Chapter

2

Safe Laboratory Practice and Waste Disposal

Competency

BI 11.1: Describe good safe laboratory practice and waste disposal.

LABORATORY SAFETY

All clinical laboratory personnel are constantly exposed to various hazards like electric shock, radioactive material hazard, gaseous hazard, corrosive substances, and risk of handling biological material.

Recognition of hazard in the lab is of foremost importance along with the right attitude of the employer and employee towards safety measures to have a safe lab practice.

Safety Awareness for Laboratory Personnel

- Both employer and employee need to share the responsibility for effective implementation of safety practices in the lab.
- Employer need to formulate the laboratory work methods and safety policies and should provide time-to-time training to all employees.
- Personal protective equipment (PPE) consisting of gloves, eye shield, apron, cap, shoe cover should be provided to them. Employee should comply with the guidelines and should have positive attitude towards safety practices.
- Signage and labelling should be used liberally to identify the critical hazards and guidelines for precautions should be displayed at appropriate places.

Biological Safety

Clinical lab personnel deal with potential infectious blood and other biological samples. Utmost care should be taken while collecting, transporting, processing and analyzing such samples. Proper gloves, gowns, face protection should be practiced while handling such samples.

Any infectious material (blood, urine, or any other biological material), if spilled, should be taken care. 10% bleach should be used at spill site for appropriate time and then the site should be rinsed with water.

All the blood and other biological samples should be handled taking universal precaution considering all of them as potentially infectious.

Chemical Safety

Material safety data sheets (MSDS) for each hazardous compound at workplace should be obtained and all employees should be educated for its use and they should be clearly explained how to work safely with the chemicals.

Fire Safety

Fire extinguisher should be placed at appropriate place and all lab personnel should be trained for its use at the time of need.

Radiation Safety

All the places where radioactive material is stored should be labelled with cautious signage and entry of only authorized personnel should be allowed.

Disposal of Hazardous Material

Chemical material disposal: Most of the water-soluble chemicals may be flushed in the drain with large amount of water. Strong acid and strong bases should be neutralized first before discarding them in drain.

Possible chemical reaction in the drain between certain chemicals should be kept in mind and due precaution is to be taken. Foul smelling chemicals should not be disposed directly, rather they should be diluted first before being dumped in the drain.

Solid chemical waste can be buried in a landfill.

Radioactive material disposal: Radioactive material should be handed over to licensed receiver for safe disposal.

Handling Accidental Exposure to Acid and Alkali

Exposure to Acid

Various acids used in biochemistry laboratory are: Hydrochloric acid, nitric acid, sulfuric acid and acetic acid.

Exposure to skin

1. Wash with large quantity of water.
2. Apply 5% sodium carbonate solution with cotton wool.

Exposure to eye

1. Spray large quantity of water in eye.
2. Add 3 to 4 drops of 2% sodium carbonate in eye every 5 minutes till you consult ophthalmologist.

Swallowing of acid

1. Ask patient to drink 2 white of egg mixed in water or milk, alternatively ask him to drink soap water.
2. Ask him to gargle with soap water as well.
3. Ask him to drink 500 mL of normal water as well.
4. Apply 2% sodium bicarbonate to lips and tongue, if they are also burnt.

Exposure to Alkali

Commonly used alkalis in biochemistry laboratory are: Sodium hydroxide, ammonium hydroxide, and potassium hydroxide.

Exposure to skin

1. Wash with large quantity of water.
2. Apply 5% acetic acid with cotton wool.

Exposure to eye

1. Spray large quantity of water in eye.
2. Add 3 to 4 drops of saturated boric acid in eye every 5 minutes till you consult ophthalmologist.

Swallowing of alkali

1. Ask patient to drink lemon juice or diluted vinegar (1:3/vinegar: water).
2. Ask him to gargle with same acid solution.
3. Ask him to drink 500 mL of normal water as well.
4. Apply 5% acetic acid solution to lips and tongue, if they are also burnt.

BIOMEDICAL WASTE (BMW) MANAGEMENT

Difference between Hospital Waste and Biomedical Waste

Hospital waste: It refers to all waste, biological or non-biological that is discarded and not intended for further use.

