



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

A large, semi-transparent biohazard symbol is positioned on the left side of the cover, overlapping the orange and red background. The symbol is rendered in a light yellow/gold color.

INFORMATION HAND BOOK ON BIO-MEDICAL WASTE MANAGEMENT FOR ADMINISTRATORS



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Information Handbook on Bio-Medical Waste Management for Administrators

Acknowledgment:

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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सी.के.मिश्रा
C.K.Mishra



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



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.

Date: 25/10/2017
Place: Delhi


(C. K. Mishra)



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 health 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 Ramaiha 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.

A handwritten signature in blue ink, appearing to read 'René Van Berkel', is positioned above the name and title of the representative.

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

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List of Abbreviations

AERB	-	Atomic Energy Regulatory Board
BAT	-	Best Available Technology
BEP	-	Best Environmental Practices
BMW	-	Biomedical Waste
BMWM	-	Biomedical Waste Management
BOD	-	Biochemical Oxygen Demand
CBWTF	-	Common Bio-medical Waste Treatment Facility
COD	-	Chemical Oxygen Demand
CPCB	-	Central Pollution Control Board
DDT	-	Dichloro Diphenyl Trichloroethane
DLMC	-	District Level Monitoring Committee
ESM	-	Environmentally Sound Management
ESMMWI	-	Environmentally Sound Management of Medical Wastes in India
GEF	-	Global Environment Facility
GOI	-	Government of India
HCFs	-	Health Care Facilities
HCW	-	Healthcare Waste
HCWM	-	Healthcare 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

NACO	-	National AIDS Control Organisation
NSC	-	National Steering Committee
OHS	-	Occupational Health and Safety
PCD	-	Polychlorinated Dibenzofurans
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 Landfill
SOP	-	Standard Operating Procedure
SPCB	-	State Pollution Control Board
SPM	-	Suspended Particulate Matter
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

Executive Summary

India being a signatory to the Stockholm Convention it is obligatory on the part of the country to take measures for reduction of emissions of persistent organic pollutants. The Project “Environmentally Sound Management of Medical waste in India” was envisaged to address the issue of unintentional release of persistent organic pollutants in the process of management of Bio- medical waste. Among the various activities envisaged under the project to achieve its objective, training is one of the activities¹.

Under the training component it is envisaged that health care personnel in the selected 28 health care facilities in each of the five participating states of Gujarat, Karnataka, Maharashtra, Odisha and Punjab would undergo training. To aid in the process of training a set of five documents has been prepared. The present manual “Information Handbook on bio-medical waste management for administrators” is one such document.

About this Manual

This manual is a compilation of information on processes and administrative aspects of Bio- Medical management developed under the training component of the Project “Environmentally Sound Management of Medical waste in India”.

The manual contains three parts with a total of 24 chapters.

Part I – (Chapter 1-3) describes the evolution, aims, objectives, components and the activities envisaged under the project.

Part II – (Chapter 4-13) describes the various processes of biomedical waste management at the health care facility level. The processes include definitions of the various terms, waste minimization, segregation, disinfection, transportation, storage etc. Only the processes done at the health care facility have been described for administrators.

Part III – (Chapter 14-24) Covers the administrative roles and responsibilities towards various personnel, setting up of waste management systems in their respective health care facilities, monitoring and documentation and training for Bio-medical waste management. These chapters have dealt with some of the important responsibilities of an administrator with respect to biomedical waste management.

Target Audience: The manual is meant for administrators / heads of the Hospitals who is usually referred to as “Occupier” under BMWM rules. As per Biomedical Waste Management Rules, 2016, **Occupier** means a person having administrative control

over the institution and the premises generating biomedical waste, which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank, health care facility and clinical establishment, irrespective of their system of medicine and by whatever name they are called. This manual though general principles remain the same, doesn't cover the specifics related to veterinary sciences.

Chapter 1: “Environmentally Sound Management of Medical Wastes in India” Project

1.1 Background:

Bio-medical waste (infectious healthcare waste) is hazardous with a potential to spread infection; and generation and release of high levels of unintentionally produced persistent organic pollutants (POPs). Bio-medical waste, therefore, requires safe management through its complete life cycle in order to safeguard public health and protect environment.

In India, until early 1990s, healthcare waste management was a neglected issue. However, with the implementation of the bio-medical waste (Management and Handling) Rules of 1998, many of the medium and large healthcare facilities installed individual incinerators with sub-optimal efficiency leading to high amount of air pollution. Similarly, ample progress has been made regarding segregation at source. However, improvement, as a continuous process is needed. Segregation at source is the crux of bio-medical waste management as approximately about 15% - 20% of waste only is infectious/ hazardous in nature.

It is estimated that the quantum of medical waste that is generated in India is 250-400 gm/bed/day, in a hospital and

200-300 gm/ bed/day in a clinic. A 100-bedded hospital may generate about 40 kg of hospital waste per day.

A detailed situation analysis was carried out during the preparatory phase of the project in five selected states of India, namely, Gujarat, Karnataka, Maharashtra, Odisha and Punjab covering bio-medical waste management in healthcare facilities and Common Biomedical Waste Treatment Facilities (CBWTFs) covering 57 CBWTFs, which is 40% of total CBWTFs in the country. The amount of PCDD/PCDF (dioxin and furans) releases was estimated to be 105.44 g I-TEQ/y using the United Nations Environmental Programme (UNEP) toolkit. By proper segregation and either by applying non-incineration techniques or by upgrading existing incinerators more than 50% of dioxin and furans can be reduced.

Article 5 of the Stockholm Convention on Persistent Organic Pollutants (POPs) requires Parties to continue minimization and where feasible, ultimate elimination of releases from unintentional production of chemicals.

PCDD/PCDF are unintentionally formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions. Incineration of medical wastes have the potential for comparatively high formation and releases of the PCDD/PCDF into the environment.

With India becoming a party to the Stockholm Convention on POPs in May 2002 and ratifying it in January 2006, the country was obliged to comply with the requirements of the Stockholm Convention. It is in this context that the project on “Environmentally Sound Management of Medical Waste in India”

(ESMMWI) has been approved by Global Environment facility (GEF) where the Ministry of Environment, forest 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 healthcare waste 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.

1.2 Aim of the ESMMWI Project^{1,2}

The ultimate aim of the project is to reduce and ultimately eliminate the release of unintentionally produced persistent organics pollutants (POPs) and other globally harmful pollutants.

The project will promote country wide adoption of best available techniques and best environmental practices (BAT/BEP) in health care institutions of widely differing complexity and size as well as in the evolving biomedical waste management infrastructure and industry in a manner that protects human health and environment.

This be achieved through private-public partnership (PPP) covering, but not limited to the following approaches:

- Segregation, decontamination and compaction of medical wastes and thus reducing its volume to be disposed off by introducing alternative technologies.
- Enhancing and optimization of incineration technologies, raising awareness and dissemination of know-how.
- Incorporation of management systems.
- Innovation and adaptation of appropriate and affordable technologies and techniques.
- Introduction of participatory funding systems and enhancement of relevant existing laws and regulations.

1.3 The immediate objectives of the ESMMWI project ^{1,2}

- Harmonization of environmental and health care policy and regulatory instruments through appropriate networking for creation and promotion of environmentally sound management of medical waste, disposal sector and market.
- Strengthening of institutional capacity for environmentally sound management (ESM) of medical waste, in particular in large, medium and small healthcare facilities in 5 selected states namely Gujarat, Karnataka, Maharashtra, Orissa and Punjab.
- Facilitation and promotion of public-private partnership (PPP) to improve support and supply capacities in medical waste management within the healthcare facility perimeter.
- Facilitation and promotion of PPP to improve local technological and manufacturing capacities in medical waste transport and disposal sectors with specific reference to avoid generation of PCDD/PCDF and other unintentionally produced POPs releases by applying BAT/BEP measures.
- Demonstration of participatory funded and integrated systems for medical waste management and disposal in 5 selected states namely Gujarat, Karnataka, Maharashtra, Orissa and Punjab.



1.4 Expected outcomes of the ESMWI Project

There are 5 Outcomes designed to achieve the project objectives^{1,2}

Outcome		Activities
Outcome 1	Enable and harmonize environmental and health-care policy and regulatory instruments through appropriate networking for creation and promotion of environmentally sound management of medical waste, disposal sector and market.	<ul style="list-style-type: none"> • Establishment of inter-ministerial network • Introduction of regulatory, economic and market incentives • Placement of policy and regulatory enforcement mechanisms.
Outcome 2	Strengthen institutional capacity for environmentally sound management (ESM) of medical waste, in particular in large, medium and small HCFs in 5 selected states	<ul style="list-style-type: none"> • Institutional capacity building • Strengthening of technical capabilities for ESM of medical wastes • Awareness raising
Outcome 3	Facilitate and promote public-private partnership (PPP) to improve support and supply capacities in medical waste management within the HCF perimeter.	<ul style="list-style-type: none"> • Specific training curriculum on medical wastes management • Effective and efficient segregation of medical wastes at source • Protocols for medical waste movement in health-care facilities from source to collection points • Introduction of significant volume reduction of medical wastes at source
Outcome 4	Facilitate and promote PPP to improve local technological and manufacturing capacities in medical waste transport (internal and external transportation) and disposal	<ul style="list-style-type: none"> • Applying BAT/BEP measures

Outcome		Activities
	sectors with specific reference to avoidance of generation of PCDD/PCDF and other unintentionally produced POPs releases	
Outcome 5	Demonstrate participatory funded and integrated systems for medical waste management and disposal in 5 selected states namely Gujarat, Karnataka, Maharashtra, Orissa and Punjab	-

1.5 Project approach

- A guidance manual on appropriate and effective medical waste management for developing national and state medical waste management plan will be prepared.
- Strengthening health professional curriculum, distance learning programs, in-service training programs and establishment of nodal training centers.
- Design and development of training manuals for policy makers, managers, doctors, nurses, health workers, CBWTF operators.
- Networking of common treatment facilities, upgrading existing facilities, supporting and developing one or two CBWTFs as eco-friendly models for the country, supporting training and capacity building of the workers in CBWTF
- Objective monitoring protocols with achievable standards for CBWTFs will be developed.
- Enforcement of “Polluter pays principle” - fee for services with co-financing and contribution for CBWTFs will be supported.
- Promotion of policies and practices towards safe management of domiciliary and immunization waste and awareness in the community at large.



1.6 Overview of the activities of the ESWMI Project ¹

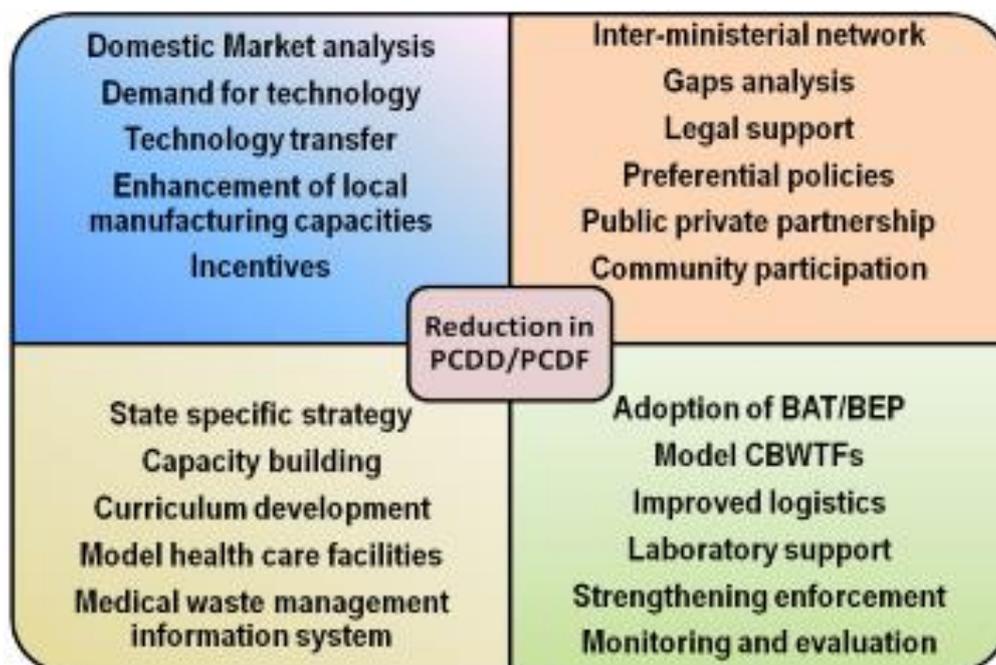


FIGURE 1: OVERVIEW OF THE ACTIVITIES OF ESWMI PROJECT

1.7 Project management Structure for ESWMI Project implementation

- National Steering Committee (NSC) for Stockholm Convention approved the management structure for project implementation at centre and state level
- United Nations Industrial Development Organization (UNIDO) is the implementing agency.
- Ministry of Environment, Forest and climate change (MoEFCC), Government of India is the national executing agency. National Project Management Unit (PMU) - established at MoEFCC headed by Joint Secretary, MoEFCC, GOI
- State Project Management Unit (SPMU) - established in all 5 participating states headed by Principal Secretary for Environment, Ecology and Forests in four states and Principal Secretary for Health and Family Welfare in state of Karnataka.
- Agency for implementing Training component: M. S. Ramaiah Medical College, Gokula Education Foundation, Bangalore

1.8 List of states and nodal departments executing the project

TABLE 1: PARTICIPATING STATES IN THE ESWMI PROJECT

State	Nodal department
Gujarat	State Pollution Control Board
Karnataka	Department of Health and Family Welfare
Maharashtra	State Pollution Control Board
Odisha	State Pollution Control Board
Punjab	State Pollution Control Board

1.9 Focus of the project

The project focus on 5 states in the country as indicated in the picture below. In each of the state, 28 healthcare facilities which includes 4 Large (more than 500 beds), 8 medium (more than 100 beds) and 16 small (less than 100 beds) health care facilities is the focus. In each state, one district is selected as Model District.

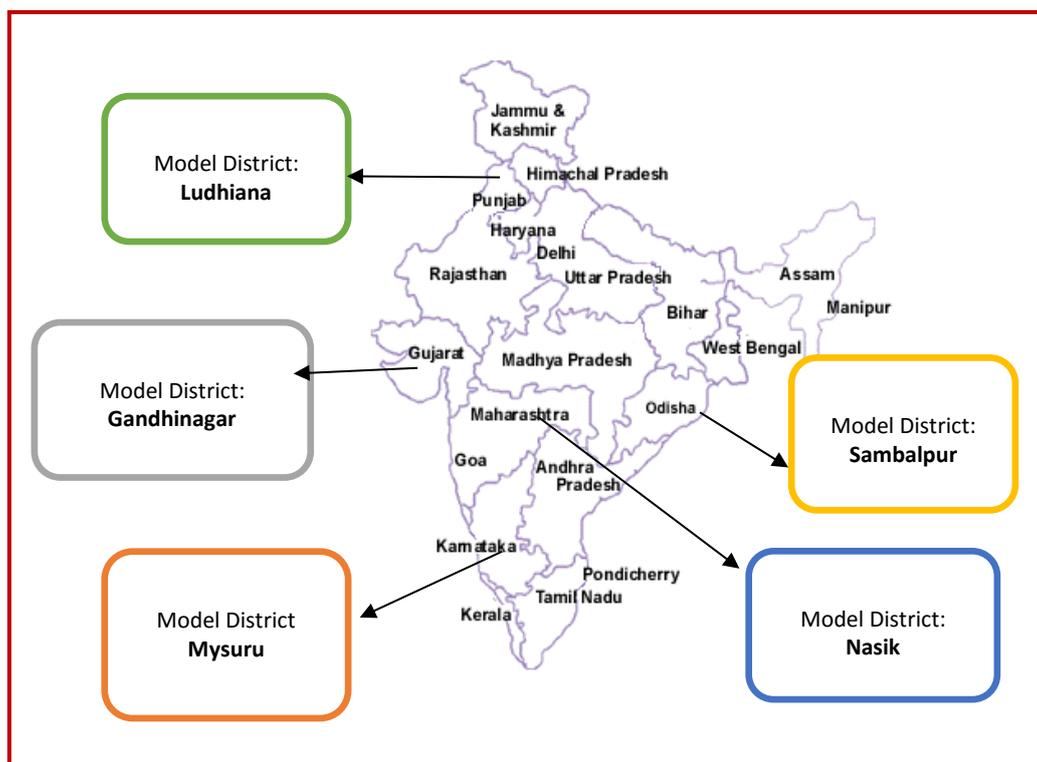


FIGURE 2: FOCUS OF THE ESWMI PROJECT IN INDIA

Chapter 2: About the Training component of the ESMMWI project

One of the important components of the project is training of various stakeholders. The important issue of medical waste management would be comprehensively addressed with a long term vision of creating enlightened and eco-sensitive healthcare professionals in future. It would necessarily imply targeting all the stakeholders, sensitize and motivate them by training and retraining.

The success of ESMWI project depends on internalization by healthcare

functionaries and practicing various waste management procedures on routine basis, which could be achieved through sustained training of the functionaries. Realizing this fact, the project attaches utmost importance to the activity of training and development of such material, which could be used by the various levels of healthcare functionaries. Conducting various training programmes for all those involved in handling of biomedical waste will help in implementation of BMW Rules 2016.

2.1. Training in bio-medical waste management will:

- Enhance the existing institutional and technical capacity in identified 28 health-care facilities in each of the five selected states.
- Enhance the effectiveness and efficiency of segregation of medical wastes at source which reduces the volume of medical waste and hence, improves the management of waste at CBWTF.
- Help to develop standard protocols for medical waste movement in healthcare facilities from source to established collection points.
- Establish the integrated system for medical waste management and disposal.

2.2. Components of training:

Component 1 :	Training Needs Assessment
Component 2 :	Development of Training Documents, Guidance Manuals and Awareness Campaign Materials on bio-medical waste management
Component 3 :	Implementation of Training Programmes on biomedical waste management

3.1 International convention and regulatory principles³

The International convention and regulatory principles which form a basis for rules at national level are given below.

3.1.1 Stockholm convention⁴

The Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment.

Exposure to Persistent Organic Pollutants can lead to serious health effects including certain cancers, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease and damage to the central and peripheral nervous systems.

Given their long range transport, no single government acting alone can act to protect its citizens or the environment from POPs.

In response to this global issue, the Stockholm Convention which was framed in 2001 came to force in 2004. The convention requires its parties to take measures to eliminate or reduce the release of POPs into the environment.

Objective of Stockholm convention- To protect human health and the environment from persistent organic pollutants.

TABLE 2: LIST OF POPs

Substances scheduled for elimination	Substances scheduled for restrictions on use	Substances with reference year obligations
Hexachlorobenzene , Toxaphene, Chlordane, Aldrin, DDT, Mirex, Dieldrin, Endrin, Heptachlor, Hexabrom- biphenyl, Chlordecone, Polychlorinated biphenyls	DDT Hexachlorocyclohexane Polychlorinated biphenyls	Polycyclic aromatic hydrocarbons (PAH) Dioxins/Furans Hexachlorobenzene

Initially the convention recognized only twelve POPs (Popularly called “The Dirty Dozen”) for their adverse effects on human health and the environment, placing a global ban on these particularly harmful and toxic compounds and requiring its parties to take measures to eliminate or reduce the release of POPs in the environment. The list of the POPs identified as dirty dand their source is mentioned below ^{4,5}.

TABLE 3: DIRTY DOZENS AND THEIR SOURCE

Sl. No.	POP (Dirty Dozens)	Global Historical Use/Source
1.	Aldrin	<ul style="list-style-type: none"> Insecticides used on crops such as corn and cotton; also used for termite control.
2.	Dieldrin	
3.	Chlordane	<ul style="list-style-type: none"> Insecticide used on crops, including vegetables, small grains, potatoes, sugarcane, sugar beets, fruits, nuts, citrus, and cotton. Used on home lawn and garden pests. Also used extensively to control termites.
4.	DDT	<ul style="list-style-type: none"> Insecticide used on agricultural crops, primarily cotton, and insects that carry diseases such as malaria and typhus.
5.	Endrin	<ul style="list-style-type: none"> Insecticide used on crops such as cotton and grains

Sl. No.	POP (Dirty Dozens)	Global Historical Use/Source
		<ul style="list-style-type: none"> • Also used to control rodents.
6.	Mirex	<ul style="list-style-type: none"> • Insecticide used to combat fire ants, termites, and mealybugs. • Also used as a fire retardant in plastics, rubber, and electrical products.
7.	Heptachlor	<ul style="list-style-type: none"> • Insecticide used primarily against soil insects and termites. • Also used against some crop pests and to combat malaria.
8.	Hexachlorobenzene	<ul style="list-style-type: none"> • Fungicide used for seed treatment. • Also an industrial chemical used to make fireworks, ammunition, synthetic rubber, and other substances. • Also unintentionally produced during combustion and the manufacture of certain chemicals. • Also an impurity in certain pesticides.
9.	Polychlorinated dibenzofurans (PCBs)	<ul style="list-style-type: none"> • Used for a variety of industrial processes and purposes, including in electrical transformers and capacitors, as heat exchange fluids, as paint additives, in carbonless copy paper, and in plastics. • Also unintentionally produced during combustion.
10.	Toxaphene	<ul style="list-style-type: none"> • Insecticide used to control pests on crops and livestock, and to kill unwanted fish in lakes.
11.	Dioxins	<ul style="list-style-type: none"> • Unintentionally produced during most forms of combustion, including burning of municipal and medical wastes, backyard burning of trash, and industrial processes. • Also can be found as trace contaminants in certain herbicides, wood preservatives, and in PCB mixtures.
12.	Furans	

3.1.2 The Basel Convention ⁶

The Basel convention on the Control of Trans boundary Movements of Hazardous waste and their disposal as adopted by 22nd March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland. This was in response to a public outcry, in 1980s following the discovery of deposits of toxic waste imported from abroad in Africa and other parts of developing World.

With environmental awareness awakening and stringent environmental regulations in the industrialized world during the 1970s and 1980s, there was increasing public resistance to the disposal of hazardous wastes – with what became to be known as the NIMBY (Not in My Back Yard) syndrome – and to an increased disposal costs. This in turn led some operators to seek cheap disposal

options for hazardous wastes in Eastern Europe and the developing world where environmental awareness was less developed with lack of regulations and enforcement mechanisms in place. Against this background that the Basel Convention was negotiated in the late 1980s, and the thrust was to combat the “toxic trade” and the Convention entered into force in 1992.

Objective of Basel Convention - To protect human health and the environment against the adverse effects of hazardous wastes.

Scope of application covers a wide range of wastes defined as “hazardous wastes” based on their origin and/or composition and their characteristics, as well as two types of wastes defined as “other wastes” - household waste and incinerator ash.

Aims and Provisions of the convention centres around the following principles ^{1,6,7}

Reduction of Hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal

Restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management

Regulatory system as applicable in cases where transboundary movements are permissible.

3.1.3 Regulatory principles ^{1,3,6,7}

The **“Polluter pay’s principle”** implies that all producers of waste are legally and financially responsible for the safe and environmentally sound management and disposal of the waste they produce

The **“Precautionary principle”** is a key principle governing health and safety protection. It states that when the magnitude of a particular risk is uncertain and there is lack of established scientific evidence of the risk, 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.

The **“Duty of care principle”** refers to that it is an obligation for any individual to follow utmost care while performing any tasks that could foreseeably harm others. It stipulates that any person handling or managing hazardous substances or related equipment is ethically responsible for using the utmost care in that task.

The **“Proximity principle”** recommends that treatment and disposal of hazardous waste take place at the closest possible location to its source in order to minimize the risks involved in its transport.

The **“Prior informed consent principle”** as embodied in various international treaties necessitates that the affected communities and other stakeholders are appraised of the hazards and risks associated during the transportation of waste and establishing of waste treatment and disposal facility. In the context of BMW, this principle specifically applies for transportation of waste and for setting up of CBWTF for its operation.



3.2 Policies

A policy is a system of principles to guide decisions and achieve outcomes. A policy is a statement of intent, and is implemented as a procedure or protocol. Policies are generally adopted by senior decision makers of an organization whereas procedures or protocols would be developed and adopted by senior implementing officers. Policies can assist in decision making process.

A policy is a blue print which will aid in decision making and mobilising resources and efforts to develop in systems in place. A national policy should be adaptable to social and economic conditions of the country and as well be flexible for regional and local variations.

Policy differs from Rules or Law. While law can compel or prohibit certain action, policy merely guides actions toward those that are most likely to achieve a desired outcome.

India has notified Bio-Medical Waste Management Rules 2016 but does not have a national policy on bio-medical waste management. Even though many policies on bio-medical waste management are available from various countries / organisations, three important policy documents by World Health Organisation (WHO) on bio-medical waste management, Injection safety and mercury management are annexed as

Annexure 1: WHO Policy Paper on “Safe Health Care Waste Management”⁸

Annexure 2: WHO Policy Paper on “Mercury in Health Care”

Annexure 3: WHO Policy on “Injection Safety Policy and Global campaign by WHO”

3.3 National Laws, regulations and standards of Biomedical Waste Management

TABLE 4: LIST OF NATIONAL LAWS, REGULATIONS AND STANDARDS

Law/Regulation Standard		Issued by	Year
Laws	The Water (Prevention & Control of Pollution) Act	GOI	1974
	The Air (Prevention & Control of Pollution) Act	GOI	1981
	Environment (Protection) Act	MoEFCC	1986
Regulations	Biomedical Waste Management (Amendment) Rules	MoEFCC	2018
	Biomedical Waste Management Rules	MoEFCC	2016
	Plastic Waste Management Rules		
	E - Waste (Management) Rules		
	Hazardous and Other Wastes (Management and Transboundary Movement) Rules		
Solid Waste Management Rules			
Standards and Technical Guidelines	Guidelines for disposal of Biomedical waste generated during Universal Immunisation Programme	CPCB	2004
	Guidelines on safe disposal of Used Needles and Syringes in the Context of Targeted Intervention for Injecting Drug Users	NACO	2009
	Environmentally Sound Management of Mercury Waste Generated From the Health Care Facilities	CPCB	2012
	Revised Guidelines on "Design & Construction of Bio-medical Waste Incinerator" and "Common Bio-medical Waste Treatment Facility"	CPCB	2016
	Guidelines for Bio-medical Waste Incinerator (Revised Draft)	CPCB	2017



3.4 Salient features of Bio-Medical Waste Management Rules 2016 ¹⁰⁻¹³

3.4.1. Introduction: Under the Environment (Protection) Act, 1986, Biomedical waste Management Rules, 2016 came into force from 28th March 2016 in superseding of the earlier Biomedical Waste (Management and Handling) Rules, 1998. Amendments to BMWM Rules 2016 was notified via Gazette notification on 16th March 2018 as Biomedical Waste Management (Amendments) Rules, 2018.

3.4.2.: Application: The rules apply to all persons who generate, collect, receive, store, transport, treat, dispose or handle biomedical waste in any form

TABLE 5: LIST OF FACILITIES TO WHICH BMWM RULES APPLY

<ul style="list-style-type: none">• Hospitals• Nursing homes• Clinics• Dispensaries• AYUSH Hospitals
<ul style="list-style-type: none">• Veterinary hospitals and institutions• Animal Houses
<ul style="list-style-type: none">• Pathological laboratories• Blood banks• Clinical establishment research or educational institutions• Forensic laboratories• Research labs
<ul style="list-style-type: none">• Health camps• Medical/surgical/OBG camps• Vaccination camps• Blood donation camps• First aid rooms of schools

3.4.3. BMWWM Rules 2016 shall not apply to

TABLE 6: LAWS GOVERNING MANAGEMENT OF OTHER WASTES GENERATED IN HOSPITAL

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	The 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	The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2016 made under the Act;
6.	E- waste	The e-Waste (Management and Handling) 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

3.4.4 Important definitions: ^{9,10}

5a. "**act**" means the Environment (Protection) Act, 1986 (29 of 1986)

5b. "**animal house**" means a place where animals are reared or kept for the purpose of experiments or testing; "**authorisation**" 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 CPCB as the case may be;

5c. "**authorised person**" means an occupier or operator authorised 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 CPCB, as the case may be

5d. "**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;

5e. "**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 the rules

5f. "**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

5g. "**Form**" means the Form appended to these rules

- 5h. "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
- 5i. "health care 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;
- 5j. "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
- 5k. "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;
- 5l. "occupier"** means a person having administrative control over the institution and the premises generating biomedical waste, which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank, health care facility and clinical establishment, irrespective of their system of medicine and by whatever name they are called
- 5m. "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
- 5n. "prescribed authority"** means the State Pollution Control Board in respect of a State and Pollution Control Committees in respect of an Union territory;
- 5o. "Schedule"** means the Schedule appended to these rules.



