REVIEW OF BIO MEDICAL WASTE MANAGEMENT IN INDIA

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ABSTRACT

Since beginning, the hospitals are known for the treatment of sick persons but we are unaware about the adverse effects of the garbage and filth generated by them on human body and environment. Now it is a well established fact that there are many adverse and harmful effects to the environment including human beings which are caused by the "medical waste" generated during the patient care. Hospital waste is a potential health hazard to the health care workers, public and flora and fauna of the area. Hospital acquired infection, transfusion transmitted diseases, rising incidence of Hepatitis B, and HIV, increasing land and water pollution lead to increasing possibility of catching many diseases. Air pollution due to emission of hazardous gases by incinerator such as Furan, Dioxin, Hydrochloric acid etc. have compelled the authorities to think seriously about hospital waste and the diseases transmitted through improper disposal of hospital waste. This problem has now become a serious threat for the public health in India and, ultimately, the Central Government of India 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.

Key words: Medical waste, health hazards, furan, dioxin, hydrochloric acid, bio-medical handling rules.

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1. Introduction

A modern hospital is a complex, multidisciplinary system which consumes thousands of items for delivery of medical care and is a part of physical environment. All these products consumed in the hospital leave some unusable leftovers i.e. hospital waste. The last century witnessed the rapid mushrooming of hospital in the public and private sector, dictated by the needs of expanding population. The advent and acceptance of "disposable" has made the generation of hospital waste a significant factor in current scenario (*Hem Chandra,1999).*

One estimate shows that some 5.2 million people (including 4 million children) die each year from waste-related diseases. Globally, the amount of municipal waste generated will double by the year 2000 and quadruple by year 2025*" (Haque, 1994 in Akter et. al. 1999).* Concerned with this situation Agenda 21, adopted in the United Nations Conference on Environment and Development (UNCED) in Rio de Janerio in June, 1992, set the following goals and targets with regard to waste management in cities:

- All countries must establish waste treatment and disposal criteria and develop the ability to monitor the environmental impact of waste by the year 2000.

- By 2025, developing countries should ensure that at least half of the sewage, wastewater and solid waste are disposed according to national and international guidelines.

- By 2025, all countries shall dispose of all waste according to international quality guidelines *(Nasima Akter,2000).*

2. Defining medical waste

Healthcare Wastes are wastes arising from diagnosis, monitoring and preventive, curative or palliative activities in field of the veterinary and human medicine. "Very broadly medical waste is defined as any solid or liquid waste that is generated in the diagnosis, treatment or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals" *(BAN & HCWH, 1999).* In the country like India the total amount of municipal waste a city generates, only 1 to 1.5% is Bio medical waste, of which 10-15% is considered infectious. Whereas, In developed countries due to increased use of disposables the waste produced has been up to 5.24 Kgs per bed per day which is very high when compared with India. Most hospitals in India generate 1-2 Kgs per bed per day, except the tertiary care hospital (e.g. AIIMS and SKIMS) which produce waste on higher side. According to World Health Organization (WHO) estimates 85% of Bio medical waste is actually non-hazardous and around 10% is infectious while the remaining 5% is non-infectious but consists of hazardous chemicals like methyl chloride and formaldehyde (Glenn and Garwal, 1999). It is estimated, a city like New Delhi with about 40,000 beds generates about 60 metric tons of Bio medical waste per day (Anurag V.Tiwari etal, 2013).

The disposal of Bio medical waste can be very hazardous particularly when it gets mixed with municipal solid waste and is dumped in uncontrolled or illegal landfills such as vacant lots in neighboring residential areas and slums. This can lead to a higher degree of environmental pollution, apart from posing serious public health risks such as AIDS, Hepatitis, plague, cholera, etc.

Johannessen et al (2000) opine that proper management of medical waste can minimize the risk both within and outside healthcare facilities. The first priority is to segregate wastes, preferable at the point of generation into reusable and non-reusable, hazardous and non-hazardous components. There are generally four key steps to medical waste management: (1) segregation into various components, including reusable and safe storage in appropriate containers; (2) transportation to waste treatment and disposal sites, (3) treatment and (4) final disposal.

Acharya and Singh (2000) also identified the medical waste management process to include, handling, segregation, mutilation, disinfection, storage, transportation and final disposal.
According to Rao, Ranyal and Sharm (2004), the key to minimization and effective management of medical waste is segregation (separation) and identification of the waste. They recommend that the most appropriate way of identifying the categories of medical waste is by sorting the waste into colour coded plastic bags or containers. Medical waste should be segregated into

containers/ bags at the point of generation. It should provide an easy access to waste collection vehicle (Srivastava,2000). All disposable plastic should be subjected to shredding before disposing off to vendor. Final treatment of medical waste can be done by technologies like incineration, autoclave, hydro clave or microwave (Rao et al, 2004).

3. Classification and components of biomedical waste

The World Health Organization (WHO) has classified medical waste into eight 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, describes following categories.

