

EMERGING TRENDS IN BIO-MEDICAL WASTE MANAGEMENT- A REVIEW

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Abstract: Medical care is necessary for our life and health, but the waste generated from medical activities is a real problem to the human world. Biomedical waste (BMW) management is one of the major challenges facing many developing countries. The main source of biomedical wastes are health care facilities, such as hospitals, physicians' clinics, dental practices, blood banks, and veterinary hospitals/clinics, as well as medical research facilities and laboratories. Because biomedical waste can be detrimental, the law requires such facilities to follow procedures that protect the public from coming into contact with it. Without proper biomedical waste disposal, this hazardous material has the potential to do harm not only to the environment, but the community at large. Reinforcing the importance of BMW disposal helps create a worker-safe, patient-safe and environmentally-safe workplace. 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 BMW Management. It also intends to create awareness amongst the personnel involved in health care unit.

Key words: Hazardous waste, Biomedical Waste Management, Health care unit.

1. INTRODUCTION

Biomedical waste management has recently emerged as an issue of major concern not only to hospitals and 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. [1]

The proper management of biomedical waste (BMW) has become a serious issue today. Hazards of poor biomedical waste management have triggered the concern world over, especially in the context of its effects on human health and the environment. [2]

It was found that there are many adverse and harmful effects caused by the 'hospital waste' generated during patient care to the environment as well as to the human beings. Hospital waste is a potential health hazard to the health care workers, public, flora and fauna of the area. The problem of the waste disposal in hospitals and other health-care institutions have become an issue of increasing concern. [3]

2. DEFINITION

According to Biomedical Waste (Management and Handling) Rules, 1998 of India "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 biologicals." [4]

It is estimated that annually about 0.33 million tons of biomedical wastes are generated in India. 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%). [5]

The Government of India (notification, 1998) specifies that Hospital Waste Management is a part of hospital hygiene and maintenance activities. This involves management of various activities, such as collection, transportation, operation or treatment of processing systems and disposal of wastes. [4]

Before the notification of Bio-Medical Solid Waste (Management and Handling) Rules 1998, waste from houses, streets, shops, offices, industries and hospitals was the responsibility of municipal or governmental authorities, but now it has become compulsory for hospitals, clinics, other medical institutions and veterinary institutions to dispose of bio-medical solid waste as per the Law as it become serious threat to the human population.

World Health Organization states that 85% of hospital wastes are actually non-hazardous, whereas 10% are infectious and 5% are noninfectious but they are included in hazardous wastes. About 15% to 35% of Hospital waste is regulated as infectious waste. This range is dependent on the total amount of waste generated. [6]

3. SOURCES OF BIOMEDICAL WASTE

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.

Major Sources

- Govt. hospitals/private hospitals/nursing homes/ dispensaries.
- Primary health centers.
- Medical colleges and research centers/paramedic services.
- Veterinary colleges and animal research centers.
- Blood banks/mortuaries/autopsy centers.
- Biotechnology institutions.
- Production units.

Minor Sources

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

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

Table 3.1: Classification of hazardous medical waste

	Type of Waste	Composition
1.	Sharps	Waste entailing risk of injury.
2.	a. Waste entailing risk of contamination b. Anatomical waste c. Infectious waste	<ul style="list-style-type: none"> • Waste containing blood, secretions or excreta entailing a risk of contamination. • Body parts, tissue entailing a risk of contamination • Waste containing large quantities of material, substances or cultures entailing the risk of propagating infectious agents (cultures of infectious agents, waste from infectious patients placed in isolation wards)
3.	a. Pharmaceutical waste b. Cytotoxic waste c. Waste containing heavy metals d. Chemical waste	<ul style="list-style-type: none"> • Spilled/unused medicines, expired drugs and used medication receptacles • Expired or leftover cytotoxic drugs, equipment contaminated with cytotoxic substances • Batteries, mercury waste (broken thermometers or manometers, fluorescent or compact fluorescent light tubes). • Waste containing chemical substances: leftover laboratory solvents, disinfectants, photographic developers and fixers.
4	Radioactive waste	<ul style="list-style-type: none"> • Waste containing radioactive substances found in laboratories or nuclear medicine, urine or excreta of patients.

