2	Discarded linen, mattresses, beddings contaminated with blood or body fluid.[2]	Non chlorinated chemical disinfection or sterilization and shredding
3	Spill management	Chemical treatment with sodium hypochlorite solution
4.	Blood and liquid samples	Chemical disinfection / autoclave / ETP

PREPARATION OF 10% SODIUM HYPOCHLORITE SOLUTION

- Sodium hypochlorite is available as a greenish –yellow solid. To prepare 10% Sodium hypochlorite solution we need to dissolve 100g in 1000ml i.e., 1 litre of water.
- However 10% Sodium hypochlorite solution is commercially available

Things to keep in mind while preparing sodium hypochlorite solution

- Chlorine solutions lose strength and hence chlorine-based disinfectants have to be prepared freshly to be effective
- Clear water should be used as the presence of organic matter would render chlorine as an ineffective disinfectant
- Avoid direct contact with skin and eyes
- The solution must be prepared in a well ventilated room
- Preferably use plastic containers for storing and preparation of sodium hypochlorite solution as it corrodes metals

FREQUENTLY ASKED QUESTIONS

1. What precautions are to be taken while using sodium hypochlorite solution?

- Personal protective equipment (PPE) – heavy duty rubber gloves, masks, goggles, apron and gum boots.
- In case of accidental splash to the eyes they have to be washed abundantly with water

2. How do I store Sodium hypochlorite solution?

- Sodium hypochlorite has to be stored in a cool and dry place away from sunlight.
- It is corrosive to metals and has to be stored in closed plastic containers.

3. Do we need to wash the surface before disinfection?

- Presence of dirt and organic matter decreases the efficiency of chlorine-based disinfectants for disinfection of surfaces and floors, dirt needs to be cleaned before disinfection is undertaken.

4. Can chlorine-based disinfectant be mixed any other cleaning agent?

- Chlorine-based disinfectant should not be mixed with other cleaning agents. Presence of ammonia in the cleaning agents can react with sodium hypochlorite causing the release of chloramines and inhaling these can be harmful.

TAKE HOME MESSAGES:

- Disinfection of waste is aimed at killing of pathogenic organisms so as to render the waste incapable of spreading disease to humans.
- It is the duty of the occupier to pre-treat microbiological and infectious lab waste on-site before sending it for final treatment and disposal. The various methods advocated for pre-treatment of biomedical waste include Autoclave, Microwave and Chemical disinfection.

Learning objectives

1. To know about the requirements for on-site transportation of waste in a HCF
2. To know about types of trolleys for different types of waste, their maintenance and routes of transport within the HCF
3. To know about requirements for off-site transportation to CBWTF

Contents

Frequently asked questions

INTRODUCTION

Occupiers of HCF have a "duty of care" to ensure that misuse or abuse of biomedical waste is prevented from the point of generation till safe final disposal either onsite or offsite. [(1)] Proper segregation, onsite and offsite transportation systems provide a continuous sequence of safe keeping at each step in the process, from the point of generation of waste to its final treatment or disposal. Hence safe transportation of waste without mixing and without spillage is an essential part of the waste management process.[1]

COLLECTION

During collection, transport and storage hazardous and general waste must not be mixed.

- Waste handlers must be well trained on risks and safety measures to be taken while handling bio-medical waste.
- Appropriate PPE should be worn before handling the Bio-medical waste
- Establish a plan for collection and transportation – Collection points, designated route, time and frequency of collection of waste should be specified
- Quantum of waste generated determines the frequency with which it is collected. It is preferred that waste is collected at least once in a day and transported to the designated temporary storage area within the health care facility.
- Plastic bags once ¾th filled, must be sealed, labelled, bar coded and transported to temporary storage area using designated trolley.
- The label must at least contain the following information
  1. Date
  2. Area / Floor / Unit shift.
  3. Type of waste
  4. Weight of the waste
- The waste movement is to be done through a designated lift through designated route
- Ensure that all bags are tied and secured and there is no spillage or leakage during the transportation
- In an event, where there is a cut or tear of the bag, ensure that double bagging is done before transporting it
- In case of spill, refer to spill management protocol.
- Once the waste is collected, a fresh same color plastic liner has to be replaced immediately.

A. TRANSPORTATION WITHIN THE HEALTHCARE FACILITY

1. General requirements

- Less busy hours to be selected for transportation of biomedical waste within the health care facility.[1]
- A fixed route to used every day.[1]
- Separate floors, stairways or elevators designated only for waste should be used
- Regular transport routes should be used and waste should be collected at the designated time every day
- All personnel handling waste must wear personal protective gear such as gloves closed shoes, overalls and masks.[1]
- Hazardous and non-hazardous waste must be transported separately.[1]

2. Transport systems

- Trolleys for general waste should be painted black, only be used for non-hazardous waste types and labelled clearly "General waste" or "Non-hazardous waste"
- Each trolley for bio-medical waste can have separate compartments for yellow, red and blue category of wastes. White containers can be transported separately.
- Separate colour coded trolleys, labelled with bio-hazard sign can be used.

3. Transport trolleys

- Wheeled trolleys or carts should be used. These trolleys should not be used for any other purpose
- Trolleys should not have sharp edges that could damage waste bags or containers
- Trolleys should not be overloaded
- See that trolleys are labelled (label sample see annexure for BMWM Rules, 2016)
- See that the trolley for hazardous waste has a locking arrangement
- AVOID transportation of waste specially hazardous waste by hand. The risk of accident or injury is high if transported by hand.
- It is preferred to keep ready a spare trolley exclusive for transportation of waste in case of breakdowns or repair.
- Trolleys used for transportation of waste have to be cleaned and disinfected daily
- Ensure that all the plastic bags are intact and sealed at the beginning and at the end of transportation.[1]

4. Routing

FIGURE 15: TRANSPORT TROLLEYS

- See that separate routes are followed for hazardous and non-hazardous (food and general) waste
- Collection should start from potentially high risk areas like intensive care units, dialysis units, operation theaters.
- Following a fixed route for transportation of waste within the health care facilities would minimize the exposure.[1]
- Infectious waste must be collected daily
- Waste should never be allowed to overflow; more frequent collection should be requested

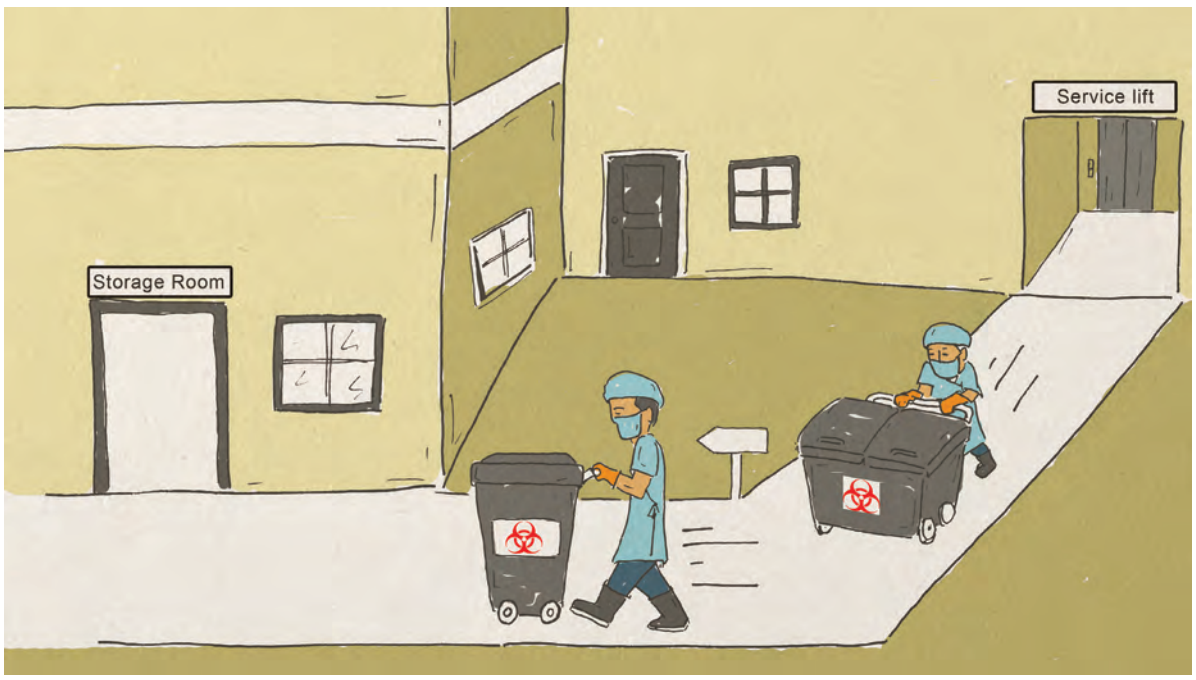


FIGURE 16: TRANSPORTATION WITHIN THE HCF

B. OFFSITE TRANSPORTATION

As per the BMWM Rules, 2016, the operator of a CBWTF shall transport the bio-medical waste from the premises of the occupier to any off-site bio-medical waste treatment facility only in the vehicles having label as provided in part A of Schedule IV along with necessary information as specified in Part B of Schedule IV. [2]

- Drivers and transporters should have certified training on handling healthcare waste
- The certificate should be renewed annually
- An emergency response intervention card should be in the drivers cabin

1. Vehicle requirements

- The vehicle should have separate compartments – one for the drivers cabin and the other for waster
- The waste should be secured and should not fall out from the vehicle
- In a separate compartment of the vehicle the below mentioned items have to be stored to combat any emergency situation such as spills.[1] Plastic bags, protective clothing equipment for necessary for cleaning, disinfectants and special kits for dealing liquid spills
- The vehicle should have the name and address of the waste carrier
- Vehicle used for transporting biomedical waste should display biohazard symbol and emergency telephone numbers.[1]

1. The vehicle should be kept locked at all times
2. No other waste should be carried in the vehicle

2. Cleaning of container and vehicle

- The vehicle should be cleaned and disinfected daily after use. [1]
- Soaps and detergents should be used for cleaning
- The vehicle should be serviced regularly

3. Transport documentation

Driver of the vehicle must carry consignment note or waste tracking note.[1]

The consignment note should include:

- Waste categories
- Sources of Waste
- Pick-up date and time
- Destination
- Driver name
- Number of containers or volume of waste
- Receipt of load received from responsible person at pick-up areas.[1]

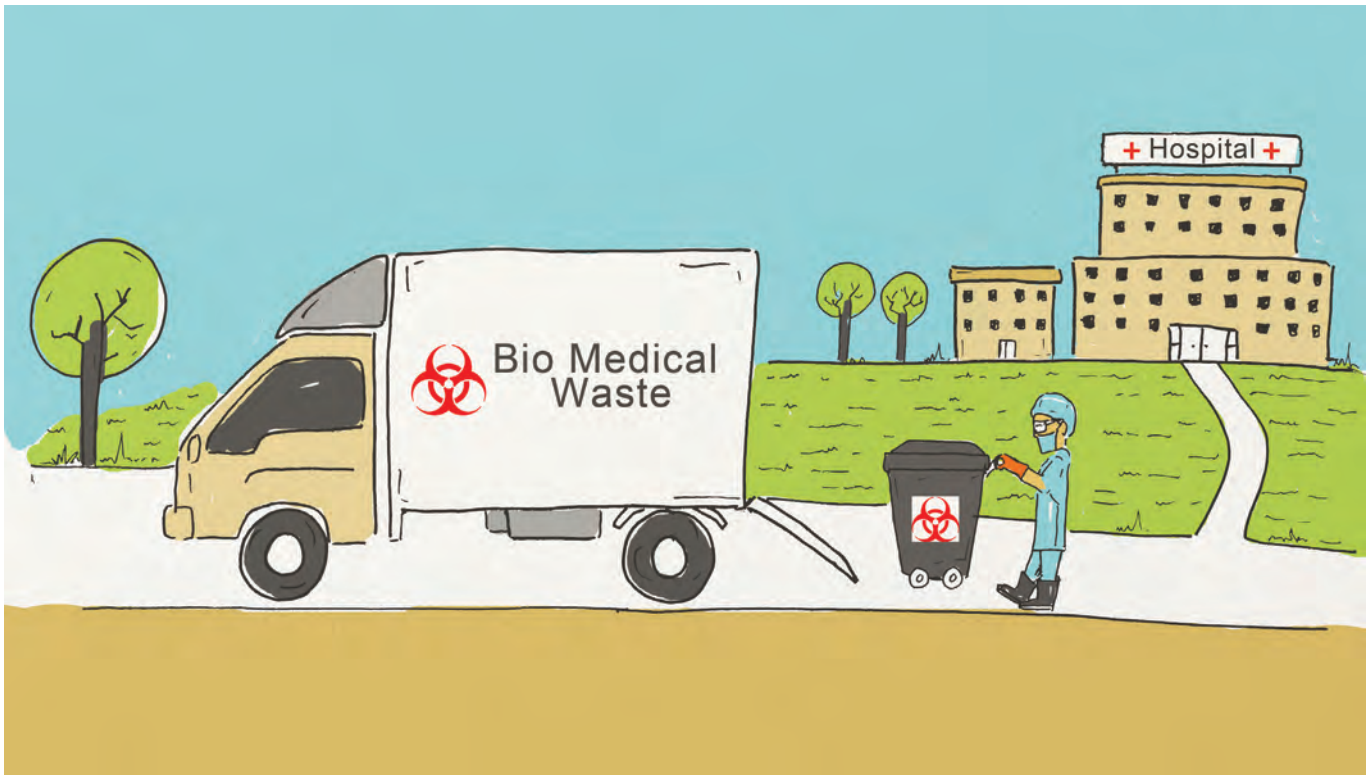


FIGURE 17: OFF-SITE TRANSPORTATION

FREQUENTLY ASKED QUESTIONS

1. Who provides the waste transport facility from the hospital to the Common bio-medical waste treatment facility (CBWTF)?

The operator of CBWTF generally provides the vehicle for the transport of bio-medical waste from the healthcare facility.

2. Who collects the non-biomedical waste from the hospitals?

The municipal body of the area picks up and transports segregated general solid waste generated in hospitals and nursing homes.

3. Is training required for waste transporters?

Yes. The waste transporters need to be trained on the following:

- Relevant legal regulations
- Hazards of bio-medical waste
- Waste classifications
- Coding and documentation
- Spillage procedures
- Use of appropriate PPE

4. What are the personal protective measures to be worn by the bio-medical waste transporter?

Cap, mask, face shield, gown, gumboots and heavy duty gloves

TAKE HOME MESSAGES:

- Ensure that waste bags are appropriately sealed, removed and replaced immediately when they are three-quarters full
- Waste collectors should wear cap, mask, heavy duty gloves, industrial boots and apron

CHAPTER 7 – TEMPORARY STORAGE IN HCF

Learning objectives

1. To know how different types of wastes need to be temporarily stored in a HCF
2. To know about the basic requirements of a temporary storage facility in a HCF

Contents:

1. Introduction
2. Recommendation for storage-location, structure and process

Frequently asked questions

INTRODUCTION

As per BMWM Rules, 2016, it is the duty of the occupier to make a provision within the premises for a safe, ventilated and secured location for storage of segregated bio-medical waste in coloured bags or containers in the manner as specified in Schedule I. The occupier has to ensure that there shall be no secondary handling, pilferage of recyclables or inadvertent scattering or spillage by animals. Bio-medical waste from such place or premises shall be directly transported in the manner as prescribed in these rules to the common bio-medical waste treatment facility or for the appropriate treatment and disposal, as the case may be, in the manner as prescribed in Schedule I.[2]

A separate designated space to be allocated within the health care facility for storing of waste collected from different waste generation points in the health care facility till disposal to common biomedical waste treatment facility or onsite treatment. The designated space may be called as temporary central storage area. In situations where space is a constraint for HCFs, daily collection and pretreatment has to be imposed prior to disposal.[1]

RECOMMENDATIONS FOR STORAGE OF BIO-MEDICAL WASTE IN HCF

1. Location

- Storage location for bio-medical waste should be designated within the health-care facility premises
- Should have easy access for waste-collection vehicles
- Should have easy access for staff in-charge of handling the waste
- Should be inaccessible to animals, insects and birds
- Location of temporary storage area should be away from food preparation areas stores with fresh food.[1]

2. Structure and facilities inside the temporary storage area:

- An impermeable floor with good drainage facility.[1]
- The floor should be easy to clean and disinfect.[1]
- The size of the storage area depends on the quantum of waste generated and frequency of collection of waste.
- Four colour coded areas should be constructed for bio-medical waste storage– yellow, red, blue and white
- Should be secured preferably by lock and key to prevent access by unauthorized persons.[1]

- Protected from the sun and rain
- Good lighting and at least passive ventilation
- Adequate supply of cleaning equipment, protective clothing and waste bags or containers located conveniently close to the storage area
- Adequate water supply for cleaning purposes
- Spillage containment equipment
- Hand washing facility with wash basin with running tap water and soap for waste handlers
- Electrical hand drier

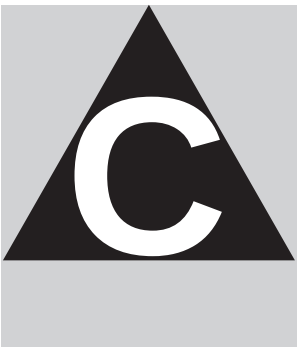
3. Process

- The bio-medical waste in the storage area is to be weighed, bar coded and documented in a log book.
- Storage area to be cleaned regularly (at least once a week on a fixed day)

FIGURE 18: LABELS FOR BIO-MEDICAL WASTE

Bio-medical waste

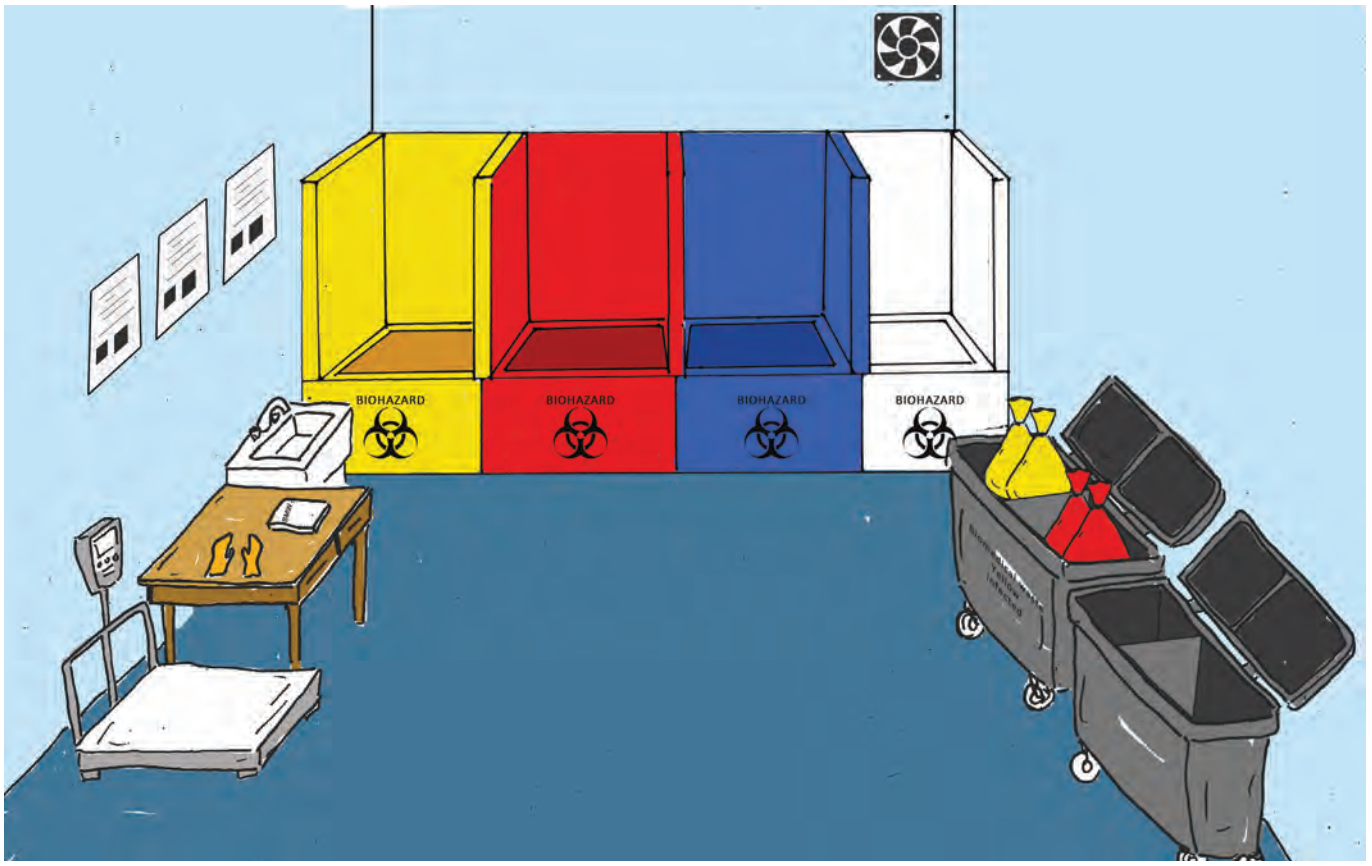
Hazardous and cytotoxic waste



Note: No untreated human and animal anatomical waste, soiled waste and micro biological waste shall be stored beyond a period of 48 hours.

