

BIO MEDICAL WASTE MANAGEMENT

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Abstract-Medical care is vital for our life and health, but the waste generated from medical activities represents a real problem of living nature and human world. Improper management of waste generated in health care facilities causes a direct health impact on the community, the health care workers and on the environment. Every day, relatively large amount of potentially infectious and hazardous waste are generated in the health care hospitals and facilities around the world. Indiscriminate disposal of BMW or hospital waste and exposure to such waste possess serious threat to environment and to human health that requires specific treatment and management prior to its final disposal. The present review article deals with the basic issues as definition, categories, problems relating to biomedical waste and procedure of handling and disposal method of Biomedical Waste Management. It also intends to create awareness amongst the personnel involved in health care unit.

The objective of this study is to summarize the rules for management and handling of biomedical wastes, to give the definition, categories of biomedical wastes, suggested storage containers including colour-coding and treatment options, mainly to highlight the effects of biomedical waste in the environment such as air, land,

radioactive pollution and disposal of wastes, regulation and recommendations. Health-care waste management in several countries including India is receiving greater attention due to stringent regulations. The waste generation rate ranges between 0.5 and 2.0 kg bed-1day-1. The solid waste from the hospitals consists of bandages, linen and other infectious waste (30-35%), plastics (7-10%), disposable syringes (0.3-0.5%), glass (3-5%) and other general wastes including food (40-45%). Several survey works carried out by various research organizations by (Government and Non government and private sectors) have been discussed and reviewed in this paper.

To provide uniform standards for the segregation, management and disposal of infectious or potentially infectious biomedical waste. To reduce the incidence of health care worker and the public from contacting a disease or injury from biomedical waste. To provide guidance to the health care system on the opportunities for waste minimization and the reduction of air contamination from incineration of biomedical waste.

1. INTRODUCTION

Biomedical waste management has recently emerged as an issue of major concern not only to hospitals, nursing home

authorities but also to the environment. the bio-medical wastes generated from health care units depend upon a number of factors such as waste management methods, type of health care units, occupancy of healthcare units, specialization of healthcare units, ratio of reusable items in use, availability of infrastructure and resources etc.

The proper management of biomedical waste has become a worldwide humanitarian topic today. Although hazards of poor management of biomedical waste have aroused the concern world over, especially in the light of its far-reaching effects on human, health and the environment.

A Common Bio-medical Waste Treatment Facility (CBWTF) is a set up where bio-medical waste, generated from a number of healthcare units, is imparted necessary treatment to reduce adverse effects that this waste may pose. The treated waste may finally be sent for disposal in a landfill or for recycling purposes. Installation of individual treatment facilities by small healthcare units requires comparatively high capital investment. In addition, it requires separate manpower and infrastructure development for proper operation and maintenance of treatment systems. The concept of CBWTF not only addresses such problems but also prevents proliferation of treatment equipment in a city. In turn it reduces the monitoring pressure on regulatory agencies. By running the treatment equipment at CBWTF to its full capacity, the cost of treatment of per kilogram gets significantly reduced. Its considerable advantages have made CBWTF

popular and proven concept in many developed countries. CBWTF as an option has also been legally introduced in India. The Bio-medical Waste (Management & Handling) Rules, 1998, gives an option to the bio-medical waste generator that such waste can also be treated at the common bio-medical waste treatment facility. The Second Amendment of the Rules in June, 2000, further eased the bottleneck in upbringing the CBWTF by making Local Authority responsible for providing suitable site within its jurisdiction. The concept of CBWTF is also being widely accepted in India among the healthcare units, medical associations and entrepreneurs.

In order to set up a CBWTF to its maximum perfection, care shall be taken in choosing the right technology, development of CBWTF area, proper designing of transportation system to achieve optimum results etc. These key features of CBWTF have been addressed in the following sections and will form the guidelines for the establishment of CBWTFs throughout the country.

2. DEFINITION

Many terms are used to identify and characterize biomedical waste, such as: biohazardous, pathological, and infectious. These terms are often used interchangeably without clearly defining their subtle differences and similarities. To assist the reader these terms are defined below. For the purpose of this document biomedical waste will be used as the general term. Where the waste may be defined more

specifically and require special treatment, this procedure will specify the requirements.

It is defined as "Any solid and/or liquid waste including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human beings or animals".



Fig. Contaminated Cotton



Fig. contaminated syringe and injection bottles

3. BIO-MEDICAL WASTE (MANAGEMENT AND HANDLING) RULES, 1998

The Biomedical Waste (Management & Handling) Rules, 1998 came into force on 1998. In exercise of the powers conferred by section 6,8 & 25 of EP Act, 1986, the Central Govt. notified these rules for the management and Handling of biomedical wastes generated from Hospitals, clinics, other institutions for scientific management of Biomedical Waste.

