
UNIT 2 GUIDELINES FOR WASTE DISPOSAL IN HOSPITAL

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2.0 OBJECTIVES

After completing this unit, you should be able to:

- identify the types of waste generated in the hospital and segregate the biomedical waste from rest of the waste;
- make understand for rationale for hospital waste disposal and potential hazards involved in improper waste disposal;
- explain the process of generation, segregation, transportation, treatment and final disposal of waste and technology involved in the process; and
- based on above to develop the sound practices of hospital waste disposal.

2.1 INTRODUCTION

Since beginning, the hospitals are known for the treatment of sick persons but the secret of these places which throw the adverse effect on human body and environment remained hidden till now. Now it is a well established fact that there

are many adverse harmful effects to the environment including human being which are caused by the hospitals. The secret of cause is the "Hospital Waste" generated while delivering the patient care. Hospital waste is a potential health hazard to the health care worker, public, and flora and fauna of the area. Disposal off hospital waste was witnessed by the health care providers and the common public but merely taken as a filthy and unwanted product. Discovery of hospital acquired infection, transfusion transmitted diseases, rising incidence of Hepatitis B and HIV, increasing land and water pollution leading to increase the possibility of many diseases, air pollution due to emission of hazardous gases by incinerator such as furan, dioxin, hydrochloric, etc. have compelled the authorities to think seriously about hospital waste and the diseases transmitted through improper disposal off hospital waste. The thrust area has now become a threat for the public health and ultimately the Central Government had to intervene for proper handling and disposal off hospital waste and passed an act in July, 1996 and made Biomedical Waste (Handling and Management) Rule in 1998.

A modern hospital is a complex, multidisciplinary system which consumes thousands of items for delivery of medical care and is a part of physical environment. All these products consumed in the hospital leave some unusable leftover i.e. hospital waste. The last century witnessed the rapid mushrooming of hospital in the public and private sector, dictated by the needs of expanding population and advent and acceptance of "disposable" has made the generation of hospital waste a significant factor in today's hospitals.

2.2 HOSPITAL WASTE

2.2.1 What is Hospital Waste

Hospital waste refers to all waste generated, discarded and not intended for further use in the hospital.

2.2.2 Types of Hospital Waste

- a) **General waste:** It is like household waste, e.g. paper, plastic, rappers etc.
- b) **Pathological waste:** It contains tissue, organ, body part, blood etc.
- c) **Infectious waste** which could cause the infection, e.g. culture stock, waste from laboratory, surgery and infectious patient.
- d) **Sharps** which could cause cut or puncture e.g. needle, scalpel, saw, glass, blade etc.
- e) **Pharmacological waste:** Example, unused or discarded drug, chemical etc.
- f) **Chemical waste:** Solid, liquid and gaseous chemical, e.g. cleaning, house keeping disinfecting product.
- g) **Radio active waste:** Solid, liquid and gaseous waste that is contaminated with radio nuclides.

2.2.3 Amount and Composition

In India the amount of hospital waste generated ranges between 1.5 kg–2 kg/bed/day.

Composition

- a) Non Hazardous 85%
- b) Hazardous 15%
 - 1) Hazardous but not infective 5%
 - 2) Hazardous and infective 10%

2.2.4 Biomedical Waste

Any solid, fluid and liquid waste including its container and any intermediate product which is generated during the diagnosis, treatment or immunization of human being or animal in research pertaining thereto, or in the production or testing of biological and the animal waste from slaughter houses or any other like establishments. All biomedical waste is hazardous.

Classification of Biomedical Waste (as per Biomedical Waste Management and Handling Rules, 1998)

Categories of Biomedical Wastes

Option	Waste Category Waste Class	Treatment and Disposal
Category 1	Human Anatomy Wastes (Human tissues, body parts)	Incineration deep burial*
Category 2	Animal Wastes (Animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals, discharge from hospitals, animals houses)	Incineration deep burial*
Category 3	Microbiology and Biotechnology Waste (Waste from laboratory culture, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)	Local autoclaving/micro-waving/incineration
Category 4	Waste Sharps (Needles, syringes, scalpels, blades, glass etc. that may cause puncture and cuts. This includes both used and unused sharps)	Disinfection (chemical treatment autoclaving/ micro-waving and mutilation/ shredding)

Option	Waste Category Waste Class	Treatment and Disposal
Category 5	Discarded Medicines and Cytotoxic drugs (Wastes comprising outdated, contaminated and discarded medicines)	Incineration/destruction and drugs disposal in secured landfills.
Category 6	Solid Waste (Items contaminated blood and body fluids including cotton, dressing, soiled plaster casts, lines bedding , other material contaminated with blood)	Incineration Autoclaving/microwaving
Category 7	Solid Waste (Waste generated from disposable items other than the waste sharps such as tubing, catheters, IV sets etc.)	Disinfection by chemical treatment and autoclaving/microwaving/shredding
Category 8	Liquid Waste (Waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities)	Disinfection by chemical treatment and discharged into drain
Category 9	Incineration Ash (Ash from incineration of any biomedical waste)	Disposal in municipal landfill.
Category 10	Chemical Waste (Chemical used in production of biologicals, chemicals used in disinfection, as insecticides etc.)	Chemical treatment and discharge into drains for liquid and secured landfill for solids.

