

CHAPTER

17

HEALTH CARE WASTE MANAGEMENT

1. **Classification and Safe Disposal of Hospital Waste**
2. **Health Hazards of Health Care Waste**
3. **Universal Precautions**
4. **Standard Precautions**
5. **Treatment of Hospital Waste**
6. **Incineration**
7. **Biomedical Waste Management Rules, 2016**

1. CLASSIFICATION AND SAFE DISPOSAL OF HOSPITAL WASTE

Definition

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

Characterisation of waste

- General waste or non-hazardous waste constitutes 75-90% of waste generated at health care facilities. Administrative, house keeping, packaging, kitchen and maintenance activities of the facilities contribute to the general waste or non hazardous waste. This waste is collected in black non chlorinated bag and goes into municipality landfills.
- Hazardous waste constitute remaining 10-25% of waste. It can pose threat to human and environmental health. This waste needs to be handled more cautiously as below.

Category	Type of waste	Type of bag/container	Treatment and disposal option
Yellow	a) <i>Human anatomical waste</i> - Human tissue - Organ - Body parts - Foetus below the viability period	Yellow coloured non-chlorinated plastic bags	- Incineration OR - Plasma Pyrolysis OR - Deep burial in rural or remote areas without access to biomedical waste treatment facility
	b) <i>Animal anatomical waste</i> - Experimental animal carcasses - Body part - Organs - Tissue - Waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.		
	c) <i>Soiled Waste</i> - Items contaminated with blood, body fluids like dressings - Plaster casts - Cotton swabs - Bags containing residual or discarded blood and blood components		
	d) <i>Expired or Discarded Medicines</i> - Cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc. - Non-cytotoxic pharmaceutical waste like antibiotics	Yellow coloured non-chlorinated plastic bags or containers with cytotoxic label Yellow coloured non-chlorinated plastic bags or container	Expired cytotoxic drugs and items contaminated with cytotoxic drugs - To be returned back to the manufacturer or supplier for incineration at temperature > 1200°C OR - To common waste treatment facility for incineration at > 1200°C OR - Encapsulation OR - Plasma Pyrolysis at > 1200°C - All other discarded medicines shall be either sent back to manufacturer OR - Disposed by incineration

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

Category	Type of waste	Type of bag/container	Treatment and disposal option
	• Urine bags • Syringes (without needles and fixed needle syringes) • Vacutainers with their needles cut • Gloves • Drains • Suction tubes • Nasogastric tubes		• Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil OR for road making, whichever is possible • PLASTIC WASTE SHOULD NOT BE SENT TO LANDFILL SITE
White translucent	Waste sharps including metals (both used, discarded and contaminated) • Needles • Syringes with fixed needles, needles from needle tip cutter or burner • Scalpels • Blades • Guide wires • Suture needles • All sharps from lab • Any other contaminated sharp object that may cause puncture and cuts	Puncture proof, leak proof, tamper proof containers	• Autoclaving OR dry heat sterilisation followed by shredding or mutilation or encapsulation in metal container or cement concrete • Shredding cum autoclaving and sent for final disposal to iron foundries OR • Shredding cum autoclaving and final disposal in sanitary landfill or designated concrete waste sharp pit.
Blue	• Glassware: Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes. • All glass wares from lab • Metallic body implants	Puncture proof and leak proof box or container with blue coloured marking	• Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium hypochlorite solution) OR • Autoclaving OR • Microwaving OR • Hydroclaving • AND then sent for recycling

* Disposal by deep burial is permitted only in rural or remote areas where there is no access to Common biomedical waste treatment facility (CBWTF) within 75 Km.

To summarise

- In **YELLOW** goes blood, drugs and dead tissues.
- Recyclable plastics, tubes and syringe now go in **RED**.
- Sharps in **WHITE** puncture proof lockable containers.
- **BLACK** is for garbage.
- **BLUE** shall carry bottles, glasses, ampoules, vials.

2. HEALTH HAZARDS OF HEALTH CARE WASTE

Definition

Health care waste is a waste generated during the course of health care activities. Most of the health care waste is general waste and only 10-25% waste is hazardous and can result in disease or injury due to one or more of following characteristics.

1. Contains infectious agent
2. Contains toxic or hazardous chemicals or pharmaceuticals
3. Contains sharps
4. Genotoxic
5. Radioactive

Who is at risk?