If for any reason, it becomes necessary to store such waste beyond 48 hours, the occupier (HCF) should take appropriate measures to ensure that the waste does not adversely affect human health and the environment. The prescribed authority must be informed and should have extended waste storage facility.

FIGURE 19: TEMPORARY STORAGE AREA



FREQUENTLY ASKED QUESTIONS

1. How should bio-medical waste be stored?

Bio-medical waste must be stored so that it avoids being mixed with other general waste. The access to it must be limited to personnel authorized to handle it. The areas used for storage must be constructed of materials that are impermeable and can be easily maintained in a sanitary condition.

2. How long can the bio-medical waste be stored?

Immediate treatment and disposal are ideal procedures to be followed for disposal of bio- medical waste. Storage of infectious waste should not exceed 48 hours.

3. Is it necessary to have temporary storage area?

Yes, as per BMWM rules 2016, it is the duty of the occupier to ensure provision of temporary storage room area within the hospital premises.

TAKE HOME MESSAGES:

- Dedicated, secured temporary storage area to be available to store Bio-medical waste generated from all the points of generation in the health care facility before transporting the waste to CBWTF No untreated human and animal anatomical waste, soiled waste and biotechnology waste shall be stored beyond 48 hours in the temporary storage area

Learning objectives

1. To know the sources of mercury in a healthcare facility (HCF) and its adverse health impacts
2. To know how to manage an accidental mercury spill

Contents

Frequently asked questions

INTRODUCTION

Mercury is a heavy metal that is a silvery-white liquid at ambient temperature and vaporizes at high temperatures. The vapours may stay in the atmosphere for up to a year and ultimately accumulates as water sediments. Mercury use is associated with a number of health problems.[1]

Mercury released from hospitals finds its way to water where it undergoes bio-magnification and elemental mercury becomes converted to Methyl Mercury which through sea weeds and small fish end up in large fish such as Tuna. Eating such fish leads to mercury poisoning and effects the health of the community.

HEALTH PROBLEMS ASSOCIATED WITH MERCURY

1. Elemental mercury causes chemical pneumonitis and neurotoxicity
2. Inorganic form of mercury is known to cause gastrointestinal ulceration/ bleeding, necrosis of the proximal tubule leading to renal failure.[7]
3. Organic form of Mercury affects the brain.[7]

All the three forms of Mercury tend to be neurotoxic when exposure to mercury is very high. It is being observed that mercury has the propensity to cross the placental barrier to impact on the neurological development of the foetus.[7]

SOURCES OF MERCURY IN HCFS

Mercury is found in thermometers, sphygmomanometers, cantor tubes, oesophageal dilators, feeding tubes, gastrointestinal tubes, urinometers, X-Ray machines, thiomersal in vaccines, barometers used in respiratory therapy, mercury switches and some button-shaped batteries.

ACTIONS TO BE TAKEN TO CLEAR ACCIDENTAL MERCURY SPILLAGE

It is important that accidental Mercury spills in the health care facility are appropriately managed to reduce its health and environmental impacts.[7]

TABLE 7: STEPS IN AN EVENT OF MERCURY SPILL

Evacuate area

- Put caution board and cordon off area
- People not involved in the clean-up should stay away from the spill area
- Heaters and air-conditioners should be turned off
- Open windows and ventilators

Protect yourself

- Wear a mask to prevent breathing of mercury vapour
- Remove jewellery from hands and wrists so that the mercury cannot combine (amalgamate) with the precious metals
- Put on rubber gloves and remove any broken pieces of glass or sharp objects

Clean broken objects

- Place all broken objects on a paper towel and place in a puncture proof plastic bag or container with lid
- Secure the plastic bag/container and label it as containing items contaminated with mercury

Remove mercury beads

- Locate all mercury beads
- Look for mercury in any surface cracks or in hard-to-reach areas of the floor
- Use the torch to locate additional glistening beads
- Cardboard sheets should be used to push the spilled beads together
- Syringe (without a needle) canbe used to suck the beads of mercury

- Collected mercury should be placed in an unbreakable plastic container/glass bottle with an airtight lid half filled with water
- Use sticky tape to collect smaller hard-to-see beads

Collection in leak-proof bag or container

- Place all the mercury contaminated materials used during the clean-up, including gloves, mercury spills collected from the spill area into a leak-proof plastic bag or container with lid and seal properly
- Label as per guidelines and such collected waste should be stored in a designated area

Cleaning of all surfaces

- Sprinkle sulphur or zinc powder over the area
- Powder will quickly bind any remaining mercury
- Use the cardboard and then dampened paper towels to pick up the powder and bound mercury
- Place all towels and cardboard in a plastic bag and seal all the bags that were used and store in a designated area.
- All the mercury spill surfaces should be decontaminated with 10 % sodium thiosulfate solution
- After ensuring all the mercury has been removed, resume normal vacuuming and utilise the cleaned area for routine operation

Labelling

- All the bags or containers containing items contaminated with mercury should be marked properly and labelled

- AVOID disposing mercury spills into drainage or sewage as it would lead to contamination of the septic tank and the sludge in the sewage treatment plant.[7]
- AVOID washing mercury contaminated items in a washing machine.[7]
- Vacuum cleaner or broom should not be used to collect spilled mercury

Refer Flow chart in annexure 2.

MERCURY SPILL KIT FOR MERCURY SPILL MANAGEMENT

1. Mercury spill can be managed with the help of mercury spill kit hence, all health care facility need to have at least three kits.[7]

2. To prevent further exposures to Mercury, it is preferred that personnel trained in handling Mercury spill would use the spill kit.[7]

3. Mercury spill kit can be made locally by putting together the required items and storing it in a box or portable container separately.[7]

Recommendation: One spill kit at every nursing station

TABLE 8: CONTENTS OF MERCURY SPILL KIT[7]

Personal protective equipment (PPE): Rubber or nitrile gloves, safety goggles or protective eyewear, respiratory protection, face mask, coveralls, apron, disposable shoe covers

Air-tight, sealable plastic container: Air- tight, sealable plastic container: This container is needed to store elemental mercury after collecting from the floor. The container may be filled with some water and it is ideal if the container is wide mouthed.

Air-tight, puncture-resistant, rigid plastic or steel jar or container a wide mouthed steel jar or puncture proof rigid plastic container may be used for collecting broken glass contaminated with mercury.

Shiny mercury beads can be located with the help of a torch.

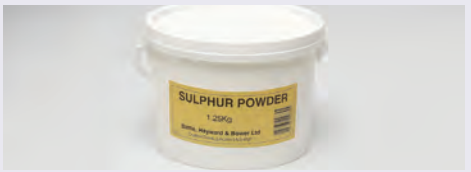
Thin pieces of **Plastic or stiff paper/ Cardboard / X rays.** They can be used to gather mercury beads on to plastic scoop.

Tweezers - help remove broken glass pieces

Eyedropper or syringe (without the needle) to draw up large mercury beads

Stick tape may be used to pick up tiny mercury droplets that could not be gathered by other methods

Sulphur powder or sodium thiosulphate to be sprinkled to absorb any leftover mercury on the floor.



FREQUENTLY ASKED QUESTIONS

1. Can mercury be disposed of along with bio-medical waste?

No. Mercury is considered as hazardous waste and should not be disposed of with bio-medical waste even if contaminated by bio-medical waste. It must be stored in a separate container half filled with water in a storage area in the health facility and must be handed over to a hazardous waste treatment facility.

2. Can anyone in the facility clean-up a mercury spill?

No. As soon as there is a mercury spill, evacuate the area and call trained personnel in the health care facility to help clean-up the spill so as to ensure proper use of PPE and steps in cleaning up.

TAKE HOME MESSAGES:

- Mercury is highly toxic to health and may get absorbed through the respiratory passages, or ingested or through the skin
- Mercury spills must be cleaned by trained personnel according to hospital policies
- It is recommended that mercury containing equipment in hospitals should be phased out

CHAPTER 9 – MANAGEMENT OF BLOOD/ BODY FLUID SPILLS

Learning objectives

1. To know how to manage a Blood / body fluid spill

Contents

1. Introduction
2. Spill kit
3. Management of a spill
4. Documentation of Spill

Frequently asked questions

INTRODUCTION

Spills of blood / infectious body fluids can be common occurrence in health care settings. They have to be managed effectively to ensure cleaning of the spill with minimal contamination to surrounding areas and to protect the health care worker from the hazards of the infectious material.

SPILL KIT

A spill kit should be present in all nursing stations to manage accidental blood spills.

FIGURE 20: CONTENTS OF SPILL KIT

Personal Protective Equipments:
a. Rubber gloves
b. Safety goggles
c. Mask
d. Apron
e. Disposable shoe cover

Old news paper /blotting paper / absorbant material

A bottle of sodium hypochlorite solution

Mop cloth

Yellow and Red plastic bags with bio – hazard logo for waste collection

MANAGEMENT OF A SPILL

FIGURE 21: STEPS IN THE MANAGEMENT OF BLOOD OR BODY FLUIDS

Isolate the area	• Contain the spill by surrounding it with an impermeable ring • Cordon off the area. If possible, close off the area by closing windows and doors. Turn off any fans which may spread the spill/aerosols. • Move patients away from the area of the spill.
Obtain spill kit and don protective clothing	• Open the spill kit and put out the caution sign. • Don PPE in the following order: 1. Disposable impermeable long-sleeved apron 2. Mask, goggles 3. Shoe covers 4. Rubber/ nitrile gloves
Clean up the spill	• Absorb the spill with absorbent material from the outside to the middle and discard it into yellow liner. Repeat the process if necessary. • Cover the spill area with sodium hypochlorite solution and leave for 20 minutes. • Wipe the area using disposable absorbent material (swab/ cloth) & discard into yellow bin. • Dry with disposable absorbent material. • Clean the area with detergent after decontamination as per hospital cleaning protocol
Dispose off the waste	• Discard gloves in red liner • Discard gown, Shoe covers, mask in yellow liner/ bag • If the goggles have been contaminated, discard into the bag, otherwise, wash wearing non-sterile gloves in warm soapy water. Dry with paper towels; discard paper towels into yellow bag. Place goggles back in the spill kit. • Wash hands with copious amounts of soapy water

FIGURE 22: MANAGEMENT OF A SPILL

DOCUMENTATION OF SPILL AND SKILL KIT REPLACEMENT

- Complete an Incident Form with the in-charge nurse/area supervisor (Refer chapter on Documentation)
- Refill the spill kit for the next use.

FREQUENTLY ASKED QUESTIONS

1. Who should handle the spill?

Only those trained and authorised to handle the spill must be involved in cleaning the spill.

2. Is it necessary to wear PPE to clean up a spill?

Definitely, yes. To prevent any infection to the health care worker, all PPE must be worn while handling any spill.

TAKE HOME MESSAGES:

- Blood/ body fluid spills must be cleaned as per the hospital policies, preferably by a trained personnel and the spill kit refilled for the next use.
- Documentation of the spill is important

CHAPTER 10 – MANAGEMENT OF CHEMICAL SPILLS

Learning objectives

1. To know how to manage a chemical spill

Contents

1. Introduction
2. Management of chemical spill
3. Documentation of spill

INTRODUCTION

Accidental spillage of chemicals / chemical waste within the health care facility has to be given the due importance and dealt by trained personnel. Only the area contaminated with spillage needs clean up.

MANAGEMENT OF CHEMICAL SPILL

Step 1: Put a caution board and cordon off the area.

Step 2: Decontaminate the eyes and skin of exposed personnel immediately.

Step3: Inform the designated person (usually the Safety Officer or the Waste Management Officer), who should coordinate the required necessary actions.

Step 4: Determine the nature of the spilled material.

Step 5: Exposed individuals to be provided with first aid and medical care.

Step 6: Wear PPE – Gown, Cap, Mask, Goggles and gloves in that order.

Step 7: Limit the spread of spill and neutralize (Neutralize acids with soda ash or sodium bicarbonate. Bases can be neutralized with citric acid or ascorbic acid) and leave it for 30 minutes.

Step 8: Decontaminate or disinfect the area: wipe the area dry using a wipe. Only one side of the cloth has to be used for wiping as turning over of the cloth may spread the contamination.

Step 9: Collect all spilled and contaminated material (sharps should be picked up by brushes and pans or other suitable tools). Spilled material and the material used for cleaning should be disposed in yellow bin.

Step 10: Wipe the area and dry with absorbent cloth.

Step 11: Remove PPE (heavy duty gloves and gum boots can be washed and dried and replaced into the spill kit; other PPE to be disposed in yellow bin)

DOCUMENTATION OF SPILL AND SKILL KIT REPLACEMENT

- Complete an Incident Form with the in-charge nurse/ area supervisor.
- Refill the spill kit for next use.

Chemical spills are to be managed appropriately by the personnel using PPE

TAKE HOME MESSAGES:

- Chemical spills should be managed as per the hospital policies, preferably by a trained personnel.
- Documentation of the spill is important

CHAPTER 11 – MANAGEMENT OF ACCIDENTAL EXPOSURE TO CYTOTOXIC DRUGS

Learning objectives

1. To know how to prevent and manage exposure to Cytotoxic Drugs

Contents

INTRODUCTION

Management of cancer cases is no longer restricted to oncology department alone. Administering chemotherapeutic agents is observed in ICU and medical/surgical wards as well. Hence knowledge on safe handling and management of cytotoxic drugs is necessary for health care workers.

Accidental exposure to chemotherapeutic agents occurs through:

- Skin - direct absorption
- If contaminated hands are used for eating or drinking ingestion -Mouth/ gastro intestinal tract
- Airborne droplets - inhalation

HOW TO MINIMIZE YOUR RISK OF EXPOSURE?

Administration of chemotherapeutic agents:

To Prevent accidental exposure to chemotherapeutic agent during infusion following steps can be followed:

1. A disposable drape has to placed below the patients arm that has the IV port.

2. Hang the chemotherapy bag on to the pole of the infusion pump

3. Remove the cap form the tubing

4. Use a luer-lok to connect the tubing to the IV port as close to the patient as possible.

Waste disposal and spills

Once the infusion of chemotherapeutic agent is complete all equipment that are contaminated with the chemotherapeutic agent are to be disposed. Disposal of the same can be done by following the below mentioned steps.

1. Contain all the equipment used for the infusion in the disposable drape spread under the patient's arm.

2. The contained waste along with the drape is disposed into a yellow bin with a yellow liner with cytotoxic symbol on it.

3. Cytotoxic waste symbol has to be displayed clearly on the bin as well as on the liner.

Preferably the yellow bag and bin should be leak proof and puncture proof.

3. Accidental exposure

In an event of accidental exposure, a chemotherapy spill kit to be used as per the protocol mentioned below.

Chemotherapy spill kit – should typically contain:

1. Chemical splash goggles
2. Gloves
3. Gown
4. Sheets of absorbent material
5. Spill control pillows
6. Sharps container
7. Scoop to collect glass fragments
8. Waste disposal bags
9. Emergency skin and eye decontamination kits
10. Material safety data sheets (MSDS)

Personal Protective Equipment to be used includes:

- Disposable, fluid-resistant, closed-front gown
- Disposable, powder-free gloves with a thickness of at least 0.007 inch that cover the gown cuff
- Goggles or other eye protection

It is advisable to wash both your hands before you put on and after you take off gloves.

Action following exposure

In an event of chemotherapeutic drug coming in contact of your skin or a patient's skin; the affected area must be thoroughly washed with soap and water. If the drug gets in your eye(s), flush with adequate amount of water for at least 15 minutes while holding back your eyelids. Then get evaluated and also report such incidents. Management of spills should be in same lines as that of the blood or body fluids but all the waste collected during the cleaning process should be collected separately in yellow plastic big with Cytotoxic symbol , labeled and sent to final tretament.

"The bottom line is that all nurses—not just those who work in oncology unit—should know their hospital's policies and procedures on safe handling and administration of chemotherapy agents. Believing that you'll never have to handle these agents and thus being unprepared if asked to do so, could be harmful to your health".