3.4.5. Duties of the Occupier: ^{9,10,11,12}

It shall be the duty of every occupier to-

- a. take all necessary steps **to ensure that Biomedical waste is handled without any adverse effect to human health and the environment** and in accordance with these rules;
- b. make a provision within the **premises for a safe, ventilated and secured location for storage of segregated biomedical waste** in colored bags or containers in the manner as specified in Schedule I
- c. **pre-treat the laboratory waste, microbiological waste, blood samples and blood bags** through disinfection or sterilization on-site in the manner as prescribed by the WHO guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and then sent to the Common bio-medical waste treatment facility for final disposal;
- d. **phase out use of chlorinated plastic bags (excluding blood bags) and gloves** within **two years by 27th March 2019**;
- e. **dispose of solid waste** other than Biomedical waste in accordance with the provisions of respective waste management rules made under the relevant laws and amended from time to time;
- f. not to give treated Biomedical waste with municipal solid waste;
- g. provide **training to all its health care workers** and others, involved in handling of bio medical waste at the time of induction and thereafter 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;
- h. **immunize all its health care workers** and others, involved in handling of Biomedical waste for protection against diseases including Hepatitis B and Tetanus that are likely to be transmitted by handling of Biomedical waste, in the manner as

prescribed in the National Immunization Policy or the guidelines of the Ministry of Health and Family Welfare issued from time to time;

- i. **establish a Bar- Code System** for bags or containers containing Biomedical waste to be sent out of the premises or for the further treatment and disposal in accordance with the guidelines issued by the Central Pollution Control Board by 27th March, 2019;
- j. ensure **segregation of liquid chemical waste at source** and ensure pre-treatment or neutralization prior to mixing with other effluent generated from health care facilities;
- k. ensure **treatment and disposal of liquid waste** in accordance with the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974);
- l. ensure **occupational safety of all its health care workers** and others involved in handling of Biomedical waste by providing appropriate and adequate personal protective equipment;
- m. **conduct health check up at the time of induction and at least once** in a year for all its health care workers and others involved in handling of bio- medical waste and maintain the records for the same;
- n. maintain and update on day to day basis the Biomedical waste management register and display the monthly record on its website according to the Biomedical waste generated in terms of category and color coding as specified in Schedule I;
- o. **report major accidents** including accidents caused by fire hazards, blasts during handling of Biomedical waste and the remedial action taken and the records relevant thereto, (including nil report) in Form I to the prescribed authority and also along with the annual report;
- p. all the health care facilities (any number of beds) shall make available **the annual report on its web-site within a period of two years from the date of publication of Bio-Medical Waste Management (Amendment) Rules, 2018;**
- q. inform the prescribed authority immediately in case the operator of a facility does not collect the Biomedical waste within the intended time or as per the agreed time;



- r. establish a system to review and monitor the activities related to Biomedical waste management, either through an existing committee or by forming a new committee and the Committee shall meet once in every six months with documentation of the minutes of meeting. HCFS with less than 30 bedded hospitals to designate a person to monitor and review the activities of BMWM and submit an annual report.

3.4.6. Salient changes in BMWM Rules 2016 and amendments, 2018¹²

- a. The **ambit of the rules** has been expanded to include camps such as vaccination camps, blood donation camps, surgical camps or any other healthcare activity
- b. **Phase out use of chlorinated plastic bags** (excluding blood bags) and gloves within two years by **27th March 2019**
- c. **Pre-treat the laboratory waste, microbiological waste, blood samples and blood bags** through disinfection or sterilization on-site in the manner as prescribed by the WHO guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and then sent to the Common bio-medical waste treatment facility for final disposal
- d. Provide **training** to all its health care workers and **immunize** all health workers regularly
- e. **Establish a Bar- Code System** for bags or containers containing Biomedical waste to be sent out of the premises or for the further treatment and disposal in accordance with the guidelines issued by the Central Pollution Control Board by 27th March, 2019;
- f. Report major accidents
- g. The new rules prescribe **more stringent standards in existing incinerators for incinerator to reduce the emission of pollutants** in environment;
- h. **Inclusion of emissions limits for Dioxin and furans**
- i. **Achieve the standards for retention time in secondary chamber and Dioxin and Furans within two years**
- j. Biomedical waste has been classified in to **4 categories instead 10** to improve the segregation of waste at source

- k. **Procedure to get authorization simplified.** Automatic authorization for bedded hospitals. The validity of authorization synchronized with validity of consent orders for bedded HCFs. **One time authorization for non-bedded HCFs**
- l. State Government to provide land for setting up common Biomedical waste treatment and disposal facility;
- m. **No occupier shall establish on-site treatment and disposal facility,** if a service of common biomedical waste treatment facility is available at a **distance of seventy-five kilometer.**
- n. Operator of a common biomedical waste treatment and disposal facility to ensure the timely collection of biomedical waste from the HCFs and assist the HCFs in conduct of training.

3.4.7. Major changes in provision of BMWM rules, 2016 and amendments, 2018 - its likely implication⁹⁻¹³

TABLE 7: CHANGES IN BMWM RULES 2016, AMENDMENTS, 2018 AND ITS IMPLICATIONS

BMW (Management and Handling) Rules, 1998 & revised in 2011	Bio- Medical Waste Management Rules, 2016 and Amendments, 2018	Reasons and likely implications
Title		
Bio- Medical Waste (Management and Handling) Rules, 2011	Bio- Medical Waste Management Rules, 2016 and Biomedical Waste Management (Amendment) Rules 2018	The word 'Management' includes Handling.
Application		
These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle biomedical waste in any form.	These rules shall apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle biomedical waste in any form and shall not apply to: <ul style="list-style-type: none"> - Radioactive waste - Municipal solid waste - Lead acid batteries - Hazardous waste - E-waste - Hazardous microorganisms 	Modified to bring more clarity in the application. Clarified that vaccination camps, blood donation camps, surgical camps or any other healthcare activity undertaken outside the healthcare facility, will be covered.
Duties of the Health care facilities including CBWTF		

BMW (Management and Handling) Rules, 1998 & revised in 2011	Bio- Medical Waste Management Rules, 2016 and Amendments, 2018	Reasons and likely implications
<p>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.</p>	<p>Additions: Health care facilities (HCF) shall make a provision within the premises for a safe, ventilated and secured location for storage of segregated biomedical waste</p>	<p>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</p>
	<p>Pre-treat the laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilization on-site in the manner as prescribed by the WHO guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and then sent to the Common bio-medical waste treatment facility for final disposal;</p>	<p>This is to prevent the possible microbial contamination.</p>
	<p>Phase out use of chlorinated plastic bags (excluding blood bags) and gloves within two years by 27th March 2019</p>	<p>Will eliminate the emission of dioxin and furans from burning of such wastes.</p>
	<p>Provide training to all its health care workers and others involved in handling of BMW at the time of induction and thereafter at least once every year</p>	<p>Will improve the management of BMW including collection, segregation.</p>
	<p>Immunise all its health care workers and others involved in handling of BMW for protection against diseases including Hepatitis B and Tetanus</p>	<p>To protect the health of workers</p>

BMW (Management and Handling) Rules, 1998 & revised in 2011	Bio- Medical Waste Management Rules, 2016 and Amendments, 2018	Reasons and likely implications
	Establish a Bar- Code System for bags or containers containing Biomedical waste to be sent out of the premises or for the further treatment and disposal in accordance with the guidelines issued by the Central Pollution Control Board by 27 th March, 2019	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	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	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
Treatment and disposal		
Every HCFs, where required, shall set requisite bio-medical waste treatment facilities like incinerator, autoclave, microwave system for the treatment of waste, or, ensure requisite	No occupier shall establish on-site treatment and disposal facility, if a service of CBWTF is available within a distance of seventy-five kilometer .	This is to make the installation and operation of CBWTF a viable one.
Segregation		



BMW (Management and Handling) Rules, 1998 & revised in 2011	Bio- Medical Waste Management Rules, 2016 and Amendments, 2018	Reasons and likely implications
Bio-medical waste classified in to 10 categories based on treatment options.	Bio-medical waste classified in to 4 categories based on treatment options.	Will improve the segregation of waste at source channelize proper treatment and disposal
Storage		
No untreated bio-medical waste shall be kept stored beyond a period of 48 hours. Provided that if for any reason it becomes necessary to store the waste beyond such period, the authorised person must take permission of the prescribed authority and take measures to ensure that the waste does not adversely affect human health and the environment.	Untreated human anatomical waste, animal anatomical waste, soiled waste and, biotechnology waste shall not be stored beyond a period of 48 hours. In case for any reason it becomes necessary to store such waste beyond such a period, the occupier shall take appropriate measures to ensure that the waste does not adversely affect human health and the environment and inform the SPCB along with the reasons.	Will eliminate obtaining permission within 48 hours which is not practically feasible.
Authorisation		
Hospitals treating 1000 or more patients per month to obtain authorization from SPCBs/PCCs	One time Authorisation for Non-bedded HCFs. The validity of authorization shall be synchronised with validity of consent orders for Bedded HCFs	HCFs can make application along with consent and hence getting authorisation will not be additional burden for HCFs. and operator of treatment facility. It will also help to SPCB in making single inspection / monitoring to consider both the consent and authorisation.
Advisory committee		
The Government of every State/Union Territory shall constitute an advisory committee with the experts in the field of	No change in the concept except additional members. Shall meet once in six months.	Advisory Committee has strengthened suitably with additional members.

BMW (Management and Handling) Rules, 1998 & revised in 2011	Bio- Medical Waste Management Rules, 2016 and Amendments, 2018	Reasons and likely implications
<p>medical and health, animal husbandry and veterinary sciences, environmental management, municipal administration, and any other related department or organisation including non-governmental organisations.</p> <p>Ministry of Defence shall constitute, an Advisory Committee under Additional Director General of Armed Forces Medical Services with representative of Ministry of Defence, MoEFCC, for HCFs under Armed forces under the Ministry of Defence.</p>		
Standards for emission from incinerators		
SPM in the Incinerator's emission- 150 mg/Nm ³	50 mg/Nm ³	The proposed stringent standards for emission from Incinerator (reduction of permissible limit for particulate matter, introduction of standards for Dioxin and Furans and increasing the residence time in the Incinerator Chambers) will improve the operation of incinerator and reduce the emission of pollutants in environment.
Residence Time in Secondary chamber of incinerators is 1 second	2 seconds	
Nil - Standards for Dioxin and furans	Standards for Dioxin and furans prescribed.	
Site for Common bio-medical waste treatment and disposal facility		
--Nil..	The department dealing the allocation of land shall be responsible for providing suitable site for setting up of CBWTF in the State Government	Getting suitable land is the problem in many States for establishment of CBWTF. Making the responsibility of state Government to provide land would eliminate the issue of getting land for the CBWTF.

BMW (Management and Handling) Rules, 1998 & revised in 2011	Bio- Medical Waste Management Rules, 2016 and Amendments, 2018	Reasons and likely implications
Monitoring of implementation		
..Nil..	<p>MOEFCC shall review the implementation of the rules in the country once in a year through the State Health Secretaries and CPCB,SPCBs State Government shall constitute District Level Monitoring Committee (DLMC) under the chairmanship of District Collector or District Magistrate or Deputy Commissioner or Additional District Magistrate to monitor the compliance of the provisions of these rules in the HCF.</p> <p>DLMC shall submit its report once in six months to the State Advisory Committee, SPCB for taking further necessary action.</p> <p>DLMC shall comprise of District Medical Officer or District Health Officer, representatives from SPCB, Public Health Engineering Department, local bodies or municipal corporation, IMA, CBWTF, registered NGO working in the field of BMW management.</p> <p>District Medical Officer shall be the Member Secretary of this Committee.</p>	<p>The monitoring of the implementation was earlier only with SPCBs and review of implementation through the District Committee is likely to improve the implementations.</p>

3.4.8. Schedules ^{9,10}

TABLE 8: LIST OF SCHEDULES UNDER BMWM RULES 2016

Schedule	Details
Schedule I	Biomedical waste categories and their segregation, collection, treatment, processing and disposal options
Schedule II	1. Standards for incinerators <ul style="list-style-type: none"> a. Operating standards b. Emission standards c. Stack Height
	2. Operating and Emission standards for disposal by Plasma pyrolysis or Gasification: <ul style="list-style-type: none"> a. Operating standards b. Air emission standards and air pollution control measures c. Disposal of ash vitrified materials
	3. Standards for autoclaving of biomedical waste
	4. Standards for 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 biomedical waste containers or bags
Schedule IV Part B	Label for transporting biomedical waste bags or containers

3.4.9. Forms ¹⁰

TABLE 9: LIST OF FORMS TO BE FILLED UNDER BMWWM RULES 2016 AND AMENDMENTS, 2018

Forms	Details	Line of reporting
FORM - I	Accident reporting	To be submitted by authorised person of the HCF or CBWTF to the prescribed authority
FORM – II	Application for authorisation or Renewal of authorisation	To be submitted by the occupier of the HCF or CBWTF
FORM –III	Authorisation for operating a facility for generation, collection, reception, treatment, storage, transport and disposal of biomedical wastes	To be submitted by the occupier of the HCF or CBWTF
FORM –IV	Annual Report from HCF or CBWTF	To be submitted by prescribed authority on or before 30 th June every year for the period from January to December of the preceding year by the occupier of the HCF or CBWTF
FORM IV A*	Annual Report from SPCB to CPCB	To be submitted by the SPCB or Pollution Control Committees and Director General Armed Forces Medical Services to CPCB on or before 31 st July of every year for the period from January to December of the preceding calendar year
FORM –V	Application for filing appeal against order passed by the prescribed authority	To be applied by person against whom the orders have been passed

* New addition as per BMWWM (amendments) rules 2018

PART II - Process of Bio-Medical Waste Management

Chapter 4: Introduction

The Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment. POPs are chemicals that remain intact in the environment for long periods, get widely distributed geographically, and accumulate in the fatty tissue of humans and wildlife. They are known to have harmful impacts on human health as well as on the environment.

Most of the twelve POPs listed in the Stockholm convention have been identified as potential carcinogens by the International agency for research on Cancer. POPs have also been linked to the reproductive, developmental, behavioural, neurologic, endocrine and immunologic adverse health effects. 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 "bio magnification." When contaminants found in small amounts at the bottom of the food chain bio magnify, they can pose a significant hazard to predators that feed at the top of the food chain. This means that even small releases of POPs can have significant impact on human health.

Health care services which aim at reducing health problems and treatment of diseases, generate bio-medical waste (also called as hospital waste or health care 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 of the major contributors to POPs in the environment. Therefore, sound management of bio-medical waste is a crucial component of environmental health protection.

Effective biomedical waste management in a health care facility will not only require the involvement of administrators and health care personnel but also the participation of the public and community. Hence Bio-medical waste management should be addressed in a comprehensive manner and a systemic framework should be developed and integrated into health care system such that multi-sectoral cooperation is ensured at all levels.

5.1 Introduction:

Hospitals and other health care facilities, diagnostic centres, blood banks, dental clinics, research centres, health camps cater to the needs of the patients for diagnostic and treatment procedures and in the process generate a variety of wastes. These wastes if not managed properly become a health hazard.

5.2 General definitions:

(a) Health care waste includes all the waste that is generated within health care facilities, research centres, laboratories related to medical procedures. It also includes the waste generated at minor sources including waste generated at health care activities undertaken at household level as well.

(b) Biomedical waste : As per BMWM Rules 2016, Bio-medical waste is defined as any waste, which is generated during the diagnosis, treatment or

immunisation of human beings or animals or research activity pertaining thereto or in the production or testing of biological or in health camps, including the categories mentioned in Schedule I of the BMWM Rules, 2016.^{9,10}

(c) Health Care Facility [HCF]: 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.

(d) Occupier: 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, health care facility and clinical establishment, irrespective of their system of medicine and by whatever name they are called.

5.3 Categories of health care waste^{7,14}:

TABLE 10: CATEGORIES OF HEALTH CARE WASTE

Waste category	Description and examples
Hazardous health Care waste	
Sharps waste	Used/ unused sharps (e.g. hypodermic, intravenous or other needles; auto-disable, syringes; syringes with attached needles; infusion sets; scalpels; pipettes; knives; blades; broken glass)
Infectious waste	Waste suspected to harbor pathogens which have risk of disease transmission (e.g. waste contaminated with blood and other body fluids; laboratory cultures and microbiological stocks; waste including excreta and other materials that are in contact with highly infectious disease patients in isolation wards)
Pathological waste	Human tissues, organs or fluids; body parts; fetuses; unused blood products, placenta
Pharmaceutical waste	Expired and unused pharmaceuticals; items contaminated by or containing pharmaceuticals
Cytotoxic waste	Cytotoxic waste having substances with genotoxic properties (e.g. waste containing cytotoxic drugs – used in cancer treatment; genotoxic chemicals)
Chemical waste	Waste containing chemical substances (e.g. laboratory reagents; film developer; expired or no longer required disinfectants; solvents; waste with high content of heavy metals, e.g. batteries; broken thermometers and blood-pressure instruments)
Radioactive waste	Waste containing radioactive substances (e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources)
Non-hazardous or general health-care waste	
Non-hazardous or general health-care waste	Waste that does not pose any particular biological, chemical, radioactive or physical hazard. Example: Paper, food waste, packaging material etc.

Source: WHO Blue book

5.4 Hazards of Biomedical waste:

About 75- 90% of the waste generated in a health care facility is comparable to domestic waste and usually referred to as “non-hazardous” or “general waste”. It composites of waste generated from the administrative, kitchen and housekeeping areas at health-care facilities and also includes packaging waste and waste generated during maintenance of health-care facility. Only the remaining 10–25% of the health care waste is considered as

It is clear that health care waste has potential risk to human health and environment. Hence proper and careful handling and safe disposal of biomedical waste is recognised one of

“hazardous” as they may pose a variety of environmental and health risks. ¹⁴

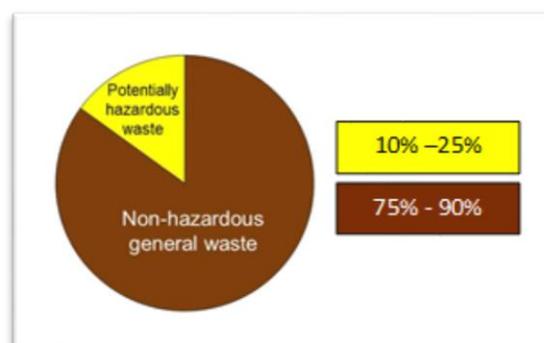


FIGURE 3: PROPORTION OF HAZARDOUS WASTE IN HCF

the important source of preventable infection in a health care setting. Sound management of biomedical waste is synonymous with perception of public as good standard of care.¹⁴

TABLE 11: HAZARDS AND IMPACT OF HEALTH CARE WASTE

Sl. No.	Type of waste	Hazards from waste	Impact from the waste
1.	Infectious waste and sharps	<ul style="list-style-type: none"> • Cuts • Abrasions • Infections 	<ul style="list-style-type: none"> • Percutaneous infections with Hepatitis B, Hepatitis C, HIV
2.	Chemical and pharmaceutical waste	<ul style="list-style-type: none"> • Intoxication by acute or chronic exposure • Physical injury • Chemical burns • Injury to skin • Injury to eye 	<ul style="list-style-type: none"> • Toxic to wildlife • Antibiotic resistance development in bacteria • The chemicals can also cause contamination of water bodies and soil.

		<ul style="list-style-type: none"> • Injury to mucous membrane of airways • Respiratory disease • Skin disease 	<ul style="list-style-type: none"> • When large quantities of disinfectants are released into sewers they can bring down the efficiency of the sewage treatment plant.
3.	Genotoxic waste	<ul style="list-style-type: none"> • Irritant • Dizziness • Nausea • Headache • Dermatitis 	<ul style="list-style-type: none"> • Spontaneous abortions
4.	Radioactive waste	<ul style="list-style-type: none"> • Headache • Dizziness • Vomiting • Fatal 	<ul style="list-style-type: none"> • The public as well as health care workers are at risk of abortion • Death
5.	Health-care waste-treatment methods	<ul style="list-style-type: none"> • Flue gases from improperly functioning waste incinerators • Physical injuries • Leachate release into water • Burning leads to heavy metal release 	<ul style="list-style-type: none"> • Flue gases released • Water pollution • Air pollution • Release of pathogens and toxic pollutants into the environment. • Solid and Land pollution

5.5 Public sensitivity:

Apart from hazards from health care waste, the general public are sensitive to the visual impact of anatomical waste, especially human body parts such as amputated body parts and foetuses. Except in cultural situations in countries like India where dead fetus are returned to patient's family for burial or cremation, dumping or disposing anatomical waste inappropriately in landfill is normally unacceptable.



5.6 Personnel at risk

All personnel who come in close contact with biomedical waste are at risk of exposure to the hazards of biomedical waste. It is not only the persons who are working at health care facilities who generate waste are at risk, but also those who handle waste at CWTF or those who handle without the knowledge of its consequences.

The people who are potentially at risk are¹⁴:

- Health care personnel – Doctors, Nurses, Technicians, Health care auxiliaries and hospital maintenance personnel
- Patients and their visitors
- Support staff such as cleaners, porters and those people working in laundries and ETP
- Workers involved in transporting waste to CBWTF or any other treatment and disposal facility
- Workers at waste management facilities such as CBWTF, TSDF, Secured landfills, ETP or any other treatment plants
- Informal recyclers as well as scavengers and rag pickers
- Lastly general public are at risk if biomedical waste is disposed off along with general waste

Key points:

- Bio-medical waste is any waste generated during the diagnosis, treatment or immunisation of human beings or animals or research activity
- All health care facilities, research centre and laboratories irrespective of the system of medicine is covered under the ambit of the BMWM rules.
- Majority of health care waste is general waste (~85%) and very small quantity of waste is hazardous health care waste.
- Hazardous health care waste includes sharps, infectious waste, pathological waste, pharmaceutical waste, cytotoxic waste, chemical waste, radioactive waste.

Chapter 6: Life-Cycle Approach in Biomedical Waste Management

Biomedical waste management should be approached in a life-cycle approach manner. The management of waste starts from waste minimization, segregation at source till its final treatment and disposal. The important component that should be kept in mind throughout the life cycle approach is that of worker safety, patient safety and environment safety. The below figure summarises the bio-medical waste stream in a Health care facility.

Step	Location	Health care waste stream	Key points
0		Waste Minimization	Purchasing policy; Stock management; Recycling of certain types of waste
1.	In Medical unit - At Points of generation	Generation	Color coded containers/bags. Proper waste segregation at point of generation is a crucial step to minimise the risk and reduce the quantum of hazardous waste
2.		Segregation at source	
3.	Within Health facility	Collection & On –site transportation	PPE, sealed containers; transport trolleys
4.		Temporary storage area storage	Lockable easy to clean adequate storage room; limited time of max 48 hours
5.		On-site treatment/ disposal	Liquid waste treatment/ Deep burial/ Sharp pit if not connected to CBWTF
6.	Outside of Health care Facility	Off-site transportation	Appropriate vehicle and consignment for waste collection to CBWTF
7.		Off-site treatment/ disposal	CBWTF to ensure proper treatment and disposal

FIGURE 4: SYNOPSIS OF THE HCW STREAM

Source: Adapted from WHO Guidance Manual for the Preparation of National Healthcare Waste Management Plans in Sub-Saharan Countries

7.1 Introduction:

Waste minimization means prevention or reduction of waste generation through source reduction and recycling. The quantity of BMW generated shall always be minimized and precautions must be taken during their handling. Waste minimization should be part of annual planning.

7.2 Principles of waste segregation:¹⁴

Principles of waste minimization is depicted below in the figure in Hierarchy of biomedical waste management system.

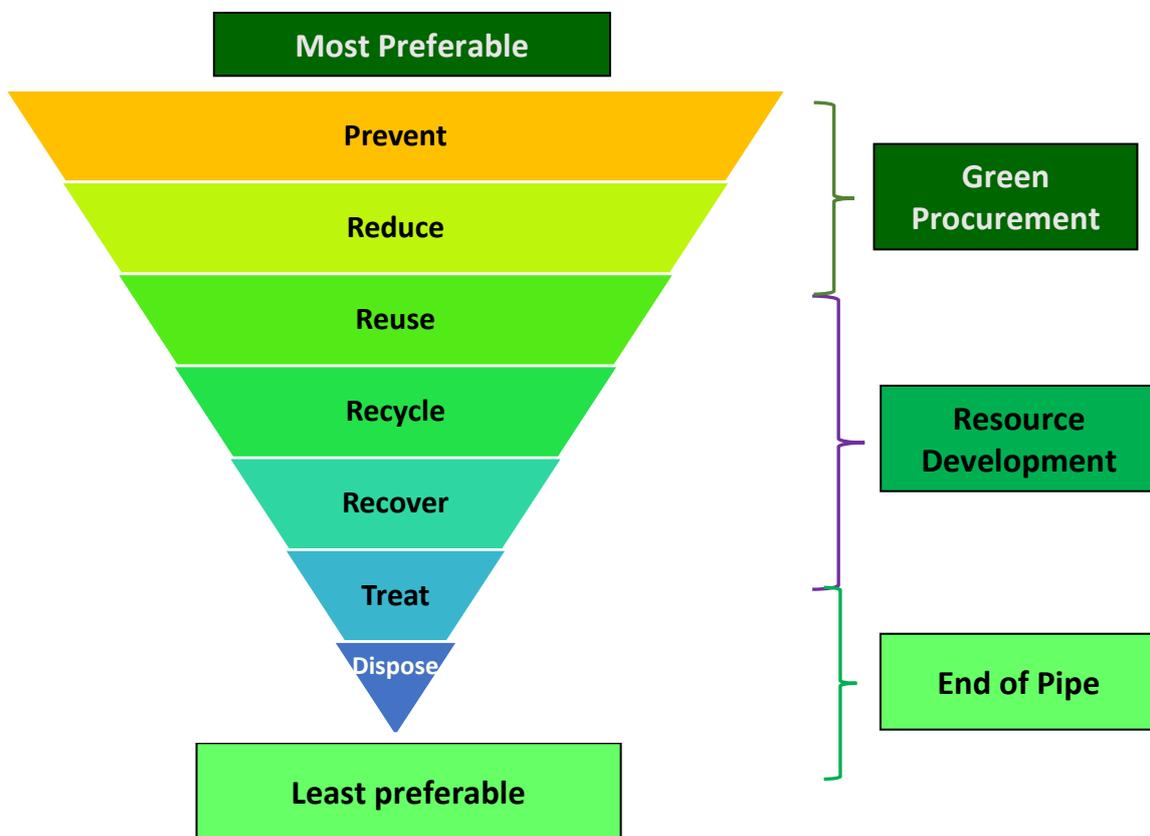


FIGURE 5: HIERARCHY IN HEALTH CARE WASTE MANAGEMENT SYSTEM

Source WHO Blue book and

http://www.wpro.who.int/philippines/publications/health_care_waste_management_manual_3rd_ed.pdf

Waste minimization can be applied using following techniques^{7,14}:

- **Green Procurement** - refers to prevention and reduction of waste at source
- **Resource Development (3Rs)** – refers to Reduce, Reuse, Recycle and Recovery of waste
- **End of Pipe** – refers to final treatment and disposal of waste

Waste minimization can be done at two points in HCFs⁷

- 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 6: FOUR 'R'S IN WASTE MINIMIZATION

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

REDUCE

- 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
- Inventory control in pharmacy and store room
- Employing reusable and recycled products

RE-USE: Re-use is use of any product over and over again for the purpose it is meant for or use for another purpose in the same form

- Re-use requires preferring reusable items in place of disposable ones wherever feasible



- Reuse will require setting standards for appropriate disinfection, sterilization and decontamination of instruments and materials for use
- Combination of appropriate sterilization methods varying from washing, cleaning, disinfection, decontamination and sterilisation may be adopted.
- Single use device such as syringes and hypodermic needles should not be reused due to risk of transmission of blood borne infections.
- Items such as paper, cardboard, glass, metal containers, plastic wrappings etc. which are not directly used for health care can be reused

RECOVER

- Solvent recovery in the hospital laboratory
- Silver recovery in Radiology Department
- Mercury recovery

RECYCLE

- Recycling office paper, newspapers, aluminium cans, glass bottles, construction debris, printer toners, etc.

