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Studies of Mixed Solid Waste in Reference to Biomedical Waste

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Abstract – Within the domain of municipal solid wastes, bio-medical wastes acquire a special dimension, since it is infected and hazardous. In hospitals and health care facilities, waste generated differs from municipal waste in general. Only one of these collection, transport and final disposal systems which be needed by municipal wastes in general. This could involve more structures, as they include parts of the body, human tissues and animal tissues, toxic wastes, gaze, cotton, plastics, liquid waste contaminated, blood and wastes from laboratories. This paper provides comprehensive discussion on mixed solid waste in reference to Biomedical Waste and makes some recommendations for their effective management besides discusses the key strategic actions required for an effective bio-medical waste management plan preparation.

Key Words: Biomedical Wastes, Hazardous Waste, Health-Care Establishment, Regulations, Waste-Management Plan, Waste Disposal.

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INTRODUCTION

Recently, biomedical waste management has become a major concern, not only for hospitals, nursing authorities, but also for the agencies, the media and the general public. Around 1-2percent of the total municipal solid waste stream is generated by biomedical waste. Any of the waste is a concern to human health and the environment. Not only countries but also countries differ in composition and quantity of biomedical wastes produced. Facilities for healthcare are involved. A varied waste stream is created in its composition by laboratories, clinics, nursing homes, medical, dental and veterinary hospitals. Hospitals have maximum waste among these services. Biomedical waste is the greatest risk from infectious and sharp components of waste, as medical staff and handlers sometimes get a needle stab injury and may get HIV or AIDS, hepatitis B and C. Risks are very large in hospitals or medical services. Given the concerns posed by the Union Ministry of Environment and Forest, the Government of India notified the 'Environment (Protection) Act, 1986,' 'Biomedical Waste (Management and Management) Regulations, 1998.' However, biomedical waste management has been found to be complex and the complex management and actions of health care staff must be further established.

Though town planners, environmental advocates and local government officials are worried about urban solid waste, there is still little concern about particular sources of waste and their management. Biomedical wastes are produced mainly from hospitals, health centres, hospitals, veterinary clinics and practitioners, drugs, blood banks, animal houses and research institutes. One of the waste products produced is biomedical waste. The other sources of biomedical waste are the following:

Households,

Industries, education institutes and research centres,

Blood banks and clinical laboratories,

Health care establishments

The sector generates all the types of waste listed under the bio-medical waste are shown in Figure 1.

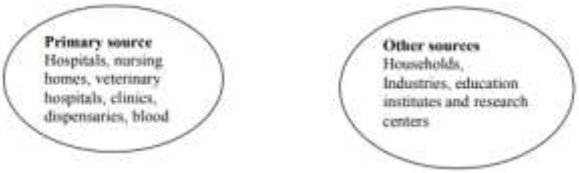

Figure 1. Source of biomedical wastes

Biomedical waste shall mean any waste produced during human diagnose, treatment or animal immunisation or research activities related to it or in the development or testing of organisms, microorganisms or metabolism products and biochemical reactions for the purposes of diagnosis, immunisation or processing. including categories mentioned in Table 1. Between 75 percent and 90 percent of the waste produced by health-care providers is non-risk or general health-care waste, comparable to domestic waste. The key functions of health care facilities are administrative and house kept and may include waste created while maintaining health facilities. The remaining 10-25% of biological waste is considered harmful and can cause different health risks..

Table 1 Categories of health-care waste

Waste Category	Description and examples
Human Anatomical Waste	Human tissues, organs and body parts
Animal Waste	Animal tissues, organs, body parts, carcasses, bleeding parts, fluids, and waste generated by veterinary hospitals, etc.
Microbiology and Biotechnology waste	Waste from laboratory cultures, stocks of specimens of micro-organism, live or attenuated vaccines, human and animal cell cultures used in research and infectious agents from research and industrial laboratories, waste from production of biologicals, toxins, dishes and devices used for transfer of cultures.
Waste Sharps	Needles, syringes, scalpels, blades, glass (broken and unbroken), etc. that may cause punctures and cuts. This includes both used and unused.
Discarded medicines and cytotoxic drugs	Wastes comprising of outdated, contaminated drugs and discarded medicines.
Soiled Waste	Items contaminated with blood, body fluids including cotton, dressing, soiled plaster casts, linen, beddings, other material contaminated with blood.
Solid Waste	Waste generated from disposable items other than waste sharps such as catheters, intravenous sets, etc.
Liquid Waste	Waste generated from laboratory and washing, cleaning, housekeeping and disinfecting activities.
Incineration Ash	Ash from incineration of any biomedical waste
Chemical Waste	Chemicals used in production of biological, chemical used in disinfection as insecticides, etc.