Reference:

Susan Newton, RN, MS, AOCN "Handling chemo safely: Your concern, too. Available at http://www.modernmedicine.com/modern-medicine/content/handling-chemo-safely-your-concern-too*, accessed on 8/5/2017*

TAKE HOME MESSAGES:

- All nurses and health care personnel must be aware of the hospitals policies and procedures for accidental exposure to cytotoxic wastes
- The chemotherapy spill kit must be in place and be used in the event of accidental exposure to cytotoxic waste

CHAPTER 12 – LIQUID WASTE MANAGEMENT

Learning objectives

1. To know what are the risks from healthcare waste water
2. To know how liquid healthcare waste should be disposed

Contents

1. Introduction
2. Hazards of waste water
3. Liquid waste generated at health care facilities
4. Treatment of waste water
    a. Standards of Liquid waste
    b. Liquid waste management

Frequently asked questions

INTRODUCTION

Liquid waste from health care facilities pose a huge health and environmental risk because of their ability to enter water bodies, pollute ground water and drinking water when disposed of improperly. They can cause various diseases in either epidemic or endemic form, leading to public health risks. Thus, proper liquid waste management is mandatory to protect health care workers and the community.

Liquid wastes from healthcare facility can be divided into the following three categories:

- **Sewage** is heavily polluted waste water that contains high concentrations of faecal matter and urine.
- **Sullage** is more dilute residue from washing, bathing, laboratory processes, laundry and technical processes such as cooling water or the rinsing of X-ray films.
- **Storm water** is the rain water collected on roofs, grounds, yards and walkways of hospitals. The storm water may be used for recharging groundwater, irrigating hospital gardens and grounds, flushing toilets or let off into drains.[1]

HAZARDS OF WASTE WATER

Depending on the services available in the healthcare facility, the waste water may contain chemicals, pharmaceuticals, radioisotopes and microbiological agents. The various hazards caused by waste water are:

a) Infectious samples and secretions can cause diseases like Campylobacteriosis, Hepatitis A and Hepatitis E, Cholera, Schistosomiasis, Typhoid fever and Ascariasis.[1]

b) Chemicals such as anaesthetics, disinfectants, chemicals from laboratory activities, silver from X-ray film washing, formaldehyde, glutaraldehyde, solutions from processing of photographic films and contrast media may cause chemical exposures leading to burns, may affect various systems and act as human carcinogens in addition to causing water pollution.[1]

c) Untreated waste water from the hospitals may contain antibiotics that may contribute to the rise and spread of microbes that are resistant to most of the antibiotics eg as methicillin-resistant Staphylococcus aureus or vancomycin-resistant enterococci.[1]

d) Risk of exposure to radioactivity may occur if radioactive isotopes are discharged into the hospital waste water before decline in their radioactivity.[1]

LIQUID WASTE GENERATED AT HEALTH CARE FACILITIES

List of liquid waste generated at health care facilities is given below:

Sl. No.	Liquid waste
1.	Acids, alkalis, aldehydes
2.	Aspirated body fluids – pleural/ peritoneal/ pericardial/ CSF/ synovial fluid
3.	Blood in small quantities
4.	Disinfectants – Discarded liquids
5.	Faeces samples
6.	Formalin - Discarded
7.	Infected secretions
8.	Liquid from floor washing, cleaning & house-keeping – phenol, formalin, lysol
9.	Liquid from labs – normal saline, distilled water, EDTA
10.	Radioactive waste water
11.	Reagents
12.	Serum
13.	Silver X ray film developing liquid
14.	Sputum samples
15.	Stains
16.	Urine samples
17.	Waste water from the dental department

TREATMENT OF WASTE WATER

Waste water from health care facilities must be treated before discharge into the municipal sewerage system.

1. Standards of Liquid waste:

As per BMWM Rules, 2016, the effluent generated or treated from the premises of occupier or operator of a common bio-medical waste treatment and disposal facility, before discharge into the sewer should conform to the following limits

TABLE 9: STANDARDS FOR LIQUID WASTE

PARAMETERS	PERMISSIBLE LIMITS
pH	6.5-9.0
Suspended solids	100 mg/l
Oil and grease	10 mg/l
Biochemical Oxygen Demand (BOD)	30 mg/l
Chemical Oxygen Demand (COD)	250 mg/l
Bio-assay test	90% survival of fish after 96 hours in 100% effluent

Note:

1. Above limits are applicable to the occupiers of Health Care Facilities (bedded) which are either connected with sewerage network without terminal sewage treatment plant or not connected to public sewers.
2. For discharge into public sewers with terminal facilities, the general standards as notified under the Environment (Protection) Act, 1986 (29 of 1986) shall be applicable.
3. Health Care Facilities having less than ten beds shall have to install Sewage Treatment Plant by the 31st December, 2019.
4. Non-bedded occupiers shall dispose infectious liquid wastes only after treatment by disinfection as per Schedule – II (6) of the principal rules.".

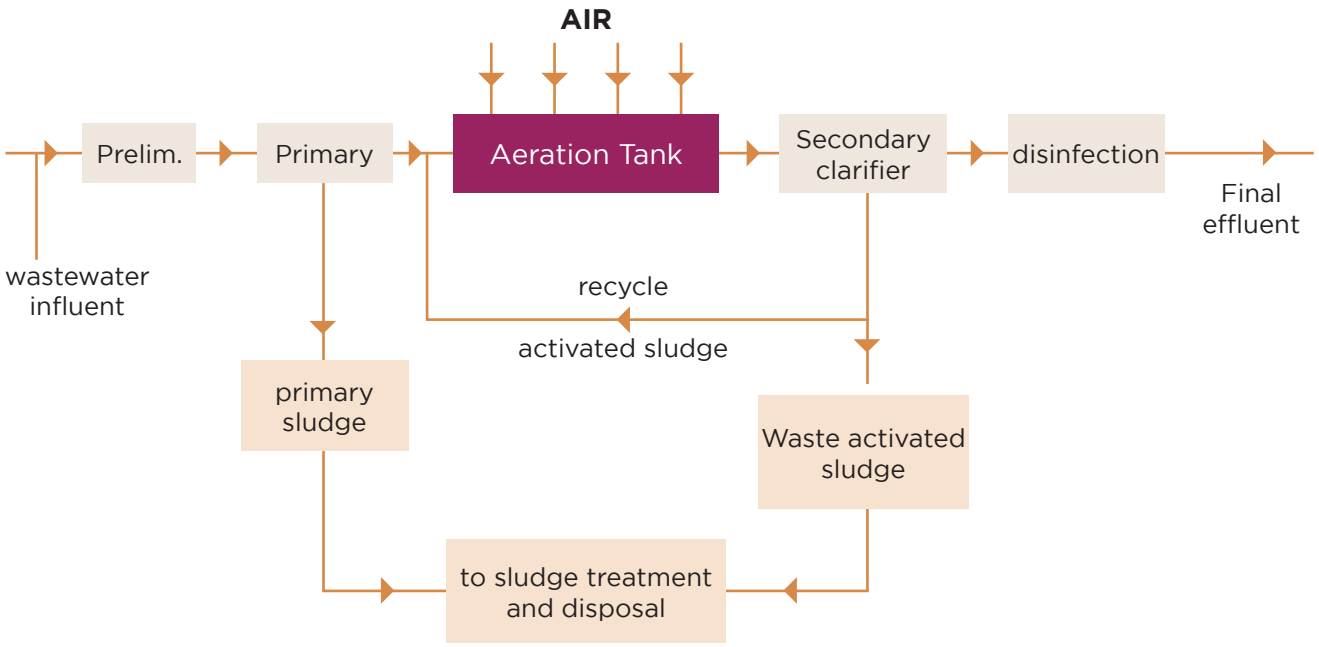
2. Liquid Waste Management

The BMWM Rules, 2016 recommend that all facilities handling bio-medical waste must have a separate collection system for chemical liquid waste leading to an effluent treatment system.

i) At facilities with effluent treatment plant:

Ideally, all health care facilities must be attached to an Effluent Treatment Plant (ETP) for treating the liquid waste before mixing with other waste water from health care facilities.

Liquid waste which is generated is directed towards a collection system that leads to an ETP with components as depicted in the figure below:



Effluent treatment plant

As per CPCB directions, it is mandatory for all 100 bedded hospitals to have ETP for liquid waste management in their premises. The effluents from the ETP should conform to the standards as per BMW rules as mentioned in the previous table.

ii) At Facilities without effluent treatment plant:

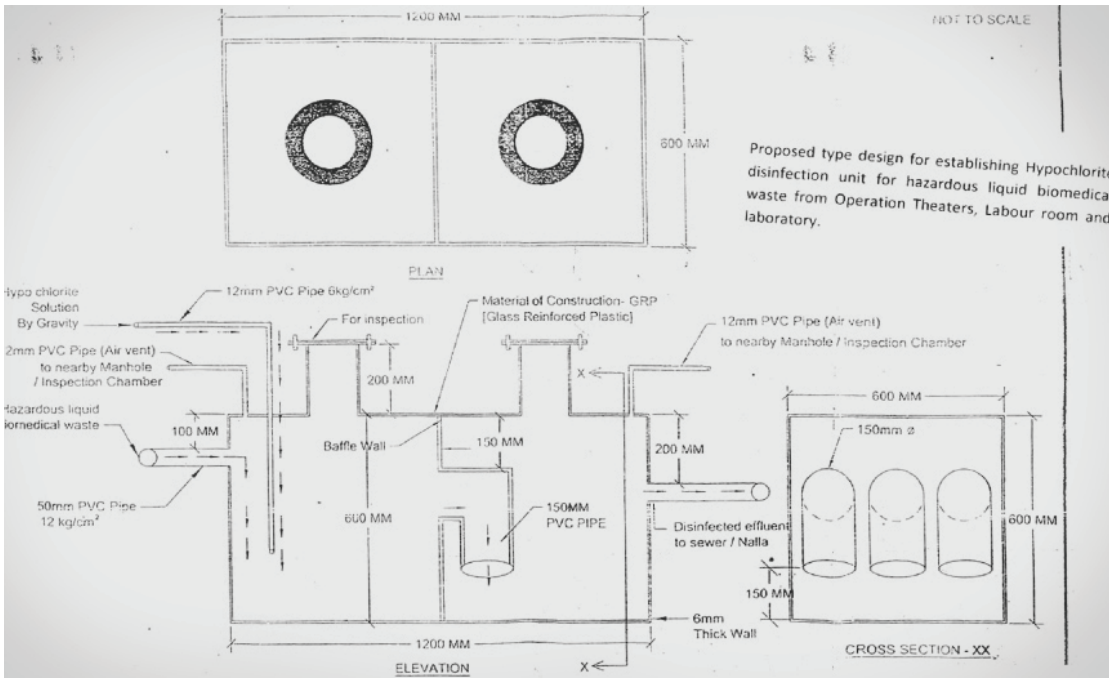
For health care facilities without an effluent treatment plant, disinfection units maybe designed and added for treatment of liquid waste. Two case studies in selected health care facilities is discussed below:

CASE STUDY 1: LUDHIANA MODEL – HYPOTREAT

'HYPOTREAT'™ is a device for Pre-Treatment of liquid medical waste at the source itself. It is a registered product of Paryavaran Solutions Ludhiana vide design registration No. 270902 Dated 1.4.15, Patent office, Govt of India, New Delhi. It is a continuous flow baffled reactor which ensures effective contact of liquid waste with disinfectant (10% NaOC) for sufficient interval of time (HRT designed for min 1hr to 5hrs depending upon quantity of waste produced) so as to automatically drain it under gravity without any manual intervention.

Hypotreat is designed according to maximum quantity of liquid waste generated at particular source. It pre-treats liquid medical waste with the help of 10% sodium hypochlorite solution. Sodium hypochlorite solution @ 30% of the volume of maximum liquid waste generated at a point and equal to active design volume of the Hypotreat, is added into the system filled with water. As liquid waste flows through the system, its unique baffle arrangement allows it to actively come in contact with sodium hypochlorite solution for sufficient time to ensure the disinfection. When fresh liquid waste enters the system, equal amount of pre-treated liquid medical waste spills into outflow compartment and drained automatically under gravity without any manual intervention. Thus the required pre-treatment of liquid waste is ensured without any possibility of manual error.

i. Operation and Maintenance of the disinfection unit introduced in District Hospitals, Taluk level Hospitals, Community Health Centres to treat the liquid bio-medical waste



Liquid Bio-Medical Waste (Human blood, all body fluids, seminal fluids, urine and human excreta etc.) is placed into 'Yellow Category' of the Bio-Medical Waste handling rules. The treatment proposed is collection of liquid waste and disinfection with 1% hypochlorite solution.

The liquid disinfection unit is designed such that the liquid Bio-Medical Waste generated in the Healthcare Facility is drained to the disinfection unit by gravity by making suitable modification in existing plumbing. The disinfectant (Sodium Hypochlorite Solution) is drained by gravity to the disinfection unit. The baffle wall inside the disinfection unit will help in mixing the contents and increases the contact period. The engineering of the disinfection is done in the proposed design by the introduction of baffle wall for mixing purposes. There are no moving parts in the system and hence require least/no maintenance.

The disinfected effluent finally leads to the existing sewer/soak pit. This does not require any routine maintenance. (Group D employees) can feed the Sodium Hypochlorite Solution to the storage tank on routine basis who will be trained for that aspect.

The system is sustainable for ease of the operation and maintenance.

The liquid Bio-Medical Waste will have lot of organic impurities and requires high dosage chlorine and also more contact time for disinfection. The treated liquid Bio-Medical Waste (disinfected effluent) should have a residual chlorine >2mg/L for safe disposal. Hence all liquid Bio-Medical Waste generated is collected in 50L can below the wash basin. Add 1% disinfection solution by trial and error method, It must be ensured that the residual chlorine in the liquid of 50L can below the sink is > 2mg/L before disposal into the sewer (Every day morning).

Following steps shall be followed daily for the safe disposal of the liquid Bio-Medical Waste.

Step 1: Fill the top 10L can on the top with 1% sodium hypochlorite solution.

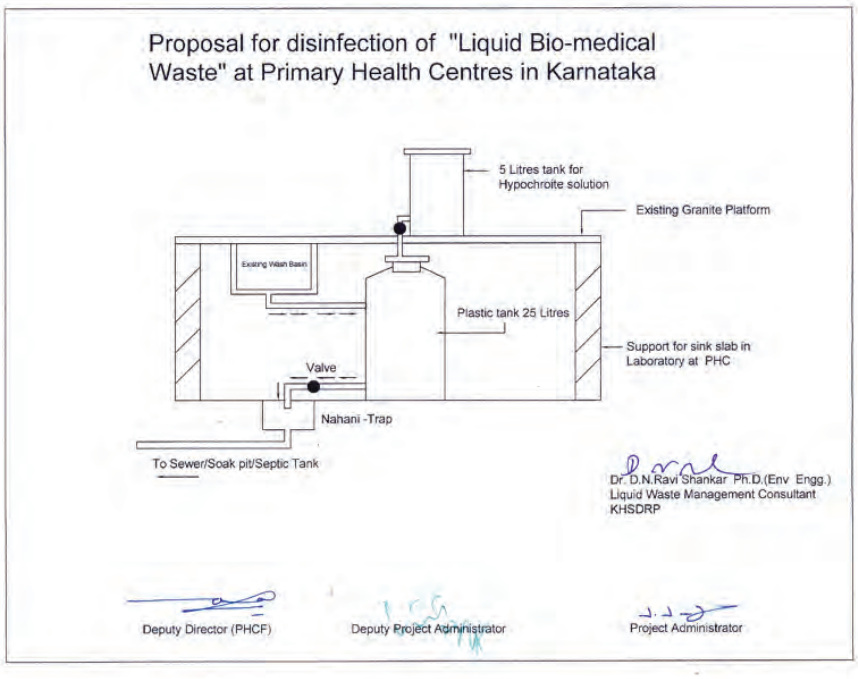
Step 2: The liquid Bio-Medical Waste from the hospital continuously flows to the disinfection unit provided.Liquid waste from the hospital is drained continuously into the disinfection unit of the system.

Step 3: The 1% sodium hypochlorite solution from the upper 10L can is allowed to flow drop by drop into the disinfection unit provided. Hence, there should be a continuous filling of the disinfectant can occurs. By trial and error, and the effluent contains is ensured to contain > 1mg/L of chlorine by trial and error. The residual chlorine should be measured using a Chloroscope.

This is to be repeated every day on a daily basis. Keep the records of the receipts and consumption of the bleaching powder / Hypochlorite solution should be maintained daily for the verification by KSPCB pollution control board officers.[9]

Note: Sewage should not be allowed inside mixed with the liquid waste in the disinfection unit

ii. Operation and Maintenance of the disinfection unit introduced in PHCs to treat the liquid Bio-Medical Waste



Liquid bio-medical waste (Human blood, all body fluids, seminal fluids, urine and human excreta etc.) is classified into 'Category -8' of the bio-medical waste handling rules. The treatment proposed is disinfection with hypochlorite solution as per the rules. The basics in the rules are that chlorine is used as a disinfecting agent as it is easily available in different forms.

The liquid bio-medical waste will have lot of organic impurities and requires high dosage chlorine and also more contact time for disinfection. The treated liquid bio-medical waste (disinfected effluent) should have a residual chlorine > 2 mg/L for safe disposal. Hence all liquid bio-medical waste generated is collected in 50 litre can below the wash basin. Add 1% disinfection solution by trial and error method, It must be ensured that the residual chlorine in the liquid of 50 L can below the sink is > 2 mg/L before disposal into the sewer [Every morning].

Following steps shall be followed daily for the safe disposal of the liquid Bio-Medical Waste.[9]

Step 1: Fill the top upper 5 litre can with 1% sodium hypochlorite solution

Step 2: Start collection of the liquid bio-medical waste from the wash basins to in the 50L can can kept

beunder itlow. and keep the outlet valve closed.

Step 3: Drain the 1% hypochlorite solution from the 5L can to the 50L can and adjust the quantity of the solution added should be such that it the mixture contains >2mg/L of residual chlorine next day morning. The residual chlorine should be measured for residual chlorine using a Chloroscope.

Step 4: Open the outlet valve of the 50L can every day in the morning so that entire disinfected liquid is entirely drained into the sewer.

Step 5: Close the outlet valve of the 50L can and start filling the liquid Bio-Medical Waste.

Repeat the process every day. Maintain the records of the consumption of the 1% sodium hypochlorite solution daily for the verification by KSPCB pollution control board officers.

FREQUENTLY ASKED QUESTIONS

1. What are the precautions before letting down waste water into the drain?

Precautions for pouring bio-medical liquid waste down the drainage system are:

- The worker should wear personal protective equipment which include an apron, gloves, safety glasses to protect from spillage and aerosols generated during the disposal process.
- The liquid waste should not be poured where people wash their hands and should be poured close to the surface of water so as to avoid splashing. The waste basin should be rinsed and the container disinfected after pouring of the liquid waste.

2. How to disinfect infectious liquid waste not connected to ETP?

Infectious liquid waste needs to be chemically treated with Sodium Hypochlorite for a contact period of 20 mins and then let to general sewer (concentration of Sodium Hypochlorite solution as mentioned in BMWM rules, 2016).