7.3 Strategies to be adopted for implementation of waste minimization by the administrators:

- Have a written policy with clear spelt out vision and mission
- Adopt the “Green Procurement Policy”
- Update database for waste management costs and quantum of waste generated
- Be trained in waste minimization
- Institutionalize the waste minimization for long sustainability

7.4 Examples of Waste minimization practices ^{7,14}

7.4.1 Source reduction

- Have good purchase policy. Select products that have less chance of being wasteful where lesser quantities can be used or indent products that have less chance of producing hazardous waste product.
- Prefer physical rather than chemical methods of cleaning (ex: Use of steam sterilizer in place of chemical disinfection)
- Minimise unnecessary wastage of supplies during nursing and cleaning activities etc.

7.4.2 Management and control initiatives at Hospital level

- Centralized purchasing policy for hazardous chemicals
- Vigilance and monitoring of hazardous chemicals within the HCF from purchase till its final disposal

7.4.3 Proper Stock management of chemical and pharmaceutical products

- Placing repeated order of smaller quantities rather than bulk order at single point of time.
- Reduce the quantities of products which are unstable
- First in- First out Principle
- Use of all the contents of each container.
- Refusing short dated expiry items form the supplier at the time of delivery



7.5. Benefits of Waste Minimization^{7,14}

7.5.1 Financial

- Judicious use of natural resources like gas, electricity, water and fuels and thereby an effective waste management in place and cost reduction
- Income generation by sale of recyclable waste in particular plastic waste.
- Legal adherence will avoid legal penalties and fines
- Better risk management will result in reduced insurance and health costs

7.5.2 Operational and Internal (within HCF)

- Increase in overall performance and efficiency of the HCF
- Compliance with the NABH & NABL standards or country specific standards
- Enhances worker safety

7.5.3 External (outside HCF)

- Helps in building public image of the HCFs
- Reduces the impact on environmental (i.e. land, air and water pollution)
- Enhances public health
- Promotes environmental sustainability

Key points

- 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
- Good purchase policy and proper stock management will reduce waste generation

8.1. Introduction:

Segregation is the primary step in safe management of BMW and is the “HEART” of biomedical waste management. Segregation in simple terms means to separate different types of waste at the point of generation into different colour coded containers.

About 75-90 % of the waste generated in health care facility is general waste as they are non-hazardous in nature. Only the remaining 10-25% of health care waste is considered which requires careful management. Hence a substantial portion of waste is non-hazardous, i.e. general waste which is recyclable or compostable. Appropriate segregation as a system will help separate hazardous and non-hazardous waste; and contribute to minimization of the quantum of biomedical waste.

8.2. Benefits of Segregation

- Segregation minimizes the quantum of infectious/ hazardous nature of the waste
 - Prolongs the operational life of the disposal facility
 - Reduces the cost of treatment and disposal of bio-medical waste
 - Benefits in terms of conservation of resources.
- Reduces the risks of exposure to hazardous bio-medical waste for workers and chances of spread of infection/ injuries
- 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 and hence can act as revenue generation activity for the HCF.
- Hospitals aesthetically look better

8.3. The following general principles of waste segregation needs to be applied^{7,14}:

- No untreated bio-medical waste shall be mixed with other wastes.
- The bio-medical waste should be segregated into containers or bags at the point of generation in accordance with schedule-I of BMWM Rules 2016 prior to its storage, transportation, treatment and disposal. (Annexure- 4)
- Segregation of waste has to be done at the point of generation by those who generate waste as close to its source of generation, i.e. segregation should be done in a medical or surgical ward area, at bed side, minor OT, Labour room, Operation theatre, and laboratory.
- Segregation waste stream should be maintained throughout the life cycle till its final disposal. Segregation started at the point of generation should continue through and through from collection to transportation and storage to its final treatment and disposal.
- To improve the segregation efficiency, use of correct colour coded bins, proper placement and labelling of the colour coded bins and same colour coded bags as per BMWM Rules 2016 must be strictly implemented.
- Regular monitoring should be done so that the procedures are correctly practiced.
- If general and hazardous wastes are accidentally mixed, the entire waste should be considered as hazardous healthcare waste. In such instances the staff should not attempt to correct the errors of segregation
- Ensure awareness and training of all health care personnel for waste segregation and labelling

8.4. Colour coding and labelling of waste bins

The container for the waste should be:

- It should be of the appropriate material for the type of waste
- It should be made of plastic/ metal/ steel bins
- It should be sturdy and leak-proof
- The waste bins should be covered with well fitted lids preferably foot operated.

- To avoid confusion and for proper segregation, it is ideal that the plastic bags should be of the same colour as the bins as specified in the BMWWM rules 2016.
- Should be of adequate size depending on the quantum of waste generated at the point of generation
- Should have a plastic bag of not less than 50µ thickness to reduce the handling & facilitate in-house transportation
- The plastic bag and the bin should have the 'biohazard' symbol or cytotoxic symbol as appropriate and prominently displayed
- As per BMWWM Rules 2016, and its amendments in 2018, Microbiology, Biotechnology and other clinical laboratory waste including the blood bags should be pre-treated on-site through disinfection or sterilisation on-site in the manner as prescribed by the WHO guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and then sent to the Common bio-medical waste treatment facility for final disposal.

Note: *As per BMWWM Rules 2016, liquid chemical waste should be segregated at source and pre-treated or neutralised before mixing with other liquid waste generated in the HCFs.*



FIGURE 7: COLOUR CODED BINS FOR SEGREGATION

8.5. Colour coding

- Helps the health care staff for easy identification and segregating different waste items into correct bins
- Helps to continue the life cycle of segregated waste from point of segregation to collection , transportation, storage to final treatment and disposal
- Visually indicates the potential risk of the waste in that container.



TABLE 12: WASTE CONTAINERS AND BAGS SPECIFICATIONS

Waste kind	Type of waste	Type of containers	Bags *	Symbol
Infectious waste (YELLOW)	Human & Animal Anatomical Waste	Yellow colored leak-proof plastic or metal or steel containers	Yellow colored non chlorinated plastic bags	
	Soiled Waste			
	Chemical Waste			
	Expired or Discarded Medicines	Yellow colored leak-proof plastic or metal or steel containers	Yellow colored non chlorinated plastic bags	
	Discarded linen, mattresses, beddings contaminated with blood or body fluid	-	-	
	Microbiology, Biotechnology and other clinical laboratory waste	Yellow colored leak-proof plastic or metal or steel containers	Yellow colored autoclave safe non chlorinated plastic bags	
Cytotoxic waste	Yellow colored leak-proof plastic or metal or steel containers	Yellow colored non-chlorinated plastic bags		
Contaminated Waste(Recyclable) (RED)	Plastics	Red colored leak-proof plastic or metal or steel containers	Red colored non-chlorinated plastic bags	
	Gloves			
Waste sharps (WHITE)	Metallic Waste sharps (both used, discarded and contaminated)	White translucent Puncture proof, Leak proof and tamper proof container	-	
Glassware/ Metallic body implants (BLUE)	Broken/ Discarded /Contaminated glass except those contaminated with cytotoxic wastes	Puncture proof and leak proof boxes or containers with blue colored marking	-	
	Metallic Body Implants			

* Bags should be of BIS standards and not less than 50 μ thickness

Part A

Label for Biomedical waste containers or Bags



HANDLE WITH CARE

HANDLE WITH CARE

Part B

DayMonth.....

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.

FIGURE 8: LABELS FOR BMW CONTAINERS AND BAGS

8.6. Placement of bins:¹⁴

Type of bins to be placed depends on the type of waste generated at the point of the generation

- Infectious waste containers should not be placed in areas where no infectious waste is generated (such as 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 colour.
- Sharps containers should be within an arm's length of the health care professionals giving the injections. Placing waste containers too far away can increase the risk of needle-stick injuries.
- Sharp container to be either wall mounted or placed on a table.
- Infectious and sharps bins should not generally be placed next to the patient bed except for isolation wards.
- The nurse's trolley should have provision for the yellow bin (for contaminated swabs or dressings), red bin (syringes, red 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 health care 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.

- Appropriate bins should be used for general waste, the colour for which should be other than the ones specified under BMWM Rules 2016. It could be green or black in colour according to the state policy prescribed.

Key points:

- Establish a four colour coded bin system according to BMWM Rules 2016
 - Yellow – Infectious waste
 - Red – recyclable waste
 - White – Metallic sharps waste
 - Blue – Glassware and metallic body implants
- Ensure awareness and training of all health care personnel including doctors and waste managers for waste segregation.
- Ensure segregation at the point of generation



9.1 Introduction

Occupier of HCF have a duty of care to ensure that biomedical waste is kept under control at all times within a health care facility and disposed off safely either onsite or offsite. Proper segregation and its maintenance

throughout the life cycle till its final treatment and disposal is essential to maintain occupational safety and also to protect environment. Hence safe transportation of waste without mixing and without spillage is an essential part of the waste management process.^{9,10}

9.2 Collection

Segregated waste must be maintained during collection, transport and storage. Hazardous and general waste should never be mixed either during collection, transportation or storage of biomedical waste.

- ✓ Waste handlers must be trained on risks and safety measures to be taken while handling bio-medical waste.
- ✓ Appropriate PPE should be worn before handling the biomedical waste
- ✓ Establish a plan for collection and transportation - Collection points, designated route, time and frequency of collection of waste should be specified. In –house waste transportation is to be done through a designated lift through designated route
- ✓ Frequency of waste collection is to be determined on the quantum of waste generated. Waste must be collected at least once daily or as frequently as required. It may be done every shift in a larger hospital and transported the BMW to the designated temporary waste storage area.
- ✓ Plastic bags once $\frac{3}{4}$ th filled, must be sealed, labelled, bar coded and transported to temporary waste storage area using designated trolley.
- ✓ The label must at least contain the following information - Date , Area / Floor / Unit Shift, type of waste , weight of the waste

- ✓ Ensure that all bags are tied and secured and there is no spillage or leakage during the transportation
- ✓ In an event of cut or tear of the bag, double bagging is to be done before transportation
- ✓ In case of spill, refer to spill management protocol
- ✓ After collection of waste, replace the new plastic bags of the same colour immediately for next use.

9.3 In-house transportation (within the health care facility)

In house transportation from the point of generation to the temporary storage area is very important.

9.3.1 General requirements

- In-house transportation of BMW should take place during less busy hours
- A pre-defined route should be used every day
- 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.
- Transport staff or waste handlers should wear appropriate PPEs such as heavy duty rubber gloves, gum boots, overalls and masks.
- Biomedical waste and general waste must be transported separately.

9.3.2 Transport systems

- Separate trolley for general waste should be used and labelled clearly as “General waste”
- Similarly separate trolley must be used for biomedical waste.
- Waste trolleys used to transport should be labelled with an “biohazard” sign
- Preferably separate colour coded trolleys for each of the category of waste can be used (yellow, red) and a separate one to transport white puncture-proof containers and blue marked container / box OR



- Separate trolley with partition for red and yellow can be used. Similarly separate cart or trolley can be used for white (puncture-proof containers) and blue for glassware and metallic implants.

9.3.3 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
 - Closed trolleys with bio-hazard symbol should be used
 - The trolley for hazardous waste should have a locking arrangement
 - Waste should be always handled wearing appropriate PPE to prevent risk of accident or injury.
- In event of breakdown, spare trolleys to be kept ready
 - Trolleys should be cleaned and disinfected daily.

FIGURE 9: TRANSPORT TROLLEY



9.3.4 Routing

- Separate routes for hazardous and non-hazardous (food and general) waste is preferable.
- Collection should start from intensive care, dialysis, and operation theatres.
- A fixed route should be followed for other medical areas and interim storage locations
- Infectious waste must be collected daily or every shift.
- Waste should never be allowed to overflow; more frequent collection should be requested



FIGURE 10: IN-HOUSE TRANSPORTATION

9.4 Off-site transportation⁷

As per the BMWM Rules 2016, it is the duty of the operator of the CBWTF to transport the biomedical waste from the premises of the HCF to CBWTF in designated vehicle only which has label as provided in part A of Schedule IV along with necessary information as specified in Part B of schedule IV .

- Drivers and transporters should have certified training on handling bio-medical waste
- The certificate should be renewed annually
- An emergency response intervention card should be in the driver's cabin

9.4.1 Vehicle requirements

- Vehicles should be secured and kept under lock at all times, except during loading and unloading.
- Vehicle should be used only for transporting bio-medical waste not any other waste
- Vehicle should have biohazard symbol and should be secured with lock and key
- Drivers cabin should be separate from the waste carrying cabin
- Empty plastic bags, PPEs, cleaning equipment, disinfectants and kits for handling any spills such as liquid should be stored in separate compartment in the vehicle.
- The name and address of the CBWTF should be prominently displayed on the vehicle
- International hazard sign and the emergency telephone number should be displayed on the vehicle.



9.4.2 Cleaning of container and vehicle

- At the end of the day after the use, the vehicle should be cleaned and disinfected properly.
- Soaps and detergents should be used for cleaning
- The vehicle should be serviced regularly

9.4.3 Transport documentation ⁷

A consignment note or a waste tracking note must be carried by the driver of the vehicle and should include the following details

The consignment note should include:

- Waste category
- Waste sources
- Pick-up date and time from health-care activities facility
- Place of CBWTF
- Name of the driver
- number of plastic bags or quantum of waste
- Receipt of waste load received at the HCF from the designated responsible person

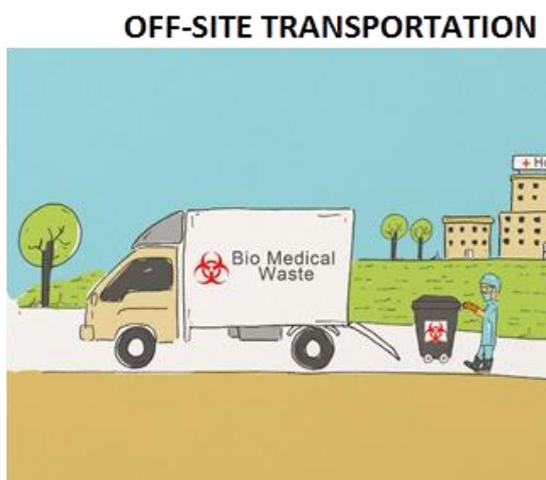


FIGURE 11: OFF-SITE TRANSPORTATION

Key points :

- Establish a plan for collection and transportation of waste within the HCF
- Ensure that waste bags are appropriately sealed, removed and replaced immediately when they are three-quarters full
- Appropriate PPE- heavy duty gloves, industrial boots and apron should be provided for waste collectors
- Ensure that BMW and general waste are collected in separate trolleys and washed regularly.



10.1 Introduction

As per BMWWM rules, 2016, it is the duty of the occupier to make a provision within the premises for a safe, ventilated and secure location for storage of segregated biomedical waste in colored bags or containers in the manner as specified in Schedule-I. This is to ensure that there shall be no secondary handling, pilferage of recyclables or inadvertent scattering or spillage by animals. The bio-medical waste from such place or premises should be directly transported in the manner as prescribed in these rules to the CBWTF or for the appropriate treatment and disposal, as the case may

be, in the manner as prescribed in Schedule I.

Temporary central storage areas are places within a health-care facility where different types of waste should be brought for safe retention until it is treated or disposed off on-site or transported off-site to CBWTF. The waste in plastic bags or containers should be stored in a separate area, room or building; the size of which should be appropriate to the Quantum of waste generated in the HCF. In cases where the HCF lacks the space, daily collection and treatment shall be imposed prior to disposal^{10,11}.

10.2 General guidelines^{9,10}

- As per BMWWM rules 2016, untreated human or animal anatomical waste, soiled waste and biotechnology waste shall not be stored beyond a period of 48 hours.
- In case for any reasons, it becomes necessary to store such waste beyond 48 hours, it is the responsibility of the occupier to take appropriate measures to ensure that the waste does not adversely affect human health or the environment and should inform the prescribed authority as well. To handle such an event, extended storage facility may be planned.
- Separate storage area for biomedical waste needs to be maintained. It shall not be stored along with the general waste.

10.3 Location

- ✓ Should be located within the health-care facility but away from dietary section, patient wards, laboratories, OT or from any easy access area for public
- ✓ Should be adequately protected from rain, strong winds, floods etc.
- ✓ Should be easily accessible for the waste-collection vehicles preferably without entering hospital premises
- ✓ Should have easy access for staff in charge of handling the waste.
- ✓ Should be inaccessible to animals and birds.
- ✓ The location should be away from the food stores and food preparation areas
- ✓ Should not be accessible to unauthorized persons
- ✓ Should be secured with lock and key with proper signage
- ✓ Display board at the entrance the name of the CBWTF and address, validity of authorisation and bio-hazard logo.

10.4 Structure and facilities inside the storage room:

A storage area

- ✓ Should have an impermeable concrete floor that is water-proof and with good drainage (away from watercourses) and adequately sloped for easy cleaning
- ✓ Should have a floor that is easy to clean and disinfect.
- ✓ Should be sized keeping in mind the quantum of waste generated.
- ✓ Should have four colour coded areas for different type of waste - Yellow, Red, Blue and White
- ✓ Should have adequate water supply for cleaning purposes.
- ✓ Should have good lighting, adequate ventilation and electricity
- ✓ Should have adequate and easy access of stock of PPE and cleaning materials near the storage area
- ✓ Should have washing facilities with running water, soap and disinfectant for the staff members to hand wash after handling of waste
- ✓ Should have spill management kit in an event of any spill



- ✓ Preferable to have electrical hand drier
- ✓ Should have good drainage system that is connected to ETP/WTP
- ✓ Protocol for cleaning of the area on regular basis must be developed
- ✓ Cytotoxic waste shall be stored separately from other wastes in a designated secure location.
- ✓ Should have warning sign prominently displayed outside the storage area and also appropriate symbol to be displayed as per rules

“CAUTION”: Biomedical waste storage area – No entry for unauthorised persons



FIGURE 12: SYMBOLS AS PER BMWM RULES

10.5 Process

- The biomedical waste is to be weighed, bar coded and documented in a log book.
- Storage area to be cleaned regularly. Preferable to clean after transporting the waste to CBWTF

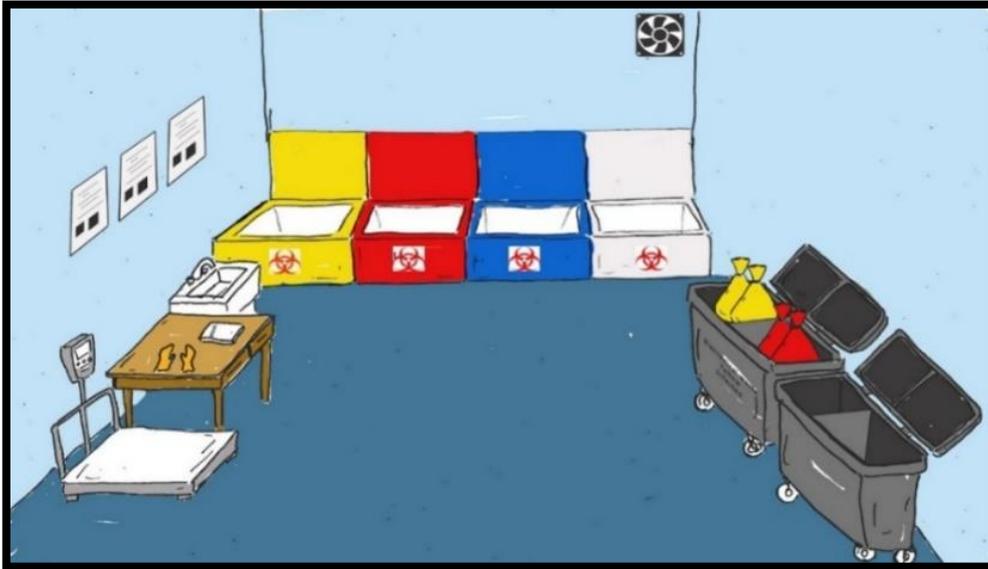


FIGURE 13: TEMPORARY STORAGE AREA

Key points:

- **No untreated human and animal anatomical waste, soiled waste and biotechnology waste shall be stored beyond 48 hours.**
- 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
- Separate areas within the storage area for different types of bio-medical waste
- Storage area should be accessible only to authorized personnel



11.1 Introduction

Microbiological and infectious laboratory waste can cause various diseases and adversely affect health of those who come in contact with such waste. It is the duty of the occupier to pre-treat such waste on-site before sending it for final treatment and disposal. For facilities which lack access to CBWTF within 75 kms of the HCF, treatment and disposal facility can be

set up on-site (Refer chapter on Final treatment and disposal). Pre-treatment kills the pathogenic organisms and renders the waste incapable of spreading disease to humans.

The pre-treatment of such waste can either be through disinfection or sterilisation.⁹⁻¹²

11.2 Differences between Sterilization and Disinfection

TABLE 13: DIFFERENCE BETWEEN DISINFECTION AND STERILIZATION

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

11.3 Waste items to be pre-treated as per BMWM Rules, 2016 at HCF level

TABLE 14: LIST OF WASTE THAT NEEDS TO BE PRE-TREATED

Sl. No	List of waste items for pre-treatment
Microbiology, biotechnology and other clinical laboratory waste	
1.	Blood bags
2.	Blood samples
3.	Cell cultures- human and animal
4.	Culture dishes
5.	Culture plates
6.	Cultures used in research, industrial labs, biological production
7.	Lab cultures
8.	Other devices in contact with cultures
9.	Petri-dishes
10.	Pipette tips used for cultures
11.	Residual toxins
12.	Specimens of micro-organisms
13.	Stocks
14.	Vaccines – live and attenuated



11.4 Methods of pre-treatment

The various methods advocated for pre-treatment of healthcare waste include:

- Autoclave
- Microwave
- Chemical disinfection

11.4.1 Autoclave

- An autoclave helps in sterilisation of waste items.
- The basic principle of an autoclave is that steam under pressure and high temperatures is micro biocidal and sporicidal.
- The autoclaves for waste treatment must have separate from the one used for sterilising items to be used in the hospital.
- Items to be autoclaved should be placed in autoclave safe plastic bags or containers.



FIGURE 14 FIGURE SHOWING AUTOCLAVE

Standards for autoclaving of bio-medical waste:

Separate autoclave exclusively meant for disinfection and treatment of biomedical waste should be maintained.

- When operating a **gravity flow autoclave**, medical waste shall be subjected to either of this specifications

TABLE 15: SPECIFICATIONS FOR AUTOCLAVING (GRAVITY TYPE) AS PER BMWM RULES

Sl no.	Temperature	Pressure	Residence time
a.	Not < 121 ⁰ C	Not < 15 psi*	Not < 60 minutes
b.	Not < 135 ⁰ C	Not < 31 psi	Not < 45 minutes
c.	Not < 149 ⁰ C	Not < 52 psi*	Not < 30 minutes

*psi= pound per square inch

- II. When operating a vacuum autoclave, medical waste should be subjected to a minimum of three pre-vacuum pulse to purge the autoclave of all air. The air removed during the pre-vacuum, cycle should be decontaminated by means of HEPA and activated carbon filtration, steam treatment, or any other method to prevent release of pathogen. The waste shall be subjected to the following

TABLE 16: SPECIFICATIONS FOR AUTOCLAVING (VACUUM TYPE) AS PER BMWM RULES

Sl no.	Temperature	Pressure	Residence time
a.	Not < 121 ⁰ C	Not < 15 psi*	Not < 45 minutes
b.	Not < 135 ⁰ C	Not < 31 psi	Not < 30 minutes
c.	Not < 149 ⁰ C	Not < 52 psi*	Not < 30 minutes

- III. If for any reason, the temperature, pressure or residence time was not reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and residence time is achieved.
- IV. **Recording:** Each autoclave shall have graphic or computer recording devices which will automatically and continuously monitor and record dates, time of day, load identification number and operating parameters throughout the entire length of the autoclave cycle.
- V. **Validation test:** The occupier or operator shall conduct the validation test using four biological indicator strips, one as control and left at room temperature, and other three shall be placed in the approximate center of three containers with the waste. PPEs shall be used while opening the container to place the indicator.

The occupier should conduct this test three consecutive times to define the minimum operating conditions. Once the minimum operating temperature, pressure and time is determined, the occupier should conduct this test once in three months and maintain the records related to the same.

- VI. **Routine Test:** Routine test is done using a chemical indicator strip or tape that changes colour when a certain temperature is reached. This has to be done during autoclaving of each batch of the waste and records in this regard shall be maintained.



VII. **Spore testing: The autoclave should** completely and consistently kill the approved biological indicator at the maximum design capacity of each autoclave unit. Biological indicator for autoclave shall be *Geobacillus stearothermophilus* spores using vials or spore strips with at least 1×10^6 spores. The occupier or operator of the CBWTF shall conduct this test at least once in every week and records in this regard shall be maintained. ¹⁰⁻¹³

11.4.2 Microwave

- Microwave technology is essentially a steam-based process where treatment occurs through the action of moist heat and steam generated by microwave energy.
- Items not to be microwaved: Volatile and semi-volatile organic compounds, chemotherapeutic waste, mercury, other hazardous chemical waste and radiological waste



FIGURE 15: FIGURE SHOWING MICROWAVE

Source: Meteka GmbH, Austria

Standards of microwaving ^{9,10}

- I. Microwave treatment shall not be used for cytotoxic, hazardous or radioactive wastes, contaminated animal carcasses, body parts and large metal items.
- II. The microwave system shall comply with the efficacy test or routine tests and a performance guarantee may be provided by the supplier before operation of the limit.
- III. The microwave should completely and consistently kill the bacteria and other pathogenic organisms that are ensured by approved biological indicator at the maximum design capacity of each microwave unit.
- IV. Biological indicators for microwave shall be *Bacillus atrophaeus* spores using vials or spore strips with at least 1×10^4 spores per detachable strip. The biological indicator shall be placed with waste and exposed to same conditions as the waste during normal treatment cycle.

Difference between Microwave and Autoclave is annexed in Annexure -5

11.4.3 Chemical disinfection^{9,10}

This can be achieved by the use of either chlorinated or non-chlorinated chemical agents.

The standards for efficacy of chemical disinfection is measured by Microbial inactivation efficacy which is equated to “Log 10 kill” which is defined as the difference between the logarithms of number of test microorganisms before and after chemical treatment. Chemical disinfection methods shall demonstrate a 4 Log 10 reduction or greater for *Bacillus Subtilis* (ATCC 19659) in chemical treatment systems.

