

Biomedical Waste:

Bio-medical waste means “any solid and/or liquid waste produced during diagnosis, treatment or vaccination of human beings or animals.

Biomedical waste creates hazard due to two principal reasons: infectivity and toxicity.



Waste sharps



Discarded medicines



Human anatomical waste



Solid waste

Figure 1. Biomedical waste

Sources

- The source of biomedical waste is the place or the location at which biomedical waste has been generated.
- The source of biomedical waste is classified into two types based on the quantity of waste generated.
- They include major and minor source.
- **Major source** generates more amount of biomedical waste compared to minor source and also there is regular generation of biomedical waste in the major source which includes government hospitals, private hospitals, nursing home and dispensaries.
- **Minor source includes** physicians and dental clinics.



Sources of Bio-Medical Waste

Major Sources

- Hospitals
- Labs
- Research centers
- Animal research
- Blood banks
- Nursing homes
- Mortuaries
- Autopsy centers

Minor sources

- Clinics
- Dental clinics
- Home care
- Cosmetic clinics
- Paramedics
- Funeral services
- Institutions

Classification:

- The classification of the biomedical waste is carried out based on its characteristics, source of generation and the level of hazard to the environment.
- The biomedical waste is classified into two types:
 1. Non hazardous waste
 2. Hazardous waste

- **Non-hazardous waste:** About 75% to 90 % of biomedical waste characteristics were similar to that of domestic waste and are non-risky in nature. This waste is generated mainly from the organization and maintenance of hospital and health care centers.
- **Hazardous waste:** The remaining 10 – 25% of biomedical waste falls under the hazardous waste categories. The hazardous waste contains infectious characteristics of about 15% - 18 % and toxicity characteristics of about 5% - 7%. The various hazardous wastes includes,

- **Infectious waste:** Waste containing pathogens; e.g. excreta; laboratory cultures; isolation wards waste; swabs, materials, or equipments that have been in contact with infected patients.
- **Pathological waste:** Human tissues or fluids e.g. body parts; blood and other body fluids; fetuses.
- **Pharmaceutical waste:** Waste containing pharmaceuticals; e.g. pharmaceuticals that are expired or no longer needed; contaminated pharmaceuticals (bottles, boxes).
- **Genotoxic waste:** Waste containing cytostatic drugs (often used in cancer therapy)/ genotoxic chemicals.

- **Chemical waste:** Waste containing chemical substances e.g. laboratory reagents; film developer; disinfectants and solvents that are expired or no longer needed.
- **Wastes with high content of heavy metals:** Batteries, Broken thermometers, blood pressure gauges, Pressurized containers, gas cylinders, gas cartridges, aerosol cans.
- **Radioactive waste from radiotherapy:** Waste containing radioactive substances e.g. unused liquids from laboratory research; contaminated glassware, packages or absorbent paper; urine and excreta from patients treated or tested with uncapped radionuclide

Biomedical Waste management:

- Proper management of biomedical waste is highly essential since it induces various risk to the human health and to the surrounding ecosystem that leads to the ecological hazard, professional hazard and public hazard. Steps involved in biomedical waste management was shown in Figure 3