TAKE HOME MESSAGES:

- The treated wastewater before discharge into the sewer must conform to the standards prescribed by the BMWM Rules 2016.
- Wastewater treatment can be done by either constructing an ETP or a local disinfection unit.

CHAPTER 13 – FINAL TREATMENT AND DISPOSAL OPTIONS AT CBWTF

Learning objectives

1. To know what are the final waste management options for bio-medical waste.

Contents

Frequently asked questions

INTRODUCTION

As per BMWM rules 2016, it is the responsibility of the occupier and operator to dispose Bio-medical waste in such a manner that it should not cause harm to either humans or environment.

1. Bio-medical waste should be treated and disposed of in accordance with Schedule I, and in compliance with the standards provided in Schedule-II by the health care facilities and common bio-medical waste treatment facility.

2. Occupier should hand over segregated waste as per the Schedule-I to common bio-medical waste treatment facility for treatment, processing and final disposal: The laboratory and highly infectious bio-medical waste generated should be pre-treated. .

3. No occupier should set up on-site treatment and disposal facility, if the services of `common bio- medical waste treatment facility is available within a distance of seventy-five kilometre.

4. In cases where service of the common bio-medical waste treatment facility is not available, the Occupiers shall set up requisite bio-medical waste treatment equipment like incinerator, autoclave or microwave, shredder prior to commencement of its operation, as per the authorization given by the recommended authority.[2]

PURPOSE

The purpose of treatment is to reduce the potential hazard posed by biomedical waste, while endeavouring to protect the environment. "Untreated human anatomical waste, animal anatomical waste, soiled waste and, biotechnology waste shall not be stored beyond a period of forty-eight hours" (BMWM Rules, 2016). Measures to minimize and reuse waste items where it is safe should first be followed. Where this is not possible, the unusable waste materials should preferably be treated to reduce their potential health or environmental hazard and volume. The residues sent for land filling disposal at a suitably constructed site.[2]

The Stockholm Convention is a global treaty to shield human health and the environment from persistent organic pollutants. It is a known fact that improper incineration of bio-medical waste is a major contributor to POPs. Therefore, it is recommended to use an incinerator which reaches the prescribed >12000C (BMWM Rules, 2016) or a suitable non-burn technology.[1]

SELECTION OF TREATMENT TECHNIQUES IN THE CBWTF

The decision of treatment framework includes thought of waste characteristics, innovation capacities and prerequisites, environmental and security factors, and expenses.

Factors to consider include:

1. Waste characteristics

i. Quantity of wastes for treatment and disposal

ii. Types of waste for treatment and disposal

iii. Capability of the health-care facility to handle the quantity of waste.[1]

2 Technology capabilities and requirements[3]

i. Local availability of treatment options and technologies

ii. Capacity of the CBWTF system

iii. Treatment efficiency

iv. Volume and mass reduction

v. Installation requirements

vi. Available space for equipment

vii. Infrastructure requirements

viii. Operation and maintenance requirements

ix. Skills needed for operating the technology

3. Environmental and safety factors[3]

i. Environmental releases

ii. Location and surroundings of the treatment site and disposal facility

iii. Occupational health and safety considerations

iv. Public acceptability

v. Options available for final disposal

vi. Regulatory requirements

4 Cost considerations[3]

i. Equipment purchase cost

ii. Shipping fees and customs duties

iii. Installation and commissioning costs

iv. Annual operating costs, including preventive maintenance and testing

v. Cost of transport and disposal of treated waste

vi. Decommissioning costs

OVERVIEW OF FINAL WASTE-TREATMENT TECHNOLOGIES IN CBWTF

Technology: Microwave

Principle: Steam-based process where treatment occurs through the action of moist heat and steam generated by microwave energy

Used for:

- Soiled Waste: Items that are contaminated with blood, body fluids.
- Microbiology, Biotechnology and other clinical laboratory waste. Contaminated Waste (Recyclable), Waste sharps including metals
- Glassware: Broken or discarded and contaminated glass that include medicine vials and ampoules.[2]

Source: Meteka GmbH, Austria

Advantage:
Produce significantly less air pollution emissions than high-heat thermal procedures. Significant volume reduction, automated and easy to use.[1]

Disadvantage:
Volatile and semi-volatile organic compounds, chemotherapeutic waste, mercury, other hazardous chemical waste and radiological waste should not be treated in a microwave.
Offensive odour is a problem

Volatile and semi-volatile organic compounds, chemotherapeutic waste, mercury, other hazardous chemical waste and radiological waste should not be treated in a microwave

Technology: Hydroclave

Principle: Similar to Autoclave, except that the heat does not come in direct contact with the waste but is subjected indirectly to the waste through the outer jacket.

Used for:

- Soiled Waste: Things contaminated with blood, body fluids and Microbiology, Biotechnology and other clinical laboratory waste
- Contaminated Waste (Recyclable), Waste sharps including Metals
- Glassware: Broken or discarded and contaminated glass that include medicine vials and ampoules.[2]

7

Advantage:
It shreds the waste.
Reduces the waste in weight and volume. Produce significantly less air pollution emissions than high-heat thermal processes.[1]

Disadvantage:
Cannot treat all kinds of medical waste especially pharmaceutical, cytotoxic and radioactive waste.

Technology: Autoclave

Principle: Pressure and vacuum using high temperature steam

Used for:

- Soiled Waste: Items contaminated with blood, body fluids.
- Microbiology, Biotechnology and other clinical laboratory waste: Contaminated Waste (Recyclable), Waste sharps including Metals
- Glassware: Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.[2]

Advantage:
Produce significantly less air pollution emissions than high-heat thermal processes, low capital and operational cost.[1]

Disadvantage:
Volatile and semi-volatile organic compounds, chemotherapeutic waste, mercury, chemical waste and radiological waste cannot be treated. Odours can be a problem around autoclaves if there is insufficient ventilation.

Volatile and semi-volatile organic compounds, chemotherapeutic waste, mercury, other hazardous chemical waste and radiological waste should not be treated in an autoclave. Large and bulky bedding material, large animal carcasses, sealed heat-resistant containers and other waste loads that impede the transfer of heat should be avoided.

Technology: Circulating hot-air ovens

Principle: Heat is applied without addition steam or water.[1]

Used for:

- Glassware and other reusable instruments
- Waste sharps (both used, discarded and contaminated metal sharps).

Advantage:

- Dry heat never corrodes or rusts the tools or needles
- Used to sterilize devices having multiple parts that cannot be dismantled

Disadvantage:
Not suitable for Plastic and rubber items

Do not use for *Plastic and rubber items*
Not commonly used in large-scale facilities

Technology: Incineration

Principle: Incineration is a high-temperature, dry oxidation process that minimizes 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.[1]

Source: Distromed, Rajkot

Type of waste:

- Human Anatomical Waste
- Animal Anatomical Waste
- Soiled Waste
- Expired or Discarded Medicines
- Chemical Waste.[2]

Advantage:

- Reduces organic and combustible waste to inorganic, incombustible matter
- Results in a significant reduction of waste volume and weight

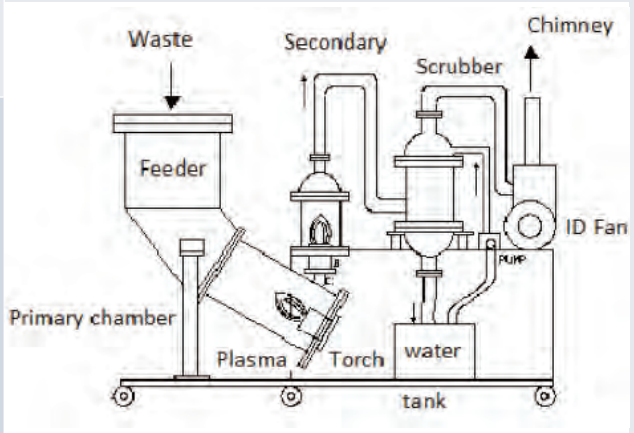
Disadvantage:

- Release of combustion by-products into the environment.
- Generation of residual ash.

Do not use for *Aerosolized containers, Mercury and Chlorinated plastic waste*

Technology: Plasma Pyrolysis

Principle: Processes operate with sub-stoichiometric air levels



Used for:

- Human anatomical Waste
- Animal anatomical Waste
- Expired or Discarded Medicines
- Chemical Waste
- Discarded linen/mattresses, beddings contaminated with blood or body fluid

Advantage:

- Quantity of toxic residuals (dioxins and furans) is much below the accepted emission standards
- Does not require segregation of hazardous waste.
- The pathogens are completely killed and there is a possibility to recover energy

Disadvantage:

- Require considerable amount of electrical energy
- Very expensive

Do not use

- *Pressurized containers*
- *Halogenated plastics such as PVC*
- *Wastes with high heavy-metal content*

Technology: Chemical treatment

Principle: Treatment usually results in disinfection rather than sterilization.[1]

Used for:

Most suitable for treating liquid waste such as blood, urine, stools or hospital sewage. Solid, even highly hazardous, health-care wastes, including microbiological cultures and sharps may also be disinfected chemically.[1]

Advantage:

No combustion and no by-products are produced. Waste becomes unrecognisable

Disadvantage:

Potential problem of chemical hazard. Shredding or milling of waste is usually necessary before disinfection. Only the surface of intact solid waste items will be disinfected.[1]

Technology: Encapsulation

Principle: Involves filling containers with waste, adding an immobilizing material, and sealing the containers.[1]

Used for:

Disposal of sharps and chemical or pharmaceutical residues.

If the healthcare facility does not have any option, the waste should be contained in some way before disposal. One option is encapsulation, that involves filling containers with waste, adding an immobilizing material, and sealing the containers. The process involves either cubic boxes made of high-density polyethylene or metallic drums, which are three quarters packed 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. Once the medium has dried, the containers are sealed and placed into landfill sites.[1]

Advantage:

This process reduces the risk of scavengers gaining access to the hazardous healthcare waste.[1]

Disadvantage:

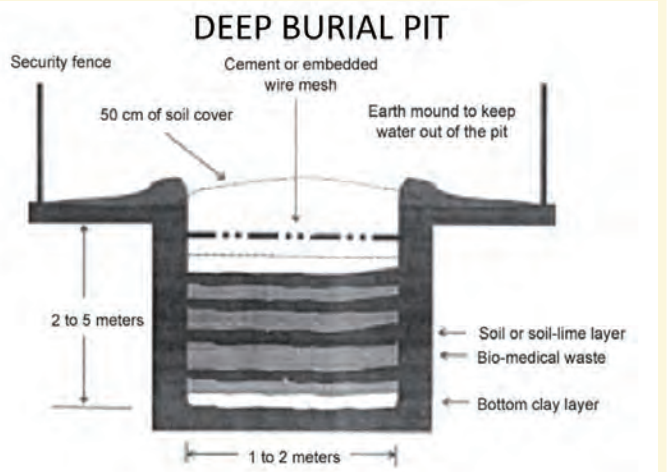
Polyethylene does not chemically incorporate the waste, and with mercury-containing wastes volatilization may be a significant concern

Small quantities of secondary waste are generated.

Wastes must be pre-treated to remove moisture.

Technology: Deep Burial

Principle: Containment



Used for:

- Soiled Waste: Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags enclosing residual or discarded blood and blood components.
- Human Anatomical Waste
- Animal Anatomical Waste.[1]

Advantage:

Prevents scavenging

Disadvantage:

Need of a secure area

Technology: Mechanical treatment

Principle: Mechanical treatment processes includes shredding, grinding, mixing and compaction technologies that reduces waste mass, although they cannot destroy pathogens. In most instances, mechanical processes are not stand-alone healthcare waste-treatment processes, but supplement other treatment methods.[1]

Source: Distromed, Rajkot

Used for:

Contaminated Waste (Recyclable)- Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and fixed needle syringes).

Advantage:

Reduces the volume of the waste significantly.

Exposes the surface of the waste to disinfection.

Disadvantage:

Workers are often at an increased risk of getting exposed to pathogens in aerosols released into the environment by mechanical destruction of untreated waste bags.[1]

Technology: Biological

Principle: Composting and vermiculture (digestion of organic wastes by the action of worms) have been used successfully to decompose hospital kitchen waste, as well as other organic digestible waste and placenta waste.
The natural decomposition of pathological waste through burial is another example of a biological process.[1]


10

Advantage:

Bio-digestion processes with higher temperatures and longer residence times are considered to be the best at elimination of pathogens.[1]

Disadvantage:

Appropriate care should be taken to prevent contact with untreated waste, such as through skin contact or splashes during collection and placement of the waste.[1]

Technology: Irradiation

1. Irradiation treatment involves the use of irradiation from electron beams, cobalt-60 or ultraviolet sources.
2. Electron beams are strong enough to penetrate waste bags and containers.
3. Germicidal ultraviolet radiation has been used to destroy airborne microorganisms as a supplement to other treatment technologies, but is unable to penetrate closed waste bags.[1]

Advantage:

Fatal to microorganisms

Disadvantage:

- Expensive
- Requires dedicated space
- Requires post shredding
- Some contaminated surfaces may face away from the radiation source.

Technology: Sanitary Landfill

Principle:

After minimization or treatment of HCW, the remaining waste needs access to land for final disposal.[1]

Whenever skills and resources are available, still higher standards of site preparation are possible to achieve a "sanitary landfill", with trained staff and specialized equipment present onsite to manage operations.[1]

Required features for a landfill are:

- Restricted access to prevent scavenging
- Covering the soil daily to prevent odours, and regular compaction
- Systematized deposit of wastes in small work areas
- Separation of waste to prevent contamination of underwater and neighbouring areas
- Trained staff.[1]

Advantage:

- Scientifically sound design
- Doesn't affect the environment

Disadvantage:

- Completed landfill areas can settle and requires maintenance
- Requires proper planning, design, and operation

Uncontrolled dumping *is featured by the scattered, uncontrolled deposit of wastes at a site. It is a practice that almost always leads to acute pollution problems, fire, higher risks of disease transmission and open access to scavengers and animals.*[1]

Note: *Controlled land filling represents various types of disposal to land characterized by better operating practices and design improvements to reduce health and environmental impacts. The first step towards improvement is "controlled dumping", where small improvements can restrict environmental consequences and physical accessibilities to waste. This is followed by "engineered landfill" where increased standards of engineering are used to improve geological isolation of wastes from the environment and to allow wastes to be covered daily.*[1]

FREQUENTLY ASKED QUESTIONS

1. What methods of treatment technologies are available at the Primary Health Centre level to manage bio-medical waste?

a. Autoclaves
b. Microwave
c. Chemical treatment
d. Deep Burial
e. Sharps pit.

2. What are the variables to keep in mind when selecting a treatment technology?

a. Waste characteristics
b. Technology capabilities and requirements
c. Environmental and safety factors
d. Cost considerations

TAKE HOME MESSAGES:

- Bio-medical waste shall be treated and disposed of in accordance with Schedule I, and in compliance with the standards provided in Schedule-II by the HCF and CBWTF
- No occupier shall establish on-site treatment and disposal facility, if a service of CBWTF is available at a distance of 75 kilometer.
- In cases where service of the CBWTF is not available, the occupier shall set up requisite biomedical waste treatment equipment as per the authorisation given by the prescribed authority.

Learning objectives

1. To understand the occupational safety of healthcare workers as an essential part of hospital management
2. To know about the methods to ensure safety of all categories of healthcare personnel including doctors, nurses, lab technicians and waste handlers

Contents

1. Introduction
2. Occupational Hazards
3. Occupational safety measures that should be developed and practiced by HCF
   a. Immunization of all healthcare workers
   b. Provision of adequate personal protective equipment and clothing
   c. First aid and Post-exposure prophylaxis following exposure to Blood and body fluids
   d. Regular medical surveillance
   e. Training and re-training of all healthcare workers

Frequently asked questions

INTRODUCTION

The occupational safety of healthcare personnel and workers handling, taking care of waste needs consideration. They may encounter hazards and infection risks, and it is therefore necessary to prevent and control these risks. Bio-medical waste management-administration strategies or plans ought to incorporate course of action for the consistent observing of workers' wellbeing and safety.[1]

OCCUPATIONAL HAZARDS

- Infectious Hazards: such as HIV/ Hepatitis-B
    1. Especially damage from sharps that are not discarded into puncture-resistant holders. The danger of obtaining a secondary infection following needle-stick damage from an infected sharp relies upon the quantum of the contamination and nature of the infection from the source patient.[1]
    2. Exposure to infectious agents in the laboratory either through skin, mucosa or airborne infections
- Chemical exposures, for example, chemotherapeutic medications, disinfectants and sterilants
- Physical hazards, for example, ionizing radiation, wounds from sharps
- Ergonomic hazards, for example, manual lifting and transporting of massive waste loads

The risk of infection with hepatitis B is more than 10 times more prominent than for hepatitis C, and up to 100 times more greater than for human immunodeficiency infection (HIV).[1]

TABLE 10: RISK OF TRANSMISSION OF INFECTION FOLLOWING OCCUPATIONAL EXPOSURE

Blood borne virus	Risk of transmission of infection
HIV	0.3%
Hepatitis B	18–30%
Hepatitis C	1.8%

OCCUPATIONAL SAFETY MEASURES THAT SHOULD BE DEVELOPED AND PRACTICED BY HCF

Training healthcare personnel to adopt 'Good Work Practices' will go a long way in promoting the safe management of bio-medical waste so that the environment is protected and as well ensure worker safety.

Examples of 'good work practices' are: Wearing personal protective equipment by waste handlers, use of proper handwashing techniques, regular training of healthcare workers.

All HCF have the responsibility to ensure occupational safety of all categories of healthcare personnel for which the following are recommended:

- Development of an institutionalized arrangement of management rules and standard operating procedures for Bio-medical waste management;
- Inform and prepare waste workers with the goal that they play out their obligations properly and fastidiously;
- Waste workers should be involved in identifying hazards and in recommending prevention and control;
- Establish an occupational safety programme that includes
    1. Immunization and annual health check-up of all healthcare workers
    2. Provision of adequate personal protective equipment and clothing
    3. Post-exposure prophylactic treatment
    4. Regular medical surveillance
    5. Training and re training of all healthcare workers.[1]

1. IMMUNIZATION AND HEALTH CHECK UP

Immunization

- All health care workers are in danger of exposure to blood at work and ought to be immunized against the hepatitis B infection before beginning employment.[1]
- All workers who get needle stick injuries must receive post exposure prophylaxis against HIV, hepatitis B and tetanus

Annual health check

All healthcare personnel including doctors, nurses, technicians and waste handlers must be provided an annual medical check-up by the employer. The check-up should include

- Clinical examination including blood pressure measurement
- ECG
- Chest X ray
- Fasting blood sugar and lipid profile
- Any other investigations depending on health complaints

2. PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment are specialized clothing or equipment worn by an employee which act as barriers or filters against infectious materials. The type of protective clothing used will depend upon the risk associated with the healthcare waste.

