

BIOMEDICAL WASTE MANAGEMENT

Meaning – Categories of biomedical wastes –Process of waste management. Disposal of biomedical waste products – Methods, Government Rules and regulations – Standards for Waste autoclaving, microwaving and deep burial. Agencies appointment for waste disposal.

Sewage wastes: Meaning, Composition, Objectives of sewage disposal, Decomposition of organic matter, Modern sewage treatment methods, Solid and Liquid wastes and their treatment.

DEFINITION

- **Hospital waste:** refers to all waste, biological or non biological, that is discarded and is not intended for further use
- **Medical waste:** refers to materials generated as a result of patient diagnoses, treatment, immunization of human beings or animals

DEFINITION

- **Infectious waste:** are the portion of medical waste that could transmit an 'infectious disease'.
- **Pathological waste :** waste removed during surgery/ autopsy or other medical procedures including human tissues, organs, body parts, body fluids and specimens along their containers.

NEED FOR BMW MANAGEMENT

- **Nosocomial infections** in patients from poor infection control practices and poor waste management.
- **Drugs which have been disposed of,** being repacked and sold off to unsuspecting buyers.
- **Risk of pollution** of air, water and soil directly due to waste, or due to defective incineration emissions and ash.
- **Risk of infection** outside hospital for waste handlers and scavengers, other peoples.

OBJECTIVE OF BMW MGMT

- **Reduce the impact** waste management .
- To **minimize the production/** generation of infective waste.
- **Adequate care in handling and reduction** in the incidence of **infection** and accidental injuries to hospital staff.
- **Recycle** the waste after treating to the extent possible.
- **Treat the waste** by safe and environment friendly/acceptable methods.
- **Safety precautions** during handling the BMW.
- **Cost-effective disposal** of hospital waste.

MAGNITUDE OF THE PROBLEM

GLOBALLY- Developed countries generate 1 to 5 kg/bed/day

DEVELOPING COUNTRIES: meager data, but figures are lower- 1-2kg/pt/day

- ▶ WHO Report: 85% non hazardous waste
: 10% infective waste

: 5% non-infectious but hazardous.

(Chemical, pharmaceutical and radioactive)

INDIA:-No national level study

- local or regional level study shows hospitals generate roughly 1-2 kg/bed/day

BMW MANAGEMENT IN INDIA

- Biomedical waste (management and handling) rule 1998, prescribed by the Ministry of Environment and Forests, Govt of India, came into force on 20th July 1998.
- This rule applies to those who generate, collect, receive, store, dispose, treat or handle bio medical waste in any manner.
- Thus bio medical waste should be segregated into containers/bags at the point of generation of waste. Thus Colour Coding & type of containers used for disposal of waste is came into existence.

CLASSIFICATION OF HOSPITAL WASTE (WHO)

- General waste
- Sharps
- Infected waste
- Chemical Waste
- Radio-active waste
- Cytotoxic drugs

CLASSIFICATION OF HEALTH CARE WASTE

▶ WASTE CATEGORY

- INFECTIOUS WASTE
- PATHOLOGICAL WASTE
- SHARP WASTE
- PHARMACEUTICAL WASTE
- GENOTOXIC WASTE
- CHEMICAL WASTE
- WASTE WITH HIGH CONTENT OF HEAVY METALS
- PRESSURIZED CONTAINERS
- RADIOACTIVE WASTE

SOURCES OF HEALTH CARE WASTE

- Government/private hospitals
- Nursing homes
- Physician/dentist office or clinic
- Dispensaries
- Primary health care centers
- Medical research and training centers
- Animal./slaughter houses
- Labs/research organizations
- Vaccinating centers
- Bio tech institutions/production units

RISKS ASSOCIATED WITH HCW

- All individuals exposed to healthcare waste are potentially at risk of being injured or infected. They include:
 - **Medical staff:** doctors, nurses, sanitary staff and hospital maintenance personnel;
 - **In and out-patients** receiving treatment in healthcare facilities as well as their visitors;
 - **Workers in support services** linked to healthcare facilities such as laundries, waste handling and transportation services;
 - **Workers in waste disposal facilities**, including scavengers;

- The **general public** and more specifically the children playing with the items they can find in the waste outside the healthcare facilities when it is directly accessible to them.
- Waste management and treatment options should first protect the healthcare workers and the population and minimise indirect impacts from environmental exposures to HCW.