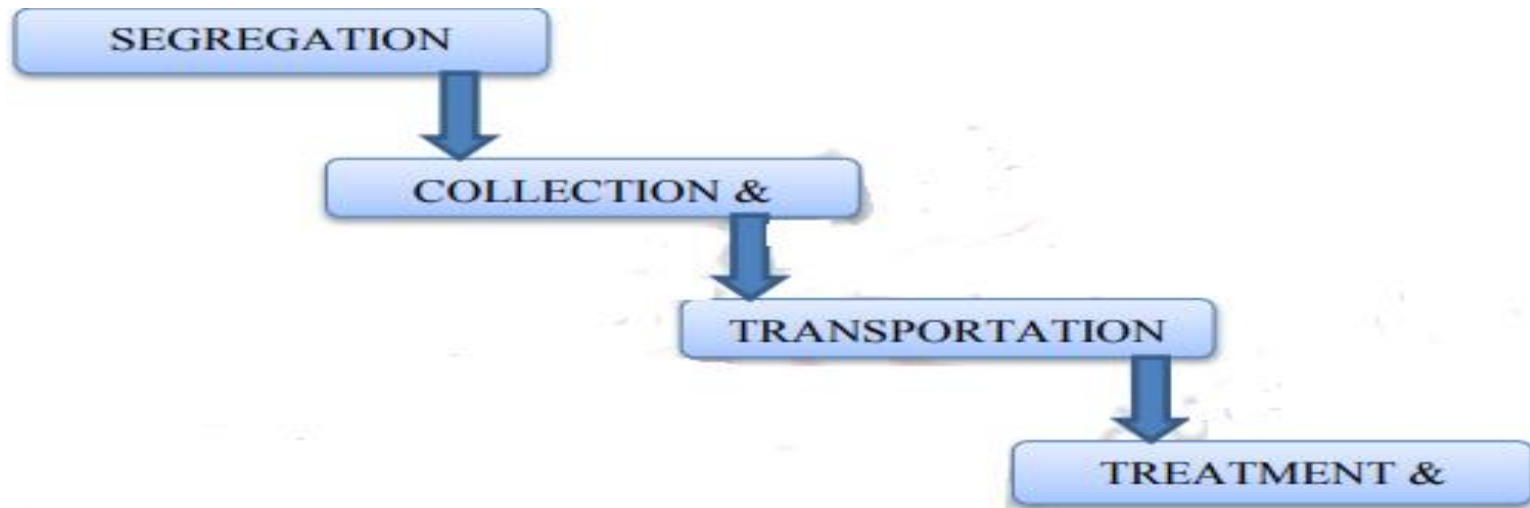


Figure 3. Steps involved in biomedical waste management

Segregation

- To avoid mixing of the biomedical waste with other, a container should be set to the side with colour coding bags at the point of generation.
- The sorting or separation of waste into different categories is referred as segregation.
- Segregation will decrease or minimize the risks in addition to rate of managing and disposal. Segregation is the most important and critical step in bio-medical waste management.
- Only, effective segregation can confirm the effective bio-medical waste management.