Points to remember while use of PPE:

- All PPEs should be safely designed and constructed, and should be maintained in a clean and reliable fashion.
- It should fit comfortably, encouraging worker use. If the PPE does not fit properly, it is as good as being dangerously exposed rather than being safely covered.
- When engineering, work practice, and administrative controls are not feasible or do not provide sufficient protection, employers must provide personal protective equipment to their workers and ensure its proper use.
- Employers need to train the healthcare workers on proper use of personal protective equipment regarding :
  1. When to use
  2. Type of PPE to be used
  3. How to use properly
  4. The limitations of the equipment
  5. Proper care, maintenance, useful life and disposal of the PPE

If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance and use of PPE; the training of employees and monitoring of the program to ensure its ongoing effectiveness.

FIGURE 24: TYPES OF PPE USED IN HCF

TABLE 11: LIST OF PPES

Equipment	Use	Technical specifications
1. Cap or head cover 	Protects scalp	Should cover the hair Should fit the head completely and be comfortable to wear
2. Goggles or face shield 	Protects eyes	1. Provide adequate protection against the particular hazards to eyes. 2. Reasonably comfortable when worn. 3. Fit snugly and not unduly interfere with the movements of the wearer. 4. Durable. 5. Capable of being disinfected. 6. Able to be worn without disturbing the adjustment of any existing prescriptive eyewear.[4]
3. Face mask, respirator  	Protects mouth/ nose, protect respiratory tract from airborne infectious agents	1. Gives safety against dust, fiber, fume, fog, smoke and soot. 2. Is sensibly comfortable when worn. 3. Fits cozily and does not unduly interfere with the movements of the wearer. 4. Is made of material that is fit for being disinfected frequently. 5. Has a belt that is either plastic or movable. 6. Is made of silicone or thermal plastic polymer. 7. Is accessible in at least three sizes: small, medium and large. Size measurements will change by maker.[4] **Determinations for the cartridges:** 1. Can accomplish the National Institute for Occupational Safety and Health P100 or N100 rating or proportionate European Committee for Standardization certification. P100 cartridges will ensure protection against any particulates including oil-based materials. N series arrangement cartridges ensure protection against solid and water-based particulates, for example, nuisance dust. 2. Contains a granular or permeable material, for example, carbon or coconut—which expels particular air particulates. 3. Is accessible in bayonet, push-in mounted cartridge, or canister frame; can evacuate 99.9% of dust and non-oil-based fogs. 4. Empowers simple breathing amid usage.[4]
4. Gown or apron 	Protects skin and/or clothing	Natural or man-made, reusable or disposable, resistance to fluid penetration and clean or sterile.
5. Gloves 	Protects hands	1. Durable, reusable design that is able to withstand periodic disinfection. 2. Available in sizes appropriate for all cleaning staff in the health care facility. 3. Prevent contact with blood borne pathogens contained in health care waste. 4. Made from puncture-resistant materials to protect against needle sticks and cuts from other sharps.
6. Impermeable shoes or gum 	Protects feet	1. Made using cut-proof materials. 2. Slip-safe sole. 3. Puncture proof sole. 4. Defensive against minimal impact. 5. Fit cozily and not unduly interfere with the movements of the wearer. 6. Strong. 7. Equipped for being sterilized. 8. Accessible in sizes to fit every single waste handler (toes ought to be around 12.5 mm from the front). 9. For incinerator operators, boots ought to be produced using heat-safe materials when accessible.[4]

TABLE 12: PERSONAL PROTECTIVE EQUIPMENT – WHEN TO USE

Procedure	Glove	Gown	Mask	Goggles
Taking BP	-	-	-	-
Temperature, pulse,	-	-	-	-
Counting respiration	-	-	-	-
IM injection	✓	-	-	-
Starting IV line or taking blood or IV injection	✓	-	-	-
Controlling minor bleeding	✓		-	-
Cleaning an incontinent patient with diarrhoea	✓	-	✓	-
Handling soiled laundry	✓	✓	✓	✓
Cleaning contaminated instruments*	✓	✓	✓	✓
Controlling massive bleeding	✓	✓	✓	✓
Irrigating a wound	✓	✓	✓	✓
Conducting Delivery	✓	✓	✓	✓
Intubation	✓	✓	✓	✓
Suctioning	✓	✓	✓	✓
Liquid spill management	✓	✓	✓	✓
Mercury spill management	✓	✓	✓	✓
Handling waste(support staff)	✓	✓	✓	✓

**Area specific e.g.: OT – all PPE; cleaning used instruments – gloves*

Sequence for donning PPE

1. Gown first
2. Mask or respirator
3. Goggles or face shield
4. Boots
5. Gloves

Hand Hygiene

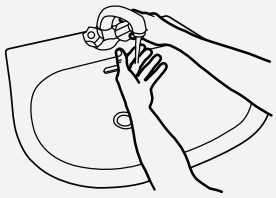
- Immediately after removing PPE.
- Wash hands thoroughly with soap and water or use alcohol-based hand rub

How to Handwash?

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

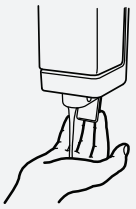
Duration of the entire procedure: 40-60 seconds

0



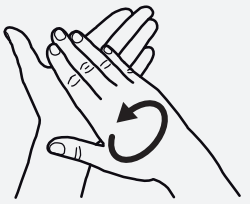
Wet hands with water;

1



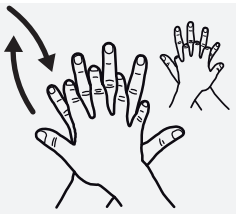
Apply enough soap to cover all hand surfaces;

2



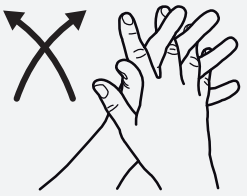
Rub hands palm to palm;

3



Right palm over left dorsum with interlaced fingers and vice versa;

4

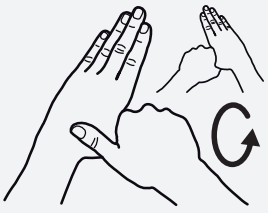


Palm to palm with fingers interlaced;

5

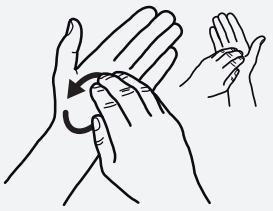
Backs of fingers to opposing palms with fingers interlocked;

6



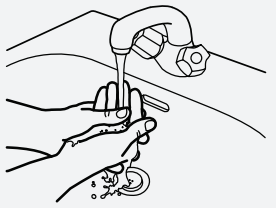
Rotational rubbing of left thumb clasped in right palm and vice versa;

7



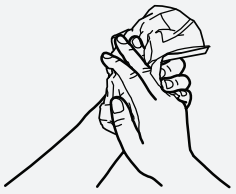
Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;

8



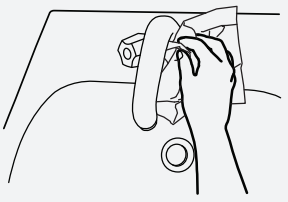
Rinse hands with water;

9



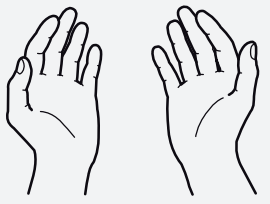
Dry hands thoroughly with a single use towel;

10



Use towel to turn off faucet;

11



Your hands are now safe.

World Health Organization | Patient Safety — A World Alliance for Safer Health Care | SAVE LIVES — Clean **Your** Hands

WHO acknowledges the Hôpitaux Universitaires de Genève (HUG), in particular the members of the Infection Control Programme, for their active participation in developing this material.

May 2009

3. FIRST AID AND POST-PROPHYLAXIS EXPOSURE FOLLOWING BLOOD/ BODY FLUID EXPOSURE

First Aid: Immediate care following needle stick injury/accidental exposure to body fluids

FIGURE 25: FIRST AID FOLLOWING NEEDLE STICK INJURY/ ACCIDENTAL EXPOSURE TO BODY FLUIDS

TO UNBROKEN SKIN

1. Wash the area immediately with running water
2. Do not panic
3. Do not put finger into the mouth
4. Do not squeeze
5. Do not use antiseptics

FOR THE EYE

1. Irrigate exposed eye immediately with water or saline
2. Sit in a chair, tilt the head back and ask a colleague to gently pour water or normal saline
3. If wearing contact lens, leave them in place while irrigating, as they form a barrier over the eye and will help protect it
4. Once the eye is cleaned, remove the contact lens and clean them in a normal manner. This will make them safe to wear again
5. Repeat irrigation after removing contact lens
6. Do not use soap or disinfectant for the eyes

(Similar management for chemical or aerosol injury to the eye)[11]

FOR MOUTH

Mouth pipettes should not be used. However, in case of fluid going into the mouth:

1. Spit the fluid immediately
2. Rinse the mouth thoroughly, using water or saline and spit again
3. Repeat this process several times
4. Do not use soap or disinfectant in the mouth

Reporting and Further action

1. Report the incident to the area supervisor/infection control nurse
2. In-charge /supervisor will document the injury/incident in the injury register
3. If injury is due to unused syringe, no further action needs to be taken
4. If injury is due to used syringe/sharp instruments, infection control nurse will collect the blood samples* and send to the lab
5. Further, refer to the nodal person for counselling and action for PEP

**Samples to be collected from Health care worker for HIV, HBsAg and anti-HBsAb and also from the source for HIV and /HBsAg*

Occupational post-exposure prophylaxis

Healthcare workers like doctors, nurses, lab technicians or waste handlers can be accidentally exposed to HIV through health care work or through accidental exposure to blood and body fluids which may be potentially infective. Hence, prevention of potential infections after exposure is termed post exposure prophylaxis (PEP)

i. Post-exposure prophylaxis (PEP) is short duration antiretroviral treatment (for HIV) or vaccination (for hepatitis B) to lessen the probability of infection after potential exposure occupationally.

ii. Within the health sector, PEP ought to be given as a major aspect of a

iii. Comprehensive universal precautions packages that reduces exposure of staff to infectious hazards at work.

iv. PEP for HIV involves an arrangement of administrations to counteract advancement of the disease in the exposed individual, which include:

- First-aid care;
- Counselling and risk assessment;
- HIV blood testing;
- Depending on the risk assessment, the provision of short-term (28 days) antiretroviral drugs with follow-up and support.

A summary of PEP recommendations are as follows:

i. PEP ought to be given as a feature of a bundle of preventive of measures that decrease staff exposure to perils infectious hazards.

ii. PEP ought to be accessible to health care workers and patients.

iii. Occupational PEP ought to likewise be accessible to all laborers who could be exposed while playing out their obligations

iv. Appropriate preparing of service providers ought to guarantee the successful management and follow-up of PEP.

v. The first dose of PEP ought to be directed as quickly as possible, ideally within two hours of exposure and the subsquent dosage ought to be given at sleep time with clear guidelines to be taken 2-3 hours after dinner and to avoid oily substances in dinner. PEP ought to be given no later than 72 hours after exposure to potentially contaminated blood or body fluids.

vi. Informed consent must be acquired before testing a source according to National guidelines

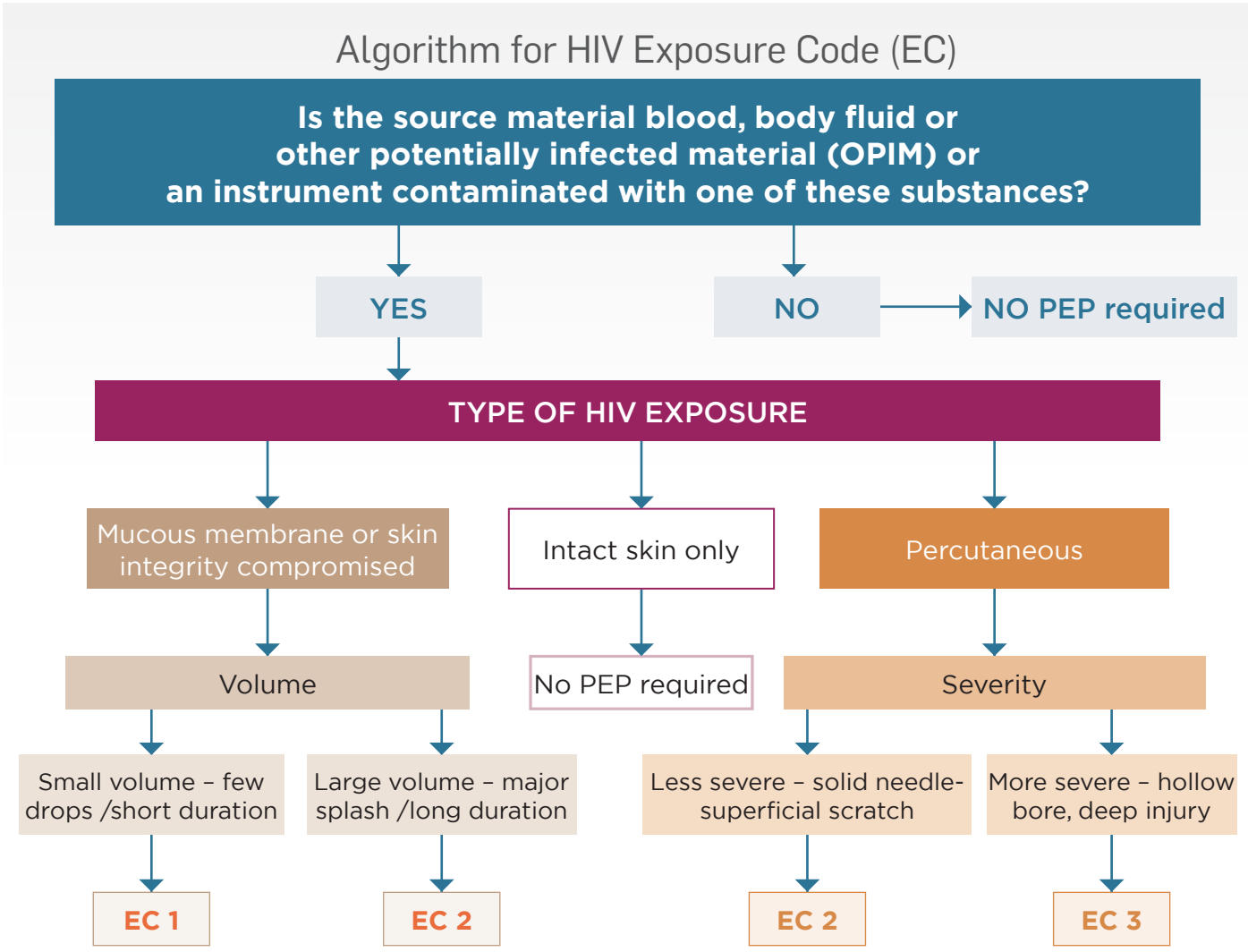
vii. PEP should not be prescribed to an individual definitely known to be infected with HIV.

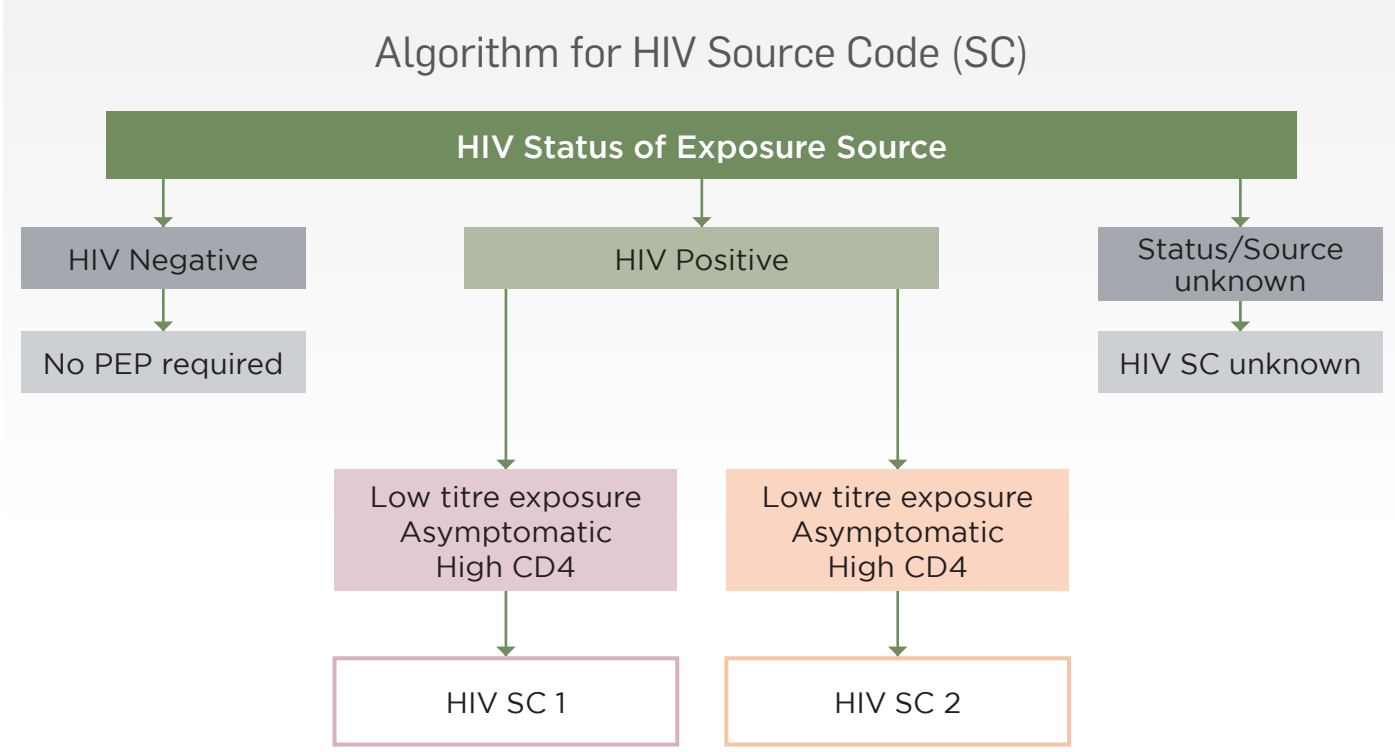
viii. In addition, risk assessment, counselling on reactions advantages of adherence and psychosocial support is required.

ix. Any occupational exposure to HIV should prompt assessment and where applicable, reinforcing of safety and working conditions.[1]

PEP for HIV and Hepatitis B is given below

FIGURE 26: POST-EXPOSURE PROPHYLAXIS FOR HIV





PEP recommendations for HIV

Exposure Codes	HIV Source Code	PEP Recommendations	Duration
1	1	Not warranted	28 days
1	2	Recommended	
2	1		
2	1		
2	2		
3	1 or 2		
2/3	Unknown	Consider PEP, if HIV prevalence is high in the given population & risk categorisation	

POST-EXPOSURE PROPHYLAXIS REGIMEN

Tenofovir 300 mg + Lamivudine 300 mg + Efavirenz 600 mg once daily for 28 days

- PEP needs to be given within 72 hours of exposure
- First dose should be administered as early as possible, preferably within 2 hours of exposure and the subsequently dose should be given at bed time with clear instructions to take it 2-3 hours after dinner & to avoid fatty food in dinner.
- In case of intolerance to Efavirenz, regimen containing Tenofovir + Lamivudine + Protease Inhibitor (Atazanavir + ritonavir or Lopinavir + ritonavir)
- In case of exposure, where source is on Anti-Retroviral Treatment, then Tenofovir 300mg + Lamivudine 300mg + Efavirenz 600mg once daily for 28 days should be started immediately.