REDUCING HCW RISKS

- Reducing the direct and indirect risks posed by HCW is one of the main objectives of HCWM. It is achieved through a set of measures that have to be taken in parallel at the management, training, regulatory, technical and financial levels.
- Action must be taken in this respect not only within the **medical** sphere of HCFs, but also at regional and national **political** levels.
- Awareness and training are certainly the first and most important means of inducing changes. A well trained person will always find solutions to the problems encountered, even if imperfect.

BIOMEDICAL WASTE MANAGEMENT:

- SEGREGATE HAZARDS AT THE SOURCE
- Separate sharps and infectious waste where they are used
 - This prevents injuries that can occur when people sort the trash after it is disposed
- Janitors can reinforce separation of sharps waste disposal by reporting sharps in garbage to Hospital Infection Control Committee members

STEPS TO MANAGE HAZARDOUS WASTES BEFORE DISPOSAL

- Know what hazards you have
- Purchase smallest quantity needed, and don't purchase hazardous materials if safe alternative exists
- Limit use and access to trained persons with personal protective gear.
- Don't accumulate unneeded products.
- Don't let peroxides and oxidising agents turn into bombs

CATEGORY	TYPE OF WASTE	TREATMENT & DISPOSAL
Category 1	Human anatomical wastes	Incineration/ deep burial
Category 2	Animal wastes	Incineration/ deep burial
Category 3	Microbiology & biotechnology waste	Local autoclaving/ microwaving/incineration
Category 4	Waste sharps like needles, syringes, scalpels, blades, glass etc	Disinfection (Chemical/autoclaving/micro waving & mutilation/shredding)
Category 5	Discarded Medicines & cytotoxic drugs	Incineration/destruction & disposal in land fills

Category 6	Soiled wastes Items contaminated with blood, body fluids including cotton, dressings etc	Incineration, autoclaving, microwaving
Category 7	Solid wastes like catheters, IV sets etc.	Disinfection by chemical treatment/autoclaving/micro waving and mutilation & shredding
Category 8	Liquid wastes: Laboratory, blood banks, hospitals, house etc.	Disinfection by chemicals and discharge into drains
Category 9	Incineration ash	Disposal in municipal land fills
Category 10	Chemical wastes	Chemical treatment & discharge into drains for liquid and secured land fills for solids.

SEGREGATION AND PACKAGING:

- Segregation refers to the basic separation of different categories of waste generated at source and thereby reducing the risks as well as cost of handling and disposal.
- Segregation is the most crucial step in bio-medical waste management. Effective segregation alone can ensure effective bio-medical waste management.
- The BMWs must be segregated in accordance to guidelines laid down under schedule 1 of BMW Rules, 1998.

PROPER LABELING OF BINS:

- The bins and bags should carry the biohazard symbol indicating the nature of waste to the patients and public.
- Schedule III (Rule 6) of Bio-medical Waste (Management and Handling) Rules, 1998 specifies the Label for Bio-Medical Waste Containers / Bags
- Label shall be non-washable and prominently visible.

TRANSPORTATION AND STORAGE:

- Transport by wheeled trolleys/containers /carts only in vehicles authorized for the purpose
- They should be
 - Easy to load and unload
 - No sharp edges
 - Easy to clean
 - Disinfect daily
- Trolleys ,Wheelbarrows: covered and open, Chutes

STORAGE:

- In an area away from general traffic and accessible only to authorized personnel
- DO NOT store for more than 48 hours
- If for any reason it becomes necessary to store the waste beyond such period take measures to ensure that the waste does not adversely affect human health and environment

PRINCIPLES OF WASTE MANAGEMENT

- Waste minimization & recycling of waste

- Identification of points of generation of waste
- Waste segregation at source
- Compiling the inventory of waste
- Waste treatment (disinfection etc.) at the site
- Waste collection and transportation, on-site and off-site
- Waste treatment , on-site & off the site
- Final disposal of waste
- Occupational safety
- Continuous monitoring of the system
- Training of the staff.