SEGREGATION

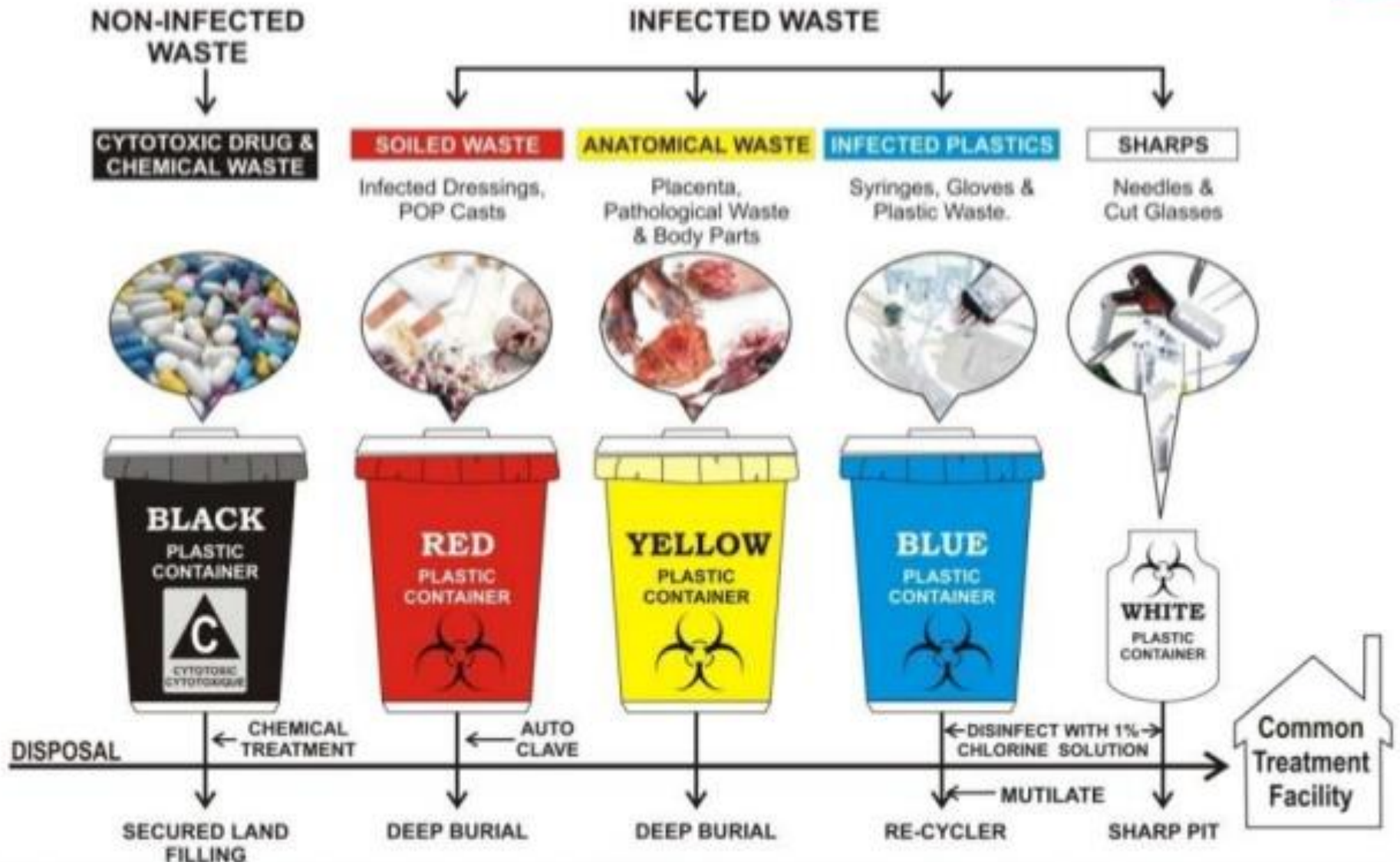


- Segregation refers to the basic separation of different categories of waste generated at source and thereby reducing the risks as well as cost of handling and disposal.
- Segregation is the most crucial step in bio-medical waste management. Effective segregation alone can ensure effective bio-medical waste management.
- The BMWs must be segregated in accordance to guidelines laid down under schedule 1 of BMW Rules, 2016.





SEGREGATION OF SOLID BIO-MEDICAL WASTE



NOTE:- USE ANY COLORED BIN OTHER THAN BLACK, RED, YELLOW, BLUE & WHITE FOR DISPOSAL OF GENERAL WASTE

Methods of disposal of bio-medical waste and their segregation

WASTE CATEGORY	TYPE OF WASTE	TREATMENT AND DISPOSAL OPTION
Category No. 1	Human Anatomical Waste (Human tissues, organs, body parts)	Incineration@ / deep burial*
Category No. 2	Animal Waste (Animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals and colleges, discharge from hospitals,)	Incineration@ / deep burial*
Category No. 3	Microbiology & Biotechnology Waste (Wastes from laboratory cultures, stocks or specimen of live microorganisms, human and animal cell cultures used in research and infectious agents from research and industrial laboratories, wastes from production of biological, toxins and devices used for transfer of cultures)	Local autoclaving / microwaving / incineration@

<p>Category No. 4</p>	<p>Waste Sharps (Needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)</p>	<p>Disinfecting (chemical treatment@@ / autoclaving / microwaving and mutilation / shredding</p>
<p>Category No. 5</p>	<p>Discarded Medicine and Cytotoxic drugs (Wastes comprising of outdated, contaminated and discarded medicines)</p>	<p>Incineration@ / destruction and drugs disposal in secured landfills</p>
<p>Category No. 6</p>	<p>Soiled Waste (Items contaminated with body fluids including cotton, dressings, soiled plaster casts, lines, bedding and other materials contaminated with blood.)</p>	<p>Incineration@ / autoclaving / microwaving</p>
<p>Category No. 7</p>	<p>Solid Waste (Waste generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets, etc.)</p>	<p>Disinfecting by chemical treatment@@ / autoclaving / microwaving and mutilation / shredding# #</p>

Category No. 8	Liquid Waste (Waste generated from the laboratory and washing, cleaning, housekeeping and disinfecting activities)	Disinfecting by chemical treatment@@ and discharge into drains
Category No. 9	Incineration Ash (Ash from incineration of any biomedical waste)	Disposal in municipal landfill
Category No.10	Chemical Waste (Chemicals used in production of biological, chemicals used in disinfecting, as insecticides, etc.)	Chemical treatment @@ and discharge into drains for liquids and secured landfill for solids.

