Periodic Research

A review on impact and management of biomedical waste

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Abstract

Human beings are exposed to a huge variety of health risks over their entire life. This review article is an attempt to prove that environmental and health risks are interlinked. Since an important issue of environmental protection process is the biomedical waste management, this study focuses on responsible planning of collecting, storage, transporting, processing and disposing of hazardous and non hazardous biomedical waste, with a special concern on effective management of biomedical waste incorporating with an appropriate waste reduction and neutralization techniques. An attempt has been made to critically review the current biomedical waste management practices followed by some hospitals in Lucknow city (King George Medical university and Vivekanand polyclinic, Fatima Hospital, Balrampur hospital and Integral hospital etc). Following the rules and legislation, methods for segregation, packaging, labeling and the treatment techniques for reduction in volume, neutralization and final disposal of the biomedical waste are analyzed.

Keyword: Biomedical waste, Health care unit, Hospital waste management system, Treatment, Disposal

Introduction

'Bio-medical waste' means any solid or liquid wastes which are generated during diagnosis, treatment or immunization of human beings or animals. Management of biomedical waste is an integral part of infection control and hygiene maintain in healthcare settings. These settings play a major role in contribution to community-acquired infection, as they produce large amounts of biomedical waste. Biomedical waste can be categorized on the basis of risk of causing injury and infection during handling and disposal process. Wastes targeted for precautions during handling and disposal include sharps (scalpel and needles), pathological wastes (Blood samples, anatomical body parts and microbiology cultures) and infectious wastes (items contaminated with body fluids and discharges such as catheters, I.V. lines and dressing,). Other wastes generated in healthcare settings include mercury containing instruments, polyvinyl chloride (PVC) plastics and radioactive wastes etc.These are among the most environmentally sensitive by-products of any healthcare unit (Askarain *et al.,* 2004; Remy, 2001).According to WHO report 85% of hospital wastes are actually non-hazardous, around 10% are infectious and around 5% are non-infectious but come in the category of hazardous wastes. In the USA, about 15% of healthcare waste is regulated as infectious waste. In India this range could vary from 15% to 35% depending on the total amount of waste produced (Chitnis et al., 2005; Glenn & Garwal, 1999; Anonymous, 1998;). There is a lot of confusion with the problems among the generators, operators, decision-makers and the general community about the safe management of healthcare waste due to lack of awareness.

Magnitude of the problem:

Magnitude of biomedical waste problem at International level:

The quantity of Bio-Medical Waste generated will vary depending on the hospital polices and practices and the type of precautions and care being taken. The data provided from developed countries indicate a range from 1-5 Kg/day/bed but the data available from developing counties indicates that the range is almost similar but the figures are lower i.e. 1-2 Kg/day/patient than the developed countries. According to a WHO report, around 85% of the hospital wastes are actually non hazardous, 10% are infective and hazardous, and the remaining 5% are non-infectious but hazardous (Pharmaceutical radioactive and chemical wastes etc).

Magnitude of problem at National level:

There are no national level studies on quantity of healthcare waste generated per day per bed but studies have been carried out at local and regional levels in different hospitals. Whatever data are available from those hospitals, it can be presumed that in most healthcare units roughly about l-2 Kg/day/bed of waste is produced. One study claimed that the estimated quantity of the waste generated in the hospitals varies from 2-3 kg/day/bed with a total Bio-Medical Waste produced 10- 15 tons/day in Lucknow city alone (with 184 hospitals, 13 nursing homes, 31 dispensaries and 88 health centers and polyclinics). (Table-1)

Table: 1

Total Hospitals in Lucknow & Quantity of Medical Waste generation

Number of Hospitals	184
Total number of beds	8534
Amount of waste generation	4872.00Kg/day
Amount of waste generation from government hospitals	1513.5 Kg/day
Amount of waste generation from private hospitals	3358.5 Kg/day

Source: Nagar Nigam Lucknow 2004-2005

Sources of Bio-Medical Waste:

While urban solid waste has posed more interest and attention to town planners, civic administrators and environmental activists but there is yet lack of concern and awareness for some special type of waste (biomedical waste) and its management process which is generated primarily from:

Primary source: Health care establishments which includes hospitals, nursing homes, clinics and general practitioners, dispensaries, blood banks, veterinary hospitals, and research institutes etc.

Other sources: Education institutes and research centers, clinical laboratories, health care establishments for humans and animals (Anonymous, 2000; Chitnis et al., 2000). etc.