Biomedical waste: It is defined as **"any solid, fluid and liquid or liquid waste, including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human being or animals".**

According to WHO:

- Nearly 85% of all waste generated by hospital is general waste.
- About 15% waste is biomedical waste, which includes:
  - Infectious waste—10%.
  - Non-infectious waste such as radioactive and chemical wastes—5%.

Why there is a Need of BMW Management?

Hospitals generate substantial quantity of waste that has potential to cause health and environmental hazards. Safe and sustainable management of biomedical waste (BMW) is social and legal responsibility of all people supporting and financing healthcare activities.

The need for effective biomedical waste management is due to following risks:

1. **Risk of infection** outside hospital for waste handlers, scavengers and at times, general public living in the vicinity of the hospitals.
2. **Injuries from sharps** leading to infection to all categories of hospital personnel and waste handlers.
3. **Risk associated with hazardous chemicals** and drugs to persons handling wastes at all levels.
4. Nosocomial infections in patients from poor infection control practices and poor waste management.
5. **Risk of recycling of "disposables"** which are being repacked and sold.
6. Risk of air, water and soil pollution directly due to waste, or due to defective incineration, emissions and ash.

On March 28, 2016, the Government of India published the **"Biomedical Waste Management Rules, 2016"** in supersession of the Biomedical Waste (Management and Handling) Rules, 1998.

Salient Features of BMW Management Rules, 2016 along with Biomedical Waste Management (Amendment) Rules, 2018

1. The scope of the rules has been expanded to include vaccination camps, blood donation camps, surgical camps or any other healthcare activity.
2. Phase-out the use of chlorinated plastic bags, gloves and blood bags within two years of notification of BMW Management 2016 Rules, i.e. by 27th March, 2018.
3. But as per the Bio-Medical Waste Management (Amendment) Rules, 2018, use of chlorinated plastic bags (excluding blood bags) and gloves has to be phased out by the 27th March, 2019.
4. Pre-treatment of the laboratory waste, microbiological waste, blood samples and blood bags through disinfection sterilization on-site in the manner as prescribed by WHO or NACO.
5. Provide training to all its healthcare workers and immunize all health workers regularly against diseases like tetanus and hepatitis B.
6. Establish a Bar-Code System for bags or containers containing biomedical waste for disposal within one year of notification of rules, i.e. 27th March, 2017. But as per the Bio-Medical Waste Management (Amendment) Rules, 2018, Bar-Code System has to be established in accordance with the guidelines issued by the Central Pollution Control Board by 27th March, 2019.
7. Report major accidents like needle stick injuries, broken mercury thermometer, accidents caused by fire, blasts during handling of biomedical waste and the remedial action taken.
8. Procedure to get authorization is simplified.
9. The new rules prescribe more stringent standards for incinerator to reduce the emission of pollutants in environment.
10. No hospital/healthcare facility (occupier) shall establish on-site treatment and disposal facility, if a service of "common biomedical waste treatment facility" (CBMWTF) is available at 75 km.
11. Operator of a common biomedical waste treatment and disposal facility to ensure the timely collection of biomedical waste from the healthcare facility and assist the healthcare facility in conducting training.

Steps in the management of biomedical waste include:

a. Generation
b. Segregation
c. Collection
d. Storage
e. Treatment
f. Transport
g. Disposal.

Colour Coding of Biomedical Wastes and their Disposal

Biomedical Waste Management Rules, 2016 has categorized the biomedical waste generated from the healthcare facility into four categories based on the segregation pathway and colour code.