	Timing	In persons taking Standard PEP
Recommended follow up laboratory tests	Weeks 2 and 4	Complete Blood count (AZT patients)
	Weeks 6	HIV-Ab
	Weeks 12	HIV-Ab
	Weeks 24	HIV-Ab

Source: Revised Guidelines for Post-exposure prophylaxis for HIV- NACO; 2014

FIGURE 27: POST EXPOSURE PROPHYLAXIS FOR HEPATITIS-B

Post-exposure management of healthcare personnel after occupational percutaneous and mucosal exposure to blood and body fluids[8]

Healthcare personnel status	Post-exposure testing		Post-exposure prophylaxis		Post-vaccination serologic testing†
	Source patient (HBsAg)	HCP testing (anti-HBs)	HBIG*	Vaccination	
Response unknown after 3 doses	Positive/ unknown	<10mIU/mL**	HBIG x1	Revaccination initiated	Yes
	Negative	<10mIU/mL	None		
	Any result	≥10mIU/mL	No action needed		
Unvaccinated/ incompletely vaccinated or vaccine refusers	Positive/ unknown	—**	HBIG x1	Complete vaccination	Yes
	Negative	—	None	Complete vaccination	Yes

Abbreviations: HCP = healthcare personnel; HBsAg = hepatitis B surface antigen; anti-HBs = antibody to hepatitis B surface antigen; HBIG = hepatitis B immunoglobulin.

* HBIG should be administered intramuscularly as soon as possible after exposure when indicated. The effectiveness of HBIG when administered >7 days after percutaneous, mucosal, or non-intact skin exposures is unknown. HBIG dosage is 0.06mL/kg.

† Should be performed 1–2 months after the last dose of the HepB vaccine series (and 4–6 months after administration of HBIG to avoid detection of passively administered anti-HBs) using a quantitative method that allows detection of the protective concentration of anti-HBs (≥10mIU/mL).

§ A responder is defined as a person with anti-HBs ≥10mIU/mL after ≥3 doses of HepB vaccine.

¶ A non-responder is defined as a person with anti-HBs <10mIU/mL after ≥6 doses of HepB vaccine.

** HCPs who have anti-HBs <10mIU/mL, or who are unvaccinated or incompletely vaccinated, and sustain an exposure to a source patient who is HBsAg-positive or has unknown HBsAg status, should undergo baseline testing for HBV infection as soon as possible after exposure, and follow-up testing approximately 6 months later. Initial baseline tests consist of total anti-HBc; testing at approximately 6 months consists of HBsAg and total anti-HBc.

4. MEDICAL SURVEILLANCE

Medical surveillance is the analysis of health information to look for problems that may be occurring in the HCF that require targeted prevention. Thus, surveillance serves as a feedback loop to the employer.

Surveillance systems use data

- To prevent exposure to infections and other hazardous chemicals, cytotoxic and radioactive waste and injuries.
- Surveillance permits an episode outbreak of infection or other hazards to be recognized and investigated.
- It likewise gives a premise to presenting control measures, assessing their efficacy, reinforcing routine preventive measures and determining the level of avoidable infection.
- Quality of ash and emissions, as indicated by the limits set down in permits, laws or plant determinations (for incinerator administrators) will help in CTF support.[1]

Records that are needed for surveillance in HCF or CTF are

i. Injury registers of all wards
ii. Spill registers
iii. Accident registers
iv. Weekly inspection records of storage area
v. Records of incinerator ash quality
vi. Records of temperature, dioxins and furans quantity of incinerator
vii. Records of microbiological tests of autoclave and microwave

5. TRAINING

Workers at risk from infection and injury include healthcare providers, hospital cleaners, maintenance workers, operators of waste-treatment equipment, and all personnel involved in waste handling and disposal within and outside healthcare facilities.

- Healthcare waste workers should be trained even before starting work on handling waste, and then on a routine basis (e.g. annually) to update their knowledge of prevention and control measures.
- Training should include information about the potential hazards from waste, the purpose of immunization, safe waste-handling procedures, reporting of exposures and injuries, preventing infection following an exposure with PEP and the use of PPE.
- Training is intended to ensure that workers know and understand the potential risks associated with healthcare waste and the rules and procedures they are required to follow for its safe management. They should be informed on the importance of reliable use of PPE and should be aware of where to obtain post-exposure follow-up in case of a needle-stick injury or other blood exposure.
- Healthcare personnel should be trained for emergency response. If injured by a waste item, the necessary first aid equipment should be readily available at all times. Written procedures for the different types of emergencies should be drawn up.
- For dangerous spills of hazardous chemicals or highly infectious materials, the clean-up operation should be carried out by assigned personnel specially trained for the purpose.[4]
- To limit the risks, the hospital management must set up management rules and standard operating procedures for healthcare waste and establish standardized emergency procedures.[3] One person should be designated as responsible for the handling of emergencies, including coordination of actions, reporting to managers and regulators and liaising with emergency services.[1]

FREQUENTLY ASKED QUESTIONS

1. Are health care workers protected from blood, body fluids and other potentially infectious materials when they wear any type of fluid-resistant garment?

Different sorts of gowns and coveralls have distinctive measures for opposing the infiltration of body liquids and infections. It is important to choose the garment that meets the recommended specifications based on the patient's clinical status and activities being performed.

While a garment may be labeled as "fluid-resistant" that does not mean it will provide resistance to blood, body fluids or viruses. Regardless of specification, protective garments must be used correctly in order to ensure intended protection.[5]

2. When should a health care worker use an apron as part of the PPE ensemble? Should the apron or other PPE be disinfected or changed in the patient room if it becomes soiled with body fluids from the patient?

CDC recommends that a health care worker wear an apron over their gown or coveralls any time a patient is vomiting or has diarrhoea. An apron is recommended in those circumstances to minimize the soiling of underlying PPE and provide an easily discarded layer if the apron becomes soiled. An apron should also be used routinely if the facility is using a coverall that has an exposed, unprotected zipper in the front.

If there is significant soiling of the PPE, the health care worker should leave the patient care area and take off the PPE in the doffing area under the observation of a trained observer. Proceeding to work in equipment that is soiled creates added risks for contamination.[5]

3. Does the employer have to provide personal protective equipment?

As per BMW rules, it is the duty of the employer to ensure that he/she supplies the necessary PPEs and also ensure that the waste handlers use it whenever indicated.

TAKE HOME MESSAGES:

- Occupational safety is the key to protect health of health care workers
- Personal protective equipment must be used while handling waste
- Immunization, Medical surveillance and periodic health checks of all staff is mandated as per BMWM Rules 2016 and documentation of the same.

CHAPTER 15 – SEGREGATION OF BIO-MEDICAL WASTE GENERATED IN A LABORATORY

Learning objectives

1. To learn about segregation of different waste items that are most likely to be generated in a laboratory where diagnostic tests are being carried out

Contents

Frequently asked questions

INTRODUCTION

Laboratories are an integral part of the health care system. Laboratories may be attached to a hospital or may be standalone diagnostic laboratories. Since a large proportion of patients seeking health care will need to undergo a diagnostic test, biomedical waste from laboratories form a large quantity of waste. Hence by its sheer quantity, a list of items that may need to be disposed off as laboratory waste needs special mention.

S.NO.	Waste Items	Pre-treatment	Disposal
1.	Broken glass	-	Blue
2.	Glass bottles	-	Blue
3.	Glass pipettes	-	Blue
4.	Slides	-	Blue
5.	Test tubes/ glass tubes	-	Blue
6.	Hypodermic collection needles	-	White
7.	Lancet	-	White
8.	Razor blade	-	White
9.	Scalpels	-	White
10.	Vacutainer needles	-	White
11.	Bacteriological medium with growth	Autoclave	Yellow
12.	Blood (Large quantities, clots)	-	Yellow
13.	Cotton swabs	-	Yellow
14.	Filter paper	-	Yellow
15.	Gauze pieces	-	Yellow
16.	Glucometer strips	-	Yellow
17.	Human tissues, organs	-	Yellow
18.	Paper strips	-	Yellow
19.	Paraffin wax	-	Yellow
20.	Sticks wooden	-	Yellow
21.	Auto-analyzer cups	-	Red
22.	Capillaries	-	Red
23.	Culture plates	Autoclave	Red
24.	ELISA plates	-	Red
25.	Plastic bottles	-	Red
26.	Plastic tips	-	Red
27.	Plastic tubes	-	Red
28.	Plastic tubing	-	Red

29.	Saline bottles	-	Red
30.	Serum storage plastic cups	-	Red
31.	Syringes	-	Red
32.	Testing containers	-	Red
33.	Urine and stool containers	-	Red
34.	Vacutainers	-	Red
35.	Chemicals	Dilution	ETP
36.	Formalin	Dilution	ETP
37.	Immersion oil	Dilution	ETP
38.	Infectious samples	Equal volume of Sodium hypochlorite solution for 20 mins	ETP
39.	Reagents	Dilution	ETP
40.	Stains	Dilution	ETP

NOTE: All laboratory and microbiology waste has to be pretreated. The container after pretreatment may be disposed to the appropriate color coded bin based on the type of material for its final disposal. eg. Culture media after pretreatment to be discarded into yellow while the culture plate can be disposed in red if plastic.

FREQUENTLY ASKED QUESTIONS

1. Which bin should glass slides with infected body fluid be disposed off?

Since slides are made of glass they should be put in the puncture and leak proof box / container with blue marking which will finally be sent for autoclaving and recycling

TAKE HOME MESSAGES:

- Laboratories generate a large amount of infectious waste
- All laboratory waste must be pre-treated on site

Learning objectives

1. To understand the main hazards in emergency situation
2. To understand the various measures taken to manage Bio-medical waste during the three different phases of emergency situation
3. To know the disposal systems to be used

Contents

Frequently asked questions

INTRODUCTION

Natural disasters and man made conflicts are considered as one of the most disruptive events. The magnitude of the damages that these events cause can be unpredictable, it is predicted that in such situations many essential services, medical services, civic services can be damaged due to various reasons. Reinstating essential services would be given utmost importance and waste management would be relegated to least importance. Early restoration of waste management services would prevent both environmental and health risks.[1]

Rapid initial assessment is the first step that has to be carried out to assess the situation in emergencies. Initial assessment will provide information for planning of interim services for biomedical waste management. Services from local bodies and aid can be sought for coordinating and utilization of available resources. Early institution of waste management services can avert risks of an imminent outbreak of diseases and public health risk. Detailed assessment to be deferred to a later phase of disaster management cycle.(1)

It is essential that proper management systems of biomedical waste be established for managing biomedical waste generated due to medical care activities undertaken during the emergency. However, the quantum, type of waste generated may vary based on the medical services offered and the stage of disaster management cycle.[3]

Source: http://www.jems.com/articles/ugc/2016/12/18/magen-david-adom--philippine-red-cross-collaborate-on-multicasualty-incident-workshop--drill-in-mani.html

Phase one: Rapid initial assessment

The expert needs to undertake the following:

- Ascertain from the chairperson of the health services if the emergency preparedness plan of the health sector includes plans for management of biomedical waste. If present follow the same.
- If not prepare an appropriate plan based on the prevailing situation.
- To assess the prevailing situation conduct a rapid survey
- Collect data regarding the extent of geographical area affected and any public, private services that are still functioning.[1]
- Visit as many health care facilities as possible to gather general and technical information. Using a standardized assessment tools and methods of survey would aid in rapid and accurate assessment.[3]

General Information would include:

- Name and location of the health care facility.
- Type of emergency services provided
- Availability of personnel and financial resource for biomedical waste management.[3]

Technical information:

- Enlist the different categories of waste generated in the health are facility.
- describe the current processes, location and methods used for disposal of biomedical waste.
- Record any documentation with regard to quantum of waste generated and any injuries related to waste management.
- Availability of land for deep burial.[3]

Phase two: Emergency response

Based on the phase two of emergency response a simple action plan has to be drawn up based on the data and information gathered in the rapid assessment survey.

The action plan should delineate the roles and responsibilities of the organizations involved. Coordination between the organizations needs to be established for smooth functioning and to avoid duplication.[1]

It is recommended that initially two bin strategy can be adopted. In this strategy sharps and non sharps can be segregated. All sharps can be contained in one bin and the other categories of waste can be contained in the other bin. Segregation needs to be maintained till the final disposal. A designated space to be allocated for deep burial. Burial of non-sharps and sharps wastes in pits or trenches may be considered as a pragmatic option in emergency situations. As the aid and resources increase and as time progresses three system can be adopted. Sharps, general waste and non sharp waste can be contained in the three bins.[3]

Phase three: Recovery phase

Recovery phase or phase is three is characterized by gradual return of the community towards normalcy or before the emergency state. A better system

of biomedical waste management can be established with availability of more resources.

A detailed assessment and plan can be evolved for the improvements in general and biomedical waste management.

As resources become available, a more detailed assessment can be conducted for planning and fundraising for future improvements and for setting priorities in the affected area.

The results of the assessment and the identified needs and priorities are the starting point for ensuring that a sustainable approach to health-care waste management is created after an emergency. Start by preparing simple, locally applicable action plans to define the improvements to be achieved and gradually improve these action plans whenever the resources become available. Detailed central strategic plans may prove difficult to prepare on a realistic timescale and a region or country may not have the capacity to implement them in the aftermath of an emergency. It is important that all planned activities respect the principles of prevailing national legislation and policies and fit into a national plan for emergency response where they are already available.[1]

FREQUENTLY ASKED QUESTIONS

1. What is the two bin strategy used in emergency?

Two bin strategy is used in emergences in the initial phase. The strategy is to contain and segregate sharps form the other types of waste.[1]

2. What is the first step in the management of healthcare waste in emergencies?

Rapid assessment is the first step in the waste management in emergencies. Information regarding available resources, quantum and types of waste generated can be gathered by rapid assessment.[1]

TAKE HOME MESSAGES:

- Assessment and response during emergencies can be classified as 3 phases -initial assessment, emergency response and recovery
- A minimum 2-bin strategy can be used to segregate waste -sharps and non-sharps where the wastes have to be buried
- During the recovery phase, a better system of bio-medical waste management may be used

CHAPTER 17 – BIO-MEDICAL WASTE MANAGEMENT IN HEALTH CAMPS

Learning objectives

1. To know about the bio-medical waste management in health camps.

Contents

Frequently asked questions

INTRODUCTION

Health camps are organized by the healthcare facilities as an extension activity of their institution. The Bio-Medical Waste Management Rules, 2016 are applicable to the health camps also. Any HCF providing healthcare services beyond the hospital premises in temporary camps need authorization from the respective pollution control boards.

The health camps are mainly for treatment of acute cases and also act as screening point for various diseases. The camps provide medications and simple laboratory facilities. The various kinds of camps are:

- General health camps
- Screening camps for non-communicable diseases like hypertension, diabetes.
- Screening camps for specific diseases of interest
- Outreach immunization camps
- Cataract surgeries done in ophthalmology camps
- Blood donation camps

Type and quantum of bio-medical waste that would be generated depends on the type of medical services, the laboratory and screening facilities provided at the camps.

The below table gives an overview of the kind of waste generated in the health camps and the categories into which the waste need to be put according to the BMWM Rules, 2016.

Color coded category			
Yellow	Red	White [translucent]	Blue
Infected cotton swab	Syringes without needles	Blades	Glassware
Dressings	Gloves	Needles from hub cutter	Broken ampoules
Face mask		Syringes with intact needle	
Glucometer strip			

Approximately, the volume of the bin needs to be double the volume of waste that is generated.

STEPS TO MANAGE BIO-MEDICAL WASTE

- The healthcare personnel involved in the health camp should identify a place for keeping the segregation bins.
- A poster depicting the segregation chart should be put up as a ready reckoner.
- A person should be designated to collect these bins after the camp.
- Transportation of waste should be done with utmost care.
- The designated person will need to ensure that the collected waste is sent to the temporary waste storage area of the hospital.

FREQUENTLY ASKED QUESTIONS

1. What are the responsibilities of the personnel in-charge of bio-medical waste?

- To carry the required color coded bins to the camp
- To display the segregation chart at the health camp
- To transport the bio-medical waste back to the hospital

TAKE HOME MESSAGES:

- Biomedical waste generated in health camps, medical or surgical camps, vaccination camps and blood donation camps also come under the ambit of BMWM Rules 2016 and it is the responsibility of the occupier to manage the same appropriately.
- Approximately the volume of the bin that needs to be made available during such camps needs to be double the volume of waste that is generated

Learning objectives

1. To understand the systematic process of collecting, analysing and using information to track the progress toward achieving safe and sound bio-medical waste management systems.

Contents

Frequently asked questions

WASTE MANAGEMENT MONITORING

Waste Management Monitoring is the systematic process of collecting, analysing and using information to track the progress toward achieving safe and sound bio-medical waste management systems. It continues throughout the programme implementation period.

Waste management should be monitored regularly. While setting up a new system, the baseline assessment is very important in providing reference data on which to base the plan. Some monitoring data may be required by the regulatory authorities while other data can show up the successes and failures in the systems so that practices can be modified accordingly and improved.

The set-up of a monitoring plan as well as adequate control procedures at health facility level is a key issue to ensure sustainability. Regular reporting and auditing are the basis of an efficient monitoring plan. The monitoring plan should aim at providing relevant information for following reasons:

- Progress in the implementation of the HCWM plans within the HCFs
- Feedback on the various stages of bio-medical waste management
- Information on the trends of waste generation for proactive future action
- Information on the areas of strengths and weakness so as to reinforce the management system with appropriate corrective actions
- Information on the effectiveness of various strategies regarding bio-medical waste management strategies
- Information on the achievements of stated targets and standards
- Measure the Operation and Maintenance (O&M) performance of the health services to maintain a good standard of HCWM within the HCFs

FREQUENTLY ASKED QUESTIONS

1. What are the two types of monitoring mechanism that needs to be established for sustainability of safe and sound bio-medical waste management system?