4. PROBLEMS RELATED TO BIOMEDICAL WASTE

The implementation of Bio-Waste regulation is a major issue related to current BMW management in many health care centers. Some hospitals are disposing off waste in a haphazard and indiscriminate manner. Lack of segregation practices, results in mixing of hospital wastes with general waste making the whole waste hazardous. Inappropriate segregation ultimately results in an improper method of waste disposal. Hence inadequate Bio-Medical waste management will results into environmental

pollution, unpleasant smell, growth and multiplication of vectors like insects, rodents and worms which may lead to the transmission of diseases like typhoid, cholera, hepatitis and AIDS through injuries from syringes and needles contaminated with human blood. [7]

Various communicable diseases, which spread through water, sweat, blood, body fluids and contaminated organs, are important to be prevented. The Bio Medical Waste scattered in and around the hospital premises invites flies, insects, rodents, cats and dogs which spread communication disease like plague and rabies. Rag pickers sorting out the garbage are at a risk of getting tetanus and HIV infections. The recycling of disposable syringes, needles, IV sets and other article like glass bottles without proper sterilization are responsible for Hepatitis, HIV, and other viral diseases. It becomes moral responsibility of Health administrators to manage hospital waste in most safe and eco-friendly manner. [7]

The general public's health can also be at risk by improper disposal of bio-medical waste. Improper practices such as dumping of bio-medical waste in open dustbins, open spaces, water bodies etc. leads to the spread of diseases. Emissions from incinerators and open burning leads to exposure of harmful gases which can cause cancer and respiratory diseases. [8]

Plastic waste can choke animals, which scavenge on openly dumped waste. Injuries from sharps are common affecting animals. Harmful chemicals can cause serious health hazards to animals and birds. Certain heavy metals can affect the reproductive health of the animals. [9]

The improper management in bio-medical waste causes major environmental problems that causes air, water and land pollution. The pollutants that cause damage can be classified into biological, chemical and radioactive. There are several legislations and guidelines in India concerning environmental problems, which can be addressed. [10]

The problem of bio-medical waste disposal in the hospitals and other healthcare establishments has become an issue of major concern, thus hospital administration should find out new ways of scientific, safe and cost-effective management of the waste, and keeping their personnel informed about the advances in this area so that they will be aware of consequences of improper disposal of waste. Proper waste management strategy is needed to ensure health and environmental safety. Thus Central Government had to intervene for enforcing proper handling and disposal of hospital waste and an act was passed in July 1996 and a bio-medical waste (handling and management) rule was introduced in 1998.

5. MANAGEMENT OF BIO-MEDICAL WASTE

The collection and transportation of BMW should be carried out in such a way that it avoids any possible risk to human health and environment. Collection and transport are the two operations, where the chances of coming in contact with public, rag pickers, animals/birds, etc are high. Therefore, all care shall be taken to ensure that the segregated BMW, handed over by the healthcare units, reach treatment facility without any damage, spillage or un-authorized access by public, animals etc. Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedical waste in any institute.

Waste Segregation: The key to effective management of biomedical waste is identification and segregation (separation) of the waste. The most appropriate way of identifying the categories of BMW is by sorting the waste into color coded plastic bags or containers. BMW should be segregated into containers/bags at the point of generation itself in accordance with schedule II of Biomedical Waste (management and handling) Rules 1998.

Waste Transportation: Biomedical waste should be collected and transported within 48 hours from the hospital by means of trolleys, containers or carts that are not used for any other purpose. The trolleys have to be cleaned daily. Offsite transportation vehicle should be marked with the name and address of carrier. All disposable plastic should be subjected to shredding before disposing off to vendor.

Treatment Equipment: As per the BMW rules, waste falling in most of the category can be treated in systems based on no burn technologies. Such waste account for about 90% of the waste streams in a health care unit.

Incineration: It is a controlled combustion process where waste is completely oxidized, and harmful microorganisms present in it are destroyed / denatured under high temperature.

Autoclaving / Microwaving / Hydroclaving: Autoclave is a low-heat thermal process where steam is brought into direct contact with waste in a controlled manner and for sufficient duration to disinfect the wastes. It shall have tamper proof control panel with efficient display and recording devices for critical parameters such as time temperature, pressure, date and batch number etc. Hydroclaving is similar to that of autoclaving that the waste is subjected to indirect heating by applying steam in the outer jacket. The waste is continuously tumbled in the chamber during this process.

Shredder: Shredding is a process by which waste is cut in to smaller pieces so as to make the waste unrecognizable. It helps in prevention of reuse of BMW and also acts as identifier that the waste has been disinfected and safe to dispose off.

Sharp Pit/Encapsulation: A sharp pit or a facility for sharp encapsulation shall be provided for treatment of sharp. An option may also worked out for recovery of metal from sharps in a factory.

6. HEALTHCARE WASTE MANAGEMENT IN INDIA

Until now, hospital waste in India was not segregated before disposal to the dump site or incinerator. Traditionally, recycling in India is conducted from the dumping grounds of waste where whole mixed waste is dumped, generally the rag pickers collect the waste manually and sort for recyclable material. These workers then contact relevant agencies and sell it to them. Most of these rag pickers are women and children from the lower socio-economic strata, and were not aware of health risks. As a result many of them were carriers of diseases from syringes and needles and other biomedical waste and became a great health risk to the general population. Since this population is generally rejected from mainstream society (as 'untouchables'), it is relevant to call for further legislation to ensure education, awareness and health care facilities for their special status, in the context of health hazards in the recycling industry.