One of the prescribed chlorinated chemical for disinfection is Sodium hypochlorite solution.⁹⁻¹²

Sodium hypochlorite: It is active against most bacteria, virus and spores. It is not effective for disinfection of liquid with high organic content such as blood or stools. It can be used for treatment of waste water. It is available as a greenish –yellow solid. To prepare 10% Sodium hypochlorite solution we need to dissolve 100 gms in 1000 ml i.e., 1 litre of water. As per BMWAM amended rules, 2018, the recommended concentration is 1-2%. However various concentrations of Sodium hypochlorite solution are commercially available. Items that are chemically treated especially those treated with chlorinated chemicals should not be incinerated.

Key Points

- 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
- All methods must conform to the standards as prescribed by BMWAM Rules 2016.

12.1. Introduction

As per BMW 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. ⁹⁻¹⁰

- 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 HCFs and CBWTF
- Occupier shall hand over segregated waste as per the Schedule-I to CBWTF for treatment, processing and final disposal. However, the laboratory and highly infectious bio-medical waste generated shall be pre-treated by equipment like autoclave or microwave.
- No occupier shall establish on-site treatment and disposal facility, if a service of CBWTF is available at a distance of 75 kilometres
- In cases where service of the CBWTF is not available, the Occupiers shall set up requisite biomedical waste treatment equipment like incinerator, autoclave or microwave, shredder prior to commencement of its operation, as per the authorisation given by the prescribed authority.
- The handling and disposal of all the mercury waste and lead waste shall be in accordance with the respective rules and regulations.

12.2. Purpose ⁷:

The purpose of treating biomedical waste is to render it non-infectious and reduce the hazard to human health and environment.

The first step to reduce risk and hazard to environment is to adopt waste minimization and reuse of waste items wherever possible. If this is not feasible, the waste should be treated to reduce the potential health risk or hazard. The residues of which should be then sent for secured land filling site.

The Stockholm convention is a global treaty which aims to protect health and environment from persistent organic pollutants (POPs). Currently the most commonly used treatment option for biomedical waste is incinerator but it is a known fact that improper incineration of biomedical waste is a one of the contributor to POPs especially the dioxins and furans. Therefore, it is recommended to adopt more of non-burn technology or use a double chambered incinerator which reaches the prescribed >1200 degrees C temperature in the second chamber as per BMW rules 2016.

12.3. Treatment option at Health care facility or at CBWTF ⁷

The treatment option chosen involves consideration of availability of CBWTF, characteristic of waste, available technology, environmental and safety factors, legal requirements and cost factors.

TABLE 17: FACTORS TO CONSIDER FOR CHOOSING FINAL TREATMENT OPTION

i. Characteristics of waste
<ul style="list-style-type: none"> • Volume of waste • Types of waste • Capacity of the HCF or CBWTF to manage the volume of the waste
ii. Technology factors
<ul style="list-style-type: none"> • Availability of treatment and disposal technology options locally • Ability of the HCF or CBWTF system to operate the technology • Treatment efficiency of the technology • Reduction of volume or mass • Installation requirements- available space , infrastructure, operation and maintenance • Personnel and skills needed to operate the technology
iii. Environmental and safety factors
<ul style="list-style-type: none"> • Environmental releases into air or water • Situation and surrounding environment of the facility • Occupational health and safety issues • Public consent and approval • Final disposal options available • Legal requirements



iv. Cost factors

- Capital cost for equipment
- shipping fees and customs duties
- installation and commissioning costs
- recurring operating costs, including maintenance cost
- cost of transport of waste to CBWTF
- cost of transport of treated waste
- decommissioning costs

Rule 5 (k) permits the occupier, who gives biomedical waste to the operator of the CBWTF to physically verify if the treatment is carried out as per the rules. Accordingly the chosen operator can be assessed if they are compliant with the rules.

(Checklist for assessing the CBWTF is annexed in Annexure -6 and also please refer the guidelines developed by CPCB for CBWTF available on CPCB website)

12.4. Overview of final waste-treatment technologies in CBWTF ^{7,9,10}

12.4.1. NON BURN TECHNOLOGIES

a. Technology: Microwave

Principle: Steam-based process where treatment is through combined action of moist heat and steam generated by microwave energy.



Source: Meteka GmbH, Austria

a. Technology: Microwave

Used for:

- Soiled Waste: Items contaminated with blood, body fluids.
- Microbiology, biotechnology and other clinical waste
- Laboratory waste: Contaminated Waste(Recyclable) Waste sharps including metals
- Glassware: contaminated glass including medicine vials and ampoules

Advantage

- Produces lesser emissions than high-heat thermal processes and thereby reduced air pollution. Significant volume reduction, automated and easy to use.

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

A comparison between Microwave and Autoclave is provided in Annexure-5.

b. 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: Items contaminated with blood, body fluids. Microbiology, Biotechnology and other clinical
- laboratory waste: Contaminated Waste(Recyclable), Waste sharps

- Glassware: Broken or discarded and contaminated glasses including medicine vials and ampoules excluding those contaminated with cytotoxic waste

Advantage:

- Reduces the waste in weight and volume.
- Less emissions and reduced air pollution as compared to incinerators

Disadvantage:

Cannot treat all kinds of bio-medical waste especially pharmaceutical, cytotoxic and radioactive waste.

c. 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/ discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.



Source: SembRamkee, Dobaspet

Advantage

- Less air pollution emissions as compared to high-heat thermal processes.
- Low capital and operational cost.

Disadvantage

Unacceptable odours can occur if there is insufficient ventilation.

- *Volatile and semi-volatile organic compounds, chemotherapeutic waste, mercury, chemical waste and radiological waste cannot be treated.*
- *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.*

d. Technology: Circulating hot-air ovens

Principle: Application of heat to the waste without adding steam or water

Used for:

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

Advantage

- Dry heat does not corrode or rust the tools or needles
- used to sterilize devices having multiple parts that cannot be dismantled

Disadvantage

Not commonly used in large-scale facilities

Do not use for Plastic and rubber items

e. Technology: Chemical treatment

Principle: Chemical treatment results in disinfection rather than sterilization.

Used for: Most suitable for treatment of liquid waste such as blood, urine, stools or hospital sewage. Microbiological culture and sharps can also be chemically disinfected.



Advantage:

- No combustion by-products are produced.
- Useful in small health care facilities where there are no sterilisation technology

Disadvantage:

Potential problem of chemical hazard. To be effective on solid waste items, shredding is necessary or else, only the surface will be disinfected.

f. Technology: Encapsulation

Principle: Immobilization and safe containment of the waste

Used for: containing sharps, chemical and pharmaceutical residues.

Process: Encapsulation involves filling containers with sharps, adding an immobilizing material, and sealing the containers.

The process uses either cubic boxes made of high-density polyethylene or metallic drums, which are three quarters filled with sharps or chemical or pharmaceutical residues. The containers or boxes are then filled up with a medium such as plastic foam, bituminous sand, cement mortar, or clay material. After the medium has dried, the containers are sealed and placed into landfill sites.

Advantage

- Safe containment of waste
- Restricting the access to rag pickers and thereby decreasing the chance of exposing to hazardous biomedical waste

Disadvantage

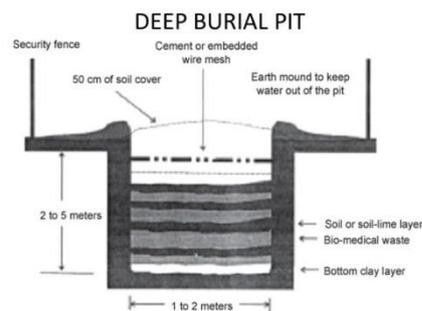
- Polyethylene does not chemically incorporate the waste
- With mercury-containing wastes, volatilization may be a significant concern

g. Technology: Deep Burial

Principle: Containment and biological treatment- decomposition

Used for:

- Soiled Waste: Infectious waste such as items contaminated with blood, body fluid like dressings, plaster casts, cotton swabs
- Human Anatomical Waste, Animal Anatomical Waste.



Advantage:

- Prevents scavenging.
- Reduction of volume of waste

Disadvantage:

- Need a secure area
- Once filled up, another area needs to be identified. Place could be a constraint.

h. Technology: Mechanical treatment

Principle: Mechanical treatment processes are the ones which are usually used as supplement to other treatment methods rather than standalone treatment option. Some of the mechanical technologies are shredding, grinding, mixing and compaction.

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*).



Source: SembRamkee, Dobaspet

Advantage:

- Reduces the volume of the waste significantly.
- Exposes the surface of the waste to disinfection.

Disadvantage:

- They cannot destroy pathogens.
- Release of aerosols by mechanical destruction of untreated waste bags can increase the risk of exposure of workers to pathogens.

i. Technique: Biological

Composting and vermiculture have been used successfully to decompose hospital kitchen waste, as well as other organic digestible waste and placenta waste. Here organic waste is digested using worms.

Pathological and anatomical waste contained in deep burial is also an example of biological process where natural decomposition occurs.



Source::
<https://www.flickr.com/photos/timothymnz/4924744171>

Advantage:

Vermiculture if left for longer period and with high temperature can reduce the microbes.
 Can be a good source of manure

Disadvantage:

Risk of exposure to untreated waste while handling waste such as skin contact or splashes

j. Technique: Irradiation

Principle: Irradiation treatment is the use of irradiation from electron beams, cobalt-60 or ultraviolet sources.

Electron beams are powerful and can penetrate waste bags and containers. Germicidal ultraviolet radiation as a supplement to other treatment technologies is useful for destroying airborne microorganisms, but cannot penetrate the closed waste bags.

Advantage:

Destroys the microorganisms

Disadvantage:

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

k. Technique: Sanitary Landfill

Principle: Safe containment of residues left over after treatment of waste for its final disposal



Source: SembRamkee, Dobaspet

Desirable features of a landfill are:

- Away from the residential area
- restricted access especially to scavengers/ rag pickers
- cover the soil daily so as to prevent foul smells and regular compaction
- water proofing the walls and ground to prevent seepage and ground water contamination and surrounding areas
- requires trained staff

k. Technique: Sanitary Landfill

Advantage	Disadvantage
<ul style="list-style-type: none"> filled land can be reused for other community purposes 	<ul style="list-style-type: none"> completed landfill areas can settle and requires maintenance requires proper planning, design, and operation
<p>Uncontrolled dumping is to be discouraged as it is very unsightliness, can cause air and water pollution; risk of fire and higher risk of transmission of diseases and open access to rag pickers or scavengers and animals.</p>	
<p>Controlled land filling by better operating practices and design improvements is one of the treatment and disposal options which will reduce harmful effects on human health and environment.</p>	
<p>The first step is to restrict environmental consequences and physical access to waste. This can be later improved by “engineered landfill” where increasing standards of engineering are used to improve geological isolation of wastes from the environment and cover the waste daily.</p>	

12.4.2. BURN TECHNOLOGIES^{9,10}

I. Technology: Incineration

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

- **Type of waste**
 - Human Anatomical waste
 - Animal Anatomical waste
 - Soiled waste
 - Expired or discarded medicine
 - Chemical waste



Source: Distromed, Rajkot

I. Technology: Incineration

- Discarded linen/ mattresses beddings contaminated with blood or body fluid

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 atmosphere
- Generation of residual ash.

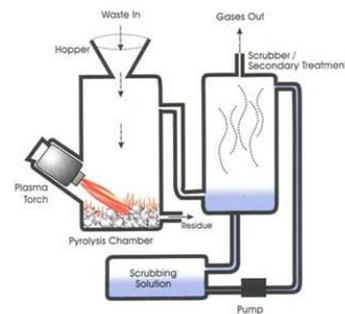
Do not use for Aerosolized containers, Mercury and Chlorinated Plastics, chemically treated waste

m. 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



Source:

<http://dae.nic.in/?q=node/305>

Advantage

- Quantity of toxic residuals (dioxins and furans) is much below the accepted emission standards
- Does not require segregation of hazardous waste.

Disadvantage

- Require considerable amount of electrical energy
- Very expensive.

m. Technology: Plasma Pyrolysis

- The pathogens are completely killed and there is a possibility to recover energy.

Do not use for

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

Note:

- *In cases where service of the CBWTF is not available, the Occupiers shall set up requisite biomedical waste treatment equipment like incinerator, autoclave or microwave, shredder prior to commencement of its operation, as per the authorisation given by the prescribed authority*
- *Any person including an occupier or operator of a CBWTF intending to use new technologies for treatment of biomedical waste other than those listed in Schedule I shall request the central Government for laying down the standards or operating parameters.*
- *For standards for treatment and disposal of biomedical waste, refer to schedule II of BMWM Rules 2016*

Key Points:

- 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 like incinerator, autoclave or microwave, shredder prior to commencement of its operation, as per the authorisation given by the prescribed authority.

13.1 Introduction ⁷

Health-care waste water is any water that has been adversely affected in quality during provision of health care services. 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 improperly disposed. 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 healthcare workers and the community.

Health-care waste water can be divided into the following three categories:

- **Sewage** is heavily polluted wastewater 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 rainfall collected on roof tops, grounds, yards and paved surfaces. This could be either let off into drains or used for groundwater recharge or used for toilet flushing or gardening after appropriate rain water harvesting process.

13.2 Hazards of wastewater

Depending on the services available in the HCF, the wastewater might contain chemicals, pharmaceuticals and contagious biological agents or radioisotopes. The various hazards caused by wastewater are:

- Infectious samples and secretions** can cause diseases like Campylobacteriosis, Hepatitis A and hepatitis E, Cholera, Schistosomiasis, Typhoid fever and Ascariasis.
- Chemicals** such as anaesthetics, disinfectants, chemicals from laboratory activities, silver from X-ray film washing, formaldehyde, glutaraldehyde, developer and fixer solutions from X-ray film processing, and iodinated X-ray contrast media may cause chemical exposures leading to burns. It may affect various systems and act as human carcinogens in addition to causing water pollution.

- c) **Antibiotics** in hospital wastewater can contribute to the emergence and spread of resistant pathogens, such as methicillin-resistant *Staphylococcus aureus* or vancomycin-resistant enterococci if the wastewater is not properly treated.
- d) **Radioactive substances** pose radioactive exposure risk if not stored for a sufficient period of time to permit radioactive decay before discharge into sewers.

13.3 Liquid chemical waste generated at healthcare facilities

TABLE 18: LIST OF LIQUID WASTE GENERATED AT HEALTH CARE FACILITIES

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

13.4 Treatment of wastewater

Liquid waste from healthcare facilities must be segregated and treated or neutralised before mixing with other effluent generated from the healthcare facility or discharge into the municipal sewerage system.

13.5 Standards of wastewater ^{9,10}:

As per BMWM rules, 2016, the effluent generated or treated from the premises of occupier or operator of a CBWTF before discharge into the sewer should conform to the following

TABLE 19: STANDARDS FOR WASTEWATER (SCHEDULE III)

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

“Note (as per BMWM (Amendment) rules, 2018)

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 standards of chemical disinfection [Schedule –II(6) of BMWM rules 2016]

13.6 Liquid Waste Management ⁷

The BMWM rules, 2016 recommend that all facilities handling biomedical waste must have a separate collection system for liquid waste leading to an sewage treatment plant and or Effluent treatment system.

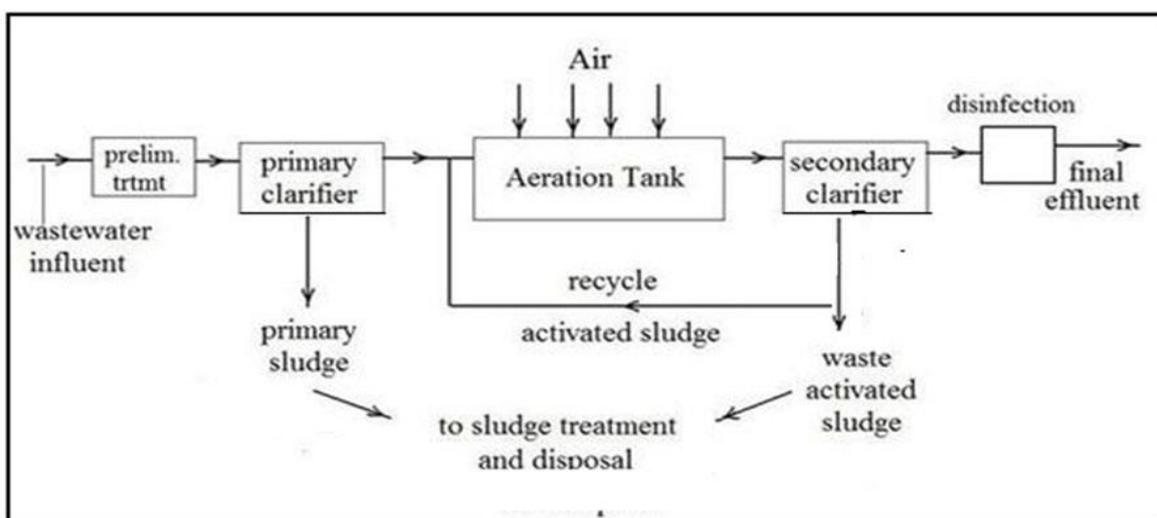
13.7 At facilities with effluent treatment plant

Ideally, all healthcare facilities must be attached to an Effluent Treatment Plant (ETP) for treating the liquid waste before mixing with other wastewater from healthcare facilities. In this case, liquid waste which is generated is directed towards a collection system that leads to an ETP. Three stages are involved in the treatment of wastewater.

First stage: Removal of solids separated by sedimentation (primary treatment). Second stage: Dissolved biological matter is progressively converted into a solid mass using indigenous waterborne bacteria. Some inorganic components will be converted to sludge particles, which are then separated from the liquid phase of the wastewater by sedimentation (secondary treatment).

Third stage: Treated water is further treated to remove suspended solids, phosphates or other chemical contaminants, or may be disinfected (tertiary treatment). The components are depicted in the figure below:

TABLE 20: EFFLUENT TREATMENT PLANT



The combined discharge from the ETP and other wastewater should conform to the standards given in BMWM Rules 2016.



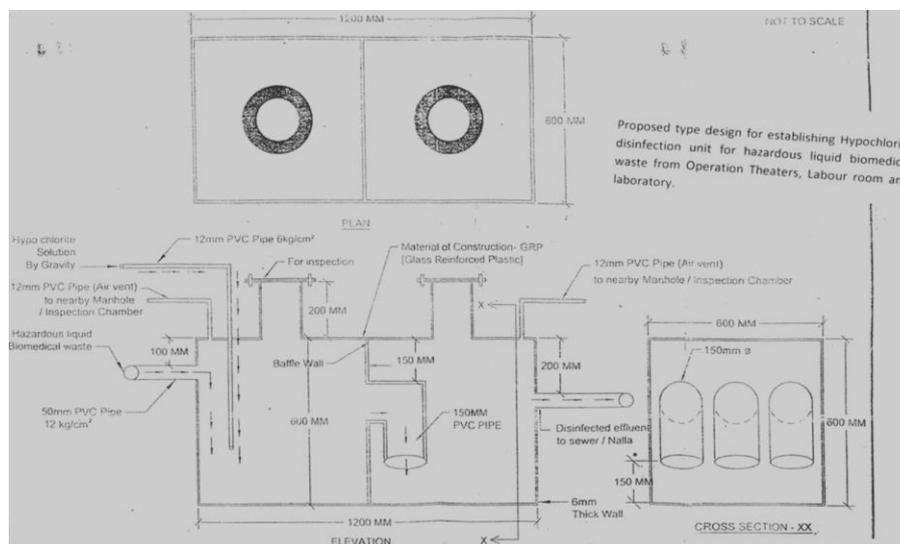
13.8 At Facilities without effluent treatment plant

For non bedded health care facilities without an effluent treatment plant, disinfection units may be designed and added for treatment of liquid waste. It is mandated that they disinfect and then let the liquid waste discharge into sewage.

Two case studies in selected healthcare facilities is presented below for reference.

Case study 1: Karnataka Model

i. Operation and Maintenance of the disinfection unit introduced in District Hospitals, Taluk level Hospitals, Community Health Centers 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 Health Care Facility is drained to the disinfection unit by gravity by making suitable modification in existing plumbing. The disinfectant (Sodium Hypo Chlorite 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 Hypo Chlorite 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 > 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 day morning].

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

Step 1: Fill the top 10 litre can with 1 % hypochlorite solution.

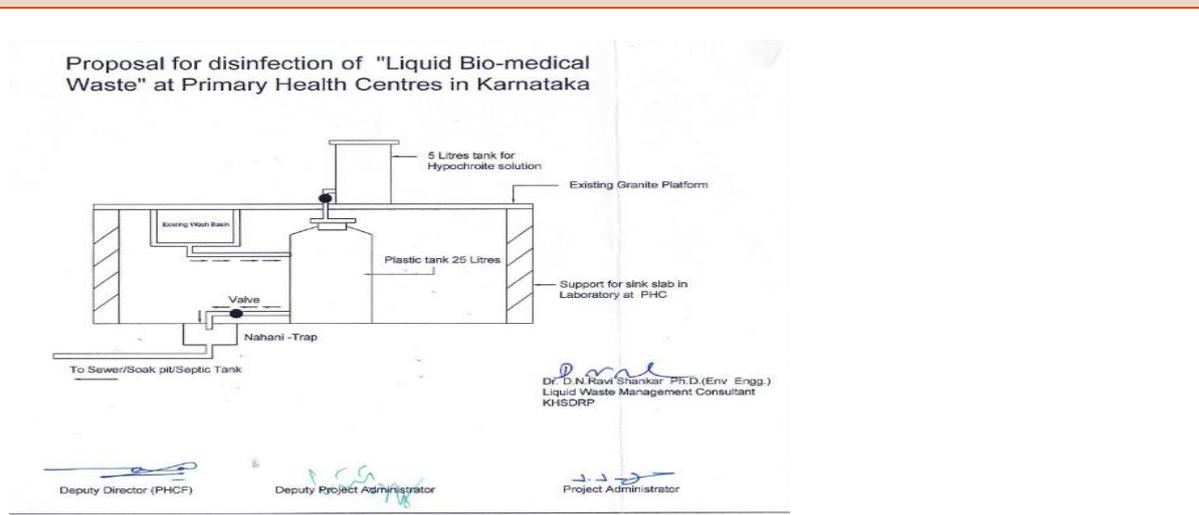
Step 2: The liquid Bio-Medical Waste from the hospital continuously flows to the disinfection unit provided.

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

Repeat every day. Keep the records of the receipts and consumption of the bleaching powder / Hypochlorite solution daily for the verification by KSPCB officers.

Note: Sewage should not be allowed inside disinfection unit

ii. Operation and maintenance of the disinfection unit introduced in PHCs to treat liquid biomedical 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 day morning].

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

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

Step 2: Start collection of the liquid bio-medical waste from the wash basins to the 50 L can below and keep the outlet valve closed.

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

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

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

Repeat every day. Keep the records of the consumption of the sodium hypochlorite solution daily for the verification by KSPCB officers

Case Study 2: Ludhiana Model – Hypotreat

HYPOTREAT™ – A Pre-Treatment Unit For Liquid Hospital Waste
A Registered Product of Paryavaran Solutions Ludhiana (Registration No. 270902 Dated: 01/04/2015
of Patent office, New Delhi (India)



'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 5 hrs 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.

Note: *The authors do not endorse any models. Here only a sample models are presented for reference. Similar models can be designed, tested and used by the HCF as appropriate to them in accordance to the BMWWM rules 2016.*

Further, New BMWWM (amendment) Rules 2018 be referred for more details on liquid waste management.

Key Points

- Health care waste water can adversely affect humans and the environment, if it is not treated.
- The treated wastewater before discharge into the sewer must conform to the standards prescribed by the BMWWM Rules 2016.
- Wastewater treatment can be done by either constructing an ETP especially for bedded HCFs
- Non bedded HCFs have to chemically disinfect their infectious liquid wastes before final disposal as per standards of chemical disinfection mentioned in BMWWM rules 2016



Chapter 14: Biomedical Waste Management in Camps

14.1 Introduction:

Health camps are organized by the health care 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 health care services beyond the hospital premises in temporary camps need authorization from the respective pollution control boards. It is the responsibility of HCFs to ensure proper biomedical waste management during such camps.

The health camps are conducted 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

14.2 Overview of the kind of waste generated in the health camps : The below table gives an overview of the kind of waste generated in the health camps and the categories into which the waste needs to be put according to the BMW Rules 2016.

TABLE 21: KIND OF WASTE GENERATED IN CAMPS

Color coded category			
Yellow	Red	White [translucent]	Blue
<ul style="list-style-type: none">• Infected cotton swab• Dressings• Face mask• Glucometer strip• Blood bags	<ul style="list-style-type: none">• Syringes without needles• Gloves• IV set	<ul style="list-style-type: none">• Blades• Needles from hub cutter• Syringes with fixed needle	<ul style="list-style-type: none">• Vials• Ampoules• Glass slide

Biomedical waste would be generated depending on the medical services provided in the camps. The laboratory and screening facilities provided would decide the type and quantum of waste generated.

14.3 Steps to manage biomedical waste:

- Person organising camp should list the probable waste that could be generated and accordingly plan for waste segregation
- The health care 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 see to it that the collected waste is sent to the temporary waste storage area of the hospital.

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

Key points:

- Health camp, Blood camps and waste generated during emergencies come under the ambit of BMWM Rules 2016.
- It is the responsibility of the occupier to ensure that waste generated during such camps shall be managed as per BMWM Rules 2016
- 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

PART III Administrative Issues and Considerations

Chapter 15: Roles of Personnel Involved in Waste Management

As per BMW Rules 2016 every occupier should “establish a system to review and monitor the activities related to bio-medical waste management, either through an existing committee or by forming a new committee and the Committee shall meet once in every six months and the record of the minutes of the meetings of this committee shall be submitted along with the annual report to the prescribed authority and the healthcare

establishments having less than thirty beds shall designate a qualified person to review and monitor the activities relating to bio-medical waste management within that establishment and submit the annual report”

The proper management of health-care waste depends largely on good administration and organization but also requires adequate legislation and financing, as well as active participation by trained and informed staff.

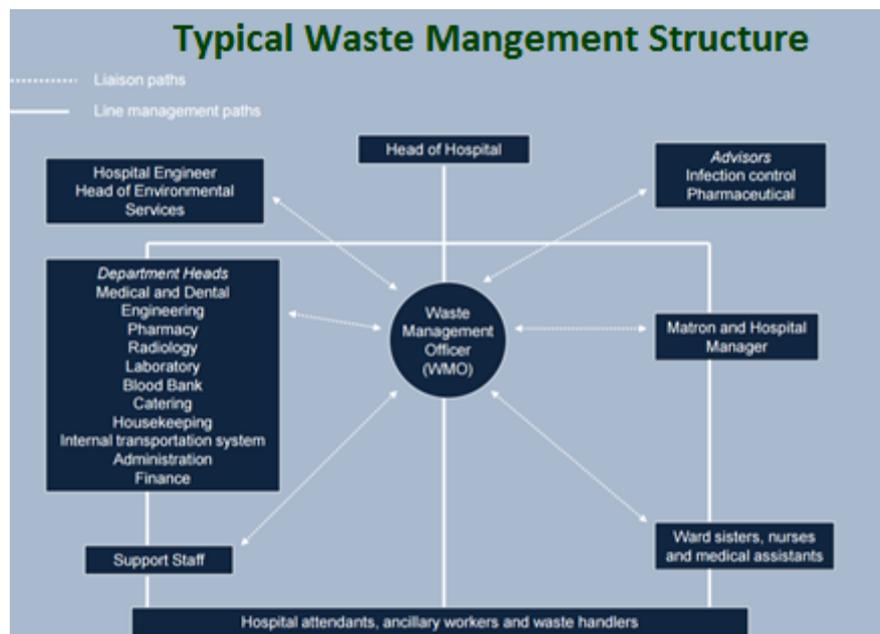


FIGURE 16: TYPICAL WASTE MANAGEMENT STRUCTURE

Source: http://www.who.int/water_sanitation_health/healthcare_waste/module24.pdf

15.1 Duties of personnel ⁷

The duties of key personnel involved is described below; in smaller health care facilities, one person may fulfil two or more sets of responsibilities.