COLLECTION, TRANSPORTATION, STORAGE (WITHIN THE HOSPITAL)

Transportation



- The collection of biomedical waste involves use of different types of container .
- The containers/ bins should be placed in such a way that 100 % collection is achieved.
- Sharps must always be kept in puncture-proof containers to avoid injuries and infection to the workers handling them.

STORAGE

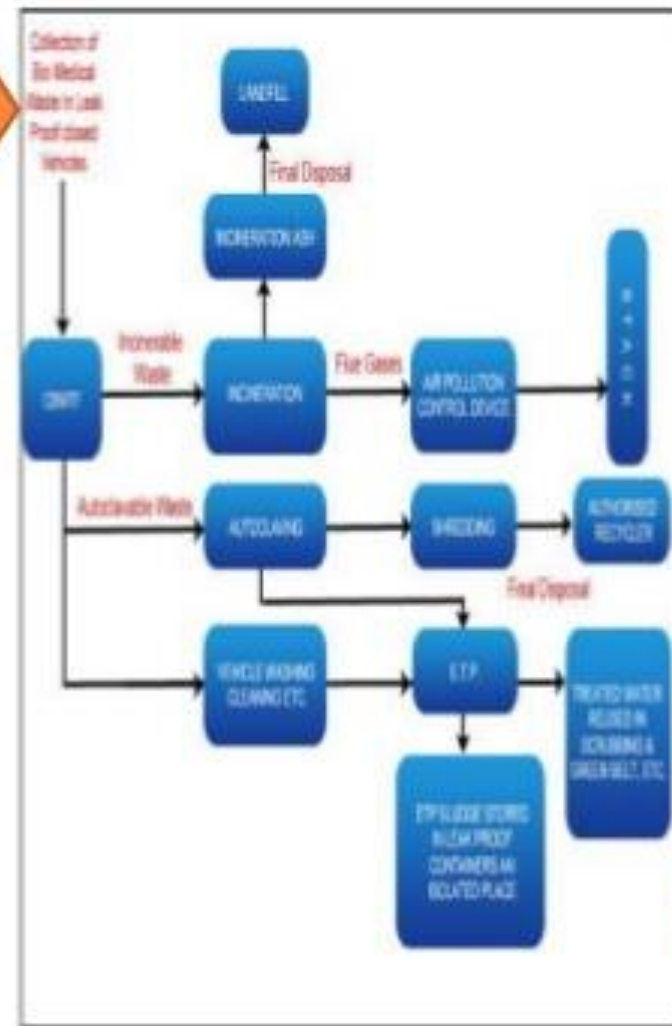


Once collection occurs then biomedical waste is stored in a proper place. Segregated wastes of different categories need to be collected in identifiable containers. The duration of storage should not exceed for 8-10 hrs in big hospitals (more than 250 bedded) and 24 hrs in nursing homes. Each container may be clearly labelled to show the ward or room where it is kept. The reason for this labelling is that it may be necessary to trace the waste back to its source. Besides this, storage area should be marked with a caution sign.