THE WASTE MANAGEMENT PLAN

1. Assess present situation and carry out a waste survey
2. Identify opportunities for minimization, reuse and recycling
3. Identify handling, treatment and disposal options
4. Evaluate options
5. Prepare a management plan
6. Establish a record keeping system
7. Estimate related costs
8. Prepare training programme
9. Prepare implementation strategy

- GENERATION, SEGREGATION, COLLECTION, STORAGE, TRANSPORTATION AND TREATMENT OF WASTE

1.Generation:

2.SEGREGATION:

Done at point of Generation of waste and put in separate coloured bags. Color coding varies from nation to nation.

3.COLLECTION OF WASTE:

- Centralized sanitation staffs or any other sanitation staffs should collect the waste during morning , afternoon or evening under the supervision of nursing staff and sanitation supervisor;
- Documentation should be done in register;
- Garbage bin should be cleaned and disinfected regularly.

4. STORAGE OF WASTE:

- Waste should not be stored in the generation area for more than a period of 4-6 hours.
- It is responsibility of paramedic/sanitation staff to check for segregation
- Waste collected in various areas should be transported for disposal/Treatment.

5. TRANSPORTATION:

- There should be separate corridor and lift in hospital to carry and transport waste.
- General waste are deposited at municipal dumps.
- Waste for autoclaving and incineration are dumped at separate site for external transport in the respective coloured plastic bag for these waste.
- Transportation should be done in sealed container/sanitation supervisor should ensure for leakage.

- **TREATMENT AND DISPOSAL OPTIONS FOR WASTE**

Treatment

- Incineration
- Chemical disinfection
- Autoclaving
- Encapsulation
- Microwave irradiation

Final disposal

- Municipal landfill
- Burying inside premises
- Discharge into sewer

INCINERATION

- Reduces organic and combustible waste to inorganic incombustible waste (ashes)
- Reduces significantly waste volume and weight
- Residues are transferred to final disposal site
- Treatment efficiency depends on incineration temperature and type of incinerator
- Not all wastes can be incinerated
- Investment and operation costs vary greatly according to type of incinerator

WASTE NOT TO BE INCINERATED

- Pressurized gas containers
- Large amounts of reactive chemical waste
- Radioactive waste
- Silver salts or radiographic waste
- Halogenated plastics (e.g. PVC)
- Mercury or cadmium
- Ampoules of heavy metals

NON-INCINERATION METHODS

1 - THERMAL PROCESSES:

A - Low-Heat Thermal Processes (93°C-177°C) Wet heat (steam) disinfection - autoclave, Dry heat (hot air) disinfection - infrared heaters.

B - Medium-Heat Thermal Processes (177°C-370°C) Chemical breakdown of organic material.

Reverse polymerization using high-intensity microwave

C - High-Heat Thermal Processes (540°C-8,300°C) or higher Electrical resistance, induction, natural gas, and/or plasma energy provide the intense heat ,total destruction of the waste Significant change in the mass and volume

- **WET THERMAL TREATMENT SYSTEMS**

Method that exposes waste to steam under pressure

Examples:

autoclaving, larger off-site treatment facilities

Characteristics:

- Low investment and operating costs for simple apparatus
- Environmentally friendly
- Not appropriate for tissue or carcasses

- Trained operatives required

Autoclaving is highly efficient because:

- ✓ High temperature.
- ✓ High penetrating power of the steam under pressure.
- ✓ When steam condenses on the articles, it liberates latent heat to the articles to be sterilized.
- ✓ Non toxic
- ✓ Not time consuming.
- **MICROWAVE TREATMENT**
 - ✓ Radiations produced by the microwave are involved to break apart molecular chemical bonds & thus disinfect infectious waste.
 - ✓ Temp-97°-100°C.
 - ✓ Cycle time-40-45 min.
 - ✓ Advantage of disinfecting the waste.
 - ✓ No hazardous emissions.
 - ✓ Can not be used to treat body parts & tissues.
 - **ADVANTAGES**
 - ✓ Absence of harmful air emissions- environment friendly.
 - ✓ Absence of liquid discharges.
 - ✓ Non-requirement of chemicals.
 - ✓ Reduced volume of waste (due to shredding & moisture loss)
 - ✓ Operator safety-worker friendly.
 - ✓ However, the investment costs are high at present.