EFFECTS OF BIOMEDICAL WASTE

Bio-medical waste management causes serious environmental problems that cause air, water and soil contamination. Due to the contamination, the biological, chemical, and radioactive substances can be categorised. There are a range of environmental regulations and guidelines in India that can be discussed. Radioactive waste classification is protected by bio-medical waste. Some of the effects of pollution on air, radio activities, land, health and hazards are discussed.

Air Pollution

Air pollution can be caused in both indoors and outdoors atmosphere. Biomedical waste that generated by air pollution are been classified in three types namely-Biological, Chemical and radioactive.

In-door air pollution

Pathogens in the waste can also, in intermittent form or as pathogens, enter and stay in the air for a long time. Waste isolation, pretreatment in the spring, etc. can also dramatically reduce this problem. Sterilization of rooms also helps to monitor the biological contamination of the indoor air. Diseases like Sick Building Syndrome (SBS) could be brought on by indoor air pollution due to the above chemicals of inadequate ventilation. The SBS can be minimised by an adequate construction and well-maintained air conditioning. Chemicals should be used in compliance with the legislation. It is important to prevent the use of chemicals.

Out-door air

Pollution Outdoor air pollution can be caused by pathogens. Pathogenic wastes without pretreatment can reach the atmosphere if they are transported outside the institution or if they are dumped in open areas. Two main sources of open burning and incinerators are chemical emissions causing outdoor air pollution. The most dangerous method is open burning of bio-medical waste. Air conditions may occur when inhaled. There is carcinogenicity in certain bio gases such as dioxins and furans. The design and maintenance parameters of such technology for treatment and disposal should adhere to the specified requirements.

Radioactive emissions

Research and radio-immunoassay activities may generate small quantities of radioactive gas. Gaseous radioactive material should be evacuated directly to the outside. The use of such device requires maintenance of the trap and monitoring of the off-gas.

Water Pollution

The liquid waste generated when let into sewers can also lead to water pollution if not treated properly. Water pollution can alter parameters such as pH, BOD, DO, COD, etc. There are instances where dioxins are reported from water bodies near incinerator plants. Dioxins enter the water body from the air.

Radioactive effluent

Liquid radioactive waste can come from chemical or biological testing, from body organ imaging, from radioactive spill decontamination, from the urine of the patient, and from scintillation fluids used in radioimmunoassay. In normal cases, as long as the patient's room is routinely inspected for radioactive pollution, urine and faces can be treated as no radioactive waste.

Land Pollution

Soil pollution due to infectious waste, disposable goods, chemicals used during treatment and ash, and other waste that is generated during

processing is caused by bio-medicinal waste. Heavy metals such as cadmium, plumes, mercury and so forth that are found in the waste can be absorbed into the food chain by plants. Even contaminants are nitrates and phosphates found in locations that are leachate. Excessive quantities of trace nutrients and other elements, including heavy metals, are harmful to plant life and often harmful to animals and humans. Table 2 presents the allowable limits for certain plant soil components. The only ways to eliminate this kind of pollution are to minimise waste and proper care before disposal.

Table 2. Comparison of treatment technologies for medical wastes

Treatment Systems	Autoclave	Hydroclave	Microwave	Incinerator	Chemical
Description	Steam sterilisation (Direct heating)	Steam sterilization, (indirect heating) simultaneous shredding and dehydration	Microwave heating of pre-shredded waste	High temperature waste incineration	Mixing pre-ground waste with chemicals, such as chlorine
Sterilization efficacy	Medium	Medium	Medium	High (total destruction of micro-organisms)	Dependent on chlorine strength and dispersement through the waste
Capital cost	Low	Low	High	High	Moderate
Operating cost	Low	Low	High	High	Low
Operator maintenance skills	Low skill level required	Low skill level required	Automated, but highly complex and high level maintenance skill required	High level operator and maintenance skills required	High level required for chemical control and grinder
Air emissions	Odorous but non-toxic	Somewhat odorous but non-toxic	Somewhat odorous but non-toxic	Can be highly toxic	Some chlorine emissions
Water emissions	Odorous, may contain live micro-organisms	Odorous but sterile	Negligible	None	None
Treated waste characteristics	Wet waste, all material recognizable	Dehydrated, shredded waste, unrecognizable material	Shredded but wet waste	Mostly ash, may contain toxic substances	Shredded wet waste, containing chemicals used as disinfectants