TRANSPORT



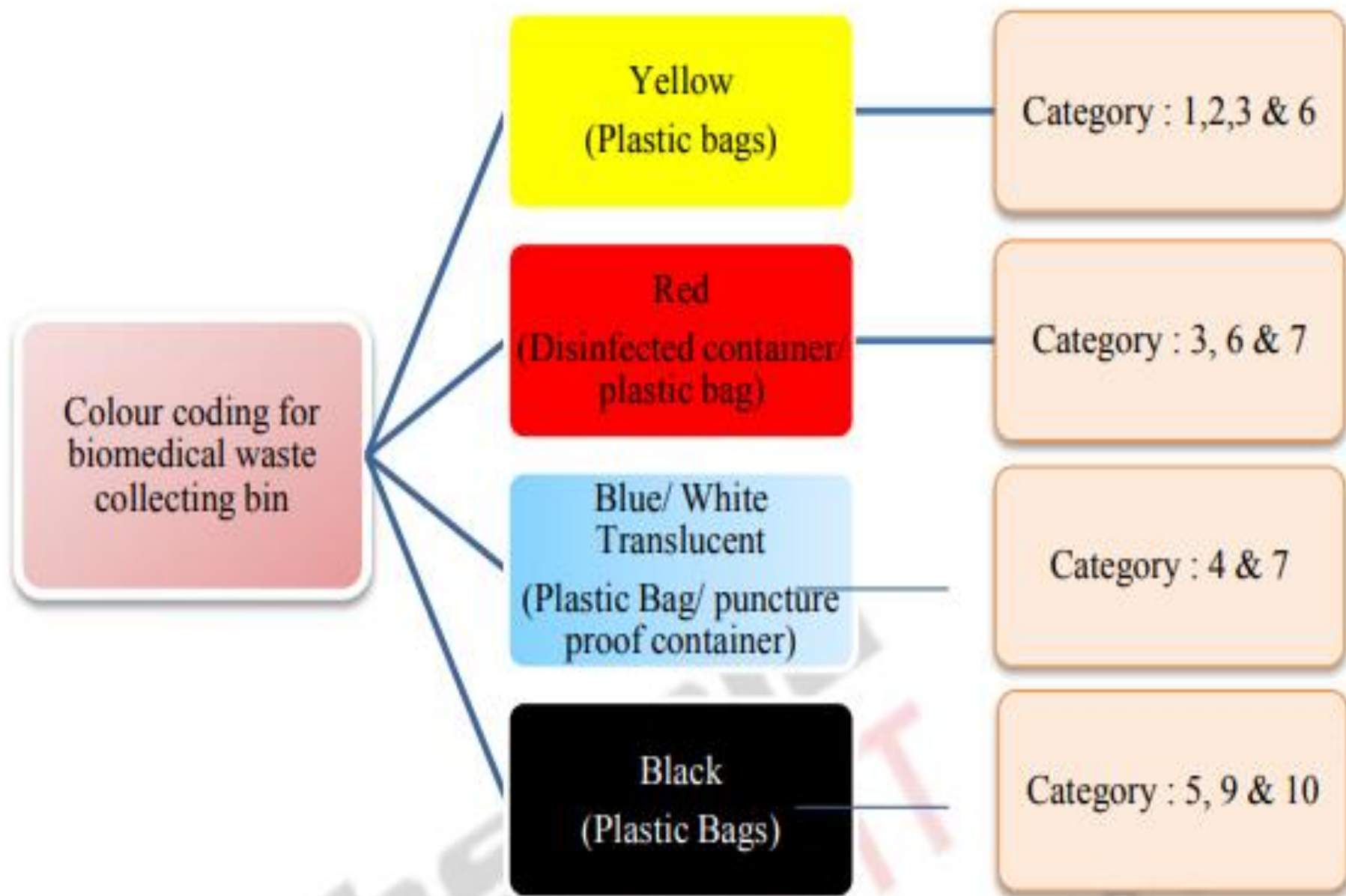
Final Transport of BMW must be to CBMWT SDF only in authorized vehicle with appropriate documentation for further record.



Transportation

- The collected wastes are transported in trolleys or in enclosed wheelbarrow for treatment. The operator should ensure to avoid manual loading.
- The bags / Container containing biomedical wastes must be tied/lidded before hauling for treatment. Vehicles used for transporting should be special to avoid contact to, and direct contact with the operator, scavengers and the public.
- While transporting the containers, it must be properly enclosed. The effects of traffic accidents should be incorporated in the design, and the driver must be trained in the actions which must be followed in case of an accidental spillage. The interior of the containers should also be rinsed thoroughly.

- **Trolleys** The use of trolleys will make the elimination of infectious waste possible at the source itself, instead of accumulation a new category of waste.
- **Wheelbarrows** Wheel barrows are used to transfer the waste from the point source to the collection centers.
- **Dustbins** It is very important to calculate the amount of waste generated at each point. Dustbins should be of such capacity so that it can be placed at this specific site and that they do not overflow between each cycle of waste collection.
- Dustbins have to be cleaned subsequently at each cycle of clearance of waste with disinfectants. Dustbins can be wrapped with plastic bags, which are chlorine-free, and colour coded as per the law.