2 - CHEMICAL PROCESSES:

- ✓ Dissolved chlorine dioxide, bleach (sodium hypochlorite), peracetic acid, or dry inorganic chemicals.
- ✓ To enhance exposure of the waste to the chemical agent, chemical processes often involve shredding, grinding, or mixing.

3 - IRRADIATIVE PROCESSES:

- ✓ Electron beams, Cobalt-60, or UV irradiation.

SIMPLE CHEMICAL DISINFECTION

Treatment by contact to commonly used products for surface disinfection

- Requires shredding of waste
- May introduce strong chemicals into the environment
- Efficiency depends on operational conditions
- Only the surface is disinfected
- Human tissue should usually not be disinfected
- Special disposal required to avoid pollution of the environment

DISPOSAL TO LAND

Not recommended for untreated hazardous waste

Minimum requirements for land disposal:

- No deposit on open dumps
- A degree of management control is exercised
- Engineered avoid leaching to water bodies and retain waste on site

- Rapid burial of HCW on site to isolate from animal or human contact

DEEP BURIAL PIT for BMW :

- ✓ Entry of scavengers to the burial site be prevented may be by using covers of galvanized iron/wire mash.
- ✓ After every burial in the same secured pit a layer of 10 cm. soil be added .
- ✓ Burial must be performed under close and dedicated supervision.
- ✓ Deep burial site should be relatively impermeable and distant from habitat.
- ✓ There should be no well, lake, river etc. close to the site to avoid contamination of surface water or ground water.
- ✓ Location of the deep burial site to be authorized by the Prescribed Authority.
- ✓ The occupier shall maintain record for all the pits.

LIQUID INFECTIOUS MEDICAL WASTES

- Placed directly in the Biohazardous waste,
- Poured down a sanitary sewer,
- Solidified using an approved disinfectant solidifier and discarded in the solid waste

DISPOSAL OF RADIOACTIVE

- Radioactive waste which has to be stored to allow decay to back ground level, shall be placed in a waste bag, in a large yellow container or drum. The container or drum shall be labeled, "RADIOACTIVE WASTE", with radiation symbol.
- Non-infectious radioactive waste which has decayed to background level, shall be placed in white waste bag.

SEWAGE WATER TREATMENT PLANT

- It is very important to provide some degree of treatment to wastewater before it can be used for agricultural or landscape irrigation or for aquaculture.
- The principal objective of sewage treatment is generally to allow human effluents to be disposed of without danger to human health or unacceptable damage to the natural environment.

OBJECTIVES OF SEWAGE DISPOSAL:

- Its objective is to produce an environmentally-safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer).
- ❖ The quality of the treated waste released from the treatment system depends on:
 - The volume and condition of the receiving water ,
 - Its ability to dilute the waste.

SEWAGE TREATMENT

- Sewage-treatment method
- Sewage collection and treatment is typically subject to local, state and federal regulations and standards. Industrial sources of wastewater often require specialized treatment processes.
- Sewage treatment stages
- ✓ Sewage treatment generally involves four stages:
 1. Preliminary treatment
 2. Primary treatment and
 3. Secondary treatment.

In addition to these three, some scientists add the preliminary stage to them obtaining by this four stages.

THE PRELIMINARY STAGE

- Preliminary stage removes materials that can be easily collected like large debris by using screens and grit channels.
- The influent sewage water is screened to remove all large objects like cans, rags, sticks, plastic packets etc. carried in the sewage stream.

PRIMARY TREATMENT STAGE

- Primary treatment consists of temporarily holding the sewage in a quiescent basin where heavy solids can settle to the bottom while oil, grease and lighter solids float to the surface.

SECONDARY TREATMENT STAGE

- ✓ Secondary treatment removes dissolved and suspended biological matter.
- ✓ Secondary treatment is typically performed by micro organisms in a managed habitat.
- ✓ Secondary treatment may require a separation process to remove the micro-organisms from the treated water prior to discharge or tertiary treatment.

TRICKLING FILTERS

- ✓ It is used in the secondary treatment. A **trickling filter** consists of a fixed bed of rocks, lava, gravel, polyurethane foam, sphagnum peat moss, ceramic, or plastic media over which sewage or other wastewater flows downward and causes a layer of microbial slime (bio film) to grow, covering the bed of media.