NEED FOR BIOMEDICAL WASTE MANAGEMENT

Today's increasing global population means that public facilities, such as solid waste collection and disposal, must be handled. Biomedical waste has a special dimension within the field of municipal solid waste, since it is contagious and harmful. It can transmit disease or it can be harmful to people. The content of infectious waste in a hospital total may be only approximately 20%, but it may infect entire hospital waste if it is not isolated or transported in compliance with prescriptions. Hospitals and medical facilities produce waste which differs from general municipal waste. Only one of these collection, transport and final disposal systems may be needed for municipal waste in general. Against this, biomedical waste will require more systems as they contain body parts, animal or human tissues, radioactive waste, gas, cotton, plastics, plaster-of-paris casts, liquid waste contaminated, blood waste and laboratory waste. The environmental and public health risks are the medical waste created in various health facilities. Inadequate treatment and disposal of diseases such as tuberculosis, hepatitis, enteric fiever, HIV infection or even AIDS may spread.

Bio-medical waste management is one of the big areas that has not been adequately addressed by policy makers and health managements for infrastructure growth. In the past several steps, primarily inspired by the developed countries, had been taken. Results were not sufficient considering the substantially varying population density, socio-economic features and climate. The strategy and goals of the government are also different. This method was not sufficient in the Indian sense for handling bio-medical waste. A system or systems must therefore be created that are appropriate for the disposal of hospital waste and must therefore be far different from the local waste disposal system. The current area of research is little aware of the significance and criticality of the proper management of bio-medical waste. This paper addresses the key strategic measures needed for the preparation of an effective bio-medical waste management strategy. Any effective biomedical waste management plan should give careful attention to waste generation, segregation, storage and collection, transportation and treatment and final disposal of bio-medical waste (BMW).

BIOMEDICAL WASTE MANAGEMENT IN INDIA

Waste generation is based on a number of factors, such as type of healthcare facility, specialties of hospital, proportion of reusable products and disposal products, national and hospital waste management policies. Any amount of waste is produced in each procedure performed in the field of health care. In Indian hospitals, average waste generates 0.5 kg a day per patient, while in developed countries; it can range from 3 to 10 kg a day per patient. In West and America, about 15-20% of the overall waste, including infectious waste, is hazardous. However, in India the proper segregation of waste would be much higher (50-75%) and the collection would be mixed. There are no national studies of the amount of hospital waste generated per bed per day, but at local or regional level studies have been performed in different hospitals. Whatever the data from these studies may be available, it can be reasonable to conclude that approximately 1-2 kg / day of waste is generated in most hospitals. Tables 3 and 4 demonstrate some of the important research. The estimated amount of waste produced in the hospitals is 2-5kg / bed / day, according to one report.

Table 3 Average weight of the waste generated in the Hospital (Kg/bed/day)

Countries	Total Waste	% of Infected Waste
USA	7-10	10-15
Western Europe	3-6	10-15
India	0.5-2	30-60

Table 4 Quantity of waste generated at various places in India

Place of Study	Type of Hospitals	Quantity of Bio-Medical waste generated in Kg/bed/day	#Composition of Medical waste
Kolkata	Government, Private Nursing Homes (Large hospitals)	1.044 to 1.368	20-30% infectious; 50-75% general
New Delhi	Government and Private Hospitals	1.5 kg. to 1.8 Kg	45% infectious waste
Mumbai	Tertiary Care Cancer Hospital	1.13 Kg.	46% infectious
Jaipur	Large Tertiary	1.5 Kg.	25-35% infectious
Manipal	Large tertiary care hospital	0.775 kg.	16-26% infectious
Punjab	Large tertiary Hospital	1.05-1.50 kg.	15-30% infectious

Various studies show the standard generation of healthcare waste. Data from some of these surveys are presented in tables showing that health waste generation varies not only country by country, but also country. Waste generation depends on a number of factors such as existing methods of waste management, type of healthcare facility, hospital specialization, proportion of recycled products in healthcare and proportion of day care-treated patients.

- 80 percent general health-care waste, which may be dealt with by the normal domestic and urban waste management system;
- 15 percent pathological and infectious waste and 1 percent sharp waste;
- 3 percent chemical or pharmaceutical waste;
- Less than 1 percent special waste, such as radioactive or cytostatic waste, pressurized containers or broken thermometers and used batteries.