All individuals exposed to such hazardous waste are potentially at risk including those who generate the waste or those who handle the waste or are exposed to it as a part of careless management.

Health Hazards

S. No.	Type of waste	Hazards from waste	Impact from waste
1	Infectious waste and sharps - Used needles, waste from isolation wards, tissues, swab materials etc.	Through • Cuts • Abrasions • Infections • Inhalation • Ingestion	• Infections with Hepatitis B, Hepatitis C, HIV
2	Chemical and pharmaceutical waste - expired medicines, medicines that are no longer needed or items contaminated by pharmaceutical substances or disinfectants.	• Intoxication by acute or chronic exposure • Physical injury • Chemical burns • Injury to skin • Injury to eye • Injury to mucous membrane of airways • Respiratory disease • Skin disease	• Harmful to wildlife • Evolution of antibiotic resistance in bacteria. • The chemicals can also cause contamination of water bodies and soil. • When large quantities of disinfectants are released into sewers they can bring down the efficiency of the sewage treatment plant.
3	Genotoxic waste - waste containing drugs used in treatment of cancer patients or waste containing genotoxic chemicals	Exposure occurs during treatment with particular drug or chemical exposure by inhalation of dust/aerosols absorption through skin; ingestion of food that is accidentally contaminated.	• Spontaneous abortions • Irritant • Dizziness • Nausea • Headache • Dermatitis
4	Radioactive waste - Unused liquids from radiotherapy; contaminated glassware, packages or absorbent paper; urine and excreta of patients treated or tested with radionuclide.	• Headache • Dizziness • Vomiting	• Can expose the public as well as healthcare workers to the risk of loss of foetus in the first three months of pregnancy • Death
5	Healthcare waste - treatment methods	• Flue gases from improperly functioning waste incinerators • Physical injuries • Leachate release into water • Burning leads to heavy metal release	• Flue gases released or Water pollution • Air pollution • Release of pathogens and toxic pollutants into the environment.
6	Anatomical waste	Public sensitivity	• Sensitivity to vision of anatomical parts • Disposal of anatomical waste inappropriately, such as dumping in a landfill is unacceptable.

3. UNIVERSAL PRECAUTIONS

Introduction

Universal precautions are an approach to infection control and assume human blood and certain human body fluids as potentially infectious for HIV, HBV and other blood borne pathogens.

Definition

Universal precautions are a standard set of guidelines to prevent the transmission of bloodborne pathogens from exposure to blood and other potentially infectious materials (OPIM).

What is OPIM?

- The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids.
- Any unfixed tissue or organ (other than intact skin) from a human (living or dead) and
- HIV containing cell or tissue cultures, organ cultures, and HIV or HBV containing culture medium or other solutions; blood, organs, or other tissues from experimental animals infected with HIV or HBV.

For Whom it is applicable?

All Healthcare workers

- Those in direct contact with patient: Doctors, nurses, and laboratory technician.
- Those in indirect contact with patient: Other staff members like aya, maushi and ward boys.

Where is Universal precaution not applicable?

Universal Precaution do not apply to sputum, faeces, sweat, vomit, tears, urine, or nasal secretions unless they are visibly contaminated with blood.

Which protective devices are used?

- 1) Barrier gowns
- 2) Gloves
- 3) Eye wear (goggles or glasses)
- 4) Face shield

Universal vs Standard precautions

Universal precautions	Standard precautions
Older concept since 1983.	Newer concept since 1996.
Include only organisms spread by blood and some body fluid i.e. HIV, HBV, HCV and other blood borne pathogens.	Integrate and expand universal precaution to include measures to prevent spread of organisms by routes like non intact skin, mucous membrane, airborne transmission.
Considers nasal secretions, sweat, vomitus, sputum, saliva as infectious only if they contain traces of blood.	Considers all body fluids, secretions and excretions except sweat as infectious regardless of whether they contain blood.
Measures include hand hygiene; use of personal protective equipment; disinfection; waste management & disposal; and prophylaxis & treatment of occupational exposure.	Hand washing, PPE, etc. is included Additionally it includes respiratory hygiene, environmental measures.

4. STANDARD PRECAUTIONS

What is Standard precaution?

Standard Precautions are the minimum infection prevention practices that apply to all patient care, regardless of suspected or confirmed infection status of the patient, in any setting where health care is delivered. These practices are designed to both protect health care provider (HCP) and prevent HCP from spreading infections among patients.

What does Standard Precautions include?

