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Environmental Aspects of the Health Care Facilities

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Abstract: *The health care facilities generated substantial quantity of biomedical waste that has potential to cause health and the environmental hazards. With the application of appropriate treatment technologies, it possible to dispose of the wastes in an environmentally sound manner. Creating awareness and training to staff engaged in the waste handling activities are key elements for success of the biomedical waste management programme in the health care facilities. The paper seeks to give an overview of the technological options available to the health care facilities, regulations and the guidelines for disposal of the biomedical wastes.*

Keywords: *Health Care Facility, Biomedical Waste, Autoclaving, Microwaving, Incineration.*

1. INTRODUCTION

The Hospitals generate wide range of wastes during diagnosis, treatment or immunization. In addition, other related units such as pathological laboratories, blood banks, clinic, dispensaries, birthing facilities etc. are also major sources the wastes. As per the literature, the solid waste quantities generated by the hospitals in India and other countries are 1.5-4.4 kg/bed/day [1]. It has been noted that 10-25% of the health care wastes is infectious or biomedical waste requiring safe disposal [2,3]. The waste and its disposal are the significant environmental aspect for the health care facilities. It has been noticed that the waste management practices followed in several health care facilities are inadequate, particularly in developing countries [4-8]. The studies also noted that awareness regarding proper disposal of the wastes and the initiatives to train the staff were insufficient [9-11].

Table1. *Types of Biomedical Wastes*

Waste categories	Constituents
Human anatomical waste	Human tissues, organs, body parts
Animal waste	Animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals, colleges, discharge from hospitals, animal houses
Microbiology and biotechnology waste	Wastes from laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures
Waste sharps	Needles, syringes, scalpels, blades, glass, etc. that may cause disinfection puncture and cuts. This includes both used and unused sharps
Discarded medicines and cytotoxic drugs	Wastes comprising of outdated, contaminated and discarded medicines
Soiled waste	Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood
Solid waste	Wastes generated from disposable items other than the waste shaprs such as tubings, catheters, intravenous sets etc.
Liquid waste	Waste generated from laboratory and washing, cleaning, house- keeping and disinfecting activities
Incineration ash	Ash from incineration of any bio-medical waste
Chemical waste	Chemicals used in production of biologicals, chemicals used in disinfection, as insecticides etc.

The biomedical wastes, if disposed of without a proper treatment, can cause public nuisance by way of foul smell. Chaudhay and Dhakad [12] studied the health effects and observed lung deceases, dermal deceases and the eye infection among the human population exposed to the biomedical wastes.

Gupta and Singhal [13] assessed the bacterial load in the liquid effluent and solid biomedical wastes as 6.0-6.5 log cfu/mL and 3.1-5.0 log cfu/g, respectively. A study by Malekahmadi et al. [14] reported that the wastes affect public health by possible diseases such as typhoid, cholera, hepatitis and other viral and bacterial infections. Hence, the importance of biomedical waste management hardly needs any emphasis. The biomedical wastes requiring safe disposal are given in Table 1 [15].

2. TREATMENT TECHNOLOGIES

The treatment technologies identified for the biomedical wastes include chemical treatment, autoclaving, microwaving and the incineration [16]. Shredding, deep burial and the plasma pyrolysis are also related methods for the waste disposal as given in Table 2 [15,17].

***Autoclaving*:** Autoclaving is a low-heat thermal treatment process. Steam is brought into direct contact with the waste in a controlled manner for a sufficient duration to disinfect the wastes. Autoclaves are provided with display and recording devices for controlling parameters such as time, temperature and pressure. The autoclaves are extensively used by the health care facilities to sterilize medical instruments. The process is also practiced to treatment the biomedical wastes.

Microwaving: Microwave system uses electricity to generate microwave energy which in turn transforms moisture into steam thereby sterilizing the waste. The heating occurs inside the waste material in the presence of steam. The autoclaving and microwaving options are used mainly for the microbiology-biotechnology wastes, soiled waste, waste sharps and the solid wastes.

