Biomedical Waste Handling and Management: Key Issues and Regulatory Framework

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ABSTRACT: It is defined that biomedical waste encompasses any waste, whether solid or liquid, containing infectious or potentially infectious materials originating from medical, laboratory, or research activities, which include the diagnosis, prevention, and treatment of diseases. A higher potential for infection and injury is posed by biomedical waste to healthcare workers, patients, and the surrounding community. Included within the scope of biomedical waste are human anatomical waste, animal waste, microbiology and biotechnology waste, sharps, discarded medicines, cytotoxic drugs, soiled waste, liquid waste, incineration ash, and chemical wastes. It is reported that biomedical waste is commonly generated by hospitals, clinics, medical and veterinary colleges, blood banks, mortuaries, autopsy centers, biotechnology institutions, research laboratories, home healthcare services, and funeral homes. It is noted that hazardous chemicals and radioactive waste, although non-infectious, also require proper disposal. According to the World Health Organization, it is stated that 10% of hospital waste is classified as infectious, while 5% is considered non-infectious but hazardous. The World Health Organization has categorized medical waste into eight classifications: general, pathological, radioactive, chemical, infectious, sharps, pharmaceuticals, and pressurized wastes. In India, the Biomedical Waste (Management & Handling) Rules 1998, along with subsequent amendments, are utilized to regulate the management of biomedical waste. These regulations are reported to consist of six schedules, which include the classification of biomedical waste, the required color coding and types of containers, the labels for biomedical waste containers or bags (which must be non-washable and highly visible), and the labels for the transport of such containers or bags. Standards for treatment and disposal, as well as schedules for waste treatment facilities like incinerators, autoclaves, and microwave systems, have been established. Furthermore, it is stated that operating standards such as combustion efficiency and emission standards are clearly defined. This review article has focused on key issues such as the definition, categories, challenges, and the procedures related to the handling and disposal of biomedical waste.

Keywords: Medical waste categories, Healthcare facilities, Color coding, Radioactive waste, Waste treatment

INTRODUCTION

Hospital is one of the complex institutions which is frequented by people from every walk of life in the society without any distinction between age, sex, race and religion. This is over and above the normal inhabitants of hospital i.e patients and staff. All of them produce waste which is increasing in its amount and type due to advances in scientific knowledge and is creating its impact. [1]Hospitals produce waste, which is increasing over the years in its amount and type.

The hospital waste, in addition to the risk for patients and personnel who handle them also poses a threat to public health and environment. Biomedical waste (BMW) is any waste produced during the diagnosis, treatment, or immunization of human or animal research activities pertaining thereto or in the production or testing of biological or in health camps. It follows the cradle to grave approach which is characterization, quantification, segregation, storage, transport, and treatment of BMW. The basic principle of good BMW practice is based on the concept of 3Rs, namely, reduce, recycle, and reuse.[2]Due to the increase in the procedures that are carried out at the various health care setups, excessive amounts of waste have been generated at the centers of care. India approximately generates 2 kg/bed/ day and this biomedical waste encompasses wastes like anatomical waste, cytotoxic wastes, sharps, which when inadequately segregated could cause different kinds of deadly infectious diseases like Human immunodeficiency virus(HIV) hepatitis C and B infections, etc, and also cause disruptions in the environment, and adverse impact on ecological balance.

Biomedical waste (BMW) is a major issue of concern in modern times.[3,4] As per WHO 15 -25% of the waste generated in the hospital is dangerous and hazardous to health as it poses a risk to health of individual .As per estimates 32% of new Hepatitis B infection, 40 % of Hepatitis C infections and 5 % of new HIV infections occur every year due to contaminated sharps and syringes.[5] Health care waste consists of solid, liquid and gaseous waste contaminated with organic and inorganic substance including pathogenic radionuclide generated from in vitro analysis of body microorganisms. Hospital waste possesses serious tissues and fluid. WHO (1999) reported that, about 85% of health hazard to the health workers, public and air hospital waste is non-hazardous, 10% infective and 5% flora on the area not infective but hazardous.[6] The Government of India (notification, 1998) specifies that Hospital Waste Management is a part of hospital hygiene and maintenance activities. This involves management of range of activities, which are mainly engineering functions, such as collection, transportation, operation or treatment of processing systems, and disposal of wastes.[7]

II CLASSIFICATION OF BIO-MEDICAL WASTE ACCORDING TO WORLD HEALTH ORGANIZATION

The World Health Organization (WHO) has classified medical waste into eight categories:

1. General Waste
2. Pathological
3. Radioactive
4. Chemical
5. Infectious to potentially infectious waste
6. Sharps
7. Pharmaceuticals
8. Pressurized containers

A. Major Sources of Bio-Medical Waste.

- Govt hospitals/private hospitals/nursing homes/ dispensaries.
- Primary health centers.
- Medical colleges and research centers/ paramedic services.
- Veterinary colleges and animal research centers.
- laboratories and research centres
- mortuary and autopsy centres
- animal research and testing laboratories
- blood banks and collection services
- nursing homes for the elderly
- Biotechnology institutions.
- Production units.