Environmental and health risks associated with biomedical waste:

There are many evidences and examples which show that indiscriminate management of Bio- Medical Waste could cause serious hazards to health and environment as follows-

1. There are many harmful biological agents in the Biomedical waste which pollute water and food items and cause alimentary infections like typhoid, cholera, infective hepatitis, dysentery, polio, and hook worm diseases etc.
2. Pests and vermin breed on biomedical wastes. Examples are:

a. Rats move on refuse and on biomedical waste.

b. Mosquitoes that transmit insect borne diseases like filarial and malarial problems.

c. Common house flies sit on waste can transmit infections.

d. Many other insects and worms can cause nuisance e.g. cockroaches, ants.

3. Infections caused by polluted soil and dust may be rich in Tetanus spores, Tuber bacilli and other germs.
4. Improper management of Biomedical waste cause Nosocomiol infections, AIDS, Hepatitis B&C etc.
5. Sludge water and refuse, all create intolerable odor and nuisance of sight.

Biomedical waste is produced in all conventional medical units where treatment of 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 are discarded in any health care facility and are not intended for any other use .Within any health care facility, the main groups submitted to risks are:

1. Doctors, nurses, healthcare unit workers and maintenance staff;
2. Patients
3. Visitors
4. Workers in ancillary services: laundry, medical supplies store, those charged
5. 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 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 per year. The workers involved in the collection and treatment of the biomedical waste are also exposed to a certain risk.

As a result, around the world there is seriously taken into consideration the implementation of immunization programs, along with a proper biomedical waste management system. Risks generated by the chemical and pharmaceutical waste are associated to the potential traits of characteristics, such as: genotoxic, corrosive, flammable, explosive, teratogenic, mutagenic.When unwanted or expired chemicals and pharmaceutical products are removed can cause poisoning by absorption through the skin or mucous membranes, by inhalation or by ingestion. Chemicals and pharmaceuticals may also determine lesions of skin, eye, and respiratory mucosa. These Chemical waste removed by drainage system may have toxic effects on ecosystems and water where are discharged.

Risks associated to final elimination of biomedical waste should be also considered within a health care and environmental protection program. Incineration of medical waste which containing plastic with chlorine component determines the dioxin production. Dioxin is a known as carcinogen. Once formed, dioxin is linking to organic particles, which are carried by wind, collected in water and on land surface. The half-life of dioxin is estimated at 25-100 years. Dioxin binds to nuclear DNA. It works as a

potential cancer promoter, weak immune response and is associated with many negative effects both on human health (Low testosterone levels, endometriosis, and birth defects) and on environment.

The Management of Biomedical Pollutants:

The systematic management of biomedical waste can be described as a multistage process that involves effective legislation, training, minimization, proper handling, segregation, storage, transportation, treatment and safe disposal (WHO, 2007; Rao *et al.,* 2003; Pruss *et al.,* 1999; Socunya, Matias & Lapid, 1997).

Safety measures:

1. All the producers of biomedical waste should adopt universal precautions and appropriate safety measures while doing diagnostic, therapeutic activities and while handling of the bio-medical waste.
2. It should be ensured that drivers, collectors and other handlers are aware of the nature and risk of the waste.
3. Protective gears provided and instructions regarding their use are given by health Care units.

Training:

1. In every hospitals all the medical professionals including doctors, nurses, paramedical and administrative staff must be made aware of Bio-medical Waste (Management and Handling) Rules 1998.
2. Training should be conducted to all categories of staff in appropriate medium or language and in an acceptable manner.

Role of Hospital administration in management of biomedical waste:

Heads of every hospital will have to take authorization for generation of waste from appropriate authorities as notified by the concerned State Government, well in time and to get it renewed as per time schedule laid down in the rules. Each hospital should constitute a hospital waste management committee, chaired by the head of the Institute and having wide representation from all major departments. This committee should be responsible for making Hospital specific action plan for hospital waste management and its supervision, monitoring and implementation. The accidental reports, annual reports should be filled in BMW rules format and submitted to the concerned authorities.

Coordination with other agencies:

1. Co-ordination with Pollution Control Boards: Search for better methods technology, provision of facilities for testing, approval of certain models for hospital use in conformity with standards laid down.
2. Co-ordination with Municipal authority: A very large percentage (approximately 85%) of waste generated in Indian hospitals, belong to general category (non-toxic and non-hazardous). So hospital should have constant interaction with municipal authorities so that this category of waste is regularly taken out from the hospital premises for treatment and landfill.
3. Development of non-PVC plastics as a substitute for plastic which is used in the manufacture of disposable items.
4. To search for cost effective and environmental friendly technology for treatment of bio-medical and hazardous waste.