3.1 **General waste:** Largely composed of domestic or house hold type waste. It is non-hazardous to human beings, e.g. kitchen waste, packaging material, paper, wrappers, plastics.

3.2 **Pathological waste:** Consists of tissue, organ, body part, human foetuses, blood and body fluid. It is hazardous waste.

3.3 **Infectious waste:** The wastes which contain pathogens in sufficient concentration or quantity that could cause diseases. It is hazardous e.g. culture and stocks of infectious agents from laboratories, waste from surgery, waste originating from infectious patients.

3.4 **Sharps:** Waste materials which could cause the person handling it, a cut or puncture of skin e.g. needles, broken glass, saws, nail, blades, scalpels.

3.5 **Pharmaceutical waste:** This includes pharmaceutical products, drugs, and chemicals that have been returned from wards, have been spilled, are outdated, or contaminated.

3.6 **Chemical waste:** This comprises discarded solid, liquid and gaseous chemicals e.g. cleaning, house keeping, and disinfecting product.

3.7 **Radioactive waste:** It includes solid, liquid, and gaseous waste that is contaminated with radionucleides generated from in-vitro analysis of body tissues and fluid, in-vivo body organ imaging and tumour localization and therapeutic procedures.

4. Legislative aspect in relation to biomedical waste in India

Various central legislation related to biomedical waste management in India are as follows

- The water (prevention and control of pollution) Act, 1974
- The Air (prevention and control of pollution) Act, 1981
- The Environment(Protection) Act,1986
- The hazardous waste(management and handling) rules,1998
- The Biomedical waste(management and handling) rules,1998

- Municipal Solid waste (management and handling) rules, 2000
- The Biomedical waste(management and handling) rules Amendment ,2000 and 2003

The Bio-medical Waste (Management and Handling) Rules, 2011 [Draft]. It may be kept in mind that any person can report any alleged negligence in Management and Handling of Bio-Medical Waste to the appropriate authority (Anurag V. Tiwari , et.al., 2013).

5. Potential impacts (risks) associated with medical waste

5.1 Health hazards related to medical waste could be the following

i**.** Injuries and accidents
There is a risk of injuries related to medical waste handling and carrying by waste hauler and/or cleaner.
Akter *et. al.*, (1998) reported that, there were several incident of injury due to exposure to medical wastes inside or outside of hospital premises. These were as follows:

- Hands cut due to handling broken glass
- Injured by needle and fingers permanently damaged/ became curved
- Right hands became paralyzed by the injury by a needle
- Two legs became paralyzed due to injury by the needle
- Skin diseases on legs and hands/ body
- Pus due to injury sometimes
- Ulcer on legs

ii. Infectious medical waste risk
Infectious hospital waste represents only a small part of total medical waste; yet, because of ethical questions and infection risks, it is a focal point of public interest. Infectious waste contains different kind of pathogens or organisms that is potential for infection or disease if it is not properly disposed. Table 1, below shows few examples of different pathogen and diseases caused by them.

Bacterial	Tetanus, gas gangrene and other wound infection, anthrax, cholera,other diarrhoeal diseases, enteric fever, shigellosis, plague etc.
Viral	Various hepatitis, poliomyelitis, HIV-infections, HBV, TB, STD, rabies etc.
Parasitic	Amoebiasis, giardiasis, ascariasis, ankylomastomiasis, taeniasis, echinococcosis, malaria, leishmaniasis, filariasis etc.
Fungal infections	Various fungal infections like candidiasis, cryptococcoses, coccidiodomycosis etc.

Table 1.

5.2 **Environmental hazards related to medical waste**

The following are environmental impacts associated with the improper disposal of medical wastes:

1. Pollutants from medical waste (e.g. heavy metals and PCBs) are persistent in the environment.
2. Accumulation of toxic chemicals within soil (proximity to agricultural fields, humans, soil organisms, wildlife, cattle).
3. Ground water contamination, decrease in water quality
4. Bio-accumulation in organism's fat tissues, and biomagnifying through the food chain.
5. Repeated and indiscriminate application of chemicals over a long period of time has serious adverse effects on soil microbial population - reducing the rate of decomposition, and generally lowering the soil fertility.
6. Pathogens leads to long term accumulation of toxic substances in the soil.
7. Specimens collected for analysis have the potential to cause disease and illness in man, either through direct contact or indirectly by contamination of soil, groundwater, surface water, air.
8. Windblown dusts from indiscriminately dumping also have the potential to carry hazardous particulates.
9. Domestic animals being allowed to graze in open dumps, there is the added risk of reintroducing pathogenic micro-organisms into the food chain
10. Public nuisance (e.g. odors, scenic view, block the walkway, aesthetics, etc.)
11. Improper sterilization of instruments used in labour room may cause infection to mother and children.
12. Combination of both degradable and non-degradable waste increase the rate of habitat destruction due to the increasing number of sites necessary for disposal of wastes (degradation of habitat).
13. Plastic-bags, plastic containers, if not properly destroyed may contaminate the soil and also reduces the chance for water percolation into the soil during precipitation.
14. Open air burning does not guarantee proper incineration, and releases toxic fumes (dioxin) into the atmosphere from the burning of plastics i.e., PCB's
    (Nasima Akter, 2000).