B. Minor Sources of Bio-Medical Waste.

- Physicians/ dentists' clinics
- Animal houses/slaughter houses.
- Blood donation camps.
- Vaccination centers.
- Acupuncturists/psychiatric clinics/cosmetic piercing.
- Funeral services.
- Institutions for disabled persons

III NEED OF BIOMEDICAL WASTE MANAGEMENT IN HOSPITALS

The reasons due to which there is great need of management of hospitals waste such as:

1. It is understood that there is a significant risk of injuries from sharps, which could lead to infections affecting all categories of hospital personnel and waste handlers.

2. Nosocomial infections may occur among patients as a result of inadequate infection control practices and poor waste management within healthcare facilities.

3. There is a recognized risk of infection for waste handlers, scavengers, and at times even the general public residing near hospitals due to improper waste disposal practices.

4. Those involved in handling hospital waste are exposed to risks associated with hazardous chemicals and drugs at various levels.

5. It has been observed that disposable medical items are often repackaged and sold by unscrupulous individuals without proper cleaning, posing health risks.

6. Instances have been reported where drugs that were disposed of have been repacked and sold to unsuspecting buyers.

7. The potential for pollution of air, water, and soil exists, either directly from hospital waste or from improper incineration practices, including

defective emissions and ash disposal.

IV BENEFITS OF BIOMEDICAL WASTE MANAGEMENT

1. Cleaner and healthier surroundings are ensured through proper waste management practices.

2. The incidence of hospital-acquired and general infections is significantly reduced when effective waste disposal is implemented.

3. The cost of infection control within hospitals is likely to be minimized as a result of proper waste management strategies.

4. The possibility of disease and death caused by the reuse and repackaging of infectious disposables is considerably lowered.

5. A lower incidence of community and occupational health hazards is achieved through the safe handling and disposal of hospital waste.

6. Waste management costs are reduced, and revenue can be generated through the appropriate treatment and disposal of waste.

7. The image of healthcare establishments is improved, contributing to an overall increase in the quality of life.

V BIOMEDICAL WASTE MANAGEMENT PROCESS

The mismanagement of hospital waste is understood to involve improper handling during its generation, collection, storage, transport, and treatment. Several unsafe practices are commonly associated with this, such as handling waste without the use of personal protective equipment (PPE) and improper storage under unsuitable conditions, such as high temperatures and prolonged storage times before treatment. It is often noted that manual transport over long distances and the use of uncovered containers instead of sealed plastic bags are also prevalent. Additional concerns include exposure times exceeding acceptable limits and the absence of proper decontamination procedures for workers and equipment. These issues are recognized as having significant effects on hospital staff in various ways.

India is known to have a vast network of Health Care Institutions, where it is essential that hospital waste, including body parts, organs, tissues, blood, body fluids, as well as soiled linen, cotton, bandages, and plaster casts from contaminated areas, is properly collected, segregated, stored, transported, treated, and safely disposed of. This is done to prevent the spread of nosocomial or hospital-acquired infections.

Six steps of Bio medical waste Management

1. Waste collection
2. Segregation
3. Transportation and storage
4. Treatment & Disposal
5. Transport to final disposal site
6. Final disposal

The health care workforce is safeguarded against occupational health risks associated with hospital-waste management through the implementation of effective infectious waste control measures. In addition to ensuring the health of workers, these measures are understood to protect public health and the environment from the hazards posed by hospital waste. Proper management is carried out to ensure that infectious waste is handled in compliance with established and acceptable procedures, from the point of generation to its treatment and final disposal.

VI SALIENT FEATURES OF BIOMEDICAL WASTE RULES 2016

1. The scope of the rules is understood to have been expanded to cover various health camps, including vaccination camps, blood donation camps, and surgical camps.

2. The duties of the occupiers of Health Care Facilities (HCFs) have been revised. The occupier, defined as the individual with administrative control over the HCF generating biomedical waste (BMW), is required to ensure the compulsory pre-treatment of laboratory and microbiological waste, as well as blood bags, on-site before disposal either at Common Biomedical Waste Treatment Facilities (CBMWTF) or on-site. The methods of sterilization and disinfection must comply with guidelines issued by the National AIDS Control Organization (NACO) or the World Health Organization (WHO).

a. The use of chlorinated plastic bags, gloves, blood bags, etc., is to be phased out gradually within

two years from the date of the notification of these rules.

b. Training must be provided to all healthcare workers (HCWs), and immunization must be given to protect against diseases such as hepatitis B and tetanus.

c. Liquid waste is to be separated at the source and pre-treated before mixing with other liquid waste.

d. A barcode system for BMW that is sent out of the premises for treatment and disposal is required to be set up.

e. It is required that all major accidents, including those caused by fire hazards, explosions, or during the handling of BMW, as well as remedial actions taken, must be reported to the prescribed authority.

f. Existing incinerators are expected to be upgraded or modified to meet the new standards within two years from the date of notification.

g. A BMW disposal register is to be maintained daily and updated monthly on the official website.