The Biomedical waste means any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological and including categories mentioned in schedule I of the Rules. It shall be the duty of 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 by whatever name called to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment

BMW Rules have been adopted and notified with the objective to stop the indiscriminate disposal of hospital waste/ bio-medical waste and ensure that such waste is handled without any adverse effect on the human health and environment



Fig. Logo of Management and Handling

4. Who Generate Bio-Medical Waste?

There are many characters who generates bio-medical waste. Some of them are as follows:

- Hospital facility
- Research facility
- Laboratories

5. Classification of Bio-Medical Waste

Bio-medical waste is mainly classified into two categories. They are as follows:

- Non-hazardous (75-90%)
- Hazardous (10-25%)

Hazardous waste is also classified into two categories

- Infectious (15-18%)
 - Non-sharps
 - Sharps
 - Plastic disposables
 - Liquid waste
 - Other hazardous (5-7%)
 - Radioactive waste
 - Discarded glass
 - Pressurized containers
 - Chemical waste
 - Cytotoxic waste
 - Incineration ash

6. Problems associated with Bio-Medical Waste

A. Organism

1. Viruses

HIV, Hepatitis B, Hepatitis A, C, Arboviruses, Enteroviruses.

2. Bacteria

Salmonella typhi, Vibrio-Cholerae, Clostridium tetam, Pseudomonas, Streptococcus.

3. Parasites

Wuchereria Bancroft, Plasmodium

B. Diseases Caused

AIDS, infectious Hepatitis, Dengue, tick-borne fever typhoid, cholera, wound infections, septicemia, rheumatic fever, endocarditis, skin and soft tissues infections, coetaneous leishmaniasis, kala aazar, malaria.

C. Related waste item

Infected needles, body fluids, human excreta, solid linen, blood, body fluid in landfills and hospitals wards, sharps such as needles surgical blades poorly manage sewage system of hospital.



Fig. Contaminated Injections

SCHEDULE I (Rule 5)

7. CATEGORIES OF BIO-MEDICAL WASTE

Category No. 1

Human Anatomical Waste (human tissues, organs, body parts)

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 colleges)

Category No. 3

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Microbiology & Biotechnology Waste (wastes from laboratory cultures, stocks or specimens of micro- organisms live or attenuated vaccines, human and animal catera)

Category No. 4

Waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)

Category No. 5

Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)

Category No. 6

Solid Waste (Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood)

Category No. 7

Solid Waste (wastes generated from disposable items other than the waste [sharps] such as tubings, catheters, intravenous sets etc).

Category No. 8

Liquid Waste (waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities)

Category No. 9

Incineration Ash (ash from incineration of any bio-medical waste)

Category No. 10

Chemical Waste (chemicals used in production of biologicals, chemicals used in disinfection, as insecticides, etc.)

8. Colour code and Container

1. Yellow

Type of container used is plastic bags. It includes waste categories 1, 2, 3 and 6. Treatment options are incineration or deep burial.

2. Red

Types of container used are disinfected container and plastic bags. It includes waste categories 3, 6 and 7. Treatment options are autoclaving, micro waving, and chemical treatment.

3. Blue and White Transparent

Types of container used are plastics bags and puncture proof container. It includes waste categories 5, 8 and 9. Treatment option is disposal in secured landfills.

9. Biomedical Waste Management Process

There is a big network of Health Care Institutions in India. The hospital waste like body parts, organs, tissues, blood and body fluids along with soiled linen, cotton, bandage and plaster casts from infected and contaminated areas are very essential to be properly collected, segregated, stored, transported, treated and disposed of in safe manner to

prevent nosocomial or hospital acquired infection.

- Waste collection
- Segregation
- Transportation and storage
- Treatment & Disposal
- Transport to final disposal site
- Final disposal

9.1 Collection

Collection of biomedical waste varies for different services or faculty/departments depending upon waste generation practices, available resources or management approaches. For more specific information contact your service or faculty/departmental representative

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.

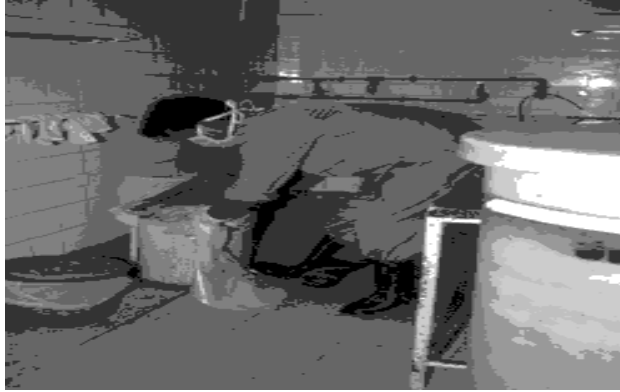
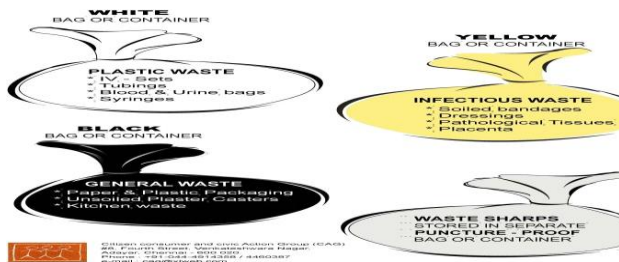