6. Approach for Biomedical waste handling, treatment and disposal methods

Based on Bio-medical Waste (Management and Handling) Rules 1998, notified under the Environment Protection Act by the Ministry of Environment and Forest (Government of India) the following are the procedures that needs to be followed for safe disposal of waste.

6.1 Segregation of waste

Segregation is the essence of waste management and should be done at the source of generation of Bio-medical waste e.g. all patient care activity areas, diagnostic services areas, operation theaters, labour rooms, treatment rooms etc. The responsibility of segregation should be with the

generator of biomedical waste i.e. doctors, nurses, technicians etc. (medical and paramedical personnel). The biomedical waste should be segregated as per categories mentioned in the rules.

6.2 Collection of bio-medical waste

Collection of bio-medical waste should be done as per Bio-medical waste (Management and Handling) Rules. At ordinary room temperature the collected waste should not be stored for more than 24 hours.

Table 2: **Type of container and colour code for collection of bio-medical waste.**

Category	Waste class	Type of container	Colour
1.	Human anatomical waste	Plastic	Yellow
2.	Animal waste	-do-	-do-
3.	Microbiology and Biotechnology waste	-do-	Yellow/Red
4.	Waste sharp	Plastic bag puncture proof containers	Blue/White Translucent
5.	Discarded medicines and Cytotoxic waste	Plastic bags	Black
6.	Solid (biomedical waste)	-do-	Yellow
7.	Solid (plastic)	Plastic bag puncture proof containers	Blue/White Translucent
8.	Incineration waste	Plastic bag	Black
9.	Chemical waste (solid)	-do-	-do-

6.3 Transportation

Within hospital, waste routes must be designated to avoid the passage of waste through patient care areas. Separate time should be earmarked for transportation of bio-medical waste to reduce chances of it's mixing with general waste. Desiccated wheeled containers, trolleys or carts should be used to transport the waste/plastic bags to the site of storage/ treatment.

Trolleys or carts should be thoroughly cleaned and disinfected in the event of any spillage. The wheeled containers should be so designed that the waste can be easily loaded, remains secured during transportation, do not have any sharp edges and is easy to clean and disinfect. Hazardous biomedical waste needing transport to a long distance should be kept in containers and should have proper labels. The transport is done through desiccated vehicles specially constructed for the purpose having fully enclosed body, lined internally with stainless steel or aluminium to

provide smooth and impervious surface which can be cleaned. The driver's compartment should be separated from the load compartment with a bulkhead. The load compartment should be provided with roof vents for ventilation.

6.4 Treatment of hospital waste

Treatment of waste is required:
i. to disinfect the waste so that it is no longer the source of infection.
ii. to reduce the volume of the waste.
iii. make waste unrecognizable for aesthetic reasons.
iv. make recycled items unusable.

6.5 Disposal of bio medical waste:

The standard procedures mentioned in the Biomedical waste (Management and Handling) Rules 1998, for different categories are as follows.

6.5.1 **Deep burial:** The waste under category 1 and 2 only can be accorded deep burial and only in cities having less than 5 lakh population.

6.5.2 **Autoclave and microwave treatment:** Standards for the autoclaving and microwaving are also mentioned in the Biomedical waste (Management and Handling) Rules 1998. All equipment installed/shared should meet these specifications. The waste under category 3,4,6,7 can be treated by these techniques. Standards for the autoclaving are also laid down.

6.5.3 **Shredding:** The plastic (IV bottles, IV sets, syringes, catheters etc.), sharps (needles, blades, glass etc) should be shredded but only after chemical treatment/microwaving/autoclaving. Needle destroyers can be used for disposal of needles directly without chemical treatment.

6.5.4 **Secured landfill:** The incinerator ash, discarded medicines, cytotoxic substances and solid chemical waste should be treated by this option.

6.5.5 **Incineration:** The incinerator should be installed and made operational as per specification under the BMW rules 1998 and a certificate may be taken from CPCB/State Pollution Control Board and emission levels etc should be defined. In case of small hospitals, facilities can be shared. The waste under category 1,2,3,5,6 can be incinerated depending upon the local policies of the hospital and feasibility. The polythene bags made of chlorinated plastics should not be incinerated.

It may be noted that there are options available for disposal of certain category of waste. The individual hospital can choose the best option depending upon the facilities available and its financial resources. However, it may be noted that depending upon the option chosen, correct colour of the bag needs to be used.

7. Conclusion:

Medical wastes pose a significant impact on health and the environment. Management of the bio medical waste is becoming a challenging issue in India. Governmental and non governmental agencies have recognized the biomedical waste management as matter of concern. There is urgent need of extensive study on this medical waste and its management aspects. Proper waste management strategy is needed to ensure health and environmental safety.

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