Colour **Coding and** Type of Container for **Disposal** of Biomedical Wastes

Colour Coding	Type of Container	Waste Category	Treatment Option
Yellow	Plastic bag	Cat. 1, Cat. 2, Cat. 3 and Cat. 6	Incineration/deep burial
Red	Disinfected container/plastic bag	Cat. 3, Cat. 6, Cat. 7	Autoclaving/Microwaving/chemical treatment
Blue/White	Plastic bag/ puncture proof container	Cat. 4, Cat. 7	Autoclaving/Microwaving/chemical treatment and destruction/shredding
Black	Plastic bag	Cat. 5 and Cat. 9 and Cat. 10 (solid)	Disposal in secured landfill

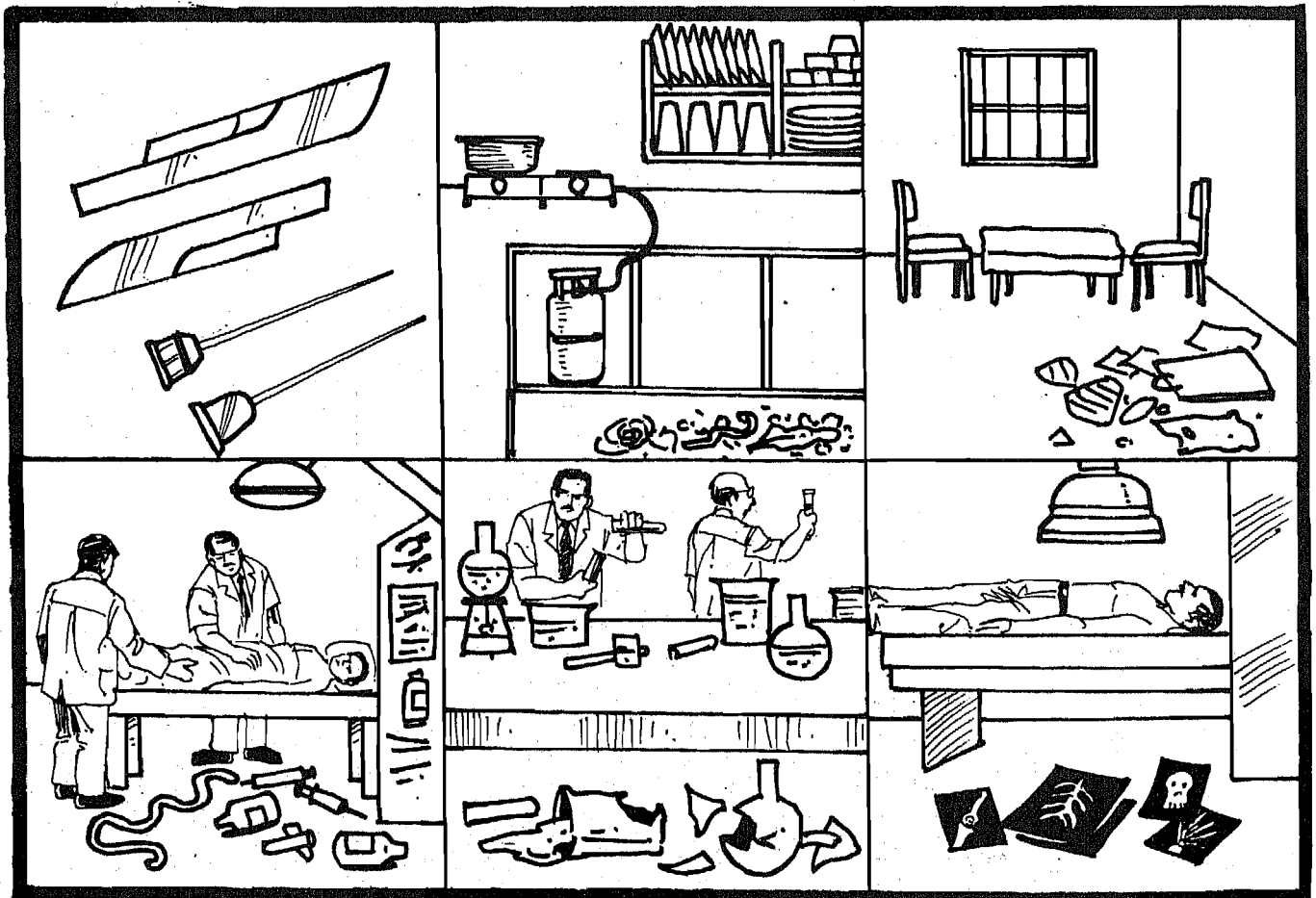


Fig. 2.1: Hospital Waste and Source of Generation

2.3 RATIONALE FOR WASTE DISPOSAL

2.3.1 Patients and Hospital Acquired Infections (Nosocomial Infection)

In last unit you have already learnt that nosocomial infections are developed in some of the patients due to hospitalisation. Infectious waste is one of the reasons for it. In addition to post operative wound infection, URI, UTI, there are more and more chances of developing HIV, Hepatitis B, etc. diseases. The hazardous waste is a potential reservoir of the infection and diseases in patients are transmitted through it.

2.3.2 Health Care Providers at Risk

In addition to patients, health care providers such as doctor, nurse, patient helper, technician, and sweepers are also exposed to develop many diseases including nosocomial infection if the waste is not properly handled and disposed. The other hazards are body injury, chemical burn, etc.

2.3.3 Population at Risk

Hospital waste without proper treatment if thrown in open area is also hazardous for the population in the vicinity. Ragpickers are mostly exposed to the diseases such as HIV and Hepatitis B.

2.3.4 Environmental Pollution and Hazards

Now it is well-established fact that there are many adverse harmful effects to the environment including human being which can be caused by hospital waste. It causes environmental pollution and effect man, animal, flora and fauna of the area. Air pollution due to emission of hazardous gases by incinerator, e.g. dioxin, furan, hydrochloric acid are very common. Environmental pollution includes air, water and soil contamination.

