Bio-Medical Waste Management And Treatment

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Abstract- The Biomedical and Health Care waste management is very different from other house waste or industries waste management. Biomedical waste management is one of the biggest challenges of the present day times because it has a direct impact on the health of human beings. Since it is hazardous in nature its safe and proper disposal is extremely important. For proper a disposal management of biomedical waste the Ministry of Environment and Forests has published the Bio-Medical Waste Rules, 1998. This review explains the hospital waste management and the environmental problem in India. This study has also focused on the problems associated with Bio- waste. In the past, medical waste was often mixed with the municipal solid waste and disposed in nearby landfills. In recent years, many efforts have been made by environmental regulatory agencies to better management of biomedical waste.

Keywords: Incineration, solid waste, Hazardous, Non-hazardous, Thermal inactivation.

INTRODUCTION

Many waste are produced as a result of human activities. Such waste may be dangerous and therefore need safe disposal. Industrial waste, sewage and agricultural waste pollute water, soil and air and it can also be dangerous to human beings and environment. Solid waste can be classified into different types depending on their source. It includes (a) House hold waste (b) Industrial waste (c) Biomedical waste or hospital waste or infectious waste. Hospital waste is considered as hazardous because they contain toxic substances. This waste is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities in these fields. Liquid waste can be divided into two components

(a) Liquid reagents/ chemicals discarded and (b) the cleaning and washing water channeled into the drain. Until recently, medical waste management was not generally considered an issue. In the 1980s and 1990s, concerns about exposure to human immunodeficiency virus (HIV) and hepatitis B virus (HBV) led to questions about potential risks inherent in medical waste. Thus, hospital waste generation has become a prime concern due to its multidimensional ramifications as a risk factor to the health of patients, hospital staff and extending beyond the boundaries of the medical establishment to the general population. Hospital waste refers to all waste, biologic or non biologic that is discarded and not intended for further use. Medical waste is a subset of hospital waste; it refers to the material generated as a result of diagnosis, treatment or immunization of patients and associated biomedical research. Biomedical waste (BMW) is generated in hospitals, research institutions, health care teaching institutes, clinics, laboratories, blood banks, animal houses and veterinary institutes.

Biomedical waste, also known as infectious waste or medical waste which is defined as waste generated during the diagnosis, testing, treatment, research or production of biological products for humans or animals. Biomedical waste includes syringes, live vaccines, laboratory samples, body parts, bodily fluids and waste, sharp needles, cultures and lancets 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. The waste generated in these institutions essentially consists of solids and liquid, which may be hazardous, infectious and non-infectious. It has been estimated that up to 85% to 90% of the waste generated in hospitals is non-infectious (free with any body fluids, which is similar to domestic waste). It is the remaining 10% to 20% of waste that is of concern because it is hazardous and infectious. In addition, waste that is un-segregated and not treated in the right manner would cause environmental pollution affecting the health of the community. From waste audits done at several hospitals by a few NGOs, arrived at some figures, which can now be used and extrapolated for the whole country. These audits must be conducted only after adequate training on waste segregation is given to health care institutions. Proper handling, treatment and disposal of biomedical wastes are important elements of health care office infection control programme. Correct procedure will help protect health care workers, patients and the local community. Proper collection and segregation of biomedical waste are important. At the same time, the quantity of waste generated is equally important. A lesser amount of biomedical waste means a lesser burden on waste disposal work, cost saving and a more efficient waste disposal system. Hence, health care providers should always try to reduce the waste generation in day-to-day work in the clinic or at the hospital. To protect the environment and community health, the Ministry of Environment and Forest has notified, "Biomedical waste (Management and Handling) Rules 1998/ 2000 under the Environment (Protection) Act, 1986 that compel all hospitals, clinics, nursing homes, slaughter houses and laboratories to ensure

safe and environmentally sound management of waste produced by them. Safe and effective management of waste is not only a legal necessity but also a social responsibility. Lack of concern, motivation, awareness and cost factor are some of the problems faced in the proper hospital waste management. Clearly, there is a need for education as to the hazards associated with improper waste disposal. An effective communication strategy is imperative keeping in view the low awareness level among different category of staff in the health care establishments regarding biomedical waste management.