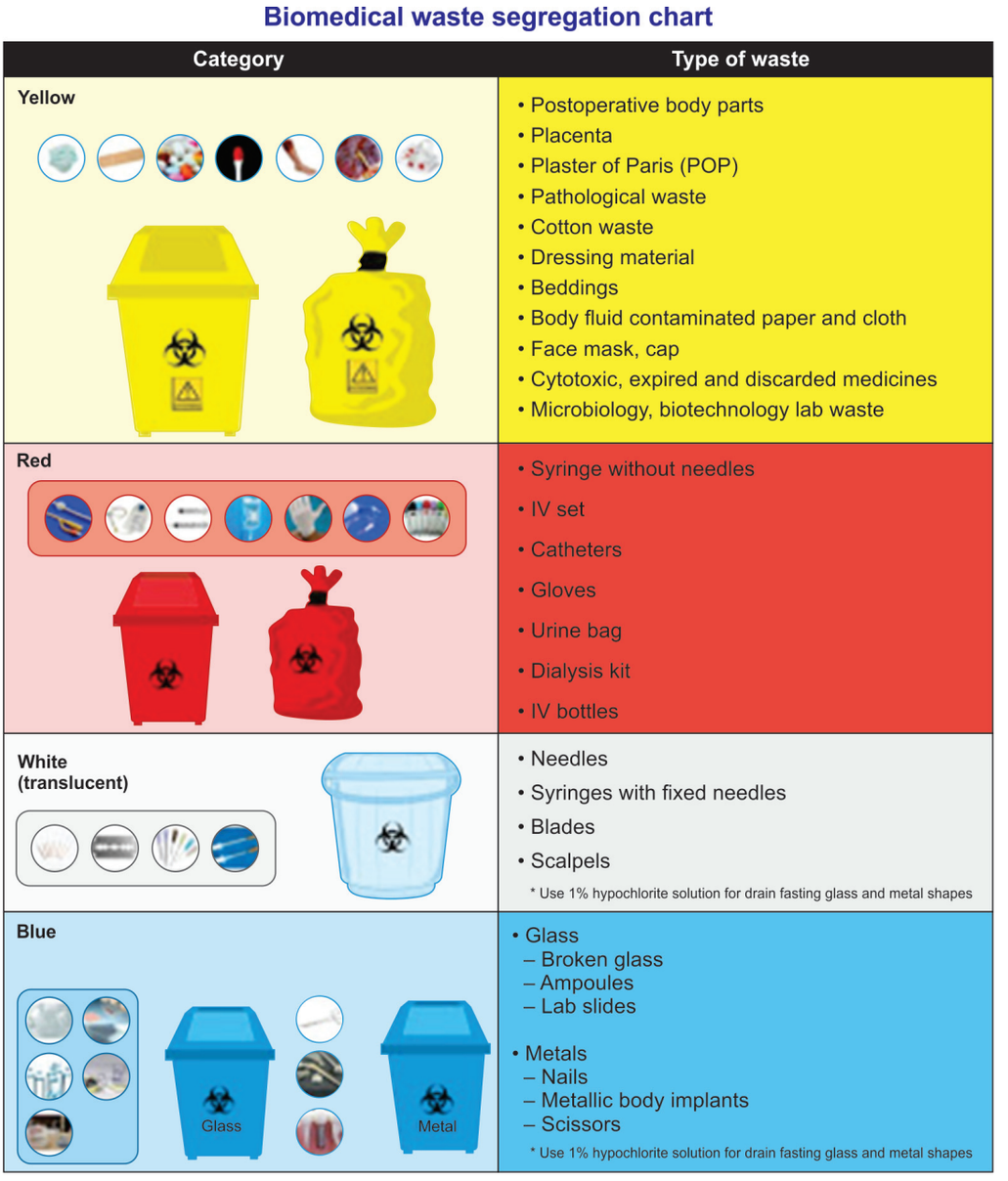

Fig. 2.1: Color coding of biowaste container

Various types of biomedical waste are further assigned to each one of the categories, as detailed below (Fig. 2.1):

1. Yellow category
2. Red category
3. White category
4. Black category

Biomedical wastes' categories and their segregation, collection, treatment, processing and disposal options are summarized in Table 2.1.