2.4 DEMONSTRATION OF WASTE GENERATION

A hospital consumes thousands of items for delivery of medical care. All those items leave some unusable leftovers. During the health care delivery, some products of the body such as blood, tissue, organ, pus, etc. are released which also become part of waste. Different types of waste are generated from different types of treatment and procedure. Here we will see that how the waste is generated in different areas of the hospital,

2.4.1 Visit to Ward

The following are the waste generated in ward:

- Leftover food
- Leftover drug
- Rappers of drug, syringe and edible items
- Bark of fruits—such as orange, banana etc.
- Needle and plastic syringe after use
- Dressing material after use (pus or blood soaked)
- IV canula, IV set and IV bottle pack
- Blood bottle pack and BT set

- Plaster material removed
- Chemical such as savlon, spirit, **betadine** used during dressing
- Disposable gloves, catheter and other tubes
- Used paper

2.4.2 Visit to Intensive Care Unit (ICU) and Operation Theatres (OTs)

During your visit to ICU and OT, you will observe that following wastes are generated.

- Leftover drugs and chemicals
- Rappers of drug, syringe and other consumable items:
- Needle and syringe and other types of consumable after use.
- Blood, tissue, body organ taken out during operation.
- Sponge and other items used for soaking.
- IV canula, IV set and IV bottle.
- Blood bottle and BT set.
- Chemical such as savlon, spirit, betadine, iodine used during dressing.
- Disposable syringe, gloves, face mask, cap, catheter and other items.
- Broken vials, ampule, blades, scalpels etc.

2.4.3 Visit to Laboratory

In the laboratory set-up following wastes are generated.

- Chemical, reagent, culture media used during experiment.
- Gloves, face mask used.
- Syringe, needle after use.
- Rappers of vials, ampule, bottles.
- Container used for sample collection.

2.4.4 Visit to Areas where Radioactive Material is Used

You will notice following waste material where you visit to areas radioactive material.

- Vials, bottles, syringes used for keeping and using the radioactive material.
- Gloves, syringe, needle, face mask etc.

2.4.5 Visit to Other Areas

In other areas you will find following wastes materials.

- a) Kitchen
 - Leftover food
- b) Blood bank
 - Syringe and needle after use
 - Blood used for testing
 - Gloves, face mask
 - Rappers of disposables
 - Paper

- c) Sample collection centre
 - Needle, syringe **after** use
 - Rappers of the consumables
 - Cotton swab **after** use
 - Drop out blood, CSF etc.
- d) Medical store
 - Drug and chemical rapper
 - Carton, used bottles
- e) Laundry
 - Unusable linen
- f) **Animal house**
 - Used animal
 - Blood
 - Gloves, syringe, chemical used
 - Sharps.

2.5 DEMONSTRATION OF SAFE DISPOSAL

2.5.1 Segregation and Container

Biomedical waste (hazardous) consists of approximately 15% of total waste generated in the hospital. Rest 85% waste is non-hazardous. But **infact**, usually the segregation of the waste is not done at the source of generation and all waste is mixed up. Therefore, the complete waste becomes **Hazardous**. Segregation is the essence of waste management. Biomedical Waste (Management and handling) Rules, 1998 has described 10 types of biomedical waste and different types of containers for segregation, collection and transportation of biomedical waste.

Demonstration – Biomedical waste

1) **Surgical Ward**

In surgical ward you will find many post operative patients. The dressing of the wound is done periodically. During the dressing of the patient following waste is generated:

- a) Removed gauze and cotton soaked with discharge or blood or both.
- b) While cleaning the wound some of the **chemical/antiseptic** solution used.
- c) Gauze and cotton used for cleaning the wound.
- d) Gloves **used** during cleaning the wound.
- e) Wound debridement was also done and tissue taken out.

Analysis

As per **Biomedical Waste Management and Handling Rule** following category of waste is generated and to be **segregated** and collected in different coloured containers.

Waste	Category	Container
Blood/pus soaked cotton gauze	Solid waste (Biomedical)	Yellow/Red plastic bag
Chemical/antiseptic solution	Chemical waste	Diluted and drained
Gauze/cotton used for cleaning the wound	Solid waste (Biomedical)	Yellow/red plastic bag
Gloves used for dressing	Solid waste (Plastic)	Blue/white
Tissue	Human Anatomical waste	Yellow plastic bag
Scalpel used	Sharp	Puncture proof container

Opinion

- a) Yellow, red, blue and white coloured plastic bags are required for collection of different types of waste.
- b) Waste should be segregated in different types of bags at the time of generation.

2) Blood Collection Centre and Laboratory.

You will find following types of waste generated in this area:

- a) Gauzelcotton used for applying the antiseptic on body.
- b) Syringe and needle used for drawing the blood.
- c) Blood drops fall down on table etc.
- d) Chemical discarded after testing the blood.
- e) Gloves used in drawing and processing the blood.
- f) Rapper of the syringe/needle.

Analysis

As per Biomedical Waste (Management and Handling) Rules, 1998, following types of waste is generated and to be segregated and collected in different types of containers.

Waste	Category	Container
Cotton/Gauze applied	Solid waste	Black Plastic bag
Needle used	Sharps	Puncture proof container
Syringe and gloves used	Solid waste (Plastic)	Blue/white bags
Blood and tissue–Human	Anatomical waste	Yellow plastic bag
Chemical discarded	Liquid waste	Diluted and drained
Rappers of syringe/needle	General waste	Black

Opinion

- a) Yellow, red, blue, white, black plastic bags and puncture proof container are required for segregation and collection of different types of waste.
- b) Before collecting the waste it should be segregated in different types of containers at the time of generation.