Fig. Collection of Waste

9.2 Segregation

Biomedical waste must be stored in a secure environment at all times. Whenever possible, biomedical waste must not be mixed with chemical, radioactive or other laboratory trash. This may be unavoidable (i.e. radioactive carcasses) and in such instances special handling may be required. For further information contact ORM. The various types of biomedical waste should be segregated from each other. Fluid waste should be contained separately from solid waste.

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9.3 Storage

Although biomedical waste should be treated as promptly as possible it can be held temporarily. Treatable waste should not be allowed to accumulate. Waste that is to be disposed off-site should be stored in designated areas which are secure and access is limited to delegated individuals. To prepare for off-site disposal the following measures must be undertaken.

Sufficient ventilated storage space for untreated and treated bio-medical waste shall be provided. ii. The flooring and walls (to a height of 2M from floor) shall be finished with smooth and fine material. There shall be minimum number of joints. 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.



Fig. Storage Container

BMW must be staged in an area away from general traffic & accessible only to authorized personnel. Storage area must be Labeled with biohazard sticker, Secure (locked/non-accessible), Easily cleanable & tidy. The 30 day period shall commence when the first non-sharps item of biomedical waste is placed into a red bag or sharps container, or when a sharps container containing only sharps is sealed. Packages must be labeled as biomedical waste with the biohazard symbol, name, location, phone & date. Some locations stage the waste & then transport it to outdoor containers removed for disposal by a designated hauler.

9.4. Transport

The waste should be transported for treatment either in trolleys or in covered wheelbarrow. Manual loading should be avoided as far as possible. The bags / Container containing BMWs should be tied/ lidded before transportation. Before transporting the bag containing BMWs, it

should be accompanied with a signed document by Nurse/ Doctor mentioning date, shift, quantity and destination. Special vehicles must be used so as to prevent access to, and direct contact with, the waste by the transportation operators, the scavengers and the public. The transport containers should be properly enclosed. The effects of traffic accidents should be considered in the design, and the driver must be trained in the procedures he must follow in case of an accidental spillage. It should also be possible to wash the interior of the containers thoroughly.

The bio-medical waste collected in coloured containers shall be transported to the CBWTF in a fully covered vehicle. Such vehicle shall be dedicated for transportation of bio-medical waste only. The waste cabin may be designed for storing waste containers in tiers. The waste cabin shall be so designed that it is easy to wash and disinfect. The inner surface of the waste cabin shall be made of smooth surface to minimize water retention. The vehicle shall be labeled with the bio-medical waste symbol (as per the Schedule III of the Rules) should display the name, address and telephone number of the CBWTF.

Depending upon the area to be covered under the CBWTF, the route of transportation shall be worked out. The transportation routes of the vehicle shall be designed for optimum travel distance and to cover maximum number of healthcare units. As far as possible, the transportation shall be carried out during non-peak traffic hours. If the area to be covered is very large, a satellite station may be established to store

the bio-medical waste collected from the adjoining areas. The wastes so stored at satellite station may then be transported to the CBWTF in a big vehicle.



Fig. Vehicle for transporting Bio-medical waste

9.5. Treatment

Bio-medical waste shall be treated and disposed of in accordance with Schedule I, and in compliance with the standards prescribed in Schedule V. Every occupier, where required, shall set up in accordance with the time-schedule in Schedule VI, requisite bio-medical waste treatment facilities like incinerator, autoclave, microwave system for the treatment of waste, or, ensure requisite treatment of waste at a common waste treatment facility or any other waste treatment facility.

Treatment used for bio-medical waste management are Chemical process, Thermal process, Mechanical process, Irradiation process, Biological process.

1. Incineration

This is a high temperature thermal process employing combustion of the waste under controlled condition for converting them into inert material and gases. Incinerators can be oil fired or

electrically powered or a combination thereof. Broadly, three types of incinerators are used for hospital waste : multiple hearth type, rotary kiln and controlled air types. All the types can have primary and secondary combustion chambers to ensure optimal combustion. These are refractory lined.