Standard precaution includes

- 1) Practice of hand hygiene.
- 2) Use of personal protective equipment (e.g., gloves, masks, eyewear).
- 3) Practice of respiratory hygiene / cough etiquette.
- 4) Ensuring appropriate patient placement.
- 5) Sterilising patient care equipment and instruments and devices.
- 6) Cleaning and disinfection of environmental surfaces.
- 7) Disinfecting linen.
- 8) Safe injection practices (i.e. aseptic technique for parenteral medications).
- 9) Proper handling of needles and other sharps.

Where is the standard precaution applicable?

- Apply to the care of all patients, irrespective of their disease state.
- Apply when there is a risk of potential exposure to
 - Blood.
 - All body fluids, secretions, and excretions, except sweat, regardless of whether or not they contain visible blood.
 - Non-intact skin.
 - Mucous membranes.

Hand Hygiene

- Handwashing - With soap and water for atleast 40-60 seconds.
To be performed if hands are visibly soiled.
- Hand rubbing - With alcohol for atleast 20-30 seconds.
To be performed if hand are visibly clean.

How to Handrub?

RUB HANDS FOR HAND HYGIENE! WASH HANDS WHEN VISIBLY SOILED

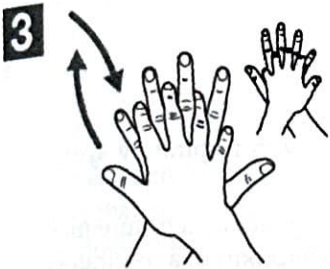
Duration of the entire procedure: 20-30 seconds



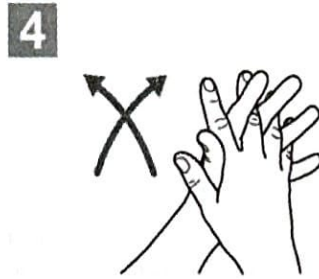
Apply a palmful of the product in a cupped hand, covering all surfaces



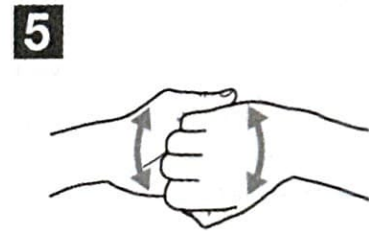
Rub hands palm to palm



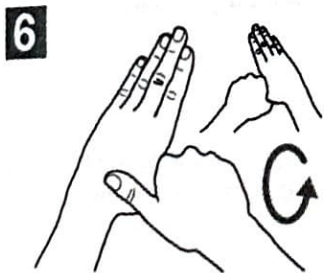
Right palm over left dorsum with interlaced fingers and vice versa



Palm to palm with fingers interlaced



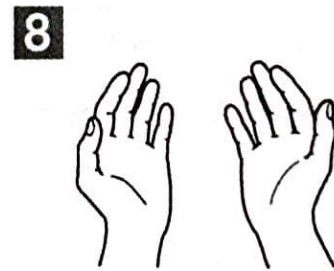
Backs of fingers to opposing palms with fingers interlocked



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



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



Once dry, your hands are safe



**World Health
Organization**

Patient Safety
A World Alliance for Safer Health Care

SAVES LIVES
Clean Your Hands

Fig 17.1 Steps of handwashing/hand rubbing
Source : WHO Infection prevention and control

- Five moments of hand hygiene as given by WHO
Hand hygiene to be performed
 - before touching a patient
 - before clean/aseptic procedures
 - after body fluid exposure/risk
 - after touching a patient
 - after touching patient surroundings

Personal Protective Equipment (PPE)

- PPE refers to wearable equipment that is designed to protect HCP from exposure to or contact with infectious agents. These include gloves, face masks, protective eyewear, face shields, and protective clothing (e.g., reusable or disposable gown, jacket, laboratory coat).
- Gloves - Must be worn when touching blood, body fluids, secretions, excretions, mucous membranes, or non-intact skin. Change when there is contact with potentially infected material in the same patient to avoid cross-contamination. Remove before touching surfaces and clean items.
- Mask, Goggles / Eye Visor, and/or Face Shield - Wear a mask and eye protection or face shield during procedures that may spray or splash blood, body fluids, secretions, or excretions.
- Gown - Wear to protect skin or clothing during procedures that may spray or splash blood, body fluids, secretions, or excretions.