3) Operation Theatre

When you visit the operation theatre, you will find the following types of waste:

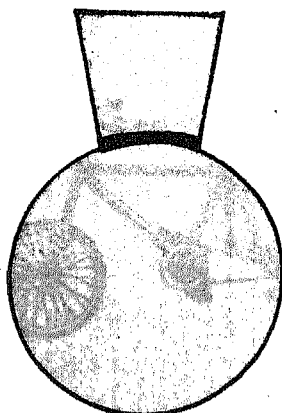
- a) Gauzelcotton and chemical/antiseptic used for part preparation
- b) Fresh blood and blood soaked sponges
- c) Body part/tissue removed during operation

- d) Gloves, face mask, cap (disposable)
- e) **Needle**, syringe, blades, scalpel, broken ampule used
- f) Rappers of needle, syringe, drugs and other consumables
- g) IV canula, IV* and BT set and bottles.

Analysis

As per Biomedical Waste (Management and Handling) Rules, 1998 you will find following category of waste generated and to be segregated and collected in different types of containers.

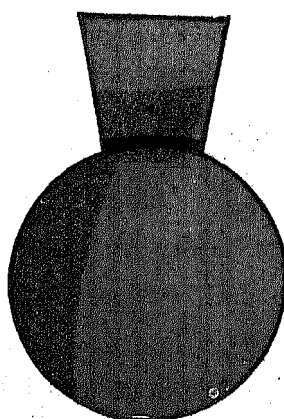
Waste	Category	Container
Gauze/cotton used	Solid waste	Black plastic bag
Blood, body part/Tissue	Human Anatomical waste	Yellow plastic bag
Gloves, syringe, Canula, IV and BT set and bottle	Solid waste (Plastic)	Blue/white bag
Needle, blade, scalpel, broken ampoule	Sharp waste	Puncture proof container
Rappers of needle, Syringe, drugs	Domestic waste	Black.



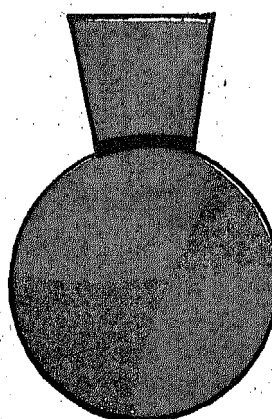
infectious Non-Sharp?Waste
(Incineration)*



Incineration Ash, Solid Chemical
Waste (Secured **Landfill**)



Plastic & Sharps (**Autoclave/Chemical/**
microwave, Shred, Recycle or Landfill)



Infectious Non-Sharp Waste
(Autoclave/Chemical/Microwave, Landfill)

• Fig. 22: **Colour** Coding of Waste Bags

Opinion

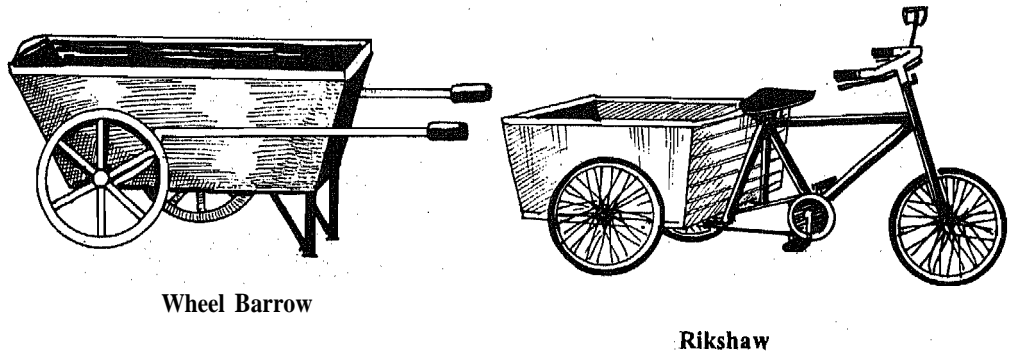
- a) Yellow, red, blue, white and black plastic bags and puncture proof containers are required for segregation and collection of different types of waste.
- b) Waste should be segregated at the time of generation.

2.5.2 Transportation

You have observed that how the different types of biomedical waste is generated, segregated at the source. The segregated waste in different plastic bags/puncture proof container is now collected by the person identified in same coloured large container. Each container is thoroughly closed and levelled for cytotoxic and bio-hazardous identification.

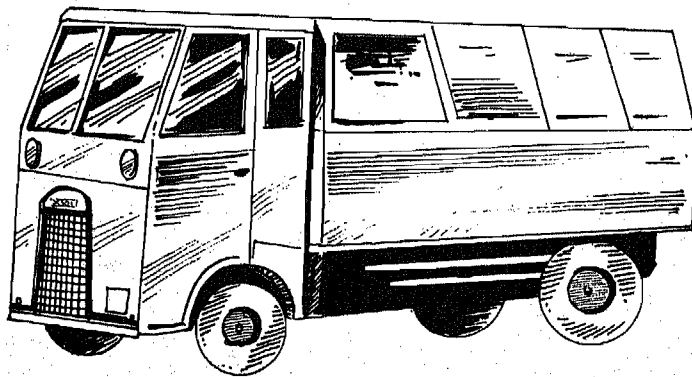
The transportation of the collected waste will now be transported by a central team of identified. Following are the pre-requisite for transportation:

- a) The waste transportation route must be designated and avoid the passage of waste through patient care area.
- b) Biomedical waste and general waste should be collected and transported separately.
- c) Dedicated wheeled container trolley or cart should be used and these should be cleaned and disinfected after use.



Wheel Barrow

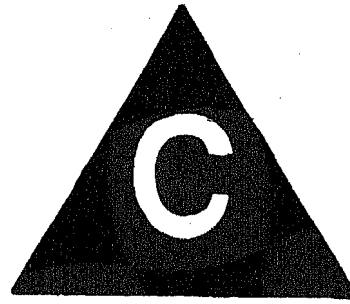
Rikshaw

**Fig. 2.3: Transportation**

- d) Transportation of waste for longer distance should be done in dedicated vehicle.
- e) All efforts to be done to prevent pilferage, spillage and transmission of infection.