CURRENT BIOMEDICAL WASTE MANAGEMENT SCENARIO

The prevalent methods of solid waste management in the town are very weak. In general, waste storage at the source is not taken care of. The streets are constantly shed by families, commercial institutions, factories, hospitals and nursing houses etc. The Pollution Control Board of India has established a large number of hospitals, nursing homes, healthcare centres but does not take any action for safe disposal of biomedical waste. The biomedical wastes are combined and processed in the traditional disposal site with municipal solid waste. It can be seen in Fig. 1 and 2.

Both waste forms are combined and disposed of together. The majority of hospitals in the city do not have sufficient biomedical waste disposal facilities. Either waste is dumped into the open behind the hospital and often burned, causing extreme air pollution and soil pollution. The incinerators are provided in some hospitals, but the same does not comply with the legislative operational and emission specifications and constitutes a source of pollution. The infected syringes and needles and other waste that are gathered by scavengers and returned illegally to the hospitals are discarded. Birds and livestock bear the body parts that are also discarded along with the waste. The hospital administrations and staff do not fully understand the severity of the problem created by the unscientific manner in which the treatment of these residues is disposed of.

Fig. 1 BMW seen mixed with general waste

Fig. 2 Waste seen disposed of in the middle of the street

Problems Faced by the Health Care Institutions:

The problems faced by health care institutions in the management of biomedical wastes are many. Even though the problems faced by health care institutions in the public and private institutions are almost the same, there is lot of differences as well. The problems faced by health care institutions are:

- The healthcare facilities are designed and run from locations where no potential enlargement is feasible. In certain situations, waste management was not taken into account during the creation of

organisations. Therefore it is very difficult for health institutions to search their hospitals for sufficient and suitable space to accommodate waste treatment and disposal facilities.

- In general, the private health institutions believe that there is no lack of funding. But biomedical waste disposal does not have sufficient priority. All are aware that some kind of incinerator should be built and all waste incinerated regardless of category or form. There is an idea that waste incineration is the best way to deal with waste. But funding is the critical issue in the case of government hospitals. The distribution of funds is not actually budgeted. Such health facilities are also subjected to problems with the procurement of biomedical waste containers and bags, waste storage facilities, treatment plants, disposal of waste treated, etc.

- The methods of waste management introduced in the Rules of Procedure are entirely new to all and distinct from those implemented by the institutions before 1998. Healthcare facilities have handled waste by dumping in the backyard according to the available knowledge and in many cases sufficient attention has not been paid to waste management. The waste management is being ignored by all organisations.

- In most healthcare facilities, particularly in most public health institutions, the waste management system is not currently established. The lowest workers level should handle waste in accordance with their will and pleasure. This must be dramatically improved and improved. The situation can be further strengthened by modern strategies such as the creation of commissions composed of workers from all categories.

- At present there is no monitoring system to assess the waste management facilities available are carried out effectively as expected. Periodical meetings of waste management committees can improve the system.

- Responsibilities of waste management and connected matters are not made mandatory to any officer of health care institutions. It is true that the head of institutions is responsible. However, the head of institutions has to find out suitable officer under him and give responsibility on these matters along with powers for carrying out the works.

- There is a problem regarding the non-availability of required instruments, waste containers, bag, etc.; of required specifications.

CONCLUSION

Proper management of bio medical waste is a problem which both government agencies and non-governmental organisations acknowledge. Sufficient care should be taken of several hazards and hazardous products containing them. Inadequate and inadequate systems of segregation and transport can also create significant problems for society and the implementation of preventive measures, both of which lead in a written form to a growing vulnerability of biomedical hazards for workers, patients and the environment. Timely regulatory and legislative policies and procedures must be enforced to speed up the pace at which proper processing and management methods are developed. They must be well-defined and demanding in order to detach process and isolate the waste properly. Secure and efficient management not only represents a legal obligation but also a social duty for biomedical waste. Some challenges in proper management of hospital waste in individuals working in the sector are lack of enthusiasm, knowledge and cost factors. In various practices, adequate surveys are required on waste management procedures. Education on the risks related to unsuitable waste disposal is clearly required. It is crucial to maintain an effective communication policy in view of the limited level of knowledge of biomedical waste management among the various categories of healthcare personnel. An significant guidance for more study will be the global and quantitative and qualitative assessment of the flows of bio-medical waste. The study aims at improving the current Indian scenario with regard to solid waste management in general and bio-medical waste management in particular, based on an understanding. On the base of a study of current trends and best practices in the field, the research has established comprehensive policy recommendations for the efficient management of biomedical waste. The study model was planned to serve as a useful studies in the evaluation of the current situation of BMW in the city by the municipal or state pollution control board.

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