COLOR CODING FOR SEGREGATION OF BIOMEDICAL WASTE: -

COLOR	WASTE	TREATMENT
Yellow	Human & Animal anatomical waste / Micro-biology waste and soiled cotton/dressings/linen/beddings etc.	Incineration / Deep burial
Red	Tubing's, Catheters, IV sets.	Autoclaving / Microwaving / Chemical treatment
Blue / White	Waste sharps (Needles, Syringes, Scalpels, blades etc.)	Autoclaving / Microwaving / Chemical treatment & Destruction / Shredding
Black	Discarded medicines/cytotoxic drugs, Incineration ash, Chemical waste.	Disposal in secured landfill





HEALTH IMPACTS OF BIO-MEDICAL WASTE

- Poor hospital waste management may cause the following:
 - Hepatitis B & C
 - HIV infection
 - Gastro-enteric infection
 - Respiratory infection
 - Blood stream infection
 - Skin infection
 - Radioactive toxicity
 - Health problems associated with air and water pollution.

PROBLEM ASSOCIATED WITH BMW



ORGANISM	DISEASES CAUSED	RELATED WASTE ITEM
<u>VIRUSES</u> HIV, Hepatitis B, Hepatitis A,C, Arboviruses, Enteroviruses	AIDS, Infectious Hepatitis, Infectious Hepatitis, Dengue, Japanese encephalitis, tick-borne fevers, etc.	Infected needles, body Fluids, Human excreta, soiled linen, Blood, body fluids.
<u>BACTERIA</u> Salmonella typhi, Vibrio cholerae, Clostridium Tetani, Pseudomonas, Streptococcus	Typhoid, Cholera, Tetanus Wound infections, septicemia, rheumatic fever, endocarditis, skin and soft tissue infections	Human excreta and body fluid in landfills and hospital wards, Sharps such as needles, surgical blades in hospital waste.
<u>PARASITES</u> Wucheraria Bancrofti, Plasmodium	Cutaneous leishmaniasis, Kala Azar, Malaria	Human excreta, blood and body fluids in poorly managed sewage system of hospitals.

Effects of 'improper hospital waste management

- Collection, reuse or resale of the single-use products without adequate treatment results in spread of infection
- Infections to waste handlers, especially the rag pickers & pourakarmikaas
- Improper burning or sub standard incineration of these plastics release dioxins and furans which are carcinogenic in nature
- Improper landfilling or dumping them results in leaching & contamination of soil & surrounding water bodies.

Responsibility



Infection control is everyone's business.



You are not only protecting yourself, but also those around you



INFECTION PREVENTION

CENTER FOR DISEASE CONTROL AND PREVENTION (CDC).

- HAND WASHING
- WEARING HAND GLOVES
- MASK, CAPS
- APRON, GARMENT, GOWN
- EYE PROTECTION
- ENVIROMENTAL PROTECTION

Treatment and disposal

- Before its final disposal of biomedical waste, it must be disinfected.
- Anatomical waste can be disposed by deep burial. Syringes to be cut (with hub cutters) and chemically disinfected with 1% bleaching powder solution at source of generation before final disposal into sharps pit.
- Infected plastics to be chemically disinfected or autoclaved, shredded and recycled and sent for final disposal into municipal dumps.

Incineration

- Most of the hazardous biomedical wastes was treated by the method of incineration to reduce organic and combustible waste to inorganic incombustible matter.
- Incineration is a high temperature, dry oxidation process that results in significant reduction of waste volume and weight.
- Wastes that cannot be reused, recycled or pose problem in disposing in landfills are treated by incineration. Examples of wastes that cannot be incinerated are chemical wastes, wastes containing high mercury or cadmium (broken thermometers, second-hand batteries, and lead lined wooden panels, sealed ampules or ampules containing heavy metals), silver salts, pressurized gas containers, photographic or radiographic wastes, halogenated plastics such as PVC.
- The advantages of incinerator include high reduction of waste volume in addition to good disinfection competence.
- It helps to save the space in the landfill. The ash generated can be disposed of safely in the landfills.

Autoclaving of Biomedical

- Autoclaves are used to sterilize medical instruments for reuse and also for the destruction of harmful medical waste.
- Autoclaves are chambers which apply high levels of heat and steam in order to kill harmful microorganisms in order to sterilize medical items.
- After the treatment in autoclaves, the medical waste can usually be disposed in landfills.