15.1.1 Head of hospital:

The head of hospital is responsible for the following tasks:

- Develop a waste-management plan for the hospital by forming a waste management team which should consist of both clinical and non-clinical representatives. The plan should clearly define the roles and responsibilities of all the staff from clinical to nonclinical staff including that of waste handlers and establish the line of authority.
- Designate a waste-management officer to supervise and implement the waste-management plan.
- Allocate adequate financial and personnel resources to ensure efficient implementation of the waste management plan.
- Ensure that monitoring procedures are incorporated in the plan.
- Designate a training coordinator or the waste management to coordinate and organise training programmes for all the staff members.

15.1.2 Waste-management officer:

Designated waste-management officer is responsible for the day-to-day supervision, implementation and monitoring of the waste-management plan. It is better a senior staff member is designated as he or she would be heard by all the members. The role of waste management officer is to

- Ensure waste segregation
- Control internal waste collection
- Ensure correct storage
- Coordinate disposal operations
- Monitor on-site and off-site transportation of waste
- Liaise with department heads to ensure training is carried out
- Monitor waste generation, disposal, costs and public health aspects (e.g. injuries) of waste



15.1.3 Duties of other key staff:

i. Department Heads:

Department heads should be made accountable the segregation, storage and disposal of waste generated in their respective departments. They should:

- Ensure that all doctors, nurses and other para clinical staff in their respective departments are aware of the segregation, sealing and storage procedures, and ensure that all of them comply highest standards
- Liaise regularly with the waste-management officer to monitor waste management practices for any lapse or mistakes
- Ensure that all staff members in their respective departments are trained in waste segregation and disinfection procedures
- Support and encourage medical and nursing staff to be alert so that hospital attendants and ancillary staff also follow correct procedures at all times.

ii. Senior Nursing Officer

The senior nursing officer is responsible for training the nursing staff, medical assistants, hospital attendants and ancillary staff in the correct procedures for segregation, sealing, storage, transport and disposal of waste. They should:

- Liaise with the waste-management officer and the advisers (infection-control officer, chief pharmacist and radiation officer) to maintain high standards of infection control
- Participate in staff induction and refresher training in the handling and treatment and disposal of health-care waste
- Liaise with department heads to ensure coordination of training activities, and decide about waste management issues specific to particular departments.

iii. Infection Control Officer:

Infection control officer should liaise with the waste-management officer on a regular basis, and provide advice about the control of infection, and the standards of the waste treatment and disposal system. Duties of the infection control officer with respect to biomedical waste are:

- Identify training needs based on the grades and occupation of the staff
- Coordinate and organise training courses for staff especially on the infection risk and hazards due to poor management of waste
- Liaise with the heads of various departments, matron and waste management officer and coordinate training.

iv. Hospital Engineer

Hospital Engineer helps in maintenance of safety measures and equipment use in the hospital. Duties regarding waste management would be to liaise with all the other department heads. They would also be responsible for installing and maintain storage facility. They are also responsible for operation and maintenance of on-site treatment facilities in the hospitals.

Key points:

- Biomedical waste management should be approached as team concept.
- Every member working in a HCF have a role and a responsibility in establishing sound management of biomedical waste



16.1 Introduction¹⁵

Infections which arise in healthcare are termed 'Healthcare associated infection' (HAI). HAIs are those infections that were neither present nor incubating at the time the patient's admission to health care facility. The majority of HAI become evident 48 hours or more following admission. However, it may not become clinically evident until after discharge.

Infection control includes the prevention and management of HAIs through the application of research based knowledge to practices that include: standard precautions, decontamination, waste management, surveillance and audit.

The key to control hospital infections is to constitute Hospital Infection Control Committee (HICC). The HICC functions at the policy making level on hospital infection surveillance and control programme.

16.2 Members of the hospital infection control committee:

- Hospital director as chairman
- Chief of Infection control team (Microbiology staff)
- Chiefs of all the major clinical departments
- Chief Nurse.
- Chief Pharmacist.
- Head of the maintenance and cleaning department.
- Director of Central Sterile Supply Department.
- Infection Control Nurse
- Any other functionaries as deemed fit can be included or called for when required by the chairman of the committee

16.3 Functions of the hospital infection control committee:

- Implementation of infection control policies
- Supervision of standards of professional care with respect to infection
- Training programme for professional staff.
- Surveillance and investigation of hospital acquired infections
- Surveillance of occupational health
- Standards of hospital domestic cleaning and food services hygiene
- Management of visitors in isolation areas
- Purchasing practices related to infection control.
- Establishment and supervision of infection control team.
- Conduct review meeting once in six months and present statistical data to the central committee

16.4 Hospital Infection control team (ICT): consisting of

- Microbiologist (Infection control officer)
- Senior Resident (Infection Control)
- Infection Control Nurses

16.5 Functions of infection control team:

- Surveillance and investigation of hospital acquired infections
- Investigation of environmental problems related to hospital infections
- Detects community acquired infections in the hospital and refers them to the appropriate authority for follow-up.
- Prompts initiation by physicians based on hospital infection report
- Monitoring of “Nosocomial infections” cases after discharge including periodic laboratory monitoring
- Helps in the development and review of infection control procedures to be placed before the central committee



- Monitoring of compliance on isolation procedures
- Development and implementation of training of employees on infection control practices
- Monitoring the effectiveness of infection control program
- Organizing occupational health programs
- Guiding and monitoring of hospital infection control through the support departments- housekeeping agency, catering agency, water supply department and other environmental agencies.

16.6 Functions of the hospital infection control officer:

- Supervise the nursing officers in matters of biomedical waste
- Liaise with the chairman of ICC and microbiology technician.
- Should be able to take decisions on day to day basis within the ambit of the infection control guidelines
- Entrusting roles and responsibilities to staff nurse/nursing officers regarding infection control activities
- Conduct antibiotic audit and update the same to the Infection control committee.
- Be well versed with the infection control policies of the hospital

16.7 Functions of the hospital infection control nurse:

- Check, detect and record HAI in wards and clinics
- Investigate hospital based infections and conduct root cause analysis
- Surveillance of isolation procedures.
- Surveillance of nursing practices which are related to infection, e.g., sterile techniques, hand washing etc.
- Monitoring of food hygiene and health of food handling staff.

- Monitoring collection and disposal of biomedical waste.
- Conduct training programs on infection control for all new entrants of nursing and paramedical
- Preparation of infection control statistics for infection control committee

Key Points

- Sound management of BMW is one of the key component of Infection control in hospitals
- Compliance of hospital infection control policy must be monitored.



17.1 Introduction¹⁵

In large hospitals it is better to establish a separate committee for bio-medical waste management, which will have the main function of implementing a safe and sound waste management, in such situations infection control committee should coordinate with the waste management committee.

17.2 Composition of a Waste Management Committee:

The Medical Superintendent/Director of hospitals shall constitute a Waste Management Committee comprising the following:

- Hospital Superintendent
- Waste Management Officer
- Heads of all hospital departments
- Chief Pharmacist
- Nursing Superintendent
- Hospital Engineer – safety trained
- Representative from support staff, e.g. sweeper
- Any other functionaries as deemed fit can be included or called for when required by the chairman of the committee

17.3 Duties and Responsibilities of the Waste Management Committee

The waste management committee shall be responsible for

- Develop biomedical waste management policy/guidelines and subsequently periodic review, revision or updating if necessary,
- Implementation of biomedical waste management systems
- Supervision and monitoring of BMWM systems
- Training programme for health care personnel on BMWM
- Surveillance of injuries and accidents related to BMWM

- Purchasing practices related to biomedical waste management
- Review of systems, identify problems and develop action plan to solve problems if any
- Allocate adequate resources for waste management
- Conduct review meeting once in six months and present statistical data to the committee

Key Points

- Hospitals with more than 30 beds need to constitute infection control committee / waste management committee
- In less than 30 bedded facilities, a nodal person is to be designated to oversee the activities of BMWM
- Biomedical waste management committee can be separate or be part of infection control committee



18.1 Introduction ¹⁰ :

As per BMWWM Rules, 2016, rule 4, it shall be the duty of every occupier to-

- 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;
- make a provision within the premises for a safe, ventilated and secured location for storage of segregated biomedical waste in colored bags or containers in the manner as specified in Schedule I, to ensure that there shall be no secondary handling, pilferage of recyclables or inadvertent scattering or spillage by animals and the 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;
- pre-treat the laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilization on-site in the manner as prescribed by the WHO guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and then sent to the Common bio-medical waste treatment facility for final disposal

A Health care facility may be called “a system” and is composed of interacting and interdependent parts, called “subsystems”. Safe management of biomedical waste in any facility is a subsystem which again has many interacting and interdependent activities like proper handling, storage, transportation and treatment of health care waste. Health care facilities should set up a comprehensive waste management system which is ‘safe, sound and environment friendly’. Waste management system in a health care setting should start with basic measures and then gradually be improved with Incremental approach as the key strategy. Human element is more important than the technology in management of bio-medical waste management.

A well-motivated and well trained health care staff would manage bio-medical waste in such a way that it causes least harm to human health and environment when compared to health care staff provided with sophisticated technology but do not understand the risks of improper management of bio-medical waste.

18.2 The basic components followed while setting up of health care waste management system in a health care facility are: ^{14,15}

1. Conducting a waste audit
2. Minimization and recycling of waste wherever possible
3. Identification of points of generation of waste
4. Segregation of waste at source
5. Compiling inventory of waste
6. Disinfection at the point of generation
7. Waste transportation – on site or off site
8. Waste treatment – on site or off site
9. Temporary storage area
10. Final treatment and disposal options
11. Occupational safety
12. Continuous monitoring of the system
13. Training of staff

18.3 Waste Audit ¹⁵:

Waste audit is one of the first steps in any waste management. Waste audit helps

- to understand and get an insight into our own system
- in inventory management for waste management.
- in characterization and quantification of waste
- to determine logistic requirements.
- to select appropriate technologies for final treatment and disposal options
- to design, generate protocols and use the same for –Segregation, transportation, handling, storage, final treatment and final disposal, monitoring of the system, for recording and reporting and tracking of waste



18.4 The waste audit exercise must be undertaken to review the following:

- Identification of points of generation of waste
- Quantum of waste
- Category of waste
- Disinfection process
- Waste movement within the HCF
- Status of equipment like needle destroyers, autoclave etc.
- Condition of personal protective equipment
- Incidence of sharp injuries

18.5 Two stage process of waste audit

- The first stage involves the visit by senior nursing staff / member of the infection control committee to audit the above said processes in the HCF
- The second stage is the report preparation and its presentation to the senior administrators / infection control committee to take further action.

The survey questionnaire for conducting waste audit can be accessed at ^{7,16}
http://www.who.int/water_sanitation_health/medical_waste/034to057.pdf

18.6 Outcome of a waste audit

- An action plan can be prepared to develop and evolve a system in place. A sample action plan is annexed in Annexure - 7
- Laying down of a system of collection and transportation of biomedical waste and selection of final disposal mechanisms.

18.7 Important activities that are included in setting up of the systems are:

- Assignment of responsibility for waste management
- Allocation of sufficient human and financial resources
- Waste minimization, including purchasing policies and stock management practices
- Segregation of waste at the point of generation

- Implementation of safe handling, storage, transportation, treatment and disposal options
- Monitoring of the system
- Training of all personnel in health care facility – doctors, nurses, paramedical staff and waste handlers

18.8 Conclusion

Proper management of bio-medical waste depends largely on good administration and organization but also requires adequate financing and active participation by trained and informed staff.

KEY POINTS

- The planning process should be dynamic and have allowance for periodic updates as improvements in biomedical waste management processes and technology become known.
- Waste audit is a primary step in establishing a good waste management system in place.



19.1 Introduction:

One of the guiding principles of bio-medical waste management is “polluter pays” principle, i.e. each health-care facility should develop and implement viable systems for safe and sound management of any waste it generates so as to avert unfavourable environmental consequences. The HCFs should allocate sufficient budgetary funds for activities pertaining to entire life cycle of bio-medical waste management.

There are several complexities involved while developing an efficient economic estimation models for bio-medical waste management. The size of the facility, nature of waste generated, quantum of waste, access to Common Bio-Medical Waste Treatment Facility are some of the major determinants for estimating costs.

19.2 Considerations:

Bio-medical waste management systems involves manpower, materials and resources for ensuring efficient functioning & complying with requisite legal provisions of BMWW Rules (2016).

Administrators need to consider biomedical waste management plan detailing the operating budget for the year considering:

- People, practices, and procedures directly related to BMWW
- Location of the Facility
- Regulatory requirements
- Available resources
- Waste management alternatives
- Size of the facility and location wise waste generation points (predominant waste sites)
- Nature & quantum of waste generated

- Access to CBWTF or in-house management as stipulated by BMWM Rules (2016).

19.3 Major activity based resources required:

- **For segregation and containment of waste:** bins, bags and other containers for different types of waste
- **For transportation of waste :** trolleys, carts and other aids to handle and transport waste from point of generation to temporary storage area
- **For treatment of waste:** autoclaves, needle destroyer and other chemical disinfectants as stipulated in the BMWM Rules (2016)
- **For storage of waste on site :** Central / temporary storage area
- **For Emergency response :** spill kits, fire safety equipment
- **For Personal Protective Equipment:** PPE for waste handlers and other personnel involved in the different process of waste management

19.4 Major cost headers⁷:

Licenses / Sanctions and Permissions: From competent authorities by paying the requisite prescribed fees.

TABLE 22: MAJOR COST HEADERS

Cost Header	Segregation & Containment	In-House Transport	Final Disposal
Manpower:	Eg:	Eg:	Eg:
Material costs			
Direct costs:			
Capital costs:	Eg:	Eg:	Eg:
Recurrent costs:	Eg:	Eg:	Eg:
Indirect Costs:			
Overhead costs:	Eg:	Eg:	Eg:
Contingency costs:	Eg:	Eg:	Eg:

Additionally one needs to factor in:

- Training Costs
 - Induction training
 - Continued Training / Special training for certain critical aspects
- Costs incurred for creating awareness regarding safe handling of bio-medical waste- development, printing and dissemination of information, educational and other relevant material through different media as required.

19.5 WHO costing tools ¹⁷:

WHO costing tools are available which assist in estimating the total costs of Health Care Waste Management activities. They are:

- Cost Analysis Tool (CAT) – helps to estimate and calculate costs relating to HCWM at national and health care facility levels.
- Expanded Cost Analysis Tool (ECAT): The expanded cost analysis tool (ECAT) is a modified version of the cost analysis tool (CAT) which provides more options and approaches than the CAT. It helps the user estimate costs related to HCWM at the healthcare facility, central treatment facility or cluster and national levels. Versions ECAT-L, ECAT-M and ECAT-H are for low income, medium-income and high-income countries respectively.

TABLE 23: INDICATIVE LIST FOR COSTING

Indicative list as provided by the UNDP-GEF-WHO document:

Capital costs could include:

- Waste management equipment such as plastic or metal bins, wheeled carts, trolleys, weighing scales, skips or dumpsters, compactors, segregation posters
- Site preparation, and construction or renovation of storage areas and treatment areas
- Treatment technology and related accessories
- Shipment, customs fees, installation, start-up and commissioning of the treatment technology

Indicative list as provided by the UNDP-GEF-WHO document:

- Waste transport vehicles
- Construction of trenches or burial pits for waste disposal
- construction of waste storage areas

Operating/ Recurrent costs could include:

- Wages and benefits for the HCWM coordinator, waste worker, treatment technology operator, waste transport vehicle driver, etc.
- Consumable items, such as plastic bags, sharps boxes or disposable sharps containers, labels, cleaning supplies, uniforms, PPE, disinfectants
- Fuel costs, such as diesel or gas for the treatment system and diesel or gasoline for the transport vehicle
- Utilities: electricity, water, steam and other utilities used by the treatment system
- Maintenance and repair costs, spare parts

Overhead/ Additional costs could include:

- Administrative and project management costs
- Staff training
- Regulatory fees
- Renting or leasing of equipment
- Sewage treatment costs
- Landfill tipping fees
- Fees paid to an outside company to pick up, transport, treat and dispose of healthcare waste (for facilities that use a service provider)
- Health insurance
- Immunisation of health care workers

Indicative list as provided by the UNDP-GEF-WHO document:

Contingency costs could include:

- Expenditure towards equipment breakdown, spills, injuries & other accidents

KEY POINTS

- In accordance with the “polluter pays” principle and the obligation of the duty of care, every health care facility has a moral as well as financial responsibility for the safe management of any waste it generates.
- Manufacturers should also take responsibility to take waste management into consideration during the development and sale of their medical products and services.

20.1 Introduction

Administrative activities under bio-medical waste management would encompass formulation of policy, guidelines and standard operative procedures, planning, allocation of resources and delineating the responsibility of each of the member in the waste management team. Formulation of written policy indicates the commitment of the HCFs towards management of biomedical waste according to BMWM Rules 2016. Any policy document prepared by the HCF should align with National policy on biomedical waste management. It is suggested that each HCF has a written policy with regard to biomedical waste management and occupational safety issues. However, smaller HCF can use the policy document prepared by the national authority.^{14,18-20}

20.2 Policy

A policy is a statement of intent and is implemented as a procedure or a protocol. A policy can assist in both subjective and objective decision making. A policy document would attempt to describe a problem and recommend actions to be taken, identifies stake holders and mobilises them to carry out stated actions. Many policy documents support the recommendation with evidence for the action.

20.2.1 The process of drafting a policy would include

- Define the problem or issue
- Position to adopt
- Discuss the impact
- Finally look at alternative proposal

The wording of the policy document should be simple, well-structured and coherent and evidence based. Whenever a policy document is drafted the audience need to be taken into consideration so that the document is understood by all.

20.2.2 Bio-Medical Waste Management policy of a Health care facility may include

- Description of environmentally sound measures to be taken by the HCF for proper management of bio-medical waste
- Policy may also include measures for waste minimization
- Policy for occupational safety that includes, annual health check-up, immunization measures and policy on post exposure prophylaxis
- Policy may include details of budget allocated for aspects of Biomedical waste management
- Written plans for emergency situations also need to be elaborated in the policy
- Any policy formulated by the HCF should comply with BMWM Rules, 2016
- Training of the healthcare personnel

20.3 Guidelines

A guideline is a statement to determine a course of action. A guideline aims to streamline particular process. Guidelines have to be practical.

- Guidelines for Biomedical waste management give details of establishment of comprehensive system of biomedical waste management from generation of waste to final disposal
- Modality of training of health care personnel
- Selection of safe environment friendly options for the management of biomedical waste
- Modality of disinfection and other processes of biomedical waste management.

20.4 Standard Operating Procedures

Standard operating procedures describe the practical implementation of the policy and guidelines specific to health care facility. It is suggested that each of the HCF prepare its own SOP.

The document is a description of each of the processes in bio-medical waste management.

SOP documents should be easily accessible at all points of generation. Certain aspects such as segregation can be depicted pictorially that even the waste handlers would be able to comprehend.

Any change in the policy and guidelines needs to be reflected in the SOP documents also. It is a good practice to review SOP documents annually. The document should be vetted and concurred with the biomedical waste management committee, hospital infection control committee and senior nursing staff and piloted at certain strategic locations in the hospital.

KEY POINTS

- Policy on BMWM will help commitment and implementation of sound management of biomedical waste in HCFs
- Standard operating procedures will help as ready reckoner for the health care personnel to practice safe management of biomedical waste



21.1 Introduction

Monitoring is “the performance and analysis of routine measurements aimed at detecting changes in the environment or health status of the population.” In management, monitoring refers to “the continuous oversight of activities to ensure that they are proceeding according to plan. It keeps track of the achievements staff movements and utilization of supplies and equipment, if not proceeding

according to plan immediate corrective measures can be taken.”

Monitoring is a management function that is planned and carried out to assist staff in carrying out assigned tasks. Monitoring systems should provide feedback to health care workers, has to motivate identify weakness and offer suggestions and should encourage two way communications. Monitoring systems builds on past gains to meet future goals.

21.2 Waste Management Monitoring¹⁸⁻²⁰

Waste Management Monitoring is the systematic process of collecting, analysing and using information to track the progress toward achieving safe and sound biomedical 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 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.

21.3 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 health care 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 HCWM 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 BMWM within the HCFs.

21.4 Types of Monitoring: Periodic monitoring is the key for sustainability of established Biomedical waste management systems in a health care facility

- Day to day monitoring
- Periodic monitoring- frequency can be determined by the HCF

21.5 Who will do it?

- Senior staff nurse
- Departmental heads
- Waste management officer

21.6 What to monitor?

- At the point of generation viz. quantity, segregation, labelling, collection, handling, use of personal protective equipment by waste handlers, transportation, storage etc. of biomedical 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.



21.7 Monitoring tools: Prepare a monitoring check list of the above activities and decide on the frequency of monitoring.

i. Day to day monitoring: HCFs can decide on what to monitor on a day to day basis. As segregation is the heart of waste management it is suggested that process of segregation be monitored on a day to day basis however, the frequency and what to monitor can be decided by the HCFs.

ii. Periodic monitoring: Periodic monitoring of bio-medical waste management should be carried out at supervisory level and managerial staff. The managerial staff should periodically monitor the waste management system:

- Segregation at different points of generation
- Transportation system
- Occupational safety issues
- Mandatory records to be maintained by HCFs as per BMW Rules 2016
- Training and capacity building of the personnel
- Monitoring of financial aspects e.g. costs of materials and consumables

Daily monitoring and Monthly monitoring checklist is available in Annexure 8 & 9

21.8 Conclusion:

Monitoring should help improve the systems of biomedical waste management systems which should be system specific and not person specific. Waste management is more of attitudinal issue and hence constant monitoring is critical in maintaining appropriate practices in BMW. Unless monitored waste management systems may not function to the optimum level.

KEY POINTS

- 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

22.1. Introduction

Health and safety of the personnel involved in providing health care is an area that is given least consideration. It is important that health and safety of health care workers also be given due importance to prevent diseases that are associated to spread in health care settings. Occupational safety of personnel involved in bio-medical waste management is an important aspect due to the hazards that are associated with it.

BMWM Rules 2016 also states that health and safety of health care workers has to be given due care.

Rule 4: Duties of the Occupier: It shall be the duty of every occupier to-

(l) ensure occupational safety of all its health care workers and others involved in handling of bio-medical waste by providing appropriate and adequate personal protective equipment;

(m) conduct health check up at the time of induction and at least once in a year for all its health care workers and others involved in handling of bio-medical waste and maintain the records for the same

22.2. Occupational risks: Risks associated with Biomedical waste management are:

- Risk due to infectious agents
- Injuries from sharps
- Exposure to chemical agents (disinfectants)
- Exposure to radiation

22.2.1. Risk due to Infectious agents ⁷

The risk of infection with hepatitis B is more than 10 times greater than for hepatitis C, and up to 100 times greater than for human immunodeficiency virus (HIV) from blood.

Exposure to infectious agents in the laboratory can occur either through skin, mucosa or airborne infections

TABLE 24: RISKS DUE TO INFECTIOUS AGENTS

Occupational risks of infection			
Virus	Route of transmission	Triggers	Control measures
HIV, Hepatitis B, Hepatitis C	Exposure to infected Blood and Blood products, percutaneous exposure to infected blood, either by skin-penetrating injuries with blood-contaminated needles (needle stick injuries) or by cuts with scalpels or other sharp instruments (sharps injuries)	Recapping the syringes, improper disposal of waste sharps, passing of sharp instruments during surgery, pricks while suturing	<ul style="list-style-type: none"> • Immunization against hepatitis B virus • Avoid recapping of needles and safe disposal of sharps into puncture proof container • Segregating sharps waste at source as far as possible
SARS , influenza	Air borne	Housekeeping tasks like sweeping of the floor, Improper disinfection of surfaces	<p>Exhaust ventilation (natural or mechanical Standard precautions</p> <p>Respiratory protection with N95, FFP3 respirators for high-risk cough-inducing procedures.</p> <p>Autoclaving laboratory waste on site before disposal</p>

Source : Health and safety practices for health-care personnel and waste workers, Safe Management of Health care waste 2nd edition , WHO, pg no 183 Table no. 11.2

22.2.2. Injuries from sharps: Sharps that are not safely contained in puncture proof containers are at risk of needle stick injury which will result in contracting blood borne infections. The risk and nature of infection depend on the amount of the contamination and nature of the infection from the source patient.

TABLE 25: FIRST AID IN AN EVENT OF ACCIDENTAL EXPOSURE TO BLOOD/ BODY FLUIDS

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

i. TO UNBROKEN SKIN	ii. FOR MOUTH
<ol style="list-style-type: none">1. Wash the area immediately with running water2. Do not panic3. Do not put finger into the mouth4. Do not squeeze5. Do not use antiseptics	<ol style="list-style-type: none">1. Spit the fluid immediately2. Rinse the mouth thoroughly, using water or saline and spit again3. Repeat this process several times4. Do not use soap or disinfectant in the mouth

iii. FOR THE EYE
<ol style="list-style-type: none">1. Irrigate exposed eye immediately with water or saline2. Sit in a chair, tilt the head back and ask a colleague to gently pour water or normal saline3. 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 the 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.

FURTHER ACTION
<ol style="list-style-type: none">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 taken4. 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. <p>*Samples to be collected from Health care worker for HIV, HBsAg and anti HBsAb and also from the source for HIV and /HBsAg.</p>

Note: Refer to Doctors Manual for details of PEP

22.2.3. Exposure to chemical agents (disinfectants)

TABLE 26: EXPOSURE TO CHEMICAL AGENTS AND CONTROL MEASURES

Chemicals	Route of entry	Triggers	Control measures
Chemicals: Chlorine disinfectants (sodium Hypochlorite)	Inhalation, absorption through skin or mucosa	Handling chemicals without using appropriate PPE Handling chemicals in ill ventilated areas	<ul style="list-style-type: none"> • Appropriate use of PPE • Accessibility of chemicals to only authorized people • Educating the health care personnel • Substitute soap and water for cleaning chemicals • Dilute chemicals appropriately according to manufacturer for less toxic exposure
Sterilants: ethylene oxide (International Programme in Chemical Safety, 2003)	Inhalation, absorption through skin or mucosa		<ul style="list-style-type: none"> • Substitute steam sterilization for ethylene oxide except for pressure-sensitive instruments • Use only in a closed and ventilated system

Health effects of exposure to chlorine are: Irritation of the eyes, nose and throat, Skin sensitization, Occupational asthma where chest tightness and difficulty in breathing can occur. Immediate first aid is to shift the person to an area where fresh air is available and later seek medical attention.

Source : Health and safety practices for health-care personnel and waste workers, Safe Management of Health care waste 2nd edition , WHO, pg no 183 Table no. 11.2

22.2.4. Exposure to radiation is not dealt here.

22.3. Occupational safety measures that should be developed and practiced by HCF

All HCF have a responsibility to ensure the occupational safety of all health care personnel for which the following are recommended:

- Development of a standardized set of policy in line with the BMWM Rules

- Training of support staff so that they perform their duties safely and meticulously
- Involve waste handlers in risk identification and recommendations for their prevention and control
- establish an occupational health programme that includes
 - i. Immunization of all health care workers
 - ii. Provision of adequate personal protective equipment and clothing
 - iii. Post-exposure prophylaxis
 - iv. Regular medical surveillance
 - v. Regular Annual Health check up
 - vi. Training and re training of all health care workers

22.3.1. Immunization

All health-care personnel are at risk of exposure to blood and blood products. As per BMWM rules, they should be immunized against hepatitis B virus and Tetanus Toxoid at the induction.

