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A Review on Biomedical Waste Management

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Abstract - *With the growth of healthcare facilities, the amount of biomedical waste produced every day is growing. If biomedical waste management is done correctly, many of the problems can be avoided. Segregation, storage, processing, transportation, and disposal of biomedical waste are all common practices undertaken as part of health care waste management. It involves interdisciplinary relationships in organizational, planning, administrative, financial, engineering, legal, and human resource creation. Medical waste management necessitates dedication from healthcare providers at all levels. The risks and value of their "contribution" are feared in a system run by reckless and untrained personnel. Also trained medical professionals, such as hospital managers, private and governmental institutes, clinics, and universities, need to be taught about the rules for disposing of biomedical waste. The importance of biomedical waste, its interaction with the ecosystem, the environmental pollutants used in the health care industry, and the effect of callousness on public health are all topics that are still largely unknown. To achieve better results, we must raise the level of training and education in biomedical waste and environmentally sustainable health care as quickly as possible, while adhering to all applicable rules and regulations.*

Keywords *– Bio-Medical Waste (BMW), Source of BMW, Effective BMW Management*
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1. Introduction

Growing medical advances and new hospital facilities for improved healthcare have increased the amount of waste generated by health care facilities. Both wastes from any medical practice in healthcare facilities, testing centers, and laboratories are referred to as "Health Care Waste" or "Bio-Medical Waste" (Babu, Parande, Rajalakshmi, Suriyakala, & Volga, 2009; Manika & Arpita, 2015; Sunil Kumar, Manjunath, Badami, & Pradeep, 2012). Hospital waste poses a health risk to healthcare staff, the general public, and the local flora and fauna. Waste disposal concerns in hospitals and other healthcare facilities have become a growing source of concern. The majority of countries around the world, especially developing countries, are facing a dire situation as a result of environmental pollution caused by pathological waste generated by growing populations and the resulting rapid growth in the number of health care centers (Manika & Arpita, 2015). Biomedical waste management has been a hot topic in India recently, particularly since the Union Ministry of Environment and Forests issued the Biomedical Waste (Management and Handling) Rules, 1998, under the provision of the Environment (Protection) Act, 1986. These regulations apply to anyone who creates, collects, receives, stores, transports, treats, disposes of, or handles biomedical waste in any way (Sunil Kumar et al., 2012). Waste management that is both safe and reliable is not only a legal requirement but also a social obligation. Lack of care, enthusiasm, understanding, and cost are only a few of the issues that can arise when it comes to proper hospital waste management. There is a need for education about the dangers of inappropriate waste disposal. Apathy against the idea of waste management is a significant impediment to waste disposal. Given the low level of knowledge about biomedical waste management among various categories of workers in health care facilities, an effective communication strategy is essential (Kalpana, Sathya, Vinodhini, & Devirajeswari, 2016). One of India's major achievements has been to shift the attitudes of healthcare facility operators, encouraging them to integrate good waste management practices into their everyday operations and to hire private-sector waste management services (Praveen, Sangeeta, & Anand, 2012).

2. Sources of Biomedical Waste

Based on the training Component of the Project "Environmentally Sound Management of Medical Wastes in India" in 2018, the main sources of healthcare waste generation (Shaida & Singla, 2019) are primary and secondary sources according to the quantities produced (Srishti, 2010). Primary sources include waste generated from hospitals, medical college, nursing center, dialysis centers, maternity homes, blood bank, research labs, immunization centers, etc and secondary sources includes waste from clinics, ambulances, funeral services, slaughterhouses, educational institutes (Shaida & Singla, 2019; Srishti, 2010).

3. Classification of Biomedical Waste

Medical waste is divided into eight categories by the World Health Organization (WHO), including General Waste, Pathological, Radioactive, Chemical, Infectious to potentially infectious waste, sharps, Pharmaceuticals, and Pressurized Containers (Manika & Arpita, 2015; Srishti, 2010).

3.1 Non–Hazardous Wastes

Non–hazardous wastes account for approximately 85 percent of waste produced in most health–care facilities. This involves wastes such as food scraps and fruit peels, as well as wash water and paper cartons, packaging materials, and so on. (Chakraborty et al., 2014; Singh, Rehman, & Bumb, 2014).