Biomedical Liquid

- Waste Before disposing the liquid form of biomedical waste into the sewer, it must be treated.
- Pathological waste after being treated with chemical disinfectants are flushed into the sewage system.
- Likewise, the chemical waste is neutralized with suitable reagents and then either flushed or treated in the sewage treatment plant.
- Mostly they are neutralized and dumped in sewer network.
- Highly skilled operators are required for this technique as it involves handling of hazardous substances.
- The biomedical waste effluent generated from the various source should conform to the following limits shown in Table 2. Environment (Protection) Act, 1986 prescribes the discharge limits of these waste into public sewers

Table 2. Disposal standard for biomedical waste

Parameters Permissible limits

pH	6.5-9.0
Suspended solids	100 mg/L
Oil and grease	10 mg/L
Biochemical Oxygen Demand (BOD)	30 mg/L
Chemical Oxygen Demand (COD)	250 mg/L

Microwave Treatment

- Microwave treatment uses a frequency and wavelength of 2450 MHz and 12.24 cm, respectively for the destruction of microorganisms.
- The infectious contaminants in water with biomedical waste are destroyed by heat conduction when it is rapidly heated by the microwaves.
- The biomedical waste is evenly heated to a temperature of 97-100°C by means of microwaves in treatment chamber.
- Treatment of biomedical waste by microwaving can be carried out in the source itself.
- No shredding is required for microwave treatment of waste.
- Most infectious wastes except body parts, human organs, infected animals carcasses and metal objects are suitable for treatment by microwave technique.
- This method shows good disinfection competence with good waste shrinking capacity. Similar to incineration this method also involves high operating costs.
- It is an eco-friendly process with potential operation and maintenance problems

Treatment and disposal of biomedical waste (Source: Biomedical Waste (Handling and management Rules 1998))

WASTE CATEGORY	TREATMENT AND DISPOSAL OPTION
Category No. 1	Incineration / deep burial
Category No. 2	Incineration / deep burial
Category No. 3	Local autoclaving/ microwaving / incineration
Category No. 4	Disinfecting (chemical treatment / autoclaving / microwaving and mutilation / shredding)
Category No. 5	Incineration / destruction and drugs disposal in secured landfills
Category No. 6	Incineration/ autoclaving / microwaving
Category No. 7	Disinfecting by chemical treatment / autoclaving / microwaving and mutilation / shredding)
Category No. 8	Disinfecting by chemical treatment and discarding it into drains
Category No. 9	Disposal in municipal landfill
Category No.10	Chemical treatment and release into drains for liquids and protected landfill for solids.



LEGISLATION

- Recognizing the deadliest nature of the Bio-Medical Waste, the Government and Pollution Control Boards under the guidelines of Ministry of Environment and Forests(MOEF).
- MOEF have promptly designed and issued guidelines to the hospitals to ensure a proper and safe disposal of bio-medical waste
- “**BIO-MEDICAL WASTE Management & Handling RULE 1998** came into effect.
- Provides uniform guidelines and code of practice for Bio-medical waste management.

STEPS IN THE MANAGEMENT OF BIOMEDICAL WASTE:-



Biomedical Waste Management and Handling Rules, 1998 [Amended in 2000]

- These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose or handle bio-medical waste in any form. All Institutions generating BMW must take all steps to ensure that such waste is handled without any adverse effect to human health and the environment



ACCIDENT REPORTING

- 1. Date and time of accident:
- 2. Sequence of events leading to accident
- 3. The waste involved in accident :
- 4. Assessment of the effects of the accidents on human health and the environment,.
- 5. Emergency measures taken
- 6. Steps taken to alleviate the effects of accidents
- 7. Steps taken to prevent the recurrence of such an accident



ANNUAL REPORT

- To be submitted to the prescribed authority by 31 January every year
- Name of the occupier with Address
- Categories of waste generated and Quantity [monthly average] basis:
- Name of treatment facility with Address
- Category-wise quantity of waste treated
- Mode of treatment with details:
- Any other information



STAFF SAFETY

- Proper training
- Personal protective clothing and equipment
- Immunization
- Post-exposure prophylaxis
- Medical surveillance
- Personal hygiene