22.3.2. 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. ^{7,21}

TABLE 27: TECHNICAL SPECIFICATIONS OF PPE

Equipment	Use	Technical specifications
1. Cap or head cover 	Protects scalp	Should cover the hair completely
2. Goggles or face shield 	Protects eyes	<ul style="list-style-type: none"> • Provide adequate protection against the particular hazards to eyes. • Reasonably comfortable when worn.

Equipment	Use	Technical specifications
		<ul style="list-style-type: none"> • Fit snugly and not unduly interfere with the movements of the wearer. • Durable. • Capable of being disinfected. • Able to be worn without disturbing the adjustment of any existing prescriptive eyewear.
<p>3. Face mask, respirator</p>  	<p>protect mouth/nose, protect respiratory tract from airborne infectious agents, dust, fibre, fumes, mist, soot, and smoke.</p>	<ul style="list-style-type: none"> • Is reasonably comfortable when worn • Fits snugly and does not unduly interfere with the movements of the wearer • Is made of material that is capable of being disinfected regularly • Has a strap that is either elastic or adjustable • Is made of silicone or thermal plastic polymer • Is available in a minimum of three sizes: small, medium, and large • Size dimensions will vary by manufacturer <p>Specifications for the cartridges:</p> <ul style="list-style-type: none"> • Is able to achieve the National Institute for Occupational Safety and Health P100 or N100 rating, or equivalent European Committee for Standardization certification. P100 cartridges will protect against any particulates, including oil-based materials. N series cartridges protect against solid and water-based particulates such as nuisance dust. • Contains a granular or porous material—such as carbon or coconut—which removes specific air particulates.

Equipment	Use	Technical specifications
		<ul style="list-style-type: none"> • Is available in bayonet, push-in mounted cartridge, or canister form; is able to remove 99.9% of dusts and non-oil-based mists. • Enables easy breathing during use.
<p>4. Gown or apron</p> 	<p>protect skin and/or clothing</p>	<p>Natural or man-made, Reusable or disposable, Resistance to fluid penetration and Clean or sterile.</p>
<p>5. Gloves</p> 	<p>protect hands</p>	<ul style="list-style-type: none"> • Durable, reusable design that is able to withstand periodic disinfection. • Available in sizes appropriate for all cleaning staff in the health care facility. • Prevent contact with blood borne pathogens contained in health care waste. • Made from puncture-resistant materials to protect against needle sticks and cuts from other sharps.
<p>6. Impermeable shoes or gum boots</p> 	<p>Protects feet</p>	<ul style="list-style-type: none"> • Made from cut-resistant materials. • Slip-resistant sole. • Puncture-resistant sole. • Protective against minimal impact. • Fit snugly and not unduly interfere with the movements of the wearer. • Durable. • Capable of being disinfected. • Available in sizes to fit all waste handlers (toes should be about 12.5 mm from the front). • For incinerator operators, boots should be made from heat-resistant materials when available.



The type of PPE that are to be used depends much upon the type of activity carried out and on the extent of the risk involved. However following PPE must be made available to all health care personnel who collect or handle waste:⁷

- Mandatory
 - ✓ Disposable latex gloves or heavy-duty gloves (waste workers)
 - ✓ Industrial aprons
 - ✓ Overalls (coveralls)
 - ✓ Leg protectors and/or industrial boots
- Additional depending on type of operation
 - ✓ Eye protectors (safety goggles)
 - ✓ Face masks or face shield (if there is a risk of splash into eyes)
 - ✓ Helmets, with or without visors.

Industrial boots and heavy-duty gloves are particularly important for waste handlers. The thick soles of the boots offer protection in the storage area from spilt sharps and from slips or falls on the slippery floor.

22.3.3. Occupational post-exposure prophylaxis ⁷

Health care workers like doctors, nurses, lab technicians or waste handlers can be accidentally exposed to HIV through healthcare 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)

- Post-exposure prophylaxis (PEP) is a short-term antiretroviral treatment (for HIV) or immunization (for hepatitis B) to reduce the risk of infection after potential exposure, either occupationally or through sexual intercourse.
- PEP should be provided as part of an occupational health program or a comprehensive universal precautions package in an event of staff being exposed to infectious hazards at workplace.
- PEP for HIV in the exposed person includes the following set of actions to be undertaken:
 - First-aid care
 - Counselling and risk assessment
 - HIV blood testing
 - Based on risk assessment, provision of post exposure prophylaxis of short-term (28 days) antiretroviral drugs, with follow-up and support.
- **Note: Refer to Doctors Manual for further details on PEP**



A summary of PEP recommendations are as follows:

- PEP should be provided as part of an occupational health preventive package to reduce the risk of infection among exposed individuals at workplace.
- PEP should be made available to all health-care workers and patients.
- Occupational PEP should be made available to all workers who could be exposed while performing their duties
- Appropriate training of nodal persons responsible for PEP for proper management and follow-up of PEP
- PEP should be initiated as soon as possible within the first few hours and not later than 72 hours after exposure to potentially infected blood or body fluids.
- PEP is not indicated to a person already known to be infected with HIV.
- After evaluation of risk and counselling on side effects, it is also essential to counsel on benefits of compliance to PEP and also provide psychosocial support.
- Any accidental exposure to HIV during health care activities should be properly investigated, identify the causes and accordingly strengthen the safety and working conditions if required.

22.3.4. 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.

22.3.4.1. Uses of surveillance system

- To prevent exposure to infections and other hazardous chemicals, cytotoxic and radioactive waste and injuries.
- Surveillance helps in identification and investigation of an outbreak of infection



- Further it helps in implementing and evaluating control measures and streamlining the preventive measures.

22.3.4.2. Records that are needed for surveillance in HCF

- Injury registers of all wards
- Spill registers
- Accident registers
- Weekly inspection records of storage area
- Records of micro biological tests of autoclave and microwave

22.3.5. Health check-ups of the employees

All health care personnel including doctors, nurses, waste handlers must be provided with health check-up at induction and as well as annual by the employer. Annual health check-up may include the below mentioned services

- Clinical examination, blood pressure measurement
- ECG
- Chest X ray
- Complete blood count
- Fasting blood sugar and lipids
- Any other depending on health complaints or any specific exposure

Documentation of all the health check-ups need to be maintained by the administrators as mandated by BMW rules.

22.3.6. Training ^{7,8,10,22}

People who are at risk from infection and injury in a health care setting include Doctors, nurses, technicians, waste handlers, hospital cleaners, maintenance workers and also operators of waste-treatment equipment, and all personnel involved in waste handling and disposal within and outside health-care facilities. Hence it is important that all health care workers should be trained during their induction to educate them on the risks they are involved and the preventive and control measures they need to

follow. And thereafter, on a regular basis to update their knowledge of prevention and control measures.

Training should cover areas of potential hazards from the biomedical waste, occupational safety including the immunization, safe handling of biomedical waste, reporting of exposures and injuries, PEP in an event of exposure; and the use of PPE during handling of biomedical waste.

Training in occupational health and safety should be provided to all the health care workers to make them aware of the potential risks associated with biomedical waste, the safe procedures to handle and manage biomedical waste in line with the existing biomedical waste rules of the country. They should be emphasized on importance and regular use of personal protective equipment (PPE). They should be educated on how to prevent needle stick injury and in an event the actions that need to be taken including the importance of PEP.

Health-care personnel should also be trained for emergency response if injured or exposed to biomedical waste. Standard operative procedures for different emergencies should be drawn up and should be readily available for reference immediately. For dangerous spills of hazardous chemicals or highly infectious materials, a trained person should be designated to clean such spills.

It is not important to draw SOP for waste managers, it is also the responsibility of the administrators to ensure that all health care workers are aware of the emergency response that needs to be adopted. It is advisable that one person is assigned the responsibility of handling of all the emergencies, including coordination of actions, reporting to managers and regulators, and liaising with emergency services. A deputy should be appointed to act in case of absence.

22.3.7. Duties of administrator for occupational safety:

- Administrator of a health care facility need to frame policies, guidelines and standard operating procedures to adequately address the hazards faced in health care facility.
- Written policy with regard to occupational safety, unambiguous guidelines when communicated to all the employees would help to maintain occupational safety in health care facility.



22.3.8. Steps to be taken by administrator/ head of the hospital to ensure proper occupational safety in the process of management of BMW ⁷.

- To develop standard operating procedures for handling biomedical waste with respect to occupational safety
- To ensure training and communication to all health care workers regarding the standard operating procedures and precautions to be followed by them
- To identify the hazards in health care facility
- To provide personal protective equipment
- To establish an occupational safety programme that include, training, post exposure prophylaxis, immunization and regular medical check-up.
- Occupational Health and Safety Unit to be established in large hospitals which will address all the above issues

Key Points

- Standard operating procedures on occupational safety are key to protect health of health care workers
- Delineate a responsible person for occupational health
- Provide immunization, PEP and Personal protective equipment
- Training and retraining of health care workers
- Take preventive measures to limit the exposure
- Medical surveillance and periodic health checks
- To set up OHS unit in larger hospitals is desirable

23.1 Introduction

Documentation is a process of creating a record of the information generated in all the processes of biomedical waste management. Documentation plays a major role in patient care activities. It helps in providing the documentary evidence required for managerial decision making and detection of problems, loopholes in the system. Thus it can be termed as a part of management information system. As

with all other things in Medical field documentation is important in biomedical waste management. It provides evidence with regard to processes adopted and protects the occupier as well as the operator against any legal proceedings. Maintenance of records regarding information on certain aspects of biomedical waste management is mandated according to BMW Rules of 2016.⁸⁻¹¹

As per Biomedical Waste Management Rules 2016, Rule 4, Duties of the Occupier:

Rule 4 (g) : Provide information on training conducted on Biomedical waste management as a part of annual report and also indicate the number of personnel not undergone training

Rule 4 (m): Conduct health check at the time of induction and yearly health check-up of all its health care workers and others involved in involved Biomedical waste and maintain the records

Rule 4 (n): Maintain and update day to day basis the biomedical waste management register

Rule 4 (o): Report major accidents including nil report in form I

Rule 4 (p): make available annual report on its website

Rule 4(r): record of the minutes of the meeting of the committee to monitor and review activities related to biomedical waste management.

Rule 14 - (1): Every authorised person shall maintain records related to the generation, collection, reception, storage, transportation, treatment, disposal or any other form of handling of biomedical waste for a period of five years in accordance with these rules and guidelines issued by the Central Government or the Central Pollution control board or the prescribed authority.

23.2 List of records to be maintained

TABLE 28: LIST OF RECORDS TO BE MAINTAINED AT HCF

Sl.No.	Name of the record	Maintained by	Where to maintain	Details
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	Explained below + Form II and III of BMWM Rules
2.	Memorandum of understanding with CBWTF *	Administrator / waste management officer	Maintained at office of Head of HCF or as deemed necessary	Explained below.
3.	Waste generation register *	Nurse , temporary storage in charge	At every point of generation of waste in HCF and temporary storage facility	Annexure - 10
4.	Records of monthly monitoring of waste management systems	Nursing in-charge of the generation points/ administrator	Office of administrator	Annexure – 8 & 9
5.	Spill register	Nurse	At every point of generation of waste in HCF and temporary storage facility	Annexure - 11
6.	Injury register	Nurse/ ICN	At every point of generation of waste in HCF and temporary storage facility	Annexure - 12 & 13
7.	In-house transportation	Waste management officer	temporary storage facility	Annexure - 14
8.	Transport to CBWTF	Waste Management officer/ Nursing superintendent	temporary storage facility	Annexure - 15

Sl.No.	Name of the record	Maintained by	Where to maintain	Details
9.	Health Records of the personnel*	Administrator	Office of the Hospital Administrator	Annexure - 16
10.	Immunization records	Administrator	Office of the Hospital Administrator	Annexure - 17
11.	Documentation of training conducted*	Administrator/ Nursing superintendent	Office of the Hospital Administrator	Annexure - 18
12.	Annual report of Biomedical waste management *	Administrator/ Nursing superintendent/ waste management officer	Office of the Hospital Administrator	Format available in BMWM Rules (Form IV)
13.	Minutes of the waste management/ infection control committee*	Secretary of the committee	Secretary of the committee/ Administrators office	Minutes of meeting to be recorded in separate register and made available for inspection by SPCB if called for
14.	Accident report*	Administrator/ Nursing superintendent/ waste management officer	Office of the Hospital Administrator	Details below + Form I in BMWM Rules
15.	Operational records of Autoclave/ Microwave*	Administrator/ Nursing superintendent/ waste management officer	Office of the Hospital Administrator	Annexure - 19
16.	Record for effluent standards *	Hospital engineer	Office of Administrator	Annexure - 20

* **Mandated according to BMWM Rules 2016**

23.3 Authorization

Application for authorization: ⁹⁻¹⁰

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, as the case may be, for grant of authorisation and the prescribed authority shall grant the provisional authorisation in **Form III** and the validity of such authorisation for bedded health care facility and operator of a common facility shall be synchronised with the validity of the consents.

- (1) The authorisation shall be **one time** for non-bedded occupiers and the authorisation in such cases shall be deemed to have been granted, if not objected by the prescribed authority within a period of ninety days from the date of receipt of duly completed application along with such necessary documents.
- (2) In case of refusal of renewal, cancellation or suspension of the authorisation by the prescribed authority, the reasons shall be

recorded in writing: Provided that the prescribed authority shall give an opportunity of being heard to the applicant before such refusal of the authorisation.

- (3) Every application for authorisation shall be disposed of by the prescribed authority within a period of ninety days from the date of receipt of duly completed application along with such necessary documents, failing which it shall be deemed that the authorisation is granted under these rules.
- (4) In case of any change in the bio-medical waste generation, handling, treatment and disposal for which authorisation was earlier granted, the occupier or operator shall intimate to the prescribed authority about the change or variation in the activity and shall submit a fresh application in Form II for modification of the conditions of authorisation.

The following documents have a statutory character, and must be ensured.

- I. **Application for Authorisation:** [Under rule 10, it is mandatory on the part of "occupier" of the hospital/institution to apply for authorisation in the prescribed form II, along with the prescribed fee failing which the institution cannot deal with BMW]
- II. **Application for Authorisation by the occupier of a health care facility or a CBWTF (To be submitted in duplicate) (See BMWM rules, 2016)**
- III. **Annual report** (To be submitted by prescribed authority on or before 30th June every year for the period from January to December of the preceding year by the occupier of the HCF or CBWTF)

23.4 Memorandum of understanding with CBWTF ⁹⁻¹⁰

According to BMWM Rules 2016 – rule 7,

- ✓ Occupier shall hand over segregated waste as per the Schedule-I to common bio-medical waste treatment facility for treatment, processing and final disposal: Provided that the lab and highly infectious bio-medical waste generated shall be pre-treated by equipment like autoclave or microwave.
- ✓ No occupier shall establish on-site treatment and disposal facility, if a service of common bio-medical waste
- ✓ e treatment facility is available at a distance of seventy-five kilometre.

An agreement with CBWTF should be made in order to streamline the collection of waste from the health care facility by the CBWTF.

The initial letter to Common Biomedical Waste Treatment Facility (CBWTF) should be as follows

To
The Manger
 _____ **CBWTF (Name of the CBWTF) & Address**

Sl No.	Name of the institution	
1	Address	
2	Tel No, Fax No, Telex	
3	Activity for which agreement is sought - Collection - Transportation	

	- Treatment - Disposal	
4	Please state whether applying for fresh agreement or for renewal	
5	Category (see Schedule I) of waste to be handled per day and month	
6	Quantity of waste (category-wise) to be handled per day and month	

Date: _____ Signature of applicant: _____

Place: _____ Designation of the applicant: _____

23.5 Documentation of Health Records

Documentation of Health records of personnel would include

- Name, Designation of the physician
- Time of clinical examination
- Record of tested lab parameters
 - Complete blood count
 - Lipid profile
 - ECG
 - Chest X ray(optional)
 - Blood group (at the time induction)
- Record of the findings of physical examination
- Record of any other specific complaints from the employee
 - Vitals (pulse, blood pressure, Ht. Wt.)
 - Any other findings of physical examination

Sample Health record is in Annexure – 16

23.6 Reporting of Accidents/ Incidents:

All waste-management staff should be trained in emergency response and be aware of line of reporting and procedures required thereafter. Accidents or incidents, including near

misses, spillages, damaged containers, inappropriate segregation and any incidents involving sharps, should be reported to the waste-management officer (if waste is involved) or to any another designated person.

23.6.1. Accident reporting

In case of any major accident at facility or any other site while handling or transporting bio-medical waste, the authorised person shall intimate immediately to the prescribed authority about such accident and

Examples

- Toppling of truck
- Release of Biomedical waste into water body
- Any accident that will impact large masses of public

Information regarding all other accidents and remedial steps taken shall be provided in the annual report in accordance with rule 13 by the occupier.

forward a report within twenty-four hours in writing regarding the remedial steps taken in **Form I**. Incidents such as needle stick injury is not considered as major accident. They can be separately documented as incidents at HCF level.

As per BMW Rules 2016, all major accidents to be reported in Form I to the state Pollution control board within 24 hours

23.6.2. Incident reporting - Incidents that need to be documented at HCF but may not be reported to SPCB such as

- Breaking of mercury containing equipment like thermometers, blood pressure apparatus
- Breaking of non- mercury containing equipment like test tubes, glass bottles
- Spillage of blood or body fluids
- Needle stick injury
- Exposure to blood and body fluids

Further reading

1. Manual on Health care waste Management. National Center for Health Facility Development. 3rd ed. Manila, Philippines; 2011
2. Guide for Training Health Workers in Health Care Waste Management. Ministry of Health, Government of Kenya; 2015.

3. Safe management of wastes from health-care activities. WHO. 2nd ed. Switzerland: WHO Press, World Health Organization;2014

Key Points

- Documentation is important – authorization, annual report, registers at the point of generation, blood/ body fluids/chemical/mercury/cytotoxic spills and injury registers, temporary storage area register
- As per BMW Rules 2016, all major accidents to be reported in Form I to the state Pollution control board within 24 hours

24.1 Introduction

Emergency is defined as sudden unexpected, or impending situation that may cause injury, loss of life, damage to property or interfere with normal activities of a person or firm and which therefore requires immediate attention and remedial action ²³.

Any emergency situation requires urgent intervention so as to not to worsen the situation. In a hospital scenario there can be many medical emergency situations that arise and most of the health care facilities

specially the large hospitals would have an emergency plan thought of prior. However, there could be certain emergencies that could occur in the process of waste management. It could be an accidental exposure to biological agent, a chemical or a physical injury that could occur.

It would be safer for the health care personnel, patients, general public and the surrounding environment if the hospital were to plan for such exigencies. ^{14,18-20}

24.2 Emergency Management Plan: It refers to how the hospital would respond to an emergency and plan for recovery for the same. As per BMWM Rules 2016, all accidents to be reported in Form I to the state Pollution control board. A written plan would aid in executing the plan with ease.

The plan would include

- Communications
- Roles of the personnel
- Utilities and supplies
- Support activities

24.3 Steps in management of an emergency include

- Mitigation and preparedness
- Response
- Recovery

24.3.1 Mitigation and preparedness: The first step in planning for an emergency situation is to mitigate by systematic reduction of risk or the chances of occurrence of such emergency. Preparedness refers to the readiness to react and respond in such situations.

24.3.2 Response: Response should be carried out by well-trained personnel as per the management plan drawn up by the hospital. Depending on the kind of exposure whether biological or chemical, the response should be in accordance with the emergency management plan drawn up by the hospital.

24.3.3 Recovery phase: In the recovery phase i.e. when normalcy is restored, the activities that need to be performed by the health care personnel would include

- Documentation of the incident as per BMWM Rules 2016
- Reporting an accident as per BMWM Rules
- List of items used from the kits
- Replacement of consumables used
- If necessary, psychological support to the injured

24.4 The role of the administrator in an emergency situation are:

- To set up a plan for emergencies
- To draw protocols for any such event
 - Blood and Body fluid Spill Management Protocol (Annexure-21)
 - Mercury Spill Management Protocol (Annexure-22)
 - Chemical Spill Management protocol (Annexure-23)
 - Cytotoxic Spill Management Protocol (Annexure- 24)
 - Needle stick injury protocol (Refer SOP document)
- To ensure the supplies of consumables
- To ensure that the health care personnel are trained in handling emergencies
- To liaise with the other departments to frame policies
- To delineate responsibilities to the concerned authority in case of emergency
- Communication
 - With health care personnel for relief and response operations,
 - With patients to alleviate fear and apprehension
 - With general public to alleviate fear and apprehension

24.5 Emergency situations that could occur in a hospital scenario with regard to Biomedical waste would be

24.5.1 Accidental Spills:

- Exposure to body fluid spill
- Chemical spillage
- Mercury Spill
- Any untoward incident during in-house transportation (toppling of the trolley, bags torn open, spill from sharp container) - could be liquid or solid spill

24.5.2 Accidental Exposure

- Injury due to a sharp object / Needle stick injuries
- Accidental exposure to blood and body fluids
- Accidental exposure to chemical spill

24.5.3 Accidental exposure to BMW during in-house transportation

- Toppling of the vehicles
- Tear and leak from the bags during transportation

24.6 Prevention measures

24.6.1 Prevention of liquid/mercury/chemical spills

- Safety signage at strategic locations
- Capacity building of the personnel in handling spills
- Providing leak proof containers
- Collection of waste when the bin is 3/4th full
- Availability of spill kit
- Minimal handling of waste
- Secure sealing of the bags
- Adhering to the standards of bins and liners as stated in BMWM Rules 2016
- Use of PPE during the transportation of waste
- Chemical Data safety sheets of all the chemicals used need to be available and referred in an event of chemical spills



24.6.2 Preventions of injuries/ exposure

- Personnel must use PPE during the transportation of waste
- Disposal of sharps should be done in puncture proof containers
- Provision of needle burners or destroyers or hub cutters
- Collection of waste bags/ bins/ sharp containers should be done when they are $\frac{3}{4}$ filled
- Waste bags/ bins/ sharp containers should be sealed securely and barcoded as per BMW Rules 2016
- Trolleys used for transportation need to be maintained well and ensure smooth running of the trolleys
- Training of Health care workers

24.6.3 Preventive measures for incidences of toppling or leak during transportation

- The bags should be sealed securely
- Sharps should be transported in puncture proof, leak and tamper proof containers
- Personnel involved in transportation should use personal protective equipment
- The trolleys should be made of such material that it withstands the mechanical wear and tear
- Trolley should be designed such that it is easy to load and unload
- Heavy duty wheel caster
- Routing of the waste trolley should be such that there are no physical obstacles in the route taken

24.7 Immediate measures for management in an event

24.7.1 In an event of liquid/mercury/chemical spills

- Cordon off the area
- Communicate to the concerned authority
- Decontamination of the person exposed to spill

- Decontaminate the spill area
- Personnel involved in clean-up operations should don protective clothing

24.7.2 In an event of sharp injuries/ exposure to blood and body fluids

- Clean the wound or exposed area under running water for 10- 15 minutes
- Allow bleeding to occur
- Report injury to infection control nurse/ officer
- Exposed person assessed for exposure to blood borne pathogens such as Hepatitis B and HIV
- Post exposure prophylaxis to be instituted as per NACO guidelines
- Documentation of root cause analysis and steps taken after the injury would help in initiating preventive steps.

p.s. Refer to Occupational safety chapter for further details

24.7.3 In an event of incidence of toppling or leak during transportation

- Cordon off the area
- Communicate the incident to the concerned authority to minimize the exposure to patients/ visitors etc.
- Evacuate the area if required depending on the area affected and contents of the spill
- Clean the spill as per spill protocol
- Decontaminate the persons exposed to the spill (shower)
- Check for exposure to infectious agent and any injuries to the personnel involved in the incident
- Seek immediate medical attention for all those involved
- Assess the situation and if necessary provide Post exposure prophylaxis
- Root cause analysis and action taken has to be documented. Documentation of remedial measures taken would aid in instituting appropriate preventive steps in future
- If it is an accident as defined in BMWM rules, then the same has to be reported to SPCB immediately in Form I



24.8 Summary of spill management / untoward incidents

TABLE 29: SUMMARY OF SPILL MANAGEMENT / UNTOWARD INCIDENTS

Type of waste spill	Immediate response	Follow up	Person in charge
Blood or body fluid spill	<ul style="list-style-type: none"> • Cordon off the area • Limit the spill area • Evacuate if spill is large and if there is a possibility of inhalation of aerosols • Provide first aid for the persons exposed • Follow the steps as mentioned above for cleaning the spill • Disinfect the area using 1-2% Sodium hypochlorite solution 	Follow up of the persons exposed to the agent with post exposure prophylaxis as per NACO guidelines	Infection control officer and waste management officer
Chemical spills	<ul style="list-style-type: none"> • Cordon off the area. • Leave the area. • Go to fresh air area immediately if inhaled any chemical. • Report to the concerned authority • In case of chemical exposure to the eyes, they need to be washed thoroughly. • Depending on the nature of the chemical neutralize the chemical • Persons involved in cleaning should use PPE during the processes • Decontaminate the area 	<p>If eyes are exposed do not apply anything in the eye.</p> <p>Seek medical help if inhaled or swallowed</p>	Waste management officer and safety officer

Type of waste spill	Immediate response	Follow up	Person in charge
Mercury spill	<ul style="list-style-type: none"> •Cordon off the area •Gather the mercury beads •Contain mercury in an appropriate container as mentioned above •Medical assessment for the exposed persons •Decontaminate the area with Sodium this sulphate 	Follow up medical assistance to exposed persons	Waste management officer and safety officer
Any untoward incident during in-house transportation	<ul style="list-style-type: none"> •Cordon off the area •Communicate the incident to the concerned authority •Evacuate the area if required depending on the area affected and contents of the spill •Clean the spill as per spill protocol •Personnel clearing the spill should use PPE before clearing the spill •The spilled material needs to be segregated into appropriate colored labeled and barcoded plastic bags •Decontaminate the area with 1-2% Sodium Hypochlorite •Decontaminate the persons exposed to the spill (shower) 	<ul style="list-style-type: none"> •Check for exposure to infectious agent and any injuries to the personnel involved in the incident •Seek immediate medical attention for all those involved •Assess the situation and if necessary provide Post exposure prophylaxis 	Waste management officer and safety officer

Note: HCFs can prepare separate spill kits for mercury, body fluid and chemical spill kits. HCFs can modify appropriately to suit their requirements



24.9 In Disaster situation

In an event when the HCF is stuck in a disaster situation:

- Adequate facility for storage of biomedical waste should be made available till the systems return back to normal operations.
- Alternate plan for such exigencies need to be thought of before hand
- In an event where the HCF is catering to disaster situation, the quantum of waste generated would be more. Hence the extra amount of waste generated needs adequate facility for storage and disposal. When a storage facility is planned in a HCF these points need to be considered and adequate space and consumables need to be allocated prior.
- If the HCF is providing services to an area affected in a disaster (with in the country) outside the hospital premises, along with medical supplies of drugs and disposables adequate containers for collection of waste need to be supplied. The containers / bins should be colour coded according to BMWM Rules 2016. The minimum four colours bins need to be supplied i.e. yellow, red and white translucent puncture, leak and tamper proof container for sharps; and puncture proof, leak proof boxes or containers with blue colored marking. Arrangements for safe transport of the waste generated also need to be arranged for OR an understanding with the common treatment facility to pick up the waste generated at the point of generation need to be arranged for.

Key Points

- 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

25.1 Introduction:

One of the important components of the project “Environmentally Sound Management of Medical Waste in India” is training of various stakeholders. The important issue of medical waste management would be comprehensively addressed with a long term vision of creating an enlightened creed of eco-sensitive future healthcare professionals. It would necessarily imply targeting all the stakeholders, sensitize and motivate them by training and retraining.