1. Sources of biomedical waste:

Although the solid waste management has become one of the major topics of importance but still local bodies are unable to give the proper attention towards some special sources of wastes out of which biomedical waste is one. The sources of biomedical waste can be categorized as primary and secondary sources according to the quantities produced. While minor and scattered sources may produce some biomedical waste in categories similar to Bio medical waste, their composition will be different. The fig 1 and fig 2 illustrates the major and minor sources of biomedical medical waste.

a b c d e f

Fig.1 The major sources of Biomedical waste

a. Hospital
b. Lab
c. Research Center
d. Animal Research
e. Blood Bank
f. Nursing Homes

Fig.2. The Minor sources of Biomedical waste

1	Ambulance Services
2	Cosmetic Piercing
3	Funeral Services
4	Vaccinations
5	Dental Clinics

2. Classification of biomedical waste

Approximately 75-90% of the biomedical waste is nonhazardous and as harmless as any other municipal waste. The remaining 10-25% is hazardous and can be injurious to humans or animals and deleterious to environment (fig.3).

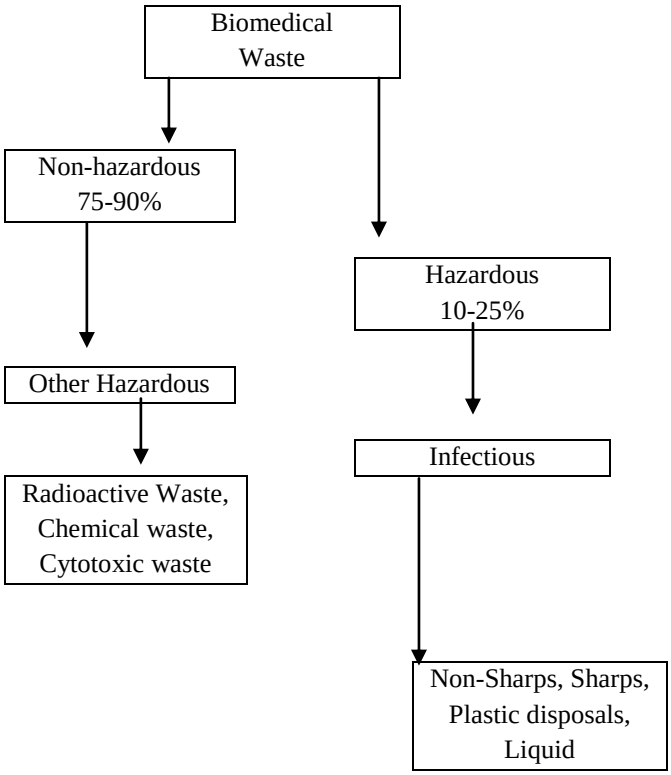

Fig.3 Classification of Biomedical waste

It is important to realize that if both these types are mixed together then the whole waste becomes harmful. Apart from these the WHO classified medical waste into 8 categories such as General Waste, Pathological, Radioactive, Chemical, Infectious to potentially infectious waste, Sharps, Pharmaceuticals, Pressurized containers. Whereas, In India, Ministry of Environment and Forest, Government of India (1998) has notified Bio-medical Waste (Management & Handling) Rules -1998, which describes ten categories shown in table 1.

Table.1: Categories and types of Biomedical waste

1	Human anatomical waste
2	Animal waste
3	Microbiology waste and laboratory waste
4	Waste sharps
5	Discarded medicines
6	Solid waste
7	Infectious solid waste
8	Chemical waste
9	Liquid waste
10	Incineration ash

3. Problems associated with biomedical waste

Biomedical waste is produced in all conventional medical units where treatment of (human or animal) patients is

provided, such as hospitals, clinics, dental offices, dialysis facilities, as well as analytical laboratories, blood banks, university laboratories. Health care waste refers to all materials, biological or non-biological, that is discarded in any health care facility and is not intended for any other use.

Within a health care facility or hospital, the main groups submitted to risks are:

Doctors, medical nurses, Patients, Visitors, Workers in ancillary services, Service workers dealing with waste treatment and disposal of health unit. Regarding the health care workers, three infections are most commonly transmitted: hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency (HIV) virus. Among the 35 million health care workers worldwide, the estimations show that each year about 3 million receive hard exposures to blood borne pathogens, 2 million of those to HBV, 0.9 million to HCV, and 170,000 to HIV. Also, the workers involved in the collection and treatment of the biomedical waste are exposed to a certain risk.

4. Treatment and disposal techniques adopted for biomedical waste

There are several methods that have been successful in the treatment of infectious waste. The following are the methods that will show the treatment that may be available at your facility. The methods are: Autoclaving, Incineration, Thermal inactivation, Gas/Vapor Sterilization, Chemical Disinfection etc.