- Day-to-day monitoring
- Periodic monitoring

2. Who will do it?

- Senior staff nurse
- epartmental heads
- Waste management officer

3. What to monitor?

- From the point of generation viz. Quantity, segregation, labelling, collection, handling, use of personal protective equipment by waste handlers, transportation, storage etc. of bio-medical waste.
- Management of spills like blood, body fluids, chemicals, mercury etc. by concerned staff.
- Inventory management of the equipment, bags, bins, liners, etc. necessary for waste management.
- Records like waste management register, injury register etc.
- Use of appropriate PPEs during handling of waste

4. How to monitor?

- Use of a monitoring check list of the above activities (Prototype given in Annexure 3 & 4).

TAKE HOME MESSAGES:

- Biomedical waste management is an attitudinal issue. Hence a regular monitoring is essential to maintain biomedical waste management systems in place.
- Monitoring could be done on a day to day basis or on a periodic basis with the help of specific tools

Learning objectives

1. To know about various types of documents that have to be maintained during the process of waste management.

Contents

1. Main documents – Annual report of Healthcare facility
2. Documentation at the point of generation of waste – waste register
3. Reporting accidents and incidents including spillage – injury register
4. Reporting spills – spill register
5. Request protocols for using, repairing and replacing emergency equipment
6. Monitoring of documentation

Frequently asked questions

MAIN DOCUMENTS-

ANNUAL REPORT OF HEALTHCARE FACILITY (SEE BMWM RULES, 2016)

DOCUMENTATION AT THE POINT OF GENERATION OF WASTE-

WASTE, TEMPORARY STORAGE FACILITY IN THE HCF AND PRE-TREATMENT

Format for registers- 200 page note book/ printed sheet/ register indicating details as given in the examples below:

Information to be maintained in the Waste Register at the point of generation

Date	Time	Location	Yellow	Red	White	puncture proof leak proof box with blue mark	Sign of ward nurse	Sign of housekeeping staff
			N	N	N	N		
N: number, Wt: weight								

Sample of records to be maintained at the temporary storage area in the HCF

Date	Time	Location	Yellow		Red		White		puncture proof leak proof box with blue mark		Total Quantity (kg)	Sign of supervisor in storage area	Sign of CBWTF person	Vehicle number, date and time of collection
			N	Wt	N	Wt	N	Wt	N	Wt				
N: number, Wt: weight														

REPORTING ACCIDENTS AND INCIDENTS INCLUDING SPILLAGE-INJURY REGISTER

All health care personnel involved in waste management should be trained to handle emergency situations and respond appropriately. They should be aware of the procedures and process need to be followed for reporting accidents or incidents. they should also be aware of line hierarchy for reporting in emergency situations. Incidents for reporting would include injuries due to sharps, improper segregation, spillage of chemicals or body fluids.[1]

Examples of accidents or incidents

1. Breaking of mercury containing equipment like thermometers, blood pressure apparatus
2. Breaking of non-mercury containing equipment like test tubes, glass bottles
3. Spillage of blood or body fluids
4. Spillage of bio-medical waste
5. Spillage of waste
6. Needle stick injury to doctors, nurses or patient attenders

The report should include details of:

- The nature of the accident or incident
- The place and time of the accident or incident
- The staff who were directly involved
- Any other relevant circumstances.

The cause of the accident or incident should be investigated by the waste management officer (in case of waste) or other responsible officer, who should also take action to prevent recurrence. The records of the investigation and subsequent remedial measures should be kept.

DOCUMENTATION OF SPILLAGE-SPILL REGISTER

Spillage of any of the following material has to be documented and reported to the seniors

1. Blood or any body fluid
2. Chemicals
3. Cytotoxic material
4. Waste
5. Mercury-whenever possible, spilt drops of mercury should be recovered.

Example of Spill Register

Serial No.	Date and time	Type of spilt material	Action taken and time	Signature of Staff in-charge

A record of injuries should be kept in each ward & follow-up of injuries should be done

Example of injury Register

Serial No.	Date	Name	Age	Sex	Designation	Sign of ward I/C	Sign of Infection control Nurse/I/C Nodal Officer

Investigation and follow-up schedule for injuries

Date	
Name, age, sex	
Time of injury	
Time of reporting	
Work area where exposure occurred	
How did it happen	
Patients HIV, HBsAg	
Status	
Type of exposure (blood filled device, body or blood fluid exposure, body part exposed, type of device)	
Post-exposure Prophylaxis Investigations done	
Treatment given	
Follow-up dates for treating and testing	

REQUEST PROTOCOLS FOR USING, REPAIRING AND REPLACING EMERGENCY EQUIPMENTS:

1. For replacement of the emergency equipment, the equipment is shown as condemned and new indent is prepared for the equipment.
2. Request should be sent to the maintenance department and records kept in a register in the ward

Sample of record of request for equipment

Sl. No.	Date and time of request	Name of equipment required	Date and time of problem with equipment	Date and time of collection of equipment by the maintenance department	Name and sign of the ward in charge

FIGURE 28: LIST OF DOCUMENTS TO BE MAINTAINED FOR BMWM

Sl. No.	Name of the record	Maintained by	Where to maintain
1.	Authorization / renewal letter from respective Pollution control boards	Administrator / waste management officer	Can be displayed or maintained at office of head of the HCF
2.	Memorandum of understanding with CBWTF	Administrator / waste management officer	Maintained at office of Head of HCF or as deemed fit
3.	Waste Register	Nurse , temporary storage in charge	At every point of generation of waste in HCF and temporary storage facility
4.	Spill Register	Nurse	At every point of generation of waste in HCF and temporary storage facility
5.	Injury Register	Nurse/ ICN	At every point of generation of waste in HCF and temporary storage facility
6.	Intramural Transport Record	Waste management officer	Temporary storage facility
7.	Transport to CBWTF	Waste Management officer/ Nursing superintendent	Temporary storage facility
8.	Health Records of the personnel – Annual/ time of induction	Administrator	Office of the Hospital Administrator
9.	Immunization Records	Administrator	Office of the Hospital Administrator
10.	Record of training conducted	Administrator/ Nursing superintendent	Office of the Hospital Administrator
11.	Annual report of Bio-medical waste management	Administrator/ Nursing superintendent/ waste management officer	Office of the Hospital Administrator
12.	Minutes of the waste management/ infection control committee*[9]	Secretary of the committee	Secretary of the committee/ Administrators office
13.	Accident Report	Administrator/ Nursing superintendent/ waste management officer	Office of the Hospital Administrator
14.	Operational records of Autoclave/ Microwave	Administrator/ Nursing superintendent/ waste management officer	Office of the Hospital Administrator
15.	Record for effluent standards	Hospital engineer	Office of Administrator
16.	Records of monthly monitoring of waste management systems	Nursing in-charge of the generation points/ administrator	Office of Administrator

MONITORING OF DOCUMENTATION

The hospital infection control committee (HICC) should monitor the documentation and also the waste segregation, storage at the waste generation point. This monitoring is done regularly every month. On a daily basis, the nurse in-charge has to monitor the various documentation process under the guidance of administrators.

FREQUENTLY ASKED QUESTIONS

1. How is the authorisation given to a hospital?

Every occupier or operator handling bio-medical waste, irrespective of the quantity shall make an application in Form II to the prescribed authority i.e. State Pollution Control Board and Pollution Control Committee for grant of authorisation.[1]

2. Why is documentation important in bio-medical waste management?

It helps in providing the documentary evidence required for managerial decision making and detection of problems, loopholes in the system.

3. How long the documents related to BMWM need to be maintained by the HCFs?

All the concerned documents and reports related to BMWM should be maintained for five years.

4. What are the reports that need to be submitted as per laws of the country?

- An annual report to be submitted in Form IV to the State Pollution Control Board by 31st Jan every year, to include the categories of waste and their quantification. .
- The Air and Water Consent forms should also be filed.
- Accident reporting in Form I (in an event of any major accidents).

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ANNEXURES

ANNEXURE 1: SEGREGATION LIST OF BIO-MEDICAL WASTE

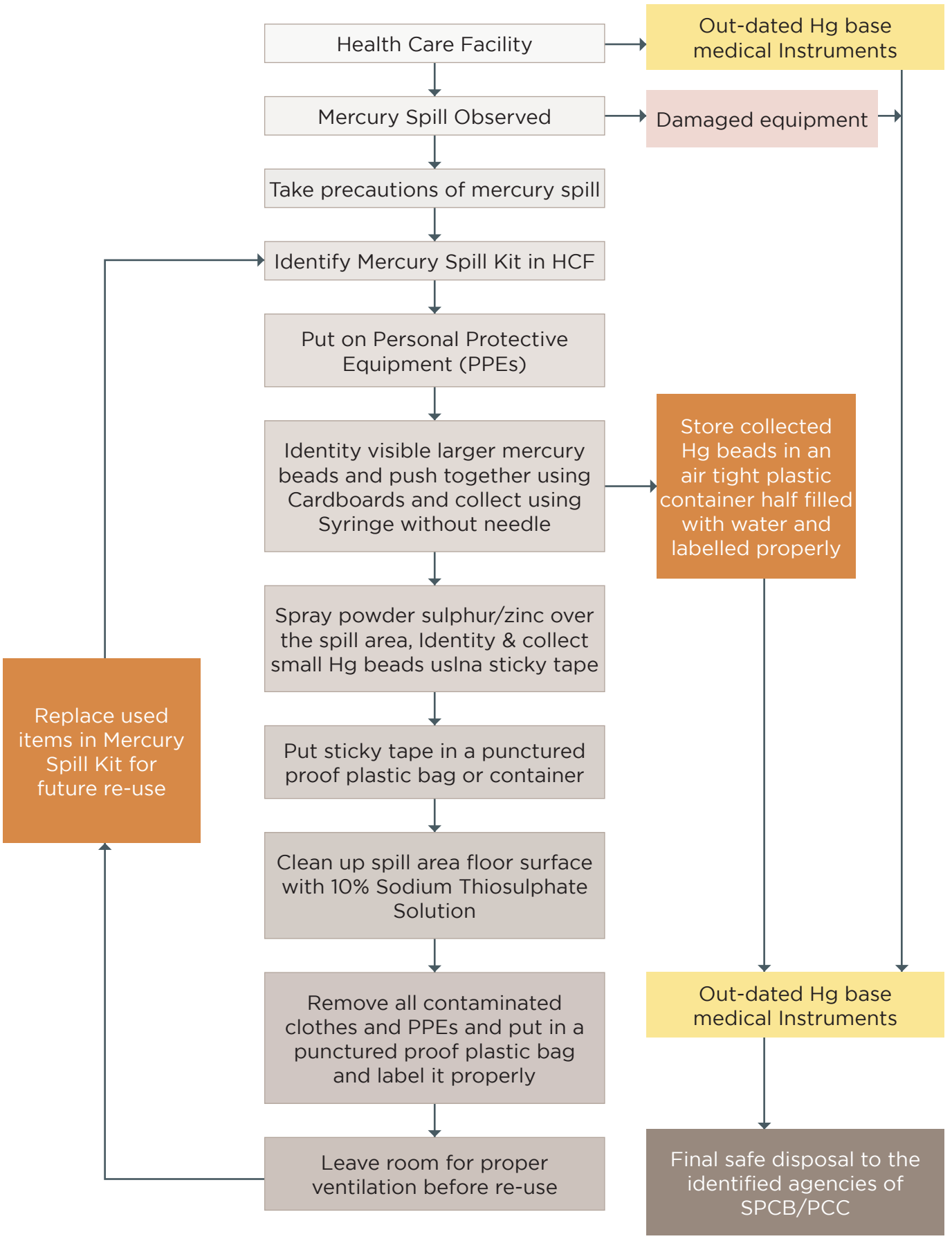
Waste	Pre-treatment	Disposal
All other discarded medicines	-	Yellow container for medicines
Antibiotics	-	Yellow container for medicines
Bedding discarded	-	Yellow bag or wrap with yellow packing material
Blood bags/ discarded and residual blood & blood components	Autoclave/ Non-chlorinated chemical disinfection	Yellow container
Chemicals in production of biologicals	-	Yellow container
Cotton swabs	-	Yellow container
Cytotoxic drugs-contaminated with cytotoxic drugs along with glass or plastic ampoules vials	-	Yellow container labelled for cytotoxics
Discarded linen, mattresses	-	Yellow bag or wrap with yellow packing material
Disinfectants – solids/ powders - Used or discarded	-	Yellow container
Dressings	-	Yellow container
Drop of blood on the floor of the ward	-	Wipe with cotton and Yellow container
Experimental animal carcasses, animal body parts, organs, tissues	-	Yellow container
Foetus below viability period	-	Yellow container
Glass medicine vials & ampoules contaminated with cytotoxic wastes	-	Yellow container labelled for cytotoxics
Human and animal cell cultures – research industrial labs, production of biological, residual toxins, dishes and devices used for cultures	Autoclave/ Non chlorinated disinfection	Yellow container
Human tissues, organs, body parts	-	Yellow container
Lab cultures	Autoclave/ Non chlorinated disinfection	Yellow container
Linen discarded	-	Yellow bag or wrap with yellow packing material
Mattresses discarded	-	Yellow bag or wrap with yellow packing material

Placenta	-	Yellow container
Plaster casts	-	Yellow container
Plastic medicine vials & ampoules	-	Yellow container for medicines
Plastic medicine vials & ampoules contaminated with cytotoxic wastes	-	Yellow container labelled for cytotoxics
PPE – used (Masks/head caps/shoe covers)	-	Yellow container
Reconstituted unused vaccines	Autoclave/ Non chlorinated disinfection	Yellow container
Stocks or specimens of micro-organisms	Autoclave/ Non chlorinated disinfection	Yellow container
Vaccines - Live or attenuated	Autoclave/ Non chlorinated disinfection	Yellow container
Vaccine vials/ ampoules with left over vaccines	Autoclave/ Non chlorinated disinfection	Yellow container
Vials with leftover antibiotics	-	Yellow container for medicines
Aspirated body fluids – pleural/ peritoneal/CSF/ synovial fluid	Chemical disinfection	Effluent treatment plant
Disinfectants – Discarded liquids	Dilution	
Faeces sample	Chemical disinfection	
Formalin - Discarded	Dilution	
Infected secretions	Chemical disinfection	
Liquid from floor washing ,cleaning & house keeping – phenol, formalin, lysol	Dilution	
Liquid from labs – normal saline, distilled water, EDTA	Dilution	
Reagents	Dilution / Neutralisation	
Serum	Chemical disinfection	
Silver X ray film developing liquid	Resource recovery	
Sputum sample	Chemical disinfection	
Stains	Dilution / Neutralisation	
Urine sample	Chemical disinfection	

Catheters	-	Red container
Gloves- surgical gloves/heavy duty gloves	-	
I.V tubes & sets	-	
Plastic Bottles	-	
Plastics	-	
Suction tubes	-	
Syringes – without needles	-	
Tubing	-	
Urine bags	-	
Vacutainers with their needles cut	-	
Canisters	-	Puncture proof and leak proof box or container with blue mark
Glass bottles (Broken & Unbroken)	-	
Glass medicine vials & ampoules without cytotoxic waste	-	
Metallic Body Implants	-	
Other contaminated sharp glass object that may cause puncture and cuts	-	
Pressurised cans	-	
Blades	-	White Translucent Puncture, leak and tamper proof container
Lancet	-	
Lumbar puncture needles		
Metal sharps – Contaminated/ discarded	-	
Needles – Broken / intact / from needle tip cutter or burner / Vacutainer needles	-	
Other contaminated sharp metallic object that may cause puncture and cuts	-	
Scalpels	-	
Syringes with fixed needles	-	
Disposable coffee /tea cups	-	General waste bin
Packaging materials, covering of food packet	-	
Paper	-	
Wrappers	-	

ANNEXURE 2: FLOWCHART FOR MANAGEMENT OF A MERCURY SPILL

FIGURE 29: FLOWCHART FOR MANAGEMENT OF A MERCURY SPILL



Source: (Central Pollution Control Board, 2012)

ANNEXURE 3: DAILY BMW COMPLIANCE OBSERVATION TOOL BY ICN

Sl. No.	Date	Yellow Bin		Red Bin		Blue Bin		Sharp Container		Score Out Of 4
		Proper (1)	Improper (0)	Proper	Improper	Proper	Improper	Proper	Improper	
1										
2										
3										
4										
5										
6										
7										
8										
9										
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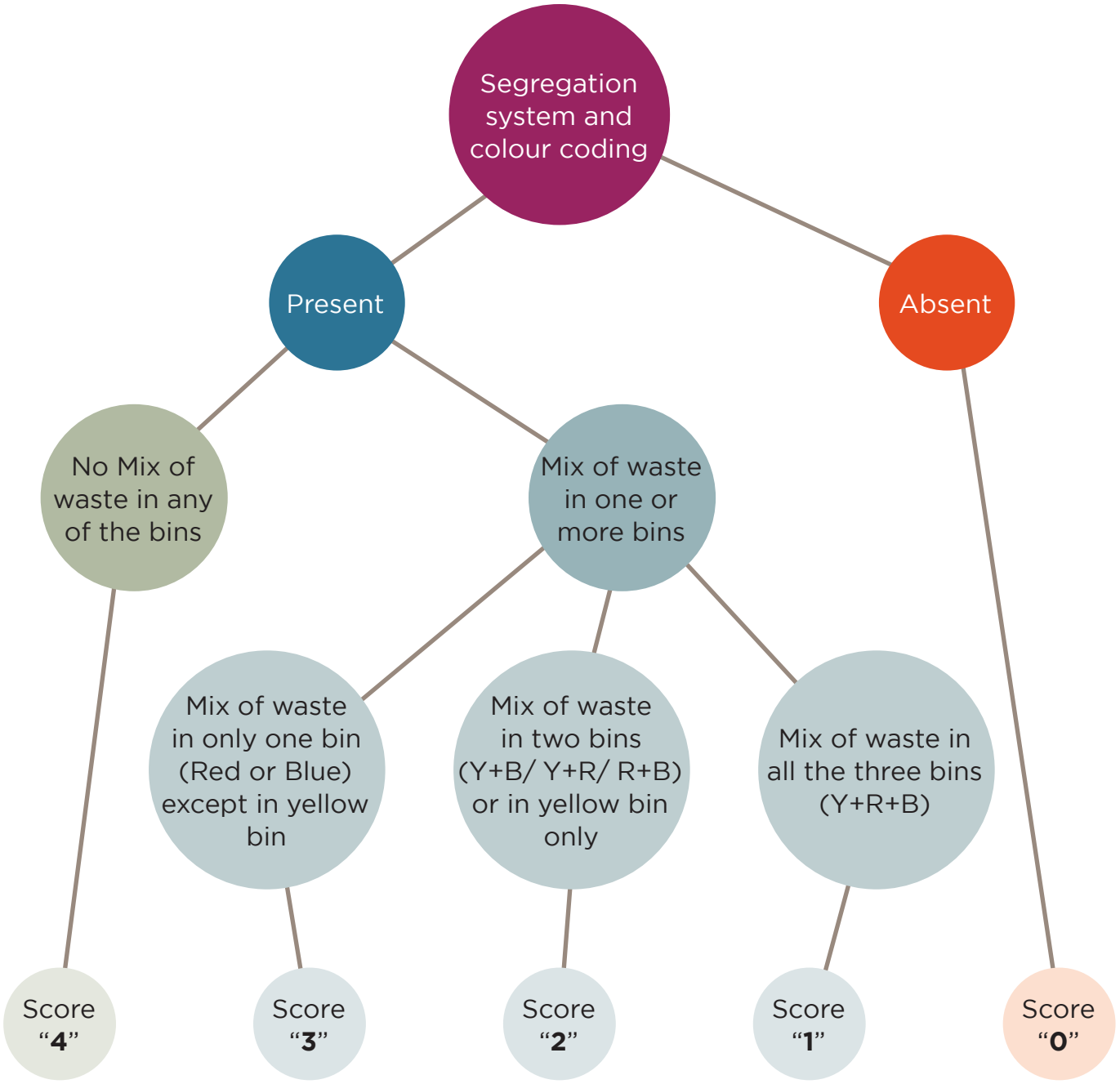
29										
30										
31										

ANNEXURE 4: MONTHLY MONITORING FORMS

No.	Locations evaluated
a	
b	
c	
d	
e	

Date :	Time:
Hospital:	
Name of the Monitors	Signature
1.	
2.	