According to BMWM Rules 2016, rule 4 it is the duty of the employer - (g) provide training to all its health care workers and others, involved in handling of biomedical waste at the time of induction and thereafter 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.¹⁰

25.2 Training in Biomedical waste management will:

- Enhance the existing institutional and technical capacity in identified 28 health-care facilities in each of the five selected states.
- Enhance the effectiveness and efficiency of segregation of medical wastes at source which reduces the volume of medical waste and hence, improves the management of waste at CBWTF.
- Help to Develop Standard Protocols for medical waste movement in healthcare facilities from source to established collection points.
- Establish the integrated system for medical waste management and disposal.

Training all levels of health care personnel is important. Systems of biomedical waste management can work smoothly provided there is a critical mass of trained personnel at levels i.e. generators, administrators of a health care facility and waste

handlers. Training of doctors is as important as training for waste handlers. All health care personnel must receive training initially and periodically to update their knowledge.

25.3 Characteristics of trainer¹⁸⁻¹⁹: The trainer should be

- trained in Biomedical waste management
- aware about hazards associated with Biomedical waste management
- aware of the processes involved in Biomedical waste management
- possess the skills for training

25.4 Contents of training¹⁸⁻¹⁹: Contents of the training varies based on the training targeted for different target audience.

i. Contents for Doctors, Nurses and waste managers

- Overview on BMWM Rules 2016 and amendments 2018
- Information and Justification of policy on Biomedical waste
- Information on the policy, guidelines and SOPs of the health care facility
- Information on emergency plans
- Information on processes of management of Biomedical waste
- Roles and responsibilities of each of the personnel in implementing SOPs for management of Biomedical waste in the HCF

ii. Contents for Waste handlers

- Hazards of Biomedical waste management
- Importance of environmentally sound management of Biomedical waste
- Processes of:
 - Segregation
 - Disinfection
 - Transportation
 - Storage
- Use of PPE
- Emergency plan protocol
- Spill management specially blood and body fluid
- Line authority for reporting of chemical spills/ mercury spills or injuries

25.5 Frequency of training:

Frequency of training for different levels of health care personnel can be decided by the respective HCFs. Every Health care personnel needs to be trained at induction and annual as per BMW rules. On job training to be done as and when required especially during monitoring.

25.6 Principles of adult learning:

All trainings whether done for health care personnel or for waste handlers need to be designed in such a way that they follow adult learning principles.²⁴

Principle	Description
Adults are autonomous and self-directed	Adults need to be free to direct their own learning. If the learning is classroom-based, the facilitator must actively involve the participants in the learning process. The facilitators should guide the participants to their own knowledge rather than furnishing them with all of the facts. They should allow the participants to assume responsibility for their learning and engage them in discussions, presentations and group-based tasks.
Adults carry their old and experience	Adults have wealth of life experiences and knowledge which they would have gained over their years of experiences. They must be encouraged to share their knowledge and experiences which will help them participate more and facilitate in active learning.
Adults need learning to be relevant and practical	Adult training will be effective only if trainings are made relevant to day to day activities. The training must provide solutions to their practical problems they face on day to day basis and this will enhance the retention of the information provided.
Adults are goal-oriented	Adults appreciate any training only if they are organised to achieve a particular goal. Clear learning objectives spelt during the beginning of the training programme will be appreciated by the participants and will make learning more relevant.
Adults are problem and application oriented	Adult learners once gained any knowledge or skill would like to experiment and implement immediately at their personal or work life. Preparing action plan and problem solving exercises during the training program will create interest and more involvement.

Principle	Description
Adults are short of time	Adults though would want to learn, time is the constraint. So training programme should be accommodated during their work place. Learning aids and methodology should be planned to suit their pace and convenience. For example, poster display in prominent places or available information easily accessible on website can be readily available.
Adults have different learning styles	A learning style refers to how a person learns, categorizes, and processes new content. Every person is have different style of learning. While some may be visual learners, some may be aural and some may be kinaesthetic learners etc. So while planning a training programme, all these styles should be kept in mind.

25.7 Types of learners: The training programme will be designed and developed to cater to the different learning styles.

Sl. No.	Type of learner	Details	Examples
1.	Visual	Visual learners need to see simple, easy-to-process diagrams or the written word.	<i>PPT, flip chart graphics, Charts, Posters</i>
2.	Aural	Aural learners need to hear something so that it can be processed. They may prefer to read aloud if presented with written material. They enjoy lecture format learning	<i>Interactive lecture session</i>
3.	Tactile	Tactile learners need to do something in order to learn it. They are likely to avoid written instructions and dive right into a hands-on attempt to work it out.	<i>Demonstration Hands on training</i>
4.	Interactive	Interactive learners need to discuss learning concepts. Breakout discussions and Question and answers (Q & A) formats support this type of learning.	<i>Demonstration followed by Q & A (Quiz), Pre-test / Post-test</i>
5.	Kinaesthetic	Kinaesthetic learners learn through movement. Training exercises and role plays help. Giving people the flexibility to stand	<i>Demonstration, Learning by Doing (Spill</i>

Sl. No.	Type of learner	Details	Examples
		and move about the classroom also helps these learners.	<i>management, Hand washing)</i>

Note: Details of training schedule and methodology for conduct of training has been discussed in Trainers Guide

Conclusion: Administrator of the HCF has to plan and implement training programmes for all cadre of health care workers as stated in BMWM Rules 2016.

Key points

- Training of all Health care professional is mandatory
- Documentation and maintaining of records on training is mandated under the BMWM Rules

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ANNEXURES

Annexure 1: WHO Policy Paper on Safe Health- Care Waste Management



SAFE HEALTH-CARE WASTE MANAGEMENT

POLICY PAPER

Unsafe health-care waste management leads to death and disability

Health care activities lead to the production of waste that may lead to adverse health effects. Most of this waste is not more dangerous than regular household waste. However, some types of health-care waste represent a higher risk to health. These include infectious waste (15% to 25% of total health-care waste) among which are sharps waste (1%), body part waste (1%), chemical or pharmaceutical waste (3%), and radioactive and cytotoxic waste or broken thermometers (less than 1%).

Sharps waste, although produced in small quantities, is highly infectious. Poorly managed, they expose health-care workers, waste handlers and the community to infections. Contaminated needles and syringes represent a particular threat and may be scavenged from waste areas and dump sites and be reused. WHO has estimated that, in 2000, injections with contaminated syringes caused:

- 21 million hepatitis B virus (HBV) infections (32% of all new infections);
- Two million hepatitis C virus (HCV) infections (40% of all new infections);
- 260000 HIV infections (5% of all new infections).

Epidemiological studies indicate that a person who experiences one needle-stick injury from a needle used on an infected source patient has risks of 30%, 1.8%, and 0.3% respectively to become infected with HBV, HCV and HIV. In 2002, the results of a WHO assessment conducted in 22 developing countries showed that the proportion of health-care facilities that do not use proper waste disposal methods ranges from 18% to 64%.

Health-care waste management may also represent a risk to health

Health-care waste management options may themselves lead to risks to health and no perfect readily achievable solution to manage health-care waste exists. Health-care waste, whether generated at smaller rural clinics or larger facilities, can be managed where adequate well-operated infrastructures exist. However, the volumes of waste generated within large facilities and targeted public efforts (e.g., immunization campaigns) are more challenging, particularly in developing countries where resources may be limited. In these difficult situations for which waste disposal options are limited, small-scale incinerators have been

used and are still used as an interim solution in less developed and transitional countries. However, small-scale incinerators often operate at temperatures below 800 degrees Celsius. This may lead to the production of dioxins, furans or other toxic pollutants as emissions and/or in bottom/fly ash. Transport to centralised disposal facilities may also produce hazards to health-care handlers, if not safely managed.

Balancing risks to make sound policy decisions in health-care waste management

In addition to risks to health from infectious agents, long-term low-level exposure of humans to dioxins and furans may lead to impairment of the immune system, and impaired development of the nervous system, the endocrine system and the reproductive functions. Short-term high level exposure may result in skin lesions and altered liver function.

The International Agency for Research on Cancer (IARC) classifies dioxins as a “known human carcinogen”. However, most of the evidence documenting the toxicity of dioxins and furans is based upon studies of populations that have been exposed to high concentrations of dioxins either occupationally or through industrial accidents. There is little evidence to determine whether chronic low-level exposure to dioxins and furans causes cancer in humans. Overall, it is not possible to estimate the global burden of diseases from exposure to dioxins and furans because of large areas of uncertainty.

In the last 10 years, the enforcement of stricter emission standards for dioxins and furans by many countries significantly reduced the release of these substances into the environment¹.

In several Western European countries where tight emissions restrictions were adopted in the late 1980s, dioxin and furan concentrations in many types of food (including breast milk) have decreased sharply.

WHO has established tolerable intake limits for dioxins and furans, but not for emissions. The latter must be set within the national context.

Guiding policy principles

In view of the challenge represented by health-care waste and its management, WHO activities are oriented by the following guiding principles:

- preventing the health risks associated with exposure to health-care waste for both health workers and the public by promoting environmentally sound management policies for health-care waste;
- supporting global efforts to reduce the amount of noxious emissions released into the atmosphere to reduce disease and defer the onset of global change;
- supporting the Stockholm Convention on Persistent Organic Pollutants(POPs);

- supporting the Basel Convention on hazardous and other waste; and reducing the exposure to toxic pollutants associated with the combustion process through the promotion of appropriate practices for high temperature incineration.

Strategy

To better understand the problem of health-care waste management, WHO guidance recommends that countries conduct assessments prior to any decision as to which health-care management methods be chosen. Tools are available to assist with the assessment and decision-making process so that appropriate policies lead to the choice of adapted technologies. WHO proposes to work in collaboration with countries through the following strategies:

Short-term

- Production of all syringe components made of the same plastic to facilitate recycling;
- Selection of PVC-free medical devices;
- Identification and development of recycling options wherever possible (e.g.: for plastic, glass, etc.); and
- Research and promotion on new technology or alternative to small-scale incineration;
- Until countries in transition and developing countries have access to health-care waste management options that are safer to the environment and health, incineration may be an acceptable response when used appropriately. Key elements of appropriate operation of incinerators include effective waste reduction and waste segregation, placing incinerators away from populated areas, satisfactory engineered design, construction following appropriate dimensional plans, proper operation, periodic maintenance, and staff training and management.

Medium-term

- Further efforts to reduce the number of unnecessary injections to reduce the amount of hazardous health-care waste that needs to be treated;
- Research in to the health effect of chronic exposure to low levels of dioxin and furan
- Risk assessment to compare the health risks associated with: (1) incineration; and (2) exposure to health-care waste.

Long-term:

- Effective, scaled-up promotion of non-incineration technologies for the final disposal of health-care waste to prevent the disease burden from: a. Unsafe health-care waste management and b. exposure to dioxins and furans;



- Support to countries in developing a national guidance manual for sound management of health-care waste; support to countries in the development and implementation of a national plan, policies and legislation on health-care waste; promotion of the principles of environmentally sound management of health-care waste asset out in the Basel Convention; and support to allocate human and financial resources to safely manage health-care waste in countries
- ¹ Standards: 0.1 ng TEQ/m³ (Toxicity Equivalence) in Europe to 0.1 ng to 5 ng TEQ/m³ in Japan according to incinerator capacity.

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MERCURY IN HEALTH CARE

POLICY PAPER

Background

Mercury is a naturally occurring heavy metal. At ambient temperature and pressure, mercury is a silvery-white liquid that readily vaporizes and may stay in the atmosphere for up to a year. When released to the air, mercury is transported and deposited globally. Mercury ultimately accumulates in lake bottom sediments, where it is transformed into its more toxic organic form, methyl mercury, which accumulates in fish tissue.

Mercury is highly toxic, especially when metabolized into methyl mercury. It may be fatal if inhaled and harmful if absorbed through the skin. Around 80% of the inhaled mercury vapour is absorbed in the blood through the lungs. It may cause harmful effects to the nervous, digestive, respiratory, immune systems and to the kidneys, besides causing lung damage. Adverse health effects from mercury exposure can be: tremors, impaired vision and hearing, paralysis, insomnia, emotional instability, developmental deficits during fetal development, and attention deficit and developmental delays during childhood. Recent studies suggest that mercury may have no threshold below which some adverse effects do not occur.

Contribution from the health-care sector and Regulation

Health-care facilities are one of the main sources of mercury release into the atmosphere because of emissions from the incineration of medical waste. The Environment Minister of the Canadian province of Ontario declared on December 2002 that emissions from incinerators were the fourth-largest source of mercury.

In the United States, according to US Environmental Protection Agency (EPA) in a 1997 report (<http://www.epa.gov/ttncaaa1/t3/reports/volume2.pdf>), medical waste incinerators may have been responsible for as much as 10% of all mercury air releases.

Health-care facilities are also responsible for mercury pollution taking place in water bodies from the release of untreated wastewater. These health-care facilities may also have been responsible for as much as 5% of all mercury releases in waste water. Environment Canada estimates that more than one-third of the mercury load in sewage systems is due to dental practice.

Dental amalgam is the most commonly used dental filling material. It is a mixture of mercury and a metal alloy. The normal composition is 45-55% mercury; approximately 30% silver and



other metals such as copper, tin and zinc. In 1991, the World Health Organization confirmed that mercury contained in dental amalgam is the greatest source of mercury vapour in non-industrialized settings, exposing the concerned population to mercury levels significantly exceeding those set for food and for air. (Source: <http://www.who.int/ipcs/publications/cicad/en/cicad50.pdf>)

According to a report submitted to the OSPAR Commission (cooperation on the protection of the marine environment of the North-East Atlantic), in the United Kingdom, annually 7.41 tonnes of mercury from dental amalgam are discharged to the sewer, atmosphere or land, with another 11.5 tonnes sent for recycling or disposed with the clinical waste stream. Together, mercury contained in dental amalgam and in laboratory and medical devices, account for about 53% of the total mercury emissions.

Waste incineration and crematoria are also listed as major sources of mercury emissions. Many countries, such as Armenia, Cameroon, Ghana, Honduras, Pakistan, and Peru, recognize the contributions from hospital thermometers, dental amalgams, hospital waste and/or medical waste incinerators but lack quantitative data. Despite the lack of data, there is good reason to believe that mercury releases from the health sector in general are substantial.

Some countries have restricted the use of mercury thermometers or have banned them without prescription. A variety of associations have adopted resolutions encouraging physicians and hospitals to reduce and eliminate their use of mercury containing equipment.

Occupational health hazard

The most common potential mode of occupational exposure to mercury is via inhalation of liquid mercury vapours. If not cleaned up properly, spills of even small amounts of mercury, such as from breakage of thermometers, can contaminate indoor air above recommended limits and lead to serious health consequences. Since mercury vapour is odourless and colourless, people can breathe mercury vapour and not know it. For liquid metallic mercury, inhalation is the route of exposure that poses the greatest health risk.

A variety of studies demonstrate that mercury containing health-care equipment will invariably break. Small spills of elemental mercury on a smooth, non-porous surface can be safely and easily cleaned up with proper techniques. However, beads of mercury can settle into cracks or cling to porous materials like carpet, fabric, or wood, making the mercury extremely difficult to remove. Spilled mercury can also be tracked on footwear. Inadequate cleaning and disposal may expose already compromised patients and health-care staff to potentially dangerous exposures.

Alternatives

A recent study found that at least one manufacturer of the non-mercury alternative was identified where the cost differences between mercury and non-mercury technologies were minimal. The research findings suggest that many non-mercury alternatives are available to address the full range of functions required by consumer products. For health care, these include blood pressure devices, gastrointestinal devices, thermometers, barometers, and in other studies, include the use of mercury fixatives uses in labs.

Both mercury and aneroid sphygmomanometers have been in use for about 100 years, and when working properly, either gives accurate results.

Of all mercury instruments used in health care, the largest amount of mercury is used in mercury sphygmomanometers (80 to 100g/unit), and their widespread use, collectively make them one of the largest mercury reservoirs in the health-care setting. By choosing a mercury-free alternative a health-care institution can make a tremendous impact in reducing the potential for mercury exposure to patients, staff and the environment. Aneroid sphygmomanometers provide accurate pressure measurements when a proper maintenance protocol is followed. It is important to recognize that no matter what type of blood pressure measurement device is used both aneroid and mercury sphygmomanometers must be checked regularly in order to avoid errors in blood pressure measurement and consequently the diagnosis and treatment of hypertension.

International Conventions

The United Nations Environment Programme Governing Council concluded that there is sufficient evidence of significant global adverse impacts from mercury to warrant further international action to reduce the risks to humans and wild life from the release of mercury to the environment. The UNEP Governing Council decided that national, regional and global actions should be initiated as soon as possible and urged all countries to adopt goals and take actions, as appropriate, to identify populations at risk and to reduce human-generated releases.

Strategy

To understand better the problem of mercury in health-care sector, it is recommended that countries conduct assessments of current mercury usage and health-care waste management programs. WHO proposes to work in collaboration with countries through the following strategic steps.

Short-term: Develop mercury clean up and waste handling and storage procedures. Until countries in transition and developing countries have access to mercury free alternatives it is imperative that safe handling procedures be instituted which minimize and eliminate patient, occupational, and community exposures. Proper procedures should include staff training, educational programs, protective gear, proper spill clean-up response, engineered storage



facilities and appropriate waste storage containment, Countries that have access to affordable alternatives should develop and implement plans to reduce the use of mercury equipment and replace them with mercury-free alternatives. Before final replacement has taken place, and to ensure that new devices conform with recommended validation protocols, health-care facilities will need to keep mercury as the “gold” standard to ensure proper calibration of mercury sphygmomanometers.

Medium-term: Increase efforts to reduce the number of unnecessary use of mercury equipment. Hospitals should inventory their use of mercury. This inventory should be categorized into immediately replaceable and gradually replaceable.

Replaced devices should be taken back by the manufacturer or taken back by the alternative equipment provider.

Progressively discourage the import and sale of mercury containing health-care devices and mercury use in health-care settings, also using global multi-lateral environmental agreements to this end. Provide support to countries to make sure that the recovered mercury equipment is not pushed back in the supply chain.

Long-term: Support a ban for use of mercury containing devices and effectively promote the use of mercury free alternatives. Support countries in developing a national guidance manual for sound management of health-care mercury waste. Support countries in the development and implementation of a national plan, policies and legislation on mercury health-care waste. Promote the principles of environmentally sound management of health-care waste containing mercury, as set out in the UN Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (www.basel.int/). Support the allocation of human and financial resources to ensure procurement of mercury free alternatives and a sound management of health-care waste containing mercury.

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Annexure 3: Injection Safety Policy and Global Campaign by WHO

All of us, at some point in our lives, will have an injection to retain or restore good health. But sometimes injections that are intended to promote health do the opposite. This happens when they are given in an unsafe way - using the same needle or syringe to give injections to more than one person. Practices like this can lead to the transmission of life-threatening infections.

According to a new study, unsafe injections are responsible for as many as 33 800 HIV infections, 1.7 million hepatitis B infections and 315 000 hepatitis C infections annually. Both patients and health workers are at risk through needle injury.

Towards safe injections for all

WHO and close partners – including the Safe Injection Global Network (SIGN), UNICEF and GAVI, the Vaccine Alliance – have been working actively together for more than a decade to promote safe injection practices. Educating policy makers and health workers on the critical importance of sterile equipment is key. The group’s initial push in 1999 focused strongly on spurring countries to use only auto-disable syringes for vaccinating children. Now the spotlight is on the risks associated with injections into muscle (intramuscular) or skin (subcutaneous or intradermal) to treat medical conditions; and how to make them safer through education on safe procedures, elimination of unnecessary injections and better design of equipment.

Breakthrough: The new smart syringes

The surest way to protect against unsafe injections is to use injection devices that have been engineered so they cannot be re-used and don’t lead to accidental needle stick injuries among health workers.

Re-use prevention features are essentially the same as the auto-disable features designed for immunization of a single child. The main difference is that syringes designed for delivering medicines allow the health worker to adjust the dose as needed and to move the plunger twice when it is necessary to mix two different medicines in one syringe or for the reconstitution of vaccines and medicines where appropriate. Some models include a weak spot in the plunger that causes it to break if the user attempts to pull back on the plunger after the injection. Others have a metal clip that blocks the plunger so it cannot be moved back while in others the needle retracts into the syringe barrel at the end of the injection.

Syringes are also being engineered with features to protect health workers from “needle stick” injuries and resulting infections. A sheath or hood slides over the needle after the



injection is completed to protect the user from being injured accidentally by the needle. These syringes also generally have a re-use prevention feature.

Stakeholder support: What needs to happen, who needs to do it

The injection safety policy and global campaign is a three to five year initiative that engages many public and private sector stakeholders such as Ministries of Health, international donor programmes, industry players and umbrella organizations representing injection device manufacturers and health care workers. Some critical goals of the initiative include:

Governments

By 2020 transition to the exclusive use, where appropriate, of safety-engineered injection devices with re-use prevention and sharps (needle) injury prevention. These devices should meet WHO quality standards.

Set health-system-wide policies and standards for procurement, use and safe disposal of disposable syringes in situations where they remain necessary, including in syringe programmes for people who inject drugs.

Develop an implementation strategy for safety syringes' procurement, training and education of health workers and sound waste management. Establish a targeted communications programme and a framework for evaluating overall progress.

Donors and development partners

Only fund procurement of safety-engineered injection devices in all projects that include administration of injectable medicines.

Provide funding for ancillary needs, including appropriate quantities of single-dose diluents and safety boxes, sharps waste management and health worker training.

Manufacturers

Begin or expand production as soon as possible of safety-engineered injection devices while maintaining sufficient production of single-use disposable syringes.

Seek WHO Performance, Quality and Safety prequalification for their products.

WHO is beginning to pilot test elements of the injection safety policy and global campaign throughout 2015 and will announce and integrate lessons learned.

Annexure 4: Schedule I of BMW Rules 2016 - Segregation

Category	Type of Waste	Type of Bag/ Container to be used	Treatment and Disposal options
Yellow	(a) Human Anatomical Waste <ul style="list-style-type: none"> • Human tissues • Organs • Body parts • foetus below the viability period 	<ul style="list-style-type: none"> • Yellow coloured non-chlorinated plastic bags 	<ul style="list-style-type: none"> • Incineration or Plasma Pyrolysis or deep burial*
	(b) Animal Anatomical Waste <ul style="list-style-type: none"> • Experimental animal carcasses • Body parts • Organs • Tissues • Waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses. 		Incineration or Plasma Pyrolysis or deep burial*
	(c) Soiled Waste <ul style="list-style-type: none"> • Items contaminated with blood, body fluids like dressings • plaster casts 		In absence of above facilities, autoclaving or micro-waving/



Category	Type of Waste	Type of Bag/ Container to be used	Treatment and Disposal options
	<ul style="list-style-type: none"> • cotton swabs • bags containing residual or discarded blood and blood components 		hydroclaving followed by shredding or mutilation or combination of sterilization and shredding.
	<p>(d) Expired or Discarded Medicines</p> <ul style="list-style-type: none"> • 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	<p><u>Expired cytotoxic drugs and items contaminated with cytotoxic drugs</u></p> <ul style="list-style-type: none"> • to be returned back to the manufacturer or supplier for incineration at temperature >1200 °C • or to CBWTF or HWTSDF for incineration at >1200 °C • Or Encapsulation • Or Plasma Pyrolysis at >1200 °C <p><u>All other discarded medicines shall</u></p> <ul style="list-style-type: none"> • be either sent back to manufacturer

Category	Type of Waste	Type of Bag/ Container to be used	Treatment and Disposal options
			<ul style="list-style-type: none"> • or disposed by incineration
	(e) Chemical Waste <ul style="list-style-type: none"> • Chemicals used in production of biological • Used or discarded disinfectants. 	Yellow coloured containers or non-chlorinated plastic bags	Incineration or Plasma Pyrolysis or Encapsulation in HWTSDF
	(f) Chemical Liquid Waste <ul style="list-style-type: none"> • Liquid waste generated due to use of chemicals in production of biological • 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 <ul style="list-style-type: none"> • Shall be pre-treated before mixing with other wastewater. • The combined discharge shall conform to the discharge norms given in Schedule III.



Category	Type of Waste	Type of Bag/ Container to be used	Treatment and Disposal options
	(g) Discarded linen, mattresses, beddings contaminated with blood or body fluid, routine mask and gown	Non-chlorinated yellow plastic bags or suitable packing material	<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Pre-treat to sterilize with non-chlorinated chemicals on-site “as per World Health Organisation guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and thereafter sent for incineration • Autoclaving / microwaving / Hydroclaving And thereafter for Incineration.