4.1 Autoclaving

Autoclaves are closed chambers that apply both heat and pressure, and sometimes steam, over a period of time to sterilize medical equipment. Autoclaves have been used for nearly a century to sterilize medical instruments for re-use. Autoclaves are used to destroy microorganisms that may be present in medical waste before disposal in a traditional landfill. Autoclaves can be used to process up to 90% of medical waste, and are easily scaled to meet the needs of any medical organization. Small counter-top autoclaves are often used for sterilizing reusable medical instruments while large autoclaves are used to treat large volumes of medical waste. Steam sterilization is most effective with low-density material such as plastics, metal pans, bottles, and flasks. High-density polyethylene and polypropylene plastic should not be used in this process because they do not facilitate steam penetration to the waste load. Plastic bags should be placed in a rigid container before steam treatment to prevent spillage and drain clogging. Bags should be opened and caps and stoppers should be loosened immediately before they are placed in the steam sterilizer. Care should be taken to separate infectious wastes from other hazardous wastes. Infectious waste that contains noninfectious hazards should not be steam-sterilized.

Waste that contains anti neoplastic drugs, toxic chemicals, or chemicals that would be volatilized by steam should not be steam-sterilized.

4.2 Incineration

This is proved in which there is increase temperature causes dry oxidation. To reduce organic & combustible waste to inorganic incombustible to reduce volume & weight that cannot be reveled, reused or disposed in outer land fields. The drawbacks to incineration include the large capital and operating costs for modern technologies. The advantage of incineration is no Pretreatment is required and suitable for low heating volume above 2000 Kcal/Kg for single chamber & 3500 Kcal/Kg for double-chamber. These waste should be less moistured as less than 30% and also combustible.

4.3 Thermal inactivation

Thermal inactivation involves the treatment of waste with high temperatures to eliminate infectious agents. This method is usually used for large volumes. Liquid waste is collected in vessel and heated by heat exchangers or a steam jacket surrounds the vessel. The types of pathogens in the waste determine the temperature and duration of treatment. After treatment, the contents can be discharged into the sanitary sewer in a manner that complies with State, Federal, and local requirements. This method requires higher temperatures and longer treatment cycles than the steam treatment.

4.4 Gas/vapor sterilization

Gas/vapor sterilization uses gaseous or vaporized chemicals as the sterilizing agents. Ethylene oxide is the most commonly used agent, but should be used with caution since it is a suspected human carcinogen. Because ethylene oxide could be adsorbed on the surface of treated materials, the potential exists for worker exposure when sterilized materials are handled.

4.5 Chemical disinfection

Chemical disinfection is the preferred treatment for liquid infectious wastes. Consider the following: Type of micro-organism **,** Degree of contamination **,** Amount of proteinaceous material present, Type of disinfectant, Contact time **,** Other relevant factors such as temperature, pH, mixing requirements, and the biology of the microorganism**.** Ultimate disposal of chemically treated waste should be in accordance with State and local requirements.

5. Disposal of treated waste:

Infectious waste that has been effectively treated is no longer biologically hazardous and may be mixed with the disposed of as ordinary solid waste, provided the waste

doesn't pose other hazards that are subject to federal or state regulations..

EPA recommends:

- Contacting state and local governments to identify approved disposal options.
- Discharge of treated liquids and pathological wastes (after grinding) to the sanitary sewer system.
- Approval of the local sewer authority must be obtained.

6. Health hazards from biomedical waste

The improper management of bio-medical waste causes serious environmental problems in terms of air, water and land pollution. The nature of pollutants can be classified into biological, chemical and radioactive. Environment problems can arise due to the mere generation of bio-medical waste and from the process of handling, treatment and disposal.

Air Pollution can be caused in both indoors and outdoors. Bio-Medical Waste that generates air pollution is of three types - Biological, Chemical and Radioactive. Indoor air pollutants like pathogens present in the waste can enter and remain in the air in an institution for a long period in the form of spores or as pathogens itself. Chemical Pollutants that cause outdoor air pollution have two major sources-open burning and incinerators. Open burning of bio-medical waste is the most harmful practice and should be strictly avoided.

Water Pollution is another major threat from Bio-medical waste. If the waste is dumped in low-lying areas, or into lakes and water bodies, can cause severe water pollution. Water pollution can either be caused due to biological, chemicals or radioactive substances. The pathogens present in the waste can leach out and contaminate the ground water or surface water. Harmful chemicals present in bio-medical waste such as heavy metals may also cause water pollution.

Land Pollution is caused by the final disposal of all bio-medical waste. Even liquid effluent after treatment is spread on land. Therefore, pollution caused to land is inevitable. Open dumping of bio-medical waste is the greatest cause for land pollution.