Biohazard



Cytotoxic

Fig. 2.4: Handle with Care

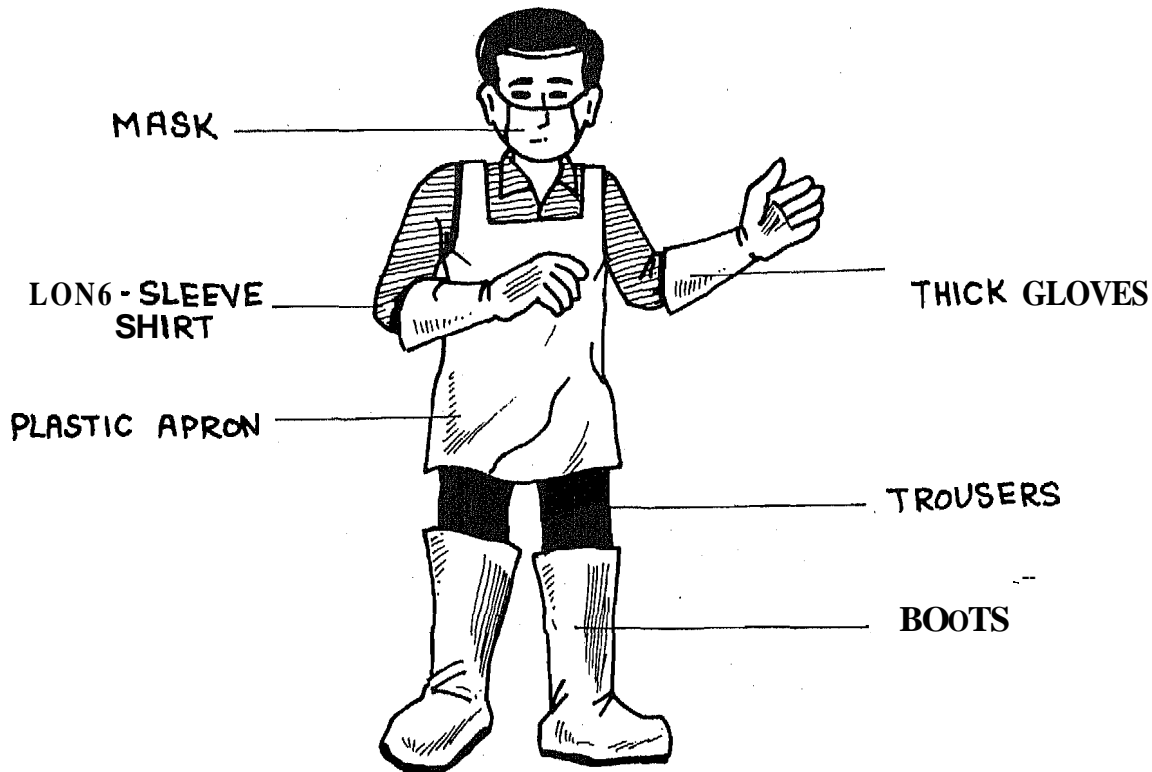


Fig. 2.5: Uniform for Cleaners and Transporters of Waste

2.5.3 Treatment and Disposal

You should know, before the final disposal of hospital waste, the treatment required for biomedical waste. The general waste (85%) does not require any treatment. This can be taken away by the local authority, rest 15% of hospital waste (biomedical) requires treatment. The objectives of treatment are:

- to disinfect the waste so that it is no longer the source of infection
- to reduce the volume of the waste for aesthetic reason.
- to make recycle items usable.

You have learnt that there are 10 categories of biomedical waste. Among all, the sharp category is very important. You must have observed that needle prick is very common to staff nurse or technician while they recap the used syringe.

Similarly broken ampoule, scalpel, blades are also likely to harm the body if not properly disposed. In view of potential hazard to doctor, nurses, technician *etc.*, it will be safe if these sharps are disinfected and destroyed at the time of generation, of waste (**immediately** after use). Watch how this can be possible.

- a) Take the syringe and needle for injection purpose or drawing the blood.
- b) Use the gloves and face mask before procedure is started.
- c) Once work is over, do not detach the needle from syringe and do not try to recap the needle.
- d) Put the needle inside needle destroyer and cut the **sharpened** end and thereafter put the complete structure in disinfectant.
- e) If needle destroyer is not available put the needle with syringe in the container of disinfectant.
- f) Leave the needle and syringe for 30-45 minutes and collect.
- g) Now the complete structure is disinfected and is no longer a biological hazard.
- h) The disinfectant used for disinfecting can be of any following types because most of the bacteria and virus including HIV are killed.
 - 1) 2% Gluteraldehyde solution
 - 2) 1% solution of hypochlorite solution
 - 3) 95% solution of ethyl alcohol
 - 4) 3% solution of hydrogen per oxide
 - 5) 5% solution of formaldehyde
 - 6) 0.5% solution of lysol
 - 7) **Boiling**

The rest of the biomedical waste is treated with following ways.

1) Autoclave and Microwave Treatment

In previous unit you have learnt that how the autoclave functions. The same principle is applied here. The principle is that some category of the waste should be autoclaved first and make it disinfected then send for final disposal. Waste category 1, 2, 3, 4, 6, 7 should be treated by this method.

Microwaving and hydroclaving are advance methods of sterilization of the waste.