BMW MANAGEMENT COMMITTEE

- Head of the hospital : chairman
- Waste Mgmt officer (dev. and implementation plan)

Members:

- HOD's of all department
- Nursing superintendent,
- Head nurse,
- Sanitary inspector
- Chief pharmacist,
- Radiation officer
- Supply officer,
- financial officer

MAINTENANCE OF RECORDS & ACCIDENT REPORTING

- a. Every authorized person shall maintain records related to BMW.
- b. All records shall be subjected to inspection and verification by the prescribed authority at any time.
- c. In any accidents, the authorized person shall report the accident in Form III along with the remedial action taken to the prescribed authority.

BMW SPILLS & SURFACE DISINFECTION

- Proper spill handling:
 - Notify people in the area

- Don appropriate PPE
- Place absorbent material on spill
- Apply appropriate disinfectant – allow sufficient contact time (30 min)
- Pick up material (watch for glass – use tongs or dust pan); dispose of material into biomedical waste
- Reapply disinfectant and wipe
- For large/high hazard spills use 10% hypochlorite

WORKERS HEALTH SAFETY

- The production, segregation, transportation, treatment and disposal of health care waste involve the handling of potentially hazardous material.
- Protection against personal injury is therefore essential for all workers who are at risk.
- Convenient washing facilities should be available, for reducing the risks from handling health care waste.
- Viral hepatitis B & tetanus immunization is commonly recommended.

IN CASE OF EMERGENCY

- Action & notification to supervisors in case of accident.
- These programmes should be periodically reviewed & updated as necessary
- Good supervision is essential for the maintenance of efficient & safe waste handling operations.
- The selection and training of supervisory personnel plays a fundamental role in IN-House Waste Management
- Information on health care waste management policy & methods should also given to support staff, maintenance personnel from external organization, such as transport firms, who may be involved in handling the waste

THE BASIC CONTENT OF TRAINING PROGRAMMES SHOULD INCLUDE INFORMATION ON

- The hazards of health care waste.
- The methods of preventing the transmission of nosocomial infections related to waste handling.
- The safety procedures for dealing with chemical, pharmaceutical & radioactive waste & sharps
- Proper waste segregation, handling packaging, transport & disposal.

<u>Bio- Medical Waste (Management and Handling) Rules, 2011</u>	<u>Bio- Medical Waste Management Rules, 2016</u>	<u>Reasons and likely implications</u>
Title Bio- Medical Waste (Management and Handling) Rules, 2011.	Bio- Medical Waste Management Rules, 2016.	The word 'Management' includes Handling.

<p>These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form.</p>	<p>These rules shall apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio-medical waste in any form and shall not apply to:</p> <ul style="list-style-type: none"> • radioactive wastes, • wastes covered under the MSW Rules, 2000, • lead acid batteries, • hazardous wastes, • E- waste, • hazardous microorganisms. 	<p>Modified to bring more clarity in the application.</p> <p>Clarified that vaccination camps, blood donation camps, surgical camps or any other healthcare activity undertaken outside the healthcare facility, will be covered.</p>
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Duties of the Health care facilities

<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><u>Additions:</u> 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 bio-medical waste from such place or premises can be directly transported in to the common bio-medical waste treatment facility.</p>
	<p>pre-treat the laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilisation on-site in the manner as prescribed by the World Health Organisation (WHO) or National AIDs Control Organisation (NACO) guidelines and then sent to the common bio-medical waste treatment facility for final disposal.</p>	

phase out use of chlorinated plastic bags, gloves and blood bags within two years from the date of notification of these rules	Will eliminate the emission of dioxin and furans from burning of such wastes.
provide training to all its health care workers and others involved in handling of bio medical waste at the time of induction and thereafter at least once every year	Will improve the management of BMW including collection, segregation.
immunise all its health care workers and others involved in handling of bio-medical waste for protection against diseases including Hepatitis B and Tetanus that are likely to be transmitted by handling of bio-medical waste,	To protect the health of workers
establish a Bar- Code System for bags or containers	Will improve the segregation, transportation and disposal system. Also will eliminate pilferage
report major accidents including accidents caused by fire hazards, blasts during handling of bio-medical waste	Help to monitor and improve the management