7. Challenges of biomedical waste in India

(Bio-medical Waste (Management and Handling) Rules. Ministry of Environment and Forests Notification, New Delhi. 1998)

- To treat 420561 kg per day of bio medical waste in accordance with Bio-Medical Waste Rules.
- Number of Common Bio-Medical Wastes Treatment Facility (CBMWTF) to be increased manifold. Presently there are 157 facilities which are not adequate to handle all the bio-medical wastes generated.
- CBMWTF is to be set up under public private partnership mode.
- New technologies to be promoted for destruction of toxic bio medical wastes.

8. Analysis Result

8.1 *Short comings in the existing system*

Medical facilities in urban areas are improving faster than those in the rural areas due to rapid urbanization. Waste management systems in the urban areas are already overburdened. Hence, an additional load due to mixing of infectious waste from HCUs aggravates the problem. Separate systems for disposal of HCU waste are available in only a few establishments. Few shortcomings in the existing system are: The segregation of waste in almost all hospitals is not satisfactory.

- Color-coding for various categories of waste is not followed.
- The storage of bio-medical waste is not in isolated area and proper hygiene is not maintained. x Personal protective equipment and accessories are not provided.
- Most of the hospitals do not have proper waste treatment and disposal facilities. In the cities where common treatment facilities have come up, many medical establishments are yet to join the common facility.
- Most of the incinerators are not properly operated and maintained, resulting in poor performance.
- Sometimes plastics are also incinerated leading to possible emission of harmful gases.
- General awareness among the hospital staff regarding bio-medical waste is lacking.

8.2 *Threats due to poor waste management*

The status of poor waste management currently practiced in the city poses a huge risk towards the health of the general people, patients, and professionals, directly and indirectly through environmental degradation. Communicable diseases like gastro-enteritis, hepatitis - A and B, respiratory infections and skin diseases are associated with hospital waste either directly as a result of waste sharp injuries or by other transmission channels. The hosts of micro organisms responsible for infection are enterococci, non-haemolytic streptococci, anaerobic cocci,

clostridium tetani, klebsiella, HIV and HBV (Blenkharn, 1995). The potential risk to health care workers comes from the handling of infected sharps; 60 percent of them sustain an injury from sharps knowingly or unknowingly during various procedures. The practice of re-heating the needle after use is the major factor for needle stick injuries. Through poor waste management practices, all health care workers (nurses, doctors, lab technicians), service personnel, rag pickers and the general public are at risk of contracting infections while handling, storage, and treatment. Incinerators operating at sub-optimal conditions are an added environmental and health hazard.

8.3 *Recommendations and Follow-up*

- All health care facilities generating Bio-medical waste shall strictly ensure segregation, color coding and other provisions of Bio-medical waste (Management & Handling) rules, 1998 and amendments thereof. Incinerators, which do not confirm to the design and emission norms as per rules, must be modified and air pollution control system may be retrofitted to minimize the emission level.
- The operator should ensure proper operation and management (O&M) of incinerator through attainment of required temperature in both the chambers, regular operation of the incinerator, proper maintenance of the logbook and storage of the waste in isolated area, plastic incineration should not be undertaken.
- Proper training and personal safety equipment / accessories should be provided to waste handling staff.
- Records of waste generation, treatment and disposal should be maintained by the hospital.
- Various regulatory agencies, Hospitals, Medical Association & Municipal Corporation should work together for proper management of Bio-medical waste in the cities/towns.
- Common bio-waste treatment facility in each city/town with strict monitoring of these facilities by regulatory agency should be implemented. Environmental agencies visit to the particular treatment plants can be made more mandatory and the management are highly possible in common facilities only. Individual and local arrangements for the same should be discouraged. This is on account of the fact that improper operation may lead to increase air pollution and other annoyance problem

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10. CONCLUSION

Medical wastes are highly hazardous and put people under risk of fatal diseases. The understanding of medical waste management and control techniques is important. In this paper, introductory materials on the definition of medical waste, medical waste management regulatory acts, the risks of exposure, medical waste management procedures and control techniques are presented. Lesser amount of bio-medical waste means lesser burden on waste disposal work. Hence, hospital should always try to reduce waste generation in day-to-day work in hospitals. According to our research work we found that the hospitals could combine and form a group to make their own incineration plant by which they don't have to depend on municipality which could be beneficial for them and reduce their process of open dumping. The results of the study demonstrate the need for strict enforcement of legal provisions and a better environmental management system for the disposal of bio-medical waste in hospitals as well as other healthcare establishments.

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