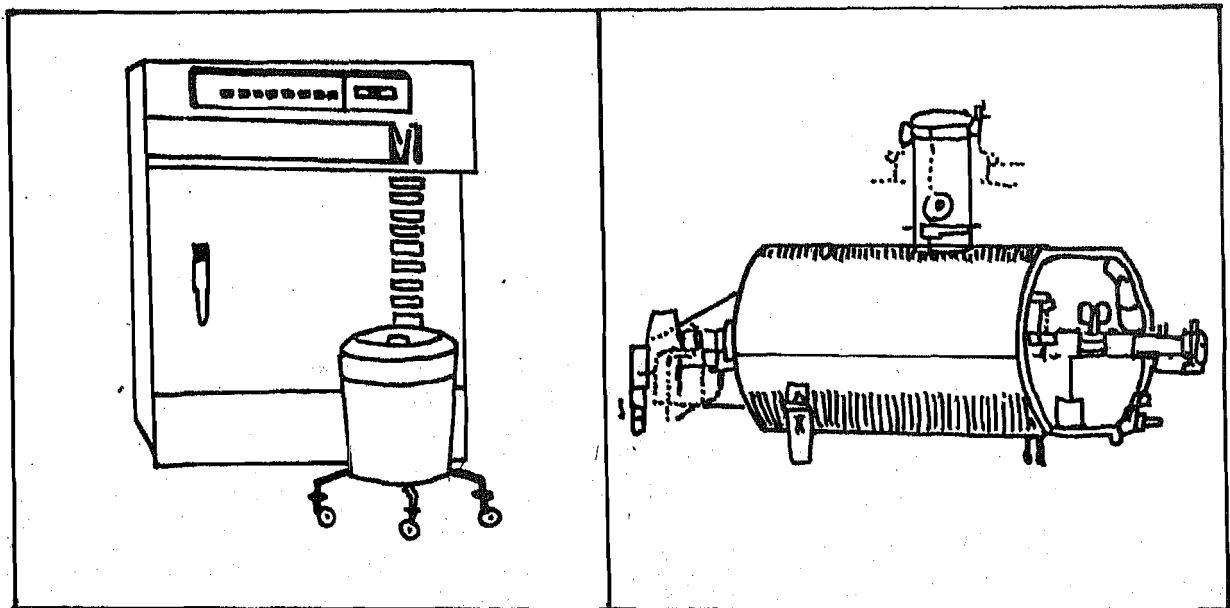


Fig. 2.6(a): Microwave

Fig. 2.6 (b): Hydroclave

2) Deep Burial

Certain waste like category 1, 2 after autoclaving should be disposed by deep burial to avoid the access of man and animal. Similarly waste sharp, should be disposed. This process can be applied in the cities where population is less than 5 lakh.

3) Land Filling

Waste like category 3, 4, 6, 7 after autoclaving can be used for land filling of low lying area. General waste can also be used for this purpose. Secured land filling is required for incinerator ash, discarded medicine, cytotoxic substances of solid chemical waste.

4) Shredding

The plastic materials such as IV canula, IV/BT set, bottle and other types of plastic can be shredded after disinfection or autoclaving. The plastic can be sold for reuse because now it is safe (non-infected),

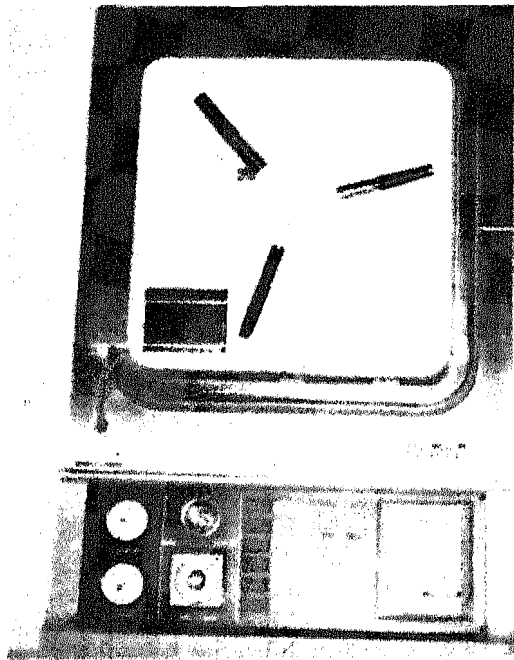


Fig. 2.6(c): Autoclaving Machine

5) Incineration

The waste category 1, 2, 3, 5 can be incinerated. It is very often seen that all category waste is just thrown inside the incinerator but it is not correct. Incinerators are of many kind but diesel operated (oil fired) is the best one. They generate the desired temperature for combustion and also are cost effective

The incinerator should meet the standards for combustion efficiency, emission and ash 'as laid down by pollution control board. The desired temperature of primary and secondary chamber are $800^{\circ}\text{C} (\pm 50^{\circ}\text{C})$ and $1050^{\circ}\text{C} (\pm 50^{\circ}\text{C})$ respectively.

The incinerator is very harmful if it does not meet the criterias. Gases like furan, dioxin, hydrogen chloride are emitted and are very harmful to the human population. They are carcinogenic and effect the lungs. The environmental pollution is very common.

Demonstration

- Identify the waste to be incinerated i.e. category 1, 2, 3, 5, 6
- Put all together in cart, wheel barrow, trolley and bring to the incinerator.
- Put all waste inside the incinerator depending upon capacity and close the door.
- Start the burners of primary chamber.
Measure and monitor the temperature of primary and secondary chamber.
- Watch the smoke coming out of stake, if it is thick black, it shows that the combustion is incomplete.
- After desired hours take out the incinerator ash.