Table 2.1: Biomedical wastes' categories and their processing

Category	*Type of waste*	*Type of bag or container to be used*	*Treatment and disposal options*
Yellow	a. **Human anatomical waste** b. **Animal anatomical waste** c. **Chemical liquid waste:** Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, silver X-ray film developing liquid, discarded formalin, infected secretions, aspirated body fluids.	Yellow-coloured non-chlorinated plastic bags	Incineration or plasma pyrolysis or deep burial
	d. **Soiled waste:** Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components.		Incineration or plasma pyrolysis or deep burial* In absence of above facilities, autoclaving or microwaving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding.
	e. **Expired or discarded medicines:** Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials, etc.	Yellow-coloured non-chlorinated plastic bags or containers	Expired cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1200°C
	f. Discarded linen, mattresses, beddings contaminated with blood or body fluid	Non-chlorinated yellow plastic bags or suitable packing material	Non-chlorinated chemical disinfection followed by incineration or plazma pyrolysis or for energy recovery. In absence of above facilities, shredding or mutilation or combination of sterilization and shredding.
	g. **Microbiology, biotechnology and other clinical laboratory waste:** Blood bags, laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories	Autoclave safe plastic bags or containers	Pre-treat to sterilize with non-chlorinated chemicals on-site as per National AIDS Control Organization or World Health Organization guidelines thereafter for incineration

(*Contd.*)

Table 2.1: Biomedical wastes' categories and their processing *(Contd.)*

Category	*Type of waste*	*Type of bag or container to be used*	*Treatment and disposal options*
Red	**Contaminated waste (recyclable):** Wastes such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and *fixed needle syringes*), vacutainers, gloves	Red-coloured non-chlorinated plastic bags or containers	Autoclaving or microwaving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated material can be recycled
White (trans-lucent)	**Waste sharps including metals:** Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts	Puncture-proof, leak-proof, tamper-proof containers	Autoclaving or dry heat sterilization followed by shredding or mutilation or encapsulation in metal container. Combination of shredding-cum-autoclaving; and sent for final disposal to iron foundries
Blue	a. **Glassware:** Broken or discarded and contaminated glass including medicine vials and ampoules (except those contaminated with cytotoxic wastes) b. **Metallic body implants**	Cardboard boxes with blue-coloured marking Cardboard boxes with blue-coloured marking	Disinfection (by soaking in sodium hypochlorite) or through autoclaving or microwaving or hydroclaving and then sent for recycling

VIVA VOCE

Q1. How will you handle the acid spill on hand of your colleague?

Ans. *Exposure to skin*

1. Wash with large quantity of water.
2. Apply 5% sodium carbonate solution with cotton wool.

Q2. What is to be done in case of accidental ingestion of acid?

Ans. *Swallowing of acid*

1. Ask patient to drink 2 white of egg mixed in water or milk, alternatively ask him to drink soap water.
2. Ask him to gargle with soap water as well.
3. Ask him to drink 500 ml of normal water as well.
4. Apply 2% sodium bicarbonate to lips and tongue, if they are also burnt.

Q3. How will you handle the alkali spill on hand of your colleague?

Ans. *Exposure to skin*

1. Wash with large quantity of water.
2. Apply 5% acetic acid with cotton wool.

Q4. What is to be done in case of accidental ingestion of alkali?

Ans. *Swallowing of alkali*

1. Ask patient to drink lemon juice or diluted vinegar (1:3/vinegar:water).
2. Ask him to gargle with same acid solution.
3. Ask him to drink 500 ml of normal water as well.
4. Apply 5% acetic acid solution to lips and tongue, if they are also burnt.

Q5. What is biomedical waste?

Ans. *Biomedical waste* is defined as "any solid, fluid and liquid or liquid waste, including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human being or animals".

Q6. What is the need of effective biomedical waste management?

Ans. The need for effective biomedical waste management is due to the following risks:

1. Risk of infection outside hospital for waste handlers and scavengers and at times, general public living in the vicinity of the hospitals.
2. Injuries from sharps leading to infection to all categories of hospital personnel and waste handlers.
3. Risk associated with hazardous chemicals and drugs to persons handling wastes at all levels.
4. Nosocomial infections in patients from poor infection control practices and poor waste management.
5. Risk of recycling of "disposables" which are being repacked and sold.
6. Risk of air, water and soil pollution directly due to waste, or due to defective incineration, emissions and ash.

Q7. How to discard broken glass ampoules?

Ans. Broken or discarded and contaminated glass including medicine vials and ampoules (except those contaminated with cytotoxic wastes.)

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