Systematic approach for hospital waste management:

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).

1. Segregation of waste:

Segregation is necessary for waste management and should be done at the source of generation of Bio-medical waste like all patient care activity areas, operation theatres, diagnostic services areas, and labour rooms etc. The responsibility of segregation should be with the producers of biomedical waste i.e. doctors, nurses, technicians etc.

2. Collection of bio-medical waste

Collection of bio-medical waste should be done as per Bio-medical waste (Management and Handling) Rules (Table-2). 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 bag	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-

Source: Biomedical waste management rule 1998

3. Transportation

Within hospital, waste path must be designed to avoid the route of waste through patient care areas. Separate time should be marked for transportation of bio-medical waste to reduce chances of its mixing with general waste. Desiccated wheeled containers and trolleys should be used to transport the waste plastic bags to the site of storage for treatment. Trolleys should be thoroughly cleaned and disinfected in the event of any spillage. The wheeled containers should be designed in this way that the waste can be easily loaded. 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 to provide smooth and impervious surface which can be cleaned. The driver's compartment should be separated from the load compartment.

4. Treatment of hospital waste:

The purpose of treatment of waste is:

1. To reduce the volume of the waste
2. To disinfect the waste so that it is no longer the source of infection.

4.1 Treatment of General waste:

The 85% of the waste produced in the hospital belongs to this group. The, safe disposal of this waste is the responsibility of the local authority.

4.2 Treatment of bio-medical waste (15% of hospital waste):

Deep burial: The biomedical waste under category 1 and 2 only can be disposed accorded deep burial and only in cities having less than 5 lakh populations.

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

Shredding: The plastic waste (Syringes, IV bottles and catheters etc.), sharps (blades, needles and glass etc) should be shredded but only after chemical treatment or by autoclaving. Needle destroyers can be used for disposal of needles directly.

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

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 and 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. 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.

Conclusion:

Hospital wastes should be classified according to their source, type and risk associated with their handling, storage and final disposal. In effective and proper biomedical waste management segregation of waste at source in a priority along with other methods like reduction, reuse and recycling. Incineration techniques are found to be one of the effective methods for management of hazardous waste. Municipal Corporations, Central and State Governments need to plan and construct centralized facilities for recycle, treatment, and disposal of biomedical waste. The final treatment of the waste should be made carefully, on the basis of various factors, many of which depend on local conditions including the quantity and composition of waste generated, available place and cost. Regularly training programs should be conducted for safe handling and disposal of biomedical waste.

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References:

1. Almuneef M, Memish Z, (2003) Effective medical waste management: it can be done. AmericanJournal of Infection Control, **31**, 188–192.
2. Acharya DB, Meeta S, (2000) *Hospital Waste Management. Minerva Press*, New Delhi 2000,pp 15,47.
3. Anonymous, (2000) Guide lines for common hazardous waste incineration Central Pollution Control Board Ministry of Environment & Forests Hazardous Waste management Series HAZWAMS/30/2005-06.by U.S. Hospitals, Journal of American Medical Association, 262:1635-1640, 1989.
4. Anonymous (1998). Biomedical waste (management and handling) rules, The Gazette of India,Extraordinary, Part II, Section 3(ii), dated 27th July, pp. 10-20, 460. Ministry of Environment and Forests, Notification N. S.O.630 (E).
5. Anonymous, (1997) World Health Organization, Regional Office of South East Asia. Safe Management of Wastes from Health Care Activities.
6. Chitnis V, Vaidya K, Chitnis DS, (2005) Biomedical waste in laboratory medicine: Audit and management, Indian Journal of Medical Microbiology, **23** (1):6-13
7. Chitnis V, Patil S, Chitnis DS, (2000) Ravikant Hospital Effluent: A Source of Multi drug Resistant Bacteria. Current Sciences **79**, 535-540.
8. EnviroNews Archives-Hospital Waste An Environment and its Management; 2011
9. Gupta SP, (1998) Statistical Methods, Revised & Enlarged, S. Chand & Sons, New Delhi, India.

10. Kralj D., Stamenkovic M., Health Service and Environment Management System, WSEAS /IASME Int.Conference ‘’06 Miami,USA, 2006
11. Marinkovic N, Vitale K, Afric I, Janev HN, (2005) Hazardous medical waste management as a public health issue. Arh Hig Rada Toksikol. **56**, 21-32.
12. Mehta, G. (1998) Hospital