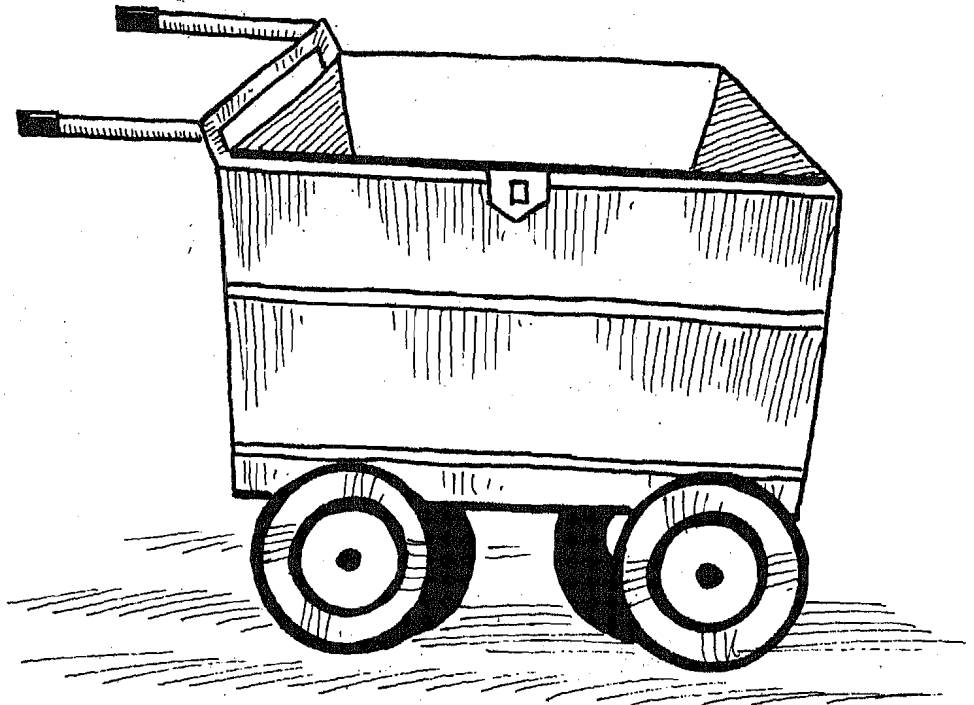


Fig. 2.8: Trolley for Transporting Hospital Waste

- Periodical inspection of the incinerator should be done for the following:
 - a) Incineration ash
 - b) Gases coming out from stake
 - c) Material to be incinerated.
- The ash is to be land filled properly. Now you can understand that the incineration is quite different from the burning. Incineration process kills all bacteria and reduces the volume to negligible quantity (ash).

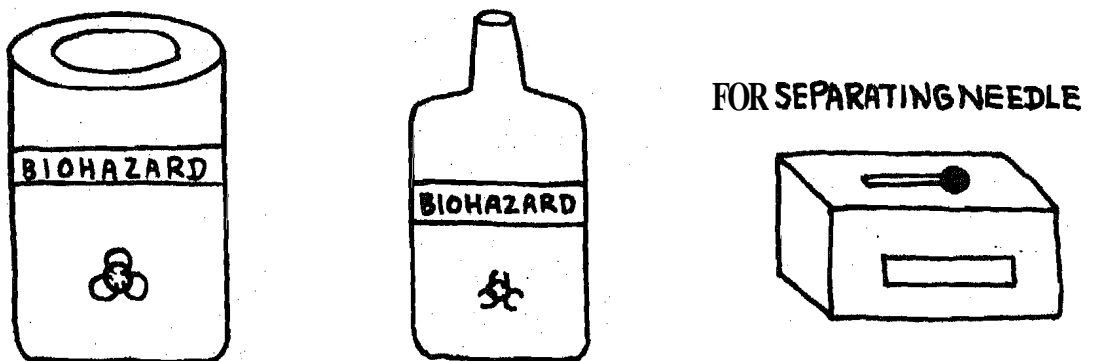


Fig. 2.9: Containers for Needles, Surgical Blades

2.6 EDUCATION, TRAINING AND SAFETY MEASURES

Each and every hospital must have well planned awareness and training programme for all category of personnel including administrator. Practice of universal precautions should be followed by all categories of hospital **employee** coming in contact of **hospital** waste, They should also be immunized for disease like Hepatitis B.