Category	Type of Waste	Type of Bag/ Container to be used	Treatment and Disposal options
Red	Contaminated Waste (Recyclable) <ol style="list-style-type: none"> 1. Tubing 2. IV bottles 3. IV tubes and sets 4. Catheters 5. Urine bags 6. Syringes (without needles and fixed needle syringes) 7. Vaccutainers with their needles cut 8. 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) <ol style="list-style-type: none"> 1. Needles 2. Syringes with fixed needles, 3. needles from needle tip cutter or burner 4. Scalpels 5. Blades 	Puncture proof, Leak proof, tamper proof containers	Autoclaving followed by <ul style="list-style-type: none"> • Shredding • or mutilation • or encapsulation in metal container • or cement concrete



Category	Type of Waste	Type of Bag/ Container to be used	Treatment and Disposal options
	6. Any other contaminated sharp object that may cause puncture and cuts		
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 boxes or containers with blue colored marking	<ul style="list-style-type: none"> • Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium Hypochlorite treatment)
	(b) Metallic Body Implants	Puncture proof and leak proof boxes or containers with blue colored marking	<ul style="list-style-type: none"> • or through autoclaving or • or microwaving • or hydroclaving and then sent for recycling

Annexure 5: Difference Between Microwave and Autoclave

KEY PARAMETERS	MICROWAVE	AUTOCLAVE
Cost analysis		
1) Installation cost	Very Low	High
2) Building modification cost	Nil	High
3) Stand by cost when machine is not in operation.	Nil	High
4) Steam generation cost.	Nil	High
5) Steam generation time	Not Required	Required (1 hour minimum)
6) Cost of start-up per cycle	Nil	High
7) Time to start up	Nil	Required
8) Steam Generator / Boiler	Nil	Required
9) Cycle time	Not Required	1-2 hours
10) RO Plant (Water Treatment Plant)	45 minutes	Required
	Not Required	



KEY PARAMETERS	MICROWAVE	AUTOCLAVE
<i>Energy</i>		
i) Electrical Energy Consumption	3.5 Kwh maximum	18 Kwh onwards
Cost of energy per hr. (Rs.4.50/Kwh)	Rs.16	Rs. 81
Cost of energy per day (8 hrs. shift)	Rs.128	Rs. 648
Cost of energy per year (350 days)		
On single shift basis	Rs.44,800	Rs. 2,26,800
On double shift basis	Rs.99,600	Rs. 4,53,600
Saving :- one year	Rs.1,82,000+ Steam Cost	Nil
Five Years	Rs.9,10,000+ Steam Cost	
Ten Years	Rs.18,20,000 + Steam Cost	Nil
ii) Steam Energy	Not required	Nil
		Very high investment (depends on capacity)

KEY PARAMETERS	MICROWAVE	AUTOCLAVE
<i>Space required</i>		
Space occupied	70 sq. ft.	1000 sq. ft. (depends on the model-can be much higher)
Cost of space including land cost (@ Rs. 3000 per sq. ft.)	Rs. 2,10,000	Rs. 30,00,000
<i>Labour cost</i>		
Cost of labour	Skilled operator required	Special Trained & skilled operator required
<i>Daily maintenance</i>		
Cleaning of Device	Easy (5 minutes)	30 minutes (approx.)
Disinfection of chamber after ever cycle	Not required	Not Required
<i>Estimated cost of spare parts</i>		
Cost of spare parts	Low (Cost of spare parts could be some electronic circuits as the system is totally electronic)	High (Cost of spare parts for autoclaves includes valves Gaskets, Electronic Accessories etc.)
<i>Environment/treatment parameters</i>		
Level of disinfection	As per CPCB standards	As per CPCB standards
Development of aerosols	None	

KEY PARAMETERS	MICROWAVE	AUTOCLAVE
Exhaust air	Pollution free & safe	Yes, air needs removal prior to disinfection cycle
Exhaust water	Pollution free & safe	Unknown
Development of smell	Negligible	Unknown
Masking of smell	Complete with deodorizers	Odorous
		No provision
<i>Handling</i>		
	Easy	More cumbersome
<i>Others</i>		
Basic operating system	Electronic	Electro-mechanical
Change of site	Easy (No cost)	Difficult
Extension of capacity	Easy	More costly

Annexure 6: Checklist for Assessing the CBWTF

Name of the CBWTF :		
Address		
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 :
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: Any other:



Operational and Technical Staff :

<p>Treatment facilities Available</p>	<ul style="list-style-type: none"> • Incineration • Shredder • Hydroclave • Autoclave (pre vacuum horizontal feeding) • Microwave 	<ul style="list-style-type: none"> • Sharp pit • Encapsulation • Effluent treatment Plant • Facilities for bin washing/ floor washing/vehicle washing • Any other
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Records of annual reports

<p>Records of receipt of wastes in the CBWTF</p>	<ul style="list-style-type: none"> • Waste collection date • Name of the health care unit • Waste category • Quantity of waste • Vehicle number • Receiving date
<p>Records of Treated waste which is removed from CBWTF</p>	<ul style="list-style-type: none"> • Date • Treated waste type • Quantity • Vehicle Number • Location of disposal
<p>Log book maintained for each treatment equipment</p>	<ul style="list-style-type: none"> • Weight of batch • Categories of waste • Time date and duration of treatment cycle • Total hours of operation

Site records	<ul style="list-style-type: none"> • 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 			
Maintain records of the transport vehicle as per State transport organization				
Records of occupational safety	<table border="1"> <tr> <td data-bbox="593 513 1709 600">Availability of PPE (heavy duty rubber gloves, mask, apron and boots)</td> </tr> <tr> <td data-bbox="593 601 1709 687">Use of personal protective equipment</td> </tr> <tr> <td data-bbox="593 689 1709 783">Immunization of the waste handlers (Hepatitis B, TT)</td> </tr> </table>	Availability of PPE (heavy duty rubber gloves, mask, apron and boots)	Use of personal protective equipment	Immunization of the waste handlers (Hepatitis B, TT)
Availability of PPE (heavy duty rubber gloves, mask, apron and boots)				
Use of personal protective equipment				
Immunization of the waste handlers (Hepatitis B, TT)				
Autoclave records	<ul style="list-style-type: none"> - Type of autoclave used (with company name and year of purchase) - Availability of graphic/Computer recording devices - Time, Temperature & Pressure reached during the autoclave process 			
Records of Validation test	Spore testing			
Maintain record of storage facilities in the CBWTF				



Annexure 7: Action plan

Areas that need attention	Action Needed	Resources Needed	Persons responsible	Time frame
Conducting a waste audit	<ul style="list-style-type: none"> To conduct waste audit using the survey proforma provided Gap analysis and delineate the follow up actions required Identify the training needs and training requirements 	<p>Survey format</p> <p>Weighing machine</p>	Identify the persons responsible in their respective HCF viz. Nursing supervisor/ nodal officer for waste management/ Infection control nurse	One week
Developing a model demonstration site	<ul style="list-style-type: none"> Based on waste audit identify the demonstration site (Preferably a site where all four categories of waste is generated) Based on the quantum and category of waste generated, place appropriate sized, coloured and labelled waste bins Display Segregation chart, SOP and IEC materials Place injury and waste management registers for documentation. Implement SOP 	<ul style="list-style-type: none"> Appropriate colour coded bins and liners Segregation chart Standard Operating Procedures (SOP) chart IEC materials Registers for documentation 	<ul style="list-style-type: none"> Identify person responsible Nursing personnel in charge of the identified demonstration site 	1 month

Areas that need attention	Action Needed	Resources Needed	Persons responsible	Time frame
Capacity building	<ul style="list-style-type: none"> Identify the training needs and training requirements based on waste audit conducted Draw up two training schedules, one for doctors & nurses and the other for waste handlers Identify the resource personnel Identify the trainees Date, venue, time and number of trainees per batch 	<ul style="list-style-type: none"> Venue Audio Visual aids Training materials Resource persons 	Health care facility in charge (Medical officer/ Medical Superintend/ Nursing Superintend/ Infection control officer/ Nodal person for waste management)	One month
Segregation and containment	<ul style="list-style-type: none"> Identify points of generation Based on the quantum and category of waste generated, indent and place appropriate sized, coloured and labelled waste bins Display Segregation chart, SOP and IEC materials Place injury and waste management registers for documentation. Implement SOP 	<ul style="list-style-type: none"> Appropriate colour coded bins and liners Segregation chart Standard Operating Procedures (SOP) chart IEC materials Registers for documentation 	<ul style="list-style-type: none"> Nursing personnel in charge of the respective identified points of generation 	One month



Areas that need attention	Action Needed	Resources Needed	Persons responsible	Time frame
Disinfection	<ul style="list-style-type: none"> Identify the items to be disinfected at each of the points of generation as per the BMWM Rules 2016 Discard the used disinfectant for every shift. Ensure adequate contact period (20 minutes) Ensure the use of appropriate Personal protective equipment like gloves and goggles during the process of disinfection 	<ul style="list-style-type: none"> 1-2% Sodium hypochlorite solution Appropriate personal protective equipment Adequate size of plastic container for disinfection 	Nursing personnel in charge of the respective identified points of generation	Two weeks
Transportation	<ul style="list-style-type: none"> Identify the route within the health care facility from points of generation to storage to avoid high risk areas. Route should be from clean area to dirty area Determine the frequency and time at which waste is transported to interim storage area Mode of transport: preferably closed containers. Ensure segregation is maintained during transportation 	<ul style="list-style-type: none"> Get secured trolley or large bins – portable (with wheels) PPE during transportation 	Waste handler	2 months

Areas that need attention	Action Needed	Resources Needed	Persons responsible	Time frame
Interim storage area	<ul style="list-style-type: none"> Identify the storage area that is away from the health care facility Storage area to be need to be accessible to authorized personnel only Floor of the storage area should be impermeable Facilities for cleaning, fire extinguishing and spill management should be present in storage area Segregation should be maintained in the storage area till it is handed over to treatment facility 	<ul style="list-style-type: none"> Physical facility with adequate lighting and ventilation Personal protective equipment Other equipment as deemed fit 	<p>Hospital engineer/ Nursing superintendent</p> <p>Waste handler</p>	6 months
Final disposal	<ul style="list-style-type: none"> Hand over waste to common treatment facility (CBWTF) In the absence of CBWTF facility within a distance of 75 Kms, onsite treatment facility can be established after obtaining authorization from State Pollution control board 	<ul style="list-style-type: none"> MOU with CBWTF On site treatment facilities complying with BMWM Rules 2016 	Medical superintend / Administrators	With immediate effect



Areas that need attention	Action Needed	Resources Needed	Persons responsible	Time frame
Committees	<ul style="list-style-type: none"> Formulate Infection Control Committee/ Waste management committee Formulate the scope, roles and responsibilities of the committee Formulate policies for the hospital pertaining to infection control, waste management and occupational safety Identify the documents that needs to be maintained 	Staff from different departments of Hospital	Chief Hospital administrator	1 month
Documentation	<ul style="list-style-type: none"> To maintain registers at all points of generation 	<ul style="list-style-type: none"> Registers for recording 	Nursing superintendent/ administrator/ and nursing personnel at each points of generation	1 month
Occupational safety	<ul style="list-style-type: none"> Identify the areas of high risk Implement health care facility's policy on occupational safety. Implement policy on PEP Ensure PPE 	<ul style="list-style-type: none"> PPE Vaccines for as per the policy on PEP and occupational safety 	Chief administrator of the hospital	2 months

Areas that need attention	Action Needed	Resources Needed	Persons responsible	Time frame
Monitoring	<ul style="list-style-type: none"> Identify the monitoring team Identify the high risk areas to be monitored Identify the frequency with which monitoring is done Identify the hierarchy of flow of follow up actions 	<ul style="list-style-type: none"> Monitoring formats Monitoring teams 	<p>Committees can identify the monitoring teams.</p> <p>A combination of staff nurse and Doctor would be preferable</p>	Ongoing activity



Annexure 8: Daily monitoring Checklist

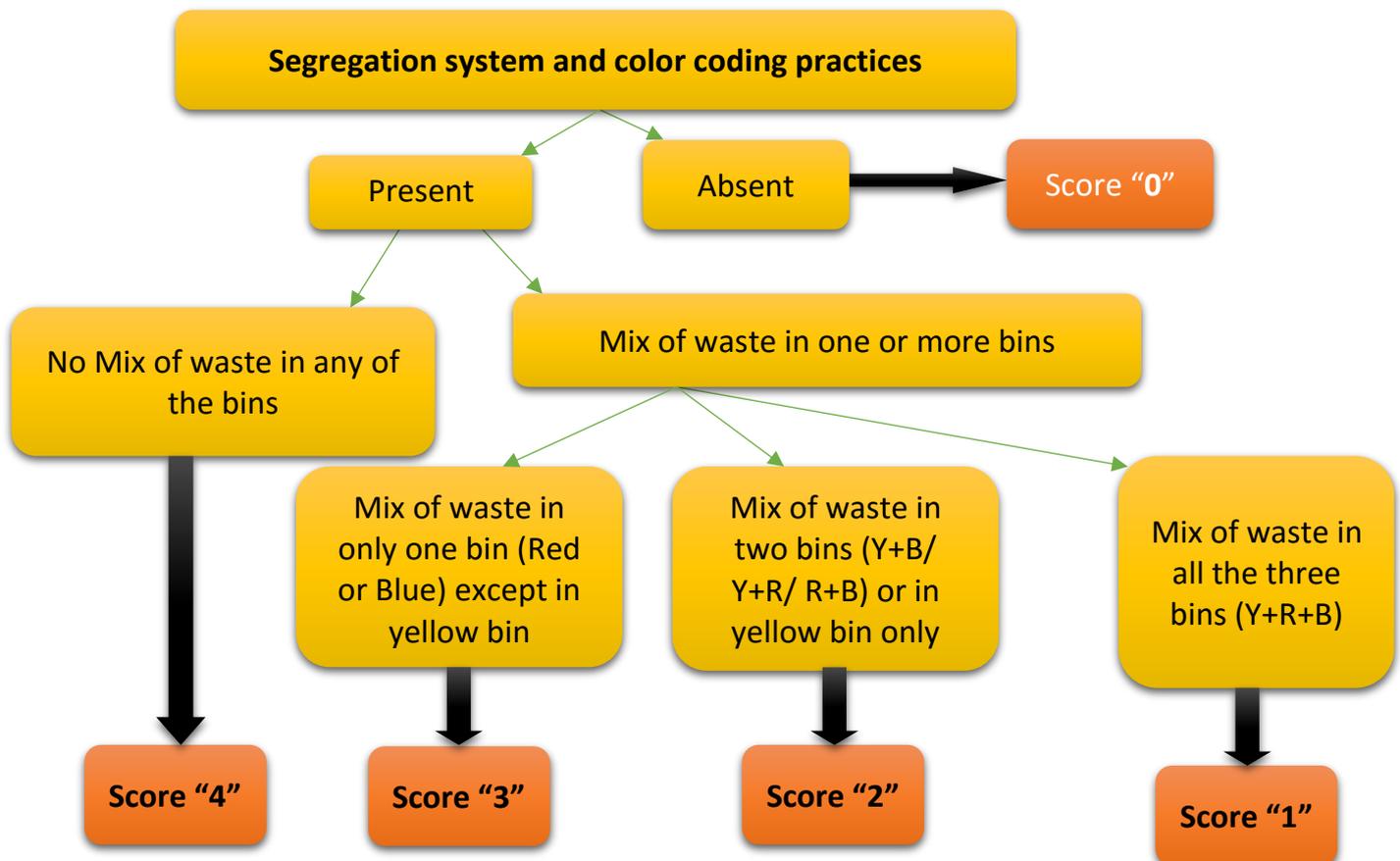
Sl no.	Date	Yellow Bin		Red Bin		Blue Bin		Sharp Container		Score out of 4
		Proper	Improper	Proper	Improper	Proper	Improper	Proper	Improper	
1										
2										
3										
4										
5										
-										
-										
-										
-										
-										
-										

Annexure 9: Monthly Monitoring Checklist

No.	Locations evaluated	
1		
2		
3		
4		
5		

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

Flow Chart for segregation score



A. Segregation Practices:

Sl no	Locations evaluated	1	2	3	4	5
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	1	2	3	4	5
1.	Is sharps contained in puncture proof container (Yes =1 No = 0)					
2.	Is the sharp container overfilled during your visit (YES =1 No=0)					

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

Sl No.	Worker's safety	1	2	3	4	5
1.	Are trained to use PPE (Yes =1. No -=0)					
3.	Are supplied with necessary PPE (Yes =1. No -=0)					
4.	During the visit, were they using PPE while handling waste (Yes =1. No -=0)					

D. Record maintenance

Sl No.	Record maintenance	1	2	3	4	5
1.	Are records in waste management register updated till date (Yes =1. No =0)					
2.	Are records in injury register updated till date (Yes =1. No =0)					
3.	In the event of an injury has it been informed to ICN (Yes =1. No =0)					

E. Other observations

Sl No.	Other observations	1	2	3	4	5
1.	Display of SOP at strategic locations (Yes =1. No =0)					
2.	Spill kit present (Yes =1. No =0)					

F. Statistics:

No.		1	2	3	4	5
	No. of spills in last one month					

G. Non compliances:

Non compliances	1	2	3	4	5
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
<ul style="list-style-type: none"> • Colour coded bins/liners/exclusive bins (with lids) present on observation • Segregation of waste is done as per color code specified in BMWM Rules • No mix at all in any of the bins 	<p>Segregation practice present and highly satisfactory</p>	<p>4</p>
<ul style="list-style-type: none"> • Colour coded bins/liners/exclusive bins present on observation • Waste other than the specified category present in one bin (other than yellow bin). 	<p>Segregation practice present & satisfactory</p>	<p>3</p>
<ul style="list-style-type: none"> • Colour coded bins/liners/exclusive bins present on observation • Waste other than the specified category present in yellow only or/+ red or blue bin. 	<p>Segregation practice present but incomplete</p>	<p>2</p>
<ul style="list-style-type: none"> • 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 	<p>Segregation practice present but not satisfactory</p>	<p>1</p>
<ul style="list-style-type: none"> • No exclusive bins for segregation. Complete mix • All waste dumped with no criteria or classification for segregation in only one bin. 	<p>No segregation practices</p>	<p>0</p>

Annexure 10: Waste Generation Register

Sample of records to be maintained in the waste register																
Date	Time	Infected waste (yellow)		Expired/discarded Drugs (yellow) Cytotoxic drugs		Plastic waste (red)		Sharps (white)		Intact glass waste (blue)		Sign of ward sister	Sign of housekeeping staff	Name of Supervisor in collection centre	Total number of bags	Total quantity in kgs
		No. of bags	Wt in Kgs	No. of bags	Wt. in Kgs	No. of bags	Wt. in Kgs	No. of cans	Wt. in Kgs	No. of boxes	Wt. in Kgs					

Annexure 11: Spill Register

(For any Blood or any body fluid, Chemicals, Cytotoxic material, Mercury)

Example of spill register					
Serial no.	Date and time	Location of spill	Type of spilled material	Action taken and time	Signature of staff in charge

Annexure 12: Injury Register

Example of injury register								
Sl.no.	Date	Name	Age	Sex	Designation	Type of injury	Sign of ward I/C	Sign of ICN / Nodal Officer

Annexure 13: Investigation and Follow Up Schedule For Injuries

Name :	Date :
Age:	Sex :
Time of injury :	Time of reporting:
Work area where exposure occurred:	
Nature of injury:	How did it happen:
Patients HIV Status:	Patients HBsAg Status:
Type of exposure (blood filled device, body or blood fluid exposure, body part exposed, type of device)	
Investigations done – HIV , HBsAg, HCV	
Time of PEP given	Follow up dates for treating and testing

Annexure 14: Documentation for In- house Transportation (within HCF)

SI no.	Date	Time	Location	Yellow bags		Red bags		Sharps container		Boxes or containers with blue colored marking		Sign of ward sister	Sign of housekeeping staff	Name of Supervisor in collection centre	Total quantity in kgs	Any incidents of spill	Any incidents of injury
				No.	Weight (kg)	No.	Weight (kg)	No.	Weight (kg)	No.	Weight (kg)						



Annexure 15: Documentation for Transportation to CBWTF (Off-site)

There are four copies of the signed consignment note:

- one for the generator
- one for the transport entity
- one for the treatment entity
- one for the relevant regulatory authority.

Daily Consignment note

Date of collection: (Day, Month, Year): _____		
Consignor (generator) – name and address_: _____		
Waste carrier – name and address: _____		
Date of receipt: (Day, Month, Year) _____		
Consignee (treatment site) – name and address: _____		
Waste description:		
Sl. No. and type packaging Proper shipping name Gross weight (kg)		
I hereby declare that the contents of the consignment are fully and accurately described above all respects in proper condition according to applicable international and national governmental regulations. I declare that all of the applicable requirements have been met.		
_____ Signature Consignor (Generator)	_____ Signature Waste Carrier (Transport)	_____ Signature Consignee (Treatment Site)

Emergency response intervention cards (ERI Cards or ERICs) kept inside the driver's cab provide guidance on initial actions for fire crews, because they are often the first to arrive at the scene of a hazardous waste transport accident. These cards provide reliable product-specific emergency information that otherwise may not be accessible immediately.

Annexure 16: Health Examination Record

Sample of records of Annual health examination							
Sl no	Date of examination	Name of the Health personnel	Designation	Name of the examining Physician	Summary of the clinical findings	Advice	Seal and Signature of the Physician with registration number

Annexure 17: Immunization Records

Immunization of health care personnel in the HCF (doctors, nurses, lab technicians, lab workers, waste handlers)

Sample of records of immunization of health personnel									
Sl no	Name	Designation	Name of vaccine	Dose		Dose		Dose	
				First Dose	Second dose	Booster dose			
			TT	Due on	Given on	Due on	Given on	Due on	Given on
				Hepatitis B	First Dose		Second dose		Third dose
			Due on		Given on	Due on	Given on	Due on	Given on

Sample of consolidated annual records of immunization of health personnel						
Sl. No	Date of immunization	No of Doctors	No of Nurses	No of Lab workers	No of Waste handlers	Total

Annexure 18: Documentation of Training

Training system and documentation (names of trained staff, job descriptions, form of training, date of training, date for refresher or re-training);

Sample of records of training sessions of health personnel						
Type of training (describe in a few lines)						
Names of trainers						
Serial no	Date of training	Name	Designation	1 st training	Refresher	To have refresher training on:

Sample of annual consolidated records of training of health personnel										
Serial No.	Date of training	Number of doctors trained		Number of nurses trained		Number of lab workers trained		Number of waste handlers trained		Names of trainers
		1 st time	Refresher	1 st time	Refresher	1 st time	Refresher	1 st time	Refresher	

Annexure 19: Operational Record of Autoclave/ Microwave

Sample of details of records for standards of Autoclave/ Microwave				
Parameters	Date	Time	Batch number	Initials of responsible authority
Pressure				
Temperature				
Time				
Validation test for sterilization				

Annexure 20: Records for Effluent Standards

Sample of details of records for standards of Effluent discharge							
Parameters	Permissible limits as per BMWM Rules 2016	Date of report	Inference with initials of the authority	Date of report	Inference with initials of the authority	Date of report	Inference with initials of the authority
pH	6.5 -9.0						
Suspended solids	100 mg/l						
Oil and grease	10 mg/l						
BOD	30 mg/l						
COD	250 mg/l						
Bio- Assay test	90% survival of fish after 96 hours in 100% effluent						



Annexure 21: Protocol for Management of Spills of Blood/ Body Fluids

Spills of infectious body fluids (blood, pus, ascitic fluid, pleural fluid, cerebrospinal fluid, etc.) should be managed effectively to ensure minimal contamination to surrounding areas and to protect the healthcare worker from the hazards of the infectious material.

Steps for managing spills of blood and body fluids:

Isolate the area	<ul style="list-style-type: none"> • Contain the spill by using an impermeable ring if available • Use stop/ caution board. Cordon off the area. • Turn off any fans which may spread the spill/aerosols. • Move patients away from the area of the spill.
Open the spill kit	<ul style="list-style-type: none"> • Open the Spill kit and place the caution board • Contents of spill kit (PPE- Gloves, Mask, Apron/Gown, Goggles, Shoe cover; Absorbent material; Bottle with sodium hypochlorite solution; mop cloth, Yellow & Red plastic bag with biohazard symbol)
Wear the personal protective equipment	<p>Wear the PPE in the following order:</p> <ul style="list-style-type: none"> • Disposable impermeable long-sleeved apron/gown • Mask, goggles • Shoe covers • Rubber/ nitrile gloves
Clean the Spill	<ul style="list-style-type: none"> • Absorb the spill with absorbent material such as paper towels/ old newspaper/cotton swab from outside to the middle and discard it into yellow bin. Repeat the process if necessary. • Cover the spill area with 1-2% sodium hypochlorite directly or after covering with tissue paper and leave it for 20 minutes. • Wipe the area using disposable absorbent material (swab/ cloth) & discard into yellow bin • Clean the area with detergent after decontamination as per hospital cleaning protocol
Dispose the waste	<ul style="list-style-type: none"> • Remove gloves and discard into red plastic bag • Discard gown, shoe covers, mask in yellow bag • If the goggles have been contaminated, discard into the red bag. Otherwise, clean it up wearing non-sterile gloves in warm soapy water, dry with paper towels and place the goggles back in the spill kit. Discard paper towels into yellow bag. • Wash hands with copious amounts of soapy water
Wash hands	<ul style="list-style-type: none"> • Wash hands using ten steps with soap and water
Rearrange the Spill kit	<ul style="list-style-type: none"> • Document the event • Rearrange the spill kit for next use

Annexure 22: Protocol for Management of Mercury Spills

Mercury spills has to be managed by trained personnel only. For more details refer, Doctors manual.

Evacuate the area	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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/sharp objects
Clean broken objects	<ul style="list-style-type: none"> • 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 mercury contaminated
Remove mercury beads	<ul style="list-style-type: none"> • Locate all mercury beads from all corners, 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) can be used to suck the beads of mercury
Collection in leak-proof container	<ul style="list-style-type: none"> • 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 mercury contaminated waste and store in a designated area
Cleaning of all surfaces	<ul style="list-style-type: none"> • Sprinkle sulphur or zinc powder over the area which binds any remaining mercury • Use the cardboard and then dampened paper towels to pick up 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 being removed, resume normal vacuuming and utilise the cleaned area for routine operation
Labelling	<ul style="list-style-type: none"> • All the bags or containers containing items contaminated with mercury should be marked properly and labelled and sent to TSDF

Annexure 23: Protocol for Management of Chemical Spills

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. **Steps in 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
- Step 3** • Inform the designated person (usually the Safety Officer or the Waste Management Officer), who should coordinate the subsequent 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 the spill (acids with soda ash/ sodium bicarbonate and bases with citric acid /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, dried and replaced into the spill kit; other PPE to be disposed in yellow bin
- Step 12** • Document the incident
• Refill the spill kit for next use

Annexure 24: Protocol for Management of Cytotoxic Spills

A cytotoxic spill can occur during agent administration, patient care or transportation and should be attended to immediately and managed by designated trained personnel only.

Management of Minor spills (Cytotoxic spills less than 50ml / body fluids containing cytotoxic agents)

Step 1	<ul style="list-style-type: none">• Put a caution board and cordon off the area.
Step 2	<ul style="list-style-type: none">• Inform the designated person (usually the Safety Officer or the Waste Management Officer), who should coordinate the subsequent actions.
Step 3	<ul style="list-style-type: none">• Wear PPE – Gown, Cap, Mask, Goggles and gloves in that order.
Step 4	<ul style="list-style-type: none">• Open the two cytotoxic waste bags from the Cytotoxic Chemical Spill Kit and place one inside the other, rolling the tops outwards. Place the bags nearby the spill area for ease of access. .• Begin containment by placing a chemosorb pad gently over the top of the spill to reduce/prevent evaporation and inhalation risk.
Step 5	<ul style="list-style-type: none">• When a cytotoxic spill is cleaned, all cleaning should begin from the outside of the spill area and gradually work towards the centre.• For Powder spills – Place the Chemosorb pad over the powder then carefully and gently pour a small amount of water on top of the chemosorb pad to dissolve and absorb the powder. Wait for the liquid to be fully absorbed into the pad.
Step 6	<ul style="list-style-type: none">• Collect up the Chemosorb pad using gloved hands and place it inside the waste bag.
Step 7	<ul style="list-style-type: none">• Scoop up slurry and broken glass using scoop and scraper provided and place inside the waste bag.
Step 8	<ul style="list-style-type: none">• Wash area with copious amounts of alkaline detergent
Step 9	<ul style="list-style-type: none">• Rinse area thoroughly with water
Step 10	<ul style="list-style-type: none">• Dry area with absorbent material
Step 11	<ul style="list-style-type: none">• Discard all waste into designated cytotoxic waste container
Step 12	<ul style="list-style-type: none">• Remove personal protective equipment, discard into designated cytotoxic waste container
Step 13	<ul style="list-style-type: none">• Wash hands thoroughly with soap and water
Step 14	<ul style="list-style-type: none">• Complete an incident report and refill the spill kit for next use

Management of major cytotoxic spill (Cytotoxic spills greater than 50 ml)

Step 1	<ul style="list-style-type: none">• Put a caution board and cordon off the area.
Step 2	<ul style="list-style-type: none">• Inform the designated person (usually the Safety Officer or the Waste Management Officer), who should coordinate the subsequent actions.
Step 3	<ul style="list-style-type: none">• Access the nearest spill kit and wear the PPP
Step 4	<ul style="list-style-type: none">• Put on gown, mask, protective eyewear, shoe coverings and double gloves (inner latex glove and outer heavy utility glove) contained in the spill kit
Step 5	<ul style="list-style-type: none">• Contain and cover the spill using appropriate absorbent material (absorbent side facing down and plastic backed side up) provided in the spill kit
Step 6	<ul style="list-style-type: none">• Use spill towels or chemosorb pads (in spills kit) on ward to wash area with alkaline detergent
Step 7	<ul style="list-style-type: none">• Use spill towels to rinse area thoroughly with water and to dry area fully
Step 8	<ul style="list-style-type: none">• Discard all waste into large poly bag of designated colour (Yellow)
Step 9	<ul style="list-style-type: none">• Remove shoe coverings and outer utility gloves and discard into poly bag of designated colour
Step 10	<ul style="list-style-type: none">• Wearing inner gloves, seal the poly bag of designated colour and place into chemotherapy waste poly bag along with gown, mask and protective eyewear
Step 11	<ul style="list-style-type: none">• Remove inner gloves and seal chemotherapy waste poly bag
Step 12	<ul style="list-style-type: none">• Place entire bag into cytotoxic waste bucket of designated colour
Step 13	<ul style="list-style-type: none">• Wash hands thoroughly with soap and water
Step 14	<ul style="list-style-type: none">• Complete an incident report and refill the spill kit for next use

Cytotoxic waste can be returned to manufacturer or incinerated or chemically degraded as per manufacturer's instructions.



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