Respiratory Hygiene and Cough etiquette

- Practice respiratory hygiene and cough etiquette.
- Asking those with respiratory symptoms to wear mask and separating those with respiratory symptoms from others or encouraging them to sit at least three feet away from others.
- Droplet precautions to be practiced by healthcare personnel (i.e., wearing a surgical or procedure mask for close contact), in addition to Standard Precautions, when examining a patient with symptoms of a respiratory infection, particularly if fever is present.

Ensure appropriate patient placement

- Place patients who pose a risk of transmission of infection to others in a single room if possible.
- Place patients with similar infection in same room/ward.

Sterilise patient care equipment, instruments and devices

- Remove organic material from critical and semi-critical instruments/devices, using recommended cleaning agents before high level disinfection and sterilization to enable effective disinfection and sterilization processes.

Environmental cleaning

- Clean and disinfect surfaces that are likely to be contaminated with pathogens, including those that are in close proximity to the patient (e.g., bed rails, tops of bed tables) and frequently-touched surfaces in the patient care environment (e.g., door knobs, surface tops in and surrounding toilets in patients' rooms) on a more frequent schedule compared to that for other surfaces (e.g., horizontal surfaces in waiting rooms).

Disinfect Linen

- Handle used textiles and fabrics with minimum agitation to avoid contamination of air, surfaces and persons.
- Disinfect linen appropriately.

Safe injection practices (i.e., aseptic technique for parenteral medications)

- Use aseptic technique to avoid contamination of sterile injection equipment.
- Use single-dose vials for parenteral medications whenever possible.
- Do not administer medications from a syringe to multiple patients, even if the needle or cannula on the syringe is changed.

- Do not administer medications from single-dose vials or ampoules to multiple patients or combine leftover contents for later use.
- If multidose vials to be used, both the needle or cannula and syringe used to access the multidose vial must be sterile.

Proper handling of Needles and Other Sharps

- Do not break, bow, or directly manipulate used needles.
- Recapping is not recommended, but if necessary, "use a one-handed scoop technique only."
- Discard all used sharps in appropriate puncture-resistant containers.

5. TREATMENT OF HOSPITAL WASTE

- 1) Incineration
- 2) Chemical disinfection
- 3) Wet and dry thermal treatment
- 4) Microwave irradiation
- 5) Encapsulation
- 6) Inertization
- 7) Sanitary landfill

Incineration

Incineration is a high temperature dry oxidation process that reduces organic and combustible waste to inorganic incombustible matter, and results in very significant reduction of volume and weight. Incineration is used for the waste that cannot be recycled, reused or disposed of in a sanitary landfill.

Anatomical waste, soiled waste and chemical waste are subjected to incineration.

Chemical disinfection

It is used for treatment of liquid wastes such as blood, urine, stool or hospital waste.

Wet and Dry thermal treatment

Wet treatment/Steam disinfection is subjecting shredded infectious waste to high temperature, high pressure steam. Not useful for anatomical waste, chemical and pharmaceutical waste.

Dry thermal treatment is a process used for infectious waste and sharp wastes where disinfection is achieved by subjecting the waste to high temperature.

Microwave irradiation

It is recommended for contaminated recyclable waste.

Encapsulation

It is a method used for disposal of sharp infectious waste. It is a simple, low cost and safe method.

Inertization

Inertization used for treatment of pharmaceutical waste, where the waste product is mixed with cement and other substances before disposal. It is relatively inexpensive.

Sanitary landfill

It is an option to be used only if there is no facility available in that area for disposal of hospital waste.

6. INCINERATION

Definition

Incineration is a high temperature dry oxidation process that reduces organic and combustible waste to inorganic incombustible matter, and results in very significant reduction of volume and weight.
Incineration is used for the waste that cannot be recycled, reused or disposed of in a sanitary landfill.

Waste that can be incinerated

- 1) Human and animal anatomical waste
- 2) Soiled waste
- 3) Chemical waste

Incineration does not require any pre-treatment.