FIGURE 30: FLOW CHART FOR SEGREGATION SCORE



A. Segregation Practices

Sl. No.	Locations evaluated	a	b	c	d	e
1	Segregation score					
2	Spill observed outside the bin (Yes=1, No=2)					
3	Segregation score in dressing trolley					

B. Management of sharps (containment measures)

Sl. No.	Management of sharps	a	b	c	d	e
4	Is sharps contained in puncture proof container (Yes =1, No=0)					
5	Was the sharp container overfilled during your visit (YES =1, No=0)					

C. Worker's safety (Interview the Waste handlers)

Sl. No.	Worker's safety	a	b	c	d	e
6	Are trained to use PPE (Yes=1, No=0)					
7	Are supplied with necessary PPE (Yes =1, No=0)					
8	During the visit, were they using PPE while handling waste (Yes=1, No=0)					

D. Record maintenance

Sl. No.	Record maintenance	a	b	c	d	e
9	Are records in waste management register updated till date (Yes=1, No=0)					
10	Are records in injury register updated till date (Yes=1, No=0)					
11	In the event of an injury has it been informed to ICN (Yes=1, No=0)					

E. Other observations

Sl. No.	Other observations	a	b	c	d	e
12	Display of SOP at strategic locations (Yes =1, No =0)					
13	Spill kit present (Yes=1, No=0)					

F. Statistics

No.	a	b	c	d	e
No. of spills in last one month					

G. Non compliances

Non compliances	a	b	c	d	e
No. of NCs observed this month					
No. of NCs observed last month					
No. of NCs corrected					
No. of NCs remaining					

Any specific observations & Comments

Ward	Observations and comments	Suggestions and action taken	No. of NCs this month	No. of NCs last month	No. of NCs corrected	No. of NCs remaining

Segregation score

Observation	Classification	Score
• Colour coded bins/liners/exclusive bins (with lids) present on observation • Segregation of waste is done as per colour code specified in BMWM Rules, 2016 • No mix at all in any of the bins	Segregation practice present and highly satisfactory	4
• Colour coded bins/liners/exclusive bins present on observation • Waste other than the specified category present in one bin (other than yellow bin).	Segregation practice present & satisfactory	3
• Colour coded bins/liners/exclusive bins present on observation • Waste other than the specified category present in yellow only or/+ red or blue bin.	Segregation practice present but incomplete	2
• Colour coded bins/liners/exclusive bins present on observation • Waste other than the specified category present in yellow, red and blue bin • More than one different category present other than prescribed category in yellow, red & blue bin	Segregation practice present but not satisfactory	1
• No exclusive bins for segregation. Complete mix • All waste dumped with no criteria or classification for segregation in only one bin.	No segregation practices	0

ANNEXURE 5: CHECKLIST FOR CBWTF VISIT

Checklist for visit to Common Bio-medical Waste Treatment Facility

Location			
Land area	Less than one acre / More than one acre, specify		
Coverage	Area : .....radius In km		
	No of beds covered:		
	Health care facilities covered (specify)		
	Large		
	Medium		
	Small /clinics		
Charges pattern	Rs_____ / bed / day Or Rs_____ / kg / day		
Quantum of waste received per day in Kgs (kg/day) (From records for last month)	Total		
	Category wise	Infectious waste for incineration/Yellow: Infectious waste for autoclave/Red : Sharps/ White : Glassware/Blue: Metals implants/ Blue:	
Staff (List by designation)			
Treatment facilities Available	Incineration	Autoclave (pre vacuum horizontal feeding)	Microwaving
	Shredder	Sharp pit with drawing details Encapsulation	Effluent treatment Plant
	Hydroclave	Facilities for bin washing/ floor washing/ vehicle washing	Any other:
Treatment equipment room	Separate room for each treatment equipment	Present / Not present	
Administrative room	Present /Not present		
Generator set	Present /Not present		
Security	Present / Not present		
Washing room	Present / Not present		
Signboard	Present / Not present		
Green belt	Present / Not present		
First Aid box	Present / Not present		
Fire fighting facilities	Present / Not present		

Record maintenance (Tick the following items if present in records)	Records submitted to authority	Submitted / Not submitted
	For Waste accepted Into the CTF	• Waste collection date • Name of the health care unit • Waste category • Quantity of waste • Vehicle number • Receiving date
	For Treated waste removed	• Date • Treated waste type • Quantity • Vehicle Number • Location of disposal
	Log book maintained for each treatment equipment	• Weight of batch • Categories of waste • Time date and duration of treatment cycle • Total hours of operation
	Site records	• Details of construction / Engineering work • Maintenance schedule, breakdowns, remedial actions • Emergencies • Incidents of unacceptable waste received and the action taken • Details of site inspections by regulatory officials & necessary action on the observations
Segregation (Randomly open three yellow bags Inspect the bags for segregation) (Tick the following)	Segregated / Not segregated (3 bags , 2 bags, 1 bag) Tick whether in yellow bag the following is present: • Pressurised gas containers • Large amount of reactive chemical waste • Silver salts • Photographic or radiographic waste • Halogenated plastics: PVC plastics (IV bag, IV fluid container, catheter set, CVP, manometer, suction catheter, blood bag & components) • Wastes with high mercury or cadmium content : Broken thermometers, used batteries and lead lined wooden panels • Sealed ampoules or ampoules containing heavy metals	
Collection of Bio-Medical waste (Tick the following)	• Waste is collected in similar coloured containers with cover as handed over by the respective health care units • Containers are labelled with Bio hazard symbol • Bags are labelled with waste category and health care facility's name and address • Sharps are collected in puncture resistant container	
Transport vehicle	Dedicated vehicle for the collection of Bio-Medical Waste.	Present/ Not Present
	Separate cabins for driver/staff and the bio-medical waste containers in the vehicle	Present/ Not Present
	The base of the waste cabin is leak proof to avoid pilferage of liquid during transportation.	Present/ Not Present
	The waste cabin is easy to wash and disinfect.	Present/ Not Present

	The inner surface of the waste cabin is made of smooth surface to minimize water retention.		Present/ Not Present
	The waste cabin has provisions of sufficient openings in the rear and/or sides so that waste containers can be easily loaded and unloaded.		Present/ Not Present
	The vehicle is labelled with the bio-medical waste symbol (as per the Schedule III of the Rules) and displays the name address and telephone number of the CBWTF.		Present/ Not Present
Storage	Sufficient ventilated storage space for untreated and treated bio-medical waste is provided		Present/ Not Present
	Separate storage facility for different categories		Present/ Not Present
Handling/Protective Equipment Used by waste collectors and equipment operators:	Availability of personal protective equipment (heavy duty rubber gloves, mask, apron and boots)		YES/NO If YES, Adequate/ inadequate
	Use of personal protective equipment		YES/NO If YES, Adequate/ inadequate
	Immunization of the waste handlers (Hepatitis B, TT)		Immunized/Not Immunized If Immunized-partial /complete
Autoclave	Type of autoclave used	Gravity flow autoclave/ Vacuum autoclave	
Time, Temperature &Pressure reached during the autoclave process	Gravity flow Autoclave	121˚C 15 pounds for 60 minutes 135˚C 31 pounds for 45 minutes 149˚C 52 pounds for 30 minutes	
	Vacuum Autoclave	Whether subjected to one pre vacuum pulse to purge the autoclave of all air: Yes / No	
		If Yes, 1210C 15 pounds for 45mins 1350C 31 pounds for 30 mins	If NO Temperature – Pressure - Time
	Availability of graphic/Computer recording devices	Available / Not available	
Validation test	Spore testing	Done/Not Done If done, How frequently	
	Chemical indicator strip	Done/Not Done If done, How frequently	
Shredder	Present / Not present		

SCHEDULE I - BMW CATEGORIES, SEGREGATION, COLLECTION, TREATMENT, PROCESSING AND DISPOSAL OPTIONS

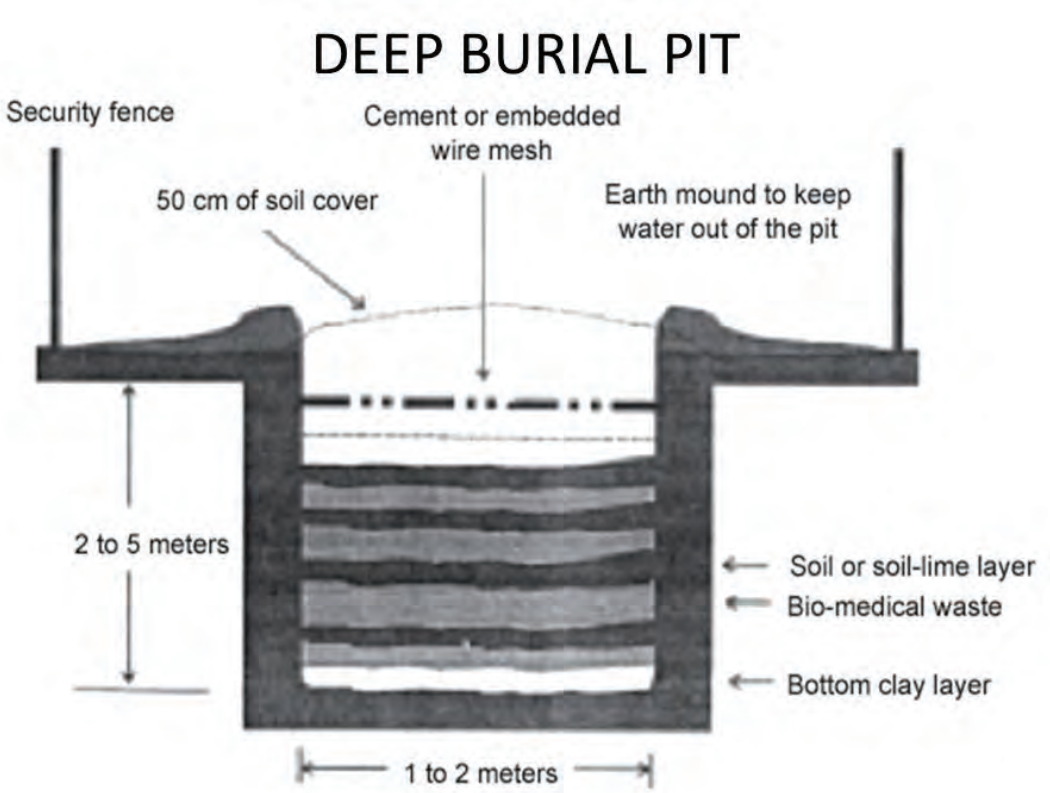
Category	Type of Waste	Type of Bag/ Container to be used	Treatment and Disposal options
Yellow	(a) Human Anatomical Waste: Human tissues, organs, body parts and foetus below the viability period (as per the Medical Termination of Pregnancy Act 1971, amended from time to time).	Yellow coloured non-chlorinated plastic bags	Incineration or Plasma Pyrolysis or deep burial*
	(b)Animal Anatomical Waste : Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.		
	(c) Soiled Waste: Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components		Incineration or Plasma Pyrolysis or deep burial* In absence of above facilities, autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery.
	(d) Expired or Discarded Medicines: Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.	Yellow coloured non-chlorinated plastic bags or containers	Expired `cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >12000C or to common bio-medical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at >12000C Or Encapsulation or Plasma Pyrolysis at >12000C. All other discarded medicines shall be either sent back to manufacturer or disposed by incineration

	(e) Chemical Waste: Chemicals used in production of biological and used or discarded disinfectants.	Yellow coloured containers or non-chlorinated plastic bags	Disposed of by incineration or Plasma Pyrolysis or Encapsulation in hazardous waste treatment, storage and disposal facility.
	(f) Chemical Liquid Waste: Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, Silver X-ray film developing liquid, discarded Formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house-keeping and disinfecting activities etc.	Separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste shall be pre-treated before mixing with other waste water. The combined discharge shall conform to the discharge norms given in Schedule II.
	(g) Discarded linen, mattresses, beddings contaminated with blood or body fluid routine mask and gown.	Non-chlorinated yellow plastic bags or suitable packing material	Non-chlorinated chemical disinfection followed by incineration or Plasma Pyrolysis or for energy recovery. In absence of above facilities, shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery or incineration or Plasma Pyrolysis.
	(h) Microbiology, Biotechnology and other clinical laboratory waste: Blood bags, Laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures	Autoclave or Microwave or Hydroclave safe plastic bags or containers	Pre-treat to sterilize with non-chlorinated chemicals on-site, as per World Health Organization guidelines, thereafter for Incineration on Safe management of wastes from health care activities and WHO Blue Book, 2014.

Red	Contaminated Waste (Recyclable)		
	Tubing		
	IV bottles		
	IV tubes and sets		
	Catheters		
	Urine bags		
	Syringes (without needles and fixed needle syringes) vacutainers with their needles cut) and gloves.	Red coloured non-chlorinated plastic bags or containers	Autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to landfill site
White (Translucent)	Waste sharps including Metals: Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and contaminated metal sharps	Puncture proof, Leak proof, tamper proof containers	Autoclaving or Dry Heat Sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete; combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State Pollution Control Boards or Pollution Control Committees) or sanitary landfill or designated concrete waste sharp pit.
Blue	(a) Glassware: Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.	Puncture proof and leak proof box or container with blue mark	Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium Hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling
	(b) Metallic Body Implants	puncture proof and leak proof box or container with blue mark	

SCHEDULE II –2, STANDARDS FOR DEEP BURIAL

1. A pit or trench should be dug about two meters deep. It should be half filled with waste, then covered with lime within 50cm of the surface, before filling the rest of the pit with soil.
2. It must be ensured that animals do not have any access to burial sites. Covers of galvanised iron or wire meshes may be used.
3. On each occasion, when wastes are added to the pit, a layer of 10cm of soil shall be added to cover the wastes.
4. Burial must be performed under close and dedicated supervision.
5. The deep burial site should be relatively impermeable and no shallow well should be close to the site.
6. The pits should be distant from habitation, and located so as to ensure that no contamination occurs to surface water or ground water. The area should not be prone to flooding or erosion.
7. The location of the deep burial site shall be authorised by the prescribed authority.
8. The institution shall maintain a record of all pits used for deep burial.
9. The ground water table level should be a minimum of six meters below the lower level of deep burial pit.



SCHEDULE II –8, STANDARDS FOR LIQUID WASTE

STANDARDS FOR LIQUID WASTE

1. The effluent generated or treated from the premises of occupier or operator of a common bio-medical waste treatment and disposal facility before discharge into the sewer should conform to the following limits

PARAMETERS	PERMISSIBLE LIMITS
pH	6.5-9.0
Suspended solids	100mg/l
Oil and grease	10mg/l
BOD	30mg/l
COD	250mg/l
Bio-assay test	90% survival of fish after 96 hours in 100% effluent.

2. Sludge from Effluent Treatment Plant shall be given to common bio-medical waste treatment facility for incineration or to hazardous waste treatment, storage and disposal facility for disposal.

Note:

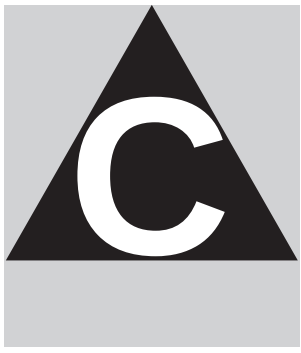
1. Above limits are applicable to the occupiers of Health Care Facilities (bedded) which are either connected with sewerage network without terminal sewage treatment plant or not connected to public sewers.
2. For discharge into public sewers with terminal facilities, the general standards as notified under the Environment (Protection) Act, 1986 (29 of 1986) shall be applicable.
3. Health Care Facilities having less than ten beds shall have to install Sewage Treatment Plant by the 31st December, 2019.
4. Non-bedded occupiers shall dispose infectious liquid wastes only after treatment by disinfection as per Schedule – II (6) of the principal rules.".

SCHEDULE IV - PART A: LABEL FOR BIO-MEDICAL WASTE CONTAINERS OR BAGS

Biohazard symbol

Handle with care

Cytotoxic hazard symbol



Handle with care

SCHEDULE IV - PART B: LABEL FOR TRANSPORTING BIO-MEDICAL WASTE BAGS OR CONTAINERS

Day: ..... Month: ..... Year: .....

Date of generation: .....

Waste category Number:.....

Waste quantity:.....

Sender's Name and Address: .....

.....

.....

Phone Number ..... Fax Number .....

Contact Person .....

Receiver's Name and Address: .....

.....

.....

Phone Number ..... Fax Number .....

Contact Person .....

In case of emergency, please contact:

Name and Address: .....

.....

..... Phone No.: .....

Note: Label shall be non-washable and prominently visible.

Form I

Accident reporting

1. Date and time of accident : .....

2. Type of Accident: .....

3. Sequence of events leading to accident: .....

4. Has the Authority been informed immediately: .....

5. The type of waste involved in accident: .....

6. Assessment of the effects of the accidents on human health and the environment:

.....

.....

.....

7. Emergency measures taken: .....

8. Steps taken to alleviate the effects of accident: .....
.....

.....

9. Steps taken to prevent the recurrence of such an accident : .....
.....

.....

10. Does your facility has an Emergency Control policy? If yes give details: .....
.....

.....

Date: ..... Signature: .....

Place: ..... Designation: .....

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