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

Salient Features:

- Published by Govt. of India, under Section 6 & 25 of Environmental Protection Act 1986 on 20/7/98 and appeared in official gazette of India on 27/7/98.
- Deals with the generation/handling/treatment/disposal of Bio Medical Waste.
- These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose or handle bio-medical waste in any form.
- Rule 4 specify duty of occupier (generator) to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment.
- Rule 5 and 6 specifies waste management procedures.
- Section 7 is about prescribed authority that shall implement these rules.[18]

These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose or handle bio-medical waste in any form.

6.2. SERIOUS ISSUES OBSERVED WHLE HANDLING BIO-MEDICAL WASTE

Despite the introduction of the Biomedical Rules, [11] Lakshmi (2003) states that waste generated by government hospitals is still largely being dumped in the open, waiting to be collected along with general waste. Hospitals should not exclusively depend on incinerators for disposal of biomedical wastes. There is no single technology available for the treatment of hospital waste. Hospitals should segregate the waste and decide about the technological option which is appropriate for their management of waste disposal. For example, contaminated plastics need to be disinfected and shredded while pathological waste may be incinerated. In India, most of the medical administrations have installed the disposal technologies but not implementing 'waste management practices' within the hospital premises.

Here are some of the serious issues observed in most of the hospitals

- 1) The segregation of waste was not satisfactory. [12,13]
- 2) Colour coding for various categories of waste was not followed.[14]
- 3) The storage of BMW was not found in isolated area and proper hygiene was not maintained.
- 4) Personal protective equipment and accessories were not provided.
- 5) Most of the hospitals don't have proper waste treatment and disposal facilities. [15]
- 6) Most of the incinerators were not properly operated and maintained, resulting in poor performance.
- 7) Many times plastics were also incinerated with the waste leading to possible emission of harmful gases.
- 8) Several hospitals had not applied to State Pollution Control Board for authorization under the rules.
- 9) General awareness among the hospital staff regarding BMW was found to be lacking.[16]

Assessment of medical waste management practice in the northern part of Jordan revealed that there were no defined methods for handling and disposal of these wastes. Moreover there were no specific regulations or guidelines for segregation or classification of these wastes. [15]

A study on knowledge, attitude and practices related to bio medical waste management on the subject was conducted in a tertiary-level teaching hospital All India Institute of Medical Sciences (AIIMS), Delhi. The results of the study revealed that personnel with a greater level of education – such as consultants, residents and scientists – had very good knowledge of the rules, but attitude and practices related to it were found to be very low. However the knowledge, attitude and practices of paramedical staff were found to be quite high. Sanitary staff, though they have very poor knowledge about the bio-medical waste Act and rules, have good percentage of people with positive attitude and practice habits. Surprised to know that laboratory staff were not

aware and showed the least interest in learning about correct procedure, as they felt that it is the responsibility of those providing direct patient care. [17]

Another study carried out in smaller nursing homes and hospitals in Delhi, showed that there was a marked improvement in the segregation practices of bio-medical waste in small private hospitals and nursing homes. The majority of nursing homes and hospitals were found to be using a service provider for the collection, management, and disposal of healthcare wastes. [18]

7. CONCLUSION

Biomedical waste management requires:

- Segregation of the hospital wastes by means of available disposal technology.
- Employment of cost-effective and available relevant technology.
- Investigate possibilities of recycling the waste in a scientific and hygienic manner.
- Setting up of common medical waste treatment facilities for/by different hospitals such as transportation of the hazardous waste to the common disposal system for the proper disposal and also helps to reduce the expenditure.
- Safety of medical staff/rag-pickers, by the use of protective equipment and accessories i.e. gloves and masks and housekeeping aspects (drinking water, sewage system of the hospitals).
- Implementation of recycling of waste by medical and paramedical personnel both. Training of Municipality workers by medical personnel on how to handle medical waste to avoid risks and health hazards.
- Private hospitals should also be allowed to use incinerator, which is installed, in government hospitals. For this purpose, a specific fees can be charged from private hospitals.
- Biomedical waste label on waste carry bags and trolleys and also put the poster on the walls near the bins (waste) giving details about the type of waste that has to dispose in the baggage as per biomedical waste management rule. Carry bags should have the biohazard symbol on them so that general public could become alert.

The management of biomedical wastes poses a great challenge to the hospital managers, policy planners, city administrators, medical personnel and workers in the recycling industry. There is a need for adopting appropriate safety measures, a cost-effective system for better management of medical waste and reduce the amount of waste generation by creating awareness and training of all concerned.

The segregation of waste should be carried out at source and reduction, reuse and recycling should be considered in proper perspectives for better management of bio medical waste. More studies should be conducted to generate awareness on challenges faced due to improper handling of bio medical waste so that the proper management of bio medical waste could take place. If we want to protect our environment and the health of community, we must sensitize ourselves to this important issue in the interest of community at large.

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