3.2 Hazardous Wastes

Various terms for infectious wastes have been used in research papers, as well as legislation and guidelines, over the years. Infectious and non-infectious wastes; medical and biological wastes; hazardous and red bag wastes; contaminated; infectious medical wastes; and managed wastes in the medical profession are among them. Essentially, both of these terms refer to the same forms of waste, even though the terms used in regulations are generally more precise (Chakraborty et al., 2014; Singh et al., 2014).

4. Categories of Biomedical Waste

As per the Rules the wastes come under ten categories are to be stored in four separate colored containers/ bags. The wastes have to be handled using methods such As per as deep burial, incineration, autoclaving, microwaving, mutilation, shredding, and chemical disinfection mentioned in Table 1.

5. Steps for Effective Bio-Medical Waste (BMW) Management

The storage and transportation of BMW should be done in such a way that there is no risk to human health or the environment. The chances of segregated BMW being revealed to the public, rag pickers, animals/birds, etc. are high during collection and transport. As a result, every precaution must be taken to ensure that the segregated BMWs delivered by healthcare units arrive at the treatment facility without being damaged, spilled, or subjected to unauthorized access by the public, animals, or others. The vehicle must always be accompanied by a responsible person from the operator of a typical bio-medical waste treatment facility to supervise the collection and transport of BMW. Collection, handling, sorting, mutilation, disinfection, storage, transportation, and final disposal are all important steps in the safe and scientific management of biomedical waste in any environment (Arshad, Nayyar, Amin, & Mahmood, 2011; Himabindu, Madhukar, & Udayashankara, 2015; Kumarasamy & Jeevaratnam, 2017; Sunil Kumar et al., 2012).

5.1 Waste Survey

It is an important component of the waste management method. A survey helps in the assessment of both the type and amount of waste generated. The waste survey is valuable in the aspect of (Singh et al., 2014):

- Make a distinction between different forms of waste.
- Compile a list of the waste generated.
- Summarize the sources of waste generation and the types of waste produced at each location.
- Determine the hospital's generation and disinfection altitudes.
- To determine the method of disposal used.

5.2 Segregation

- Segregation is the primary division of various types of waste produced daily, lowering the risks as well as the cost of handling and disposal.
- The most important step in biomedical waste management is segregation.
- Only effective segregation will ensure effective bio-medical waste management.
- BMWs must be segregated per the requirements set out in Schedule 1 of the BMW Rules, 1998.

At the point of generation, various types of waste are placed in different containers or coded bags. It contributes to the reduction of infectious waste and treatment costs. Segregation also tends to keep the virus from spreading and decreases the risk of infecting other healthcare workers. The various colour coding and waste content with disposal methods are described in Table 1 (Lakshmi Bhaskar et al., 2020; Shaida & Singla, 2019; Singh et al., 2014).

Table 1. Various categories of Bio-Medical wastes

Category Number	Colour coding	Waste content	Components	Method and treatment of disposal	References
1	Yellow	Human Anatomical Waste	Human tissues, organs, body parts	Incineration / deep burial	(Lakshmi Bhaskar, Nagavardhini, Rajiv, Malavika, & Satyanarayana, 2020; Shaida & Singla, 2019)
2	Yellow	Animal Waste	All types of Animal tissues, organs, body parts carcasses, bleeding parts etc., generated by different health sectors	Incineration / deep burial	(Lakshmi Bhaskar et al., 2020; Shaida & Singla, 2019)
3	Yellow	Microbiology & Biotechnology Waste	Wastes from laboratory cultures, stocks or specimens of micro-organisms used in research	Local autoclaving / micro waving / incineration	(Lakshmi Bhaskar et al., 2020; Shaida & Singla, 2019)
4	White	Waste sharps	Needles, syringes, scalpels, blades, glass etc.	Disinfections chemical treatment Incineration / Destruction	(Lakshmi Bhaskar et al., 2020; Shaida & Singla, 2019)
5	Yellow	Discarded Medicines and Cytotoxic drugs	Out-dated, contaminated and discarded medicines	Incineration / Destruction and disposal of drugs in landfills	(Lakshmi Bhaskar et al., 2020; Shaida & Singla, 2019)
6	Yellow	Solid Waste	Blood contaminated cotton, dressings, soiled plaster casts, lines etc.	Incineration, autoclaving / micro waving	(Shaida & Singla, 2019)
7	Blue	Solid Waste	Wastes generated from disposable items other than the waste sharps such as catheters, intravenous sets etc.	Disinfections chemical treatment Disinfections	(Sunil Kumar et al., 2012)
8	White	Liquid Waste	Waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities	Disinfection by chemical treatment and discharge into drains	(Sunil Kumar et al., 2012)
9	Black	Incineration Ash	Ash from the incineration of any bio- medical waste	Disposal in municipal landfill	(Sunil Kumar et al., 2012)
10	Black	Chemical Waste	Chemicals used in the production of biologicals, chemicals used in disinfection, insecticides, etc.	Chemical treatment and discharges into drains	(Sunil Kumar et al., 2012)