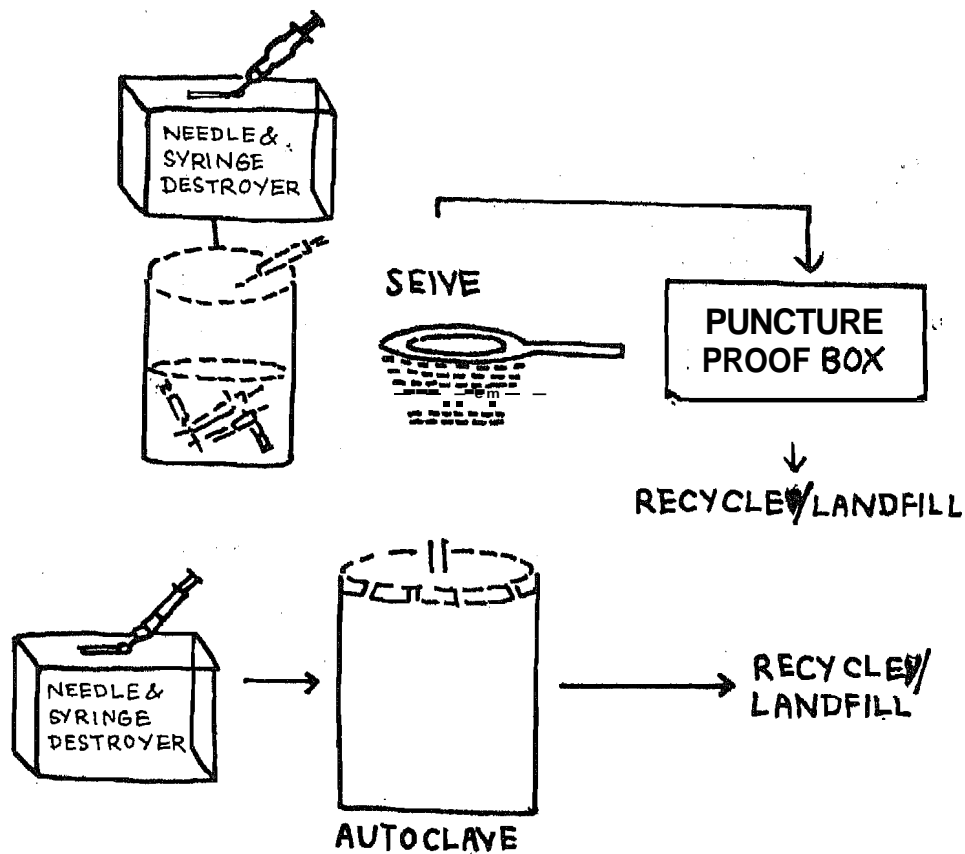


Fig. 2.10: Needle and Syringe

Demonstration – Universal precaution and waste

- Wash the hand with soap and running water before and after examining the patient and generating the waste.



Fig. 2.11: Hand Washing

- Put on gloves on hand, face mask before you go for dressing the patient, examining the infected patient.

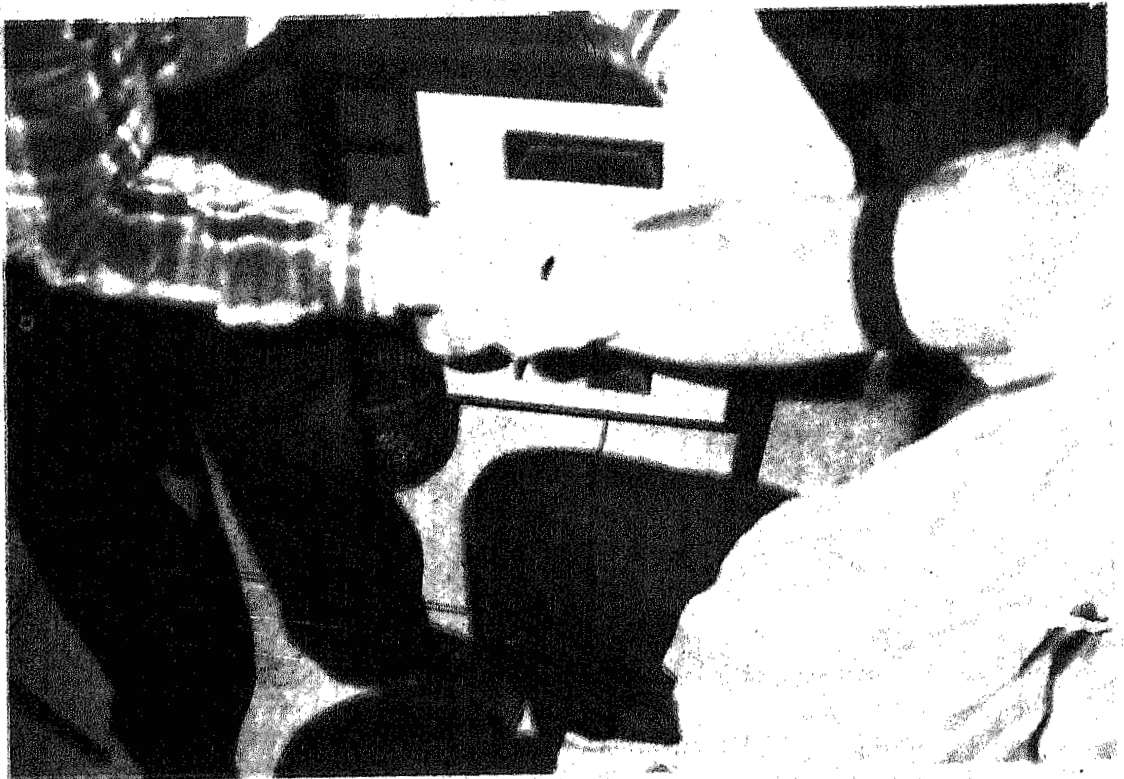


Fig. 2.12: Measures for Universal Precautions

- Throw the blood/pus soaked cotton, gauze in separate container identified for it i.e. yellow plastic bag.
- After examination generate the waste, throw the gloves in identified container (blue/white plastic bag).
- Use the sterile consumables on patients.
- Discard the needle immediately after use by needle destroyer and then put the needle and syringe inside disinfectant for one hour.
- Segregated waste at source should be collected in covered container for further disposal.
- Wash the hands after process.

2.7 · LET US SUM UP

In this unit of practical manual you have learnt that only 15% of waste is biohazardous. The average production of hospital waste is approximately 1.5-2.0 kg/bed/day. The waste should be segregated at source of generation to avoid complete waste hazardous. Therefore, segregation is essence for hospital waste management.

You have also learnt that Government of India, Ministry of Forest and Environment has passed the rules for safe hospital waste disposal known as Hospital Waste (Management and Handling) Rules, 1998 and as these rules, the waste has been classified into ten categories.

You have also learnt that waste collection is to be done in prescribed coloured bags and containers. Hazardous and non-hazardous waste to be collected and transported separately.

You have learnt the need to treat the biomedical waste to be treated before final disposal. Disinfecting the sharps at point of generation and autoclaving, incineration are the effective methods of treatment. Incinerator causes environmental pollution if it does not meet the standards laid down by Ministry of Forest and environment.

Practices of universal precautions to be adopted while dealing with biomedical waste have also been discussed and the need for educating/training all the categories of employees in the hospital for safe disposal of waste has also been emphasised.