Waste that cannot be incinerated

- 1) Pressurised gas containers
- 2) Large amount of reactive chemical wastes
- 3) Silver salts and photographic or radioactive waste
- 4) Halogenated plastics such as PVC
- 5) Waste with high mercury or cadmium content such as broken thermometer, used batteries and lead lined wooden panels
- 6) Sealed ampoules or ampoules containing heavy metals

Types of Incinerator

There are four types of Incinerator

Type of Incinerator	Advantages	Disadvantages
Double chamber pyrolytic incinerators	1. Very high disinfection efficiency 2. Adequate for a. all infectious waste b. most chemical waste c. pharmaceutical waste	1. Incomplete destruction of cytotoxics 2. Relatively high investment 3. High operating cost
Single Chamber furnace (used only if double chamber incinerator is not affordable)	1. Good disinfection efficiency 2. Drastic reduction of weight and volume of waste 3. Residue may be disposed in landfill 4. No need for highly trained operators 5. Relatively low investment cost 6. Relatively low operating cost	1. Significant emission of atmospheric pollutants 2. Need for periodic removal of slag and soot 3. Inefficient in destroying thermally resistant chemicals and cytotoxic drugs
Rotary kilns	1. Adequate for a. all infectious waste b. most chemical waste c. pharmaceutical waste 2. Decomposition of genotoxic substance and heat resistant chemicals	1. High investment 2. High operating cost
Drum or brick Incinerator	1. Drastic reduction of weight and volume of waste 2. Very low investment cost 3. Very low operating cost	1. Destruction of only 99% of microorganisms 2. No destruction of many chemicals and pharmaceuticals substances 3. Massive emission of black smoke, fly ash, toxic flue gas and odours.