Incineration: The incinerator usually consists of two combustion chambers, wherein wastes are burnt to ash under controlled temperature conditions i.e. 800±50 °C in primary chamber and 1050±50 °C in secondary combustion chamber [15]. The combustion chambers' temperatures are high enough to effect reactions between volatile components in the wastes and the atmospheric gases (oxygen and nitrogen). Incinerable wastes are human anatomical waste, animal waste, microbiology-biotechnology waste and the soiled wastes.

Chemical treatment: Chemical treatment processes use chemical disinfectants (dissolved chlorine dioxide or sodium hypochlorite) to destroy pathogens in the waste. Though this process is an option for the treatment of certain categories of biomedical wastes but considering the pollution aspect associated with the use of disinfectants, the use of chemical disinfection for the treatment of biomedical waste is limited.

Deep burial: A pit or trench having 2 m depth. It is filled with waste and then with lime within 50 cm of the surface before filling the rest of the pit with soil [15]. Deep burial caters to human anatomical waste, animal waste, microbiology-biotechnology waste, and the soiled waste.

Shredder: Shredding is used to cut the wastes into smaller pieces that help in prevention of reuse of the waste.

Plasma pyrolysis: In this process, the biomedical waste is treated at high temperature under controlled condition to form gases (methane, hydrogen and carbon monoxide) that are burnt in the secondary combustion chamber. After pyrolysis, the waste gets converted into clinker.

The above treatment options are based on available technologies. Selection of the technology mainly depends on type of waste to be treated, its quantity and other aspects. Other state-of-the-art-technologies can be implemented by the health care facilities with consent from the concerned regulatory agency.

3. REGULATIONS AND GUIDELINES

There are regulation and guidelines for the management and handling of the biomedical wastes. As per the guidelines, reduction of the wastes is the key element that minimises waste handling problems. The health care facilities generate wide range of wastes. Hence, segregation of the different at the source of its generation is prerequisite to maintain an efficient waste management practice. From the source of waste generation to the point of waste disposal, several staff is engaged with specific purposes such as collection, storage, transportation and treatment. Therefore, the segregated biomedical waste should be colour coded as given in Table 2 so that the waste is disposed of through intended method(s) [15]. Colour coding helps to avoid any error by the staff involved. The regulation also makes it mandatory to label biohazard/cytoxic symbol on container of the biomedical wastes.

Table2. *Segregation and Colour Coding of Different Biomedical Wastes and the Treatment Options*

Waste categories	Colour code of waste collection bag	Treatment options
Human anatomical waste, animal waste, microbiology- biotechnology waste, soiled waste	Yellow plastic bag	Incineration/ plasma pyrolysis/ deep burial
Microbiology-biotechnology waste, soiled waste and solid waste	Red disinfected container/plastic bag	Autoclaving/microwaving/ chemical treatment
Waste sharps, solid waste	Blue/white translucent plastic bag/puncture proof container	Autoclaving/microwaving/ chemical treatment and destruction/shredding
Discarded medicines-cytoxic drugs, incineration ash, chemical waste(Solid)	Black plastic bag	Disposal in secured landfill
Liquid waste, chemical waste(Liquid)	Not required	Disinfection by chemical treatment and discharge into drains

Colour coding of wastes with more than one treatment options as mentioned in Table 2 may be selected depending upon the treatment option chosen. The waste collection bags for the waste needing incineration should not be made of chlorinated plastics. No chemical treatment is required if the waste is to be disposed through incineration. The deep burial is the option available only to the health care facilities located in the rural areas or in the towns of population less than five lacs.

4. CONCLUSIONS

The biomedical wastes of health care facilities includes human anatomical waste, animal waste, microbiology-biotechnology waste, waste sharps, discarded medicines, soiled waste, solid waste and the liquid wastes. If disposed of without proper treatment, the biomedical wastes cause nuisance by way of foul smell. It also has potential to cause health and environmental hazards. For containment of the problems due to the biomedical wastes, the available treatment technologies are chemical treatment, autoclaving, microwaving, incineration, deep burial and the plasma pyrolysis. The above treatment options are based on available technologies. Selection of the technology mainly depends on type of waste to be treated, its quantity and other aspects. Other state-of-the-art-technologies can be implemented by the health care facilities with consent from the concerned regulatory agency. Further, creating awareness and training to staff engaged in the biomedical waste handling activities are key elements for success of the biomedical waste management programme for the health care facilities.

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