3. The duties of operators of a Common Biomedical Waste Treatment and Disposal Facility (CBMWTF) have been increased. Operators are required to assist in the training of HCWs from the facilities where waste is collected. Additionally, it has been mandated that a barcode and global positioning system (GPS) be established for the handling of BMW within one year. Records for the operation of incineration, hydroclaving, or autoclaving must be maintained for a period of five years.

4. Improvements have been made in the segregation, packaging, transportation, and storage of BMW. Biomedical waste has been classified into four categories based on color code, type of waste, and treatment options. It is stipulated that untreated human anatomical waste, animal anatomical waste, soiled waste, and biotechnology waste should not be stored for more than 48 hours. If storage beyond this period is necessary, the occupier is required to take appropriate measures to ensure that human health and the environment are not adversely affected.

5. No HCF is permitted to establish an on-site BMW treatment and disposal facility if a CBMWTF exists within a distance of seventy-five kilometers. In cases where no CBMWTF is available, the occupier is required to set up a BMW treatment facility, such as an incinerator, autoclave, microwave, or shredder, after receiving prior authorization from the prescribed authority. Plastics and glassware must be treated by autoclaving or microwaving, followed by mutilation or shredding, before being given to authorized recyclers.

6. Authorization for BMW disposal for non-bedded HCFs is granted to the occupier as a one-time authorization. The validity of this authorization is synchronized with the validity of consent orders for bedded HCFs.

7. Standards for emissions from incinerators have been modified to make them more environmentally friendly. The permissible limit for Suspended Particulate Matter (SPM) has been set at 50 mg/nm³, with a residence time in the secondary chamber of the incinerator set at two seconds. The standard for dioxins and furans is set at 0.1 ng TEQ/nm³.

8. The Ministry of Environment, Forest, and Climate Change is expected to monitor the implementation of these rules annually. Compliance checks at the state level are to be carried out by district-level committees, chaired by the District Collector, District Magistrate, or Additional District Magistrate. These committees are required to submit reports every six months to the State Pollution Control Board.

Table- Colour coding of BMW

Category	Types of Waste	Colour and type of Container
Yellow	Human Anatomical waste Animal Anatomical waste Soiled waste Discarded or expired medicine Laboratory waste Chemical waste ,Chemical liquid waste	Yellow colour non chlorinated plastic bags having thickness equal to more than 50microns or containers.
Red	Contaminated waste (Recyclable)	Red colour non chlorinated plastic bags having thickness equal to more than 50microns or containers.
White	Waste sharps including metals	White colour translucent, puncture proof, leak proof, temper proof containers.
Blue	Glassware Metallic body implants	Cardboard boxes with blue coloured marking or blue coloured puncture proof, temper proof

		containers.

VII SUGGESTIONS

The following solutions are recommended to remove obstacles and facilitate progress in hospital waste management:

1. It is suggested that the economical benefits from waste minimization in hospitals be calculated and monitored.
2. More accurate monitoring and control of the hospital waste separation process is advised to be carried out by the Ministry of Health and Medical Education and the Environmental Protection Agency.
3. It is recommended that materials management consider the three primary criteria of using less, reusing, and recycling.
4. A review of relevant laws is recommended to facilitate the reduction of hazards associated with hospital waste and to address existing problems.
5. It is suggested that the laws related to hospital waste separation at the source and their definitions be reviewed to prevent confusion among officials responsible for this separation.
6. The participation of specialists from the private sector in the hospital waste management process is encouraged.
7. Domestic and foreign investments for the importation of modern technology into the country by both the public and private sectors are advocated.
8. Meetings with managers and officials are recommended to foster closer relationships and enhance familiarity with available scientific and practical solutions.
9. Support from universities is encouraged to improve the implementation of plans and to propose new scientific recommendations.
10. Extensive advertising through public media is advised to raise public awareness.
11. The use of new technology capable of reducing waste in various areas of the hospital, particularly in those with a potential for hazardous waste production, is recommended.

VIII CONCLUSION

It is emphasized that training programs need to focus on empowering healthcare professionals regarding biomedical waste management, ensuring a broad scope and practical knowledge in all relevant aspects. It is believed that training staff with checklists and conducting regular inspections can enhance accountability among them. It is recognized that improper biomedical waste management leads to environmental pollution and facilitates the multiplication of vectors, such as insects, rodents, and worms, which can result in the transmission of diseases like typhoid, cholera, plague, hepatitis, and AIDS. It is understood that recycling disposable syringes, needles, intravenous sets, and glass bottles without proper sterilization may lead to infections such as hepatitis, tetanus, HIV, and other viral diseases.

The benefits of biomedical waste management are noted to include healthier surroundings, a reduction in hospital-acquired infections and the costs associated with infection control, a decrease in the reuse of infectious disposables, and the prevention of occupational health hazards. Awareness of the hazards posed by biomedical waste and its proper disposal is deemed essential for a safe and healthy future. It is recommended that all healthcare professionals, regardless of their designation, experience, or qualifications, be included in these interventions to prevent cross-infections among professionals and patients in the healthcare sector.

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