In the multiple hearth incinerator, solid phase combustion takes place in the primary chamber whereas the secondary chamber is for gas phase combustion. These are referred to as excess air incinerators because excess air is present in both the chambers. The rotary kiln is a cylindrical refractory lined shell that is mounted at a slight tilt to facilitate mixing and movement of the waste inside. It has provision of air circulation. The kiln acts as the primary solid phase chamber, which is followed by the secondary chamber for the gaseous combustion. In the third type, the first chamber is operated at low air levels followed by an excess air chamber. Due to low oxygen levels in the primary chamber, there is better control of particulate matter in the flue gas.

2. Autoclave Treatment

This is a process of steam sterilisation under pressure. It is a low heat process in which steam is brought into direct contact with the waste material for duration sufficient to disinfect the material. These are also of three types : Gravity type, Pre-vacuum type and Retort type.

In the first type (Gravity type), air is evacuated with the help of gravity alone. The system operates with temperature of 121 deg. C. and steam pressure of 15 psi.

for 60-90 minutes. Vacuum pumps are used to evacuate air from the Pre- vacuum autoclave system so that the time cycle is reduced to 30-60 minutes. It operates at about 132 deg. C. Retort type autoclaves are designed to handle much larger volumes and operate at much higher steam temperature and pressure.

3. Microwave Treatment

This again is a wet thermal disinfection technology but unlike other thermal treatment systems, which heat the waste externally, microwave heats the targeted material from inside out, providing a high level of disinfection.

Microwave technology has certain benefits, such as, absence of harmful air emissions (when adequate provision of containment and filters is made), absence of liquid discharges, non requirement of chemicals, reduced volume of waste (due to shredding and moisture loss) and operator safety (due to automatic hoisting arrangement for the waste bins into the hopper so that manual contact with the waste bags is not necessary). However, the investment cost is high at present.

4. Chemical Disinfecting

This treatment is recommended for waste sharps, solid and liquid wastes as well as chemical wastes. Chemical treatment involves use of at least 1% hypochlorite solution with a minimum contact period of 30 minutes or other equivalent chemical reagents such as phenolic compounds, iodine, hexachlorophene, iodine-alcohol or

formaldehyde-alcohol combination etc. Pre-shredding of the waste is desirable for better contact with the waste material.

In the USA, chemical treatment facility is also available in mobile vans. In one version, the waste is shredded, passed through 10% hypochlorite solution (dixichlor) followed by a finer shredding and drying. The treated material is landfilled.

10. Disposal According to Type of Waste

1. Human Anatomical Waste

Human anatomical waste, consisting of human tissues, organs, and body parts, but excluding teeth, hair, and nails, must be incinerated in a biomedical waste incinerator or destroyed in a crematorium incinerator.

2. Animal Waste

Most animal waste, with the exception of teeth, hair, nails, hooves, and feathers, should be incinerated in a biomedical waste incinerator. This includes all animal tissues, organs, body parts, carcasses, bedding, fluid blood and blood products, items saturated or dripping with blood, body fluids contaminated with blood, and body fluids removed for diagnosis or removed during surgery, treatment or autopsy, unless a trained person certifies that the waste does not contain the viruses.

3. Microbiology Laboratory Waste

Microbiology laboratory waste consisting of laboratory cultures, stocks or specimens of microorganisms; live

or attenuated vaccines; human or animal cell cultures used in research; and laboratory material that has come into contact with the above, must be incinerated, autoclaved, or chemically disinfected.

4.Human Blood and Body Fluid Waste

Except for those wastes associated with the exotic communicable diseases, fluid human blood and blood products, body fluids contaminated with blood, and body fluids removed for diagnosis or removed during surgery, treatment or autopsy, but excluding urine or feces, may be poured down the sanitary sewer after steam autoclave or chemical decontamination. The approval of the community works department and local Health Board is required. If approved, the treated waste should be carefully poured down a drain connected to the sanitary sewer.

5. Waste Sharps

Clinical and laboratory materials consisting of needles, syringes, blades, or laboratory glass capable of causing punctures or cuts (referred to as waste sharps), must be incinerated. They may be autoclaved or chemically disinfected prior to incineration. When autoclaved, sharps containers must remain functionally intact at high autoclaving temperatures.

11.News on biomedical waste

[News»](#)

[King George's Medical University's double gain in selling](#)

[biomedical waste](#)

TOI 06 Dec 2013, 08:05 IST Here's a perfect example of 'best out of waste'. The biomedical waste management system at King George's Medical University is helping the institute mint handsome money besides contributing to saving the environment.

[Biomedical waste management seminar concludes at Stanley](#)

[Medical College](#)

TOI 23 Nov 2013, 04:29 IST More than 50 NCC cadets at the Stanley Medical College (SMC) on Friday participated in a seminar on biomedical waste management and would impart the knowledge to other students.

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