5.3 Waste Storage

The biomedical wastes must be processed according to the Biomedical Waste (Management & Handling) Rules, 1988. The case of waste storage occurs between the point of waste generation and the point of waste management and disposal. It is possible to keep biological wastes refrigerated until they can be safely disposed of without creating an aesthetic problem. Storage areas can be found near waste treatment facilities. Floor drains should not be used to absorb spills; instead, they should be recessed to retain liquid. Floors and walls must be impervious to liquids, and cleaning methods must be simple to obey. It is also essential to disinfect regularly. Refrigeration is needed when storing putrifiable and other wastes for an extended time. In the storage room, there must be a sign that says "EXPLICIT" (Arshad et al., 2011; Bhuvan et al., 2019; Chakraborty et al., 2014; Sunil Kumar et al., 2012).

5.4 Handling and Transport

Biomedical wastes must be processed and transported in such a way that they pose no risk to human or environmental health. Only technical staff who have

received adequate training can manage or transport biohazardous waste that has not been handled. Immediately after the waste is produced, it must be separated into containers or bags that are colour coded. Handling these wastes requires minimizing the risk of needle prick injury and infection. Biomedical waste should not be combined with any other form of waste. If medical waste is not handled on-site, transportation of untreated waste from the source to another treatment site and disposal is necessary. The following factors must be considered when transporting BMWs (Bhuvan et al., 2019; Chakraborty et al., 2014; Himabindu et al., 2015; Mishra, Sharma, Sarita, & Ayub, 2016; Srishti, 2010).

1. Separate cabins should be provided for the vehicle carrier and the biomedical waste containers.
2. Checking the leak-proof consistency of the waste cabin floor.
3. The waste cabin should be designed in such a way that it is easy to clean with disinfectants and that storing waste containers in tiers is simple.
4. Minimize water stagnation; the cabin's inner surface should be sufficiently smooth.
5. Enough rear openings and/or sides should be provided for the fast loading and unloading of waste containers.
6. The BMW symbol must be shown on the vehicle.

5.5 Treatment and Disposal Methods

Mutilation or shredding must be able to avoid unwanted reuse, according to the fundamental concept involved in the disposal of biological wastes. For chemical treatment, a one-percentage solution of hypochlorite is used in its most basic form. Incineration, on the other hand, does not require any pre-treatment. Only towns with a population of fewer than 5 lakhs are expected to follow the deep burial procedure. Furthermore, waste treatment should be performed as close to the point of origin as possible. With all of these considerations in mind, the treatment and disposal of different types of wastes must be done with caution and precision, as shown in table 1 (Arshad et al., 2011; Chakraborty et al., 2014; Singh et al., 2014; Srishti, 2010).

6. Conclusion

According to the findings of this report, biomedical waste is one of the most hazardous wastes generated by humans. In India, dealing with biomedical waste has become a difficult task. Biomedical waste management has been identified as a source of concern by both government and non-government organizations. Any healthcare facility that produces biomedical waste must set up the necessary treatment facilities to ensure proper waste treatment and disposal, reducing the risk of biomedical hazards being exposed to workers, patients, physicians, and the general public. Safe and efficient biomedical waste management is not only a legal requirement but also a social obligation.

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