Incinerator

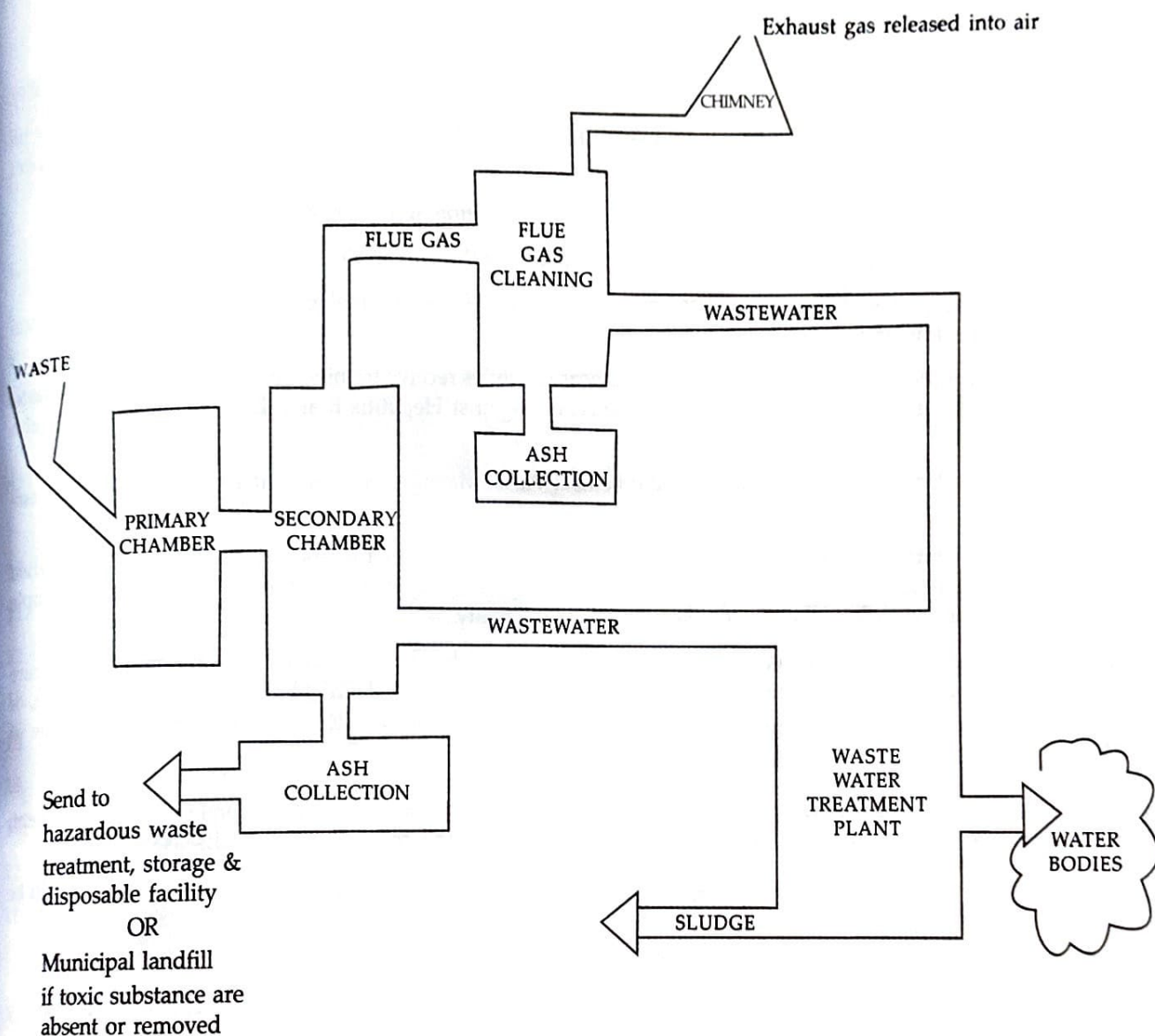


Fig 17.2 Functioning of an Incinerator

7. BIOMEDICAL WASTE MANAGEMENT RULES 2016

- Bio-medical Waste (Management & Handling) Rules, 1998 were notified by the Ministry of Environment & Forests (MoEF) under the Environment (Protection) Act, 1986, amended in 2016.
- These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio-medical waste in any form.
- Waste generated from healthcare facilities is classified as Biomedical waste.
- Colour coded as yellow, red, white, and blue.
- BMW constitutes 15% of general waste (categorised as dry waste in the blue bin and wet waste in the green bin).

Some basic rules for waste management

- Must be segregated at the point of generation.
- Should be collected daily from each ward of the hospital at a fixed interval of time.
- Ensure disposal of waste within 48 hours.

- Waste containers should be filled to no more than three-quarters full and should be sealed with a plastic tie at this level.
- All the containers must be labelled with the Symbol of Biohazard or Cytotoxic Hazard.
- Containers are required to be provided with barcode labels in accordance with CPCB guidelines.
- Transportation must be done in closed trolleys/containers preferably fitted with wheels for easy manoeuvrability.
- Biomedical waste should be collected at a designated central waste collection room of each healthcare facility till the waste is picked and transported for treatment and disposal at CBWTF (Common Biomedical Waste Treatment Facility).
- Maintain the records of category wise biomedical waste generation and its treatment disposal daily.
- Develop a separate page/web link in its website for displaying the information pertaining to their hospital.
- Ensure the occupational safety of the healthcare workers and other staff involved in the handling of Biomedical waste in the healthcare facility.
- It should be ensured that all the employees of healthcare facilities receive training for handling biomedical waste, immunization against communicable diseases especially against Hepatitis B and Tetanus, and regular health check-ups.
- Monitoring and Review by Quality team or Biomedical Waste Management Committee or by Biomedical waste supervisor.
- The liability for implementing BMWM Rules, 2016 lies with the occupier or the person having administrative control over the healthcare facility who will be liable for any harm that may occur to the environment or people due to improper handling of the BMW generated from the facility.
- In case of violations of provisions or the directions of the act, legal actions can be taken against health care facilities, in the form of imprisonment up to five years or fine up to Rs one lakh or both, or closure, prohibition, or regulation of any operation or process, Stoppage or regulation of the electricity or water supply, or closure of healthcare facility.

Additional guidelines for handling, treatment and safe disposal of biomedical waste generated during treatment, diagnosis and quarantine of patients confirmed or suspected to have the novel coronavirus disease (COVID-19).

- For isolation wards as a precaution, double-layered yellow coloured non-chlorinated bags (two bags) should be used for the collection of waste to ensure adequate strength and no-leaks.
- Collect and store biomedical waste separately prior to handing over the same to CBWTF.
- Use a dedicated collection bin labelled as **COVID-19** to store COVID-19 waste and keep it separately in a temporary storage room prior to handing over to the authorised staff of the CBWTF.
- Biomedical waste collected in such isolation wards can also be lifted directly from ward into CBWTF collection van.
- Separate record for waste from covid 19 wards to be maintained.
- Containers, bins and trolleys used should be disinfected regularly.
- Routine solid waste from quarantine centres or those cared at home to be disposed of as per solid waste management rule 2016.
- Biomedical waste from home cared patient in yellow coloured bag to be handed separately to local urban bodies.
- CBWTF operators "shall ensure regular sanitisation of workers involved in handling and collection of biomedical waste and that they should be provided with adequate personal protective equipment including three-layer masks, splash-proof aprons/gowns, nitrile gloves, gumboots and safety goggles".
- Covid 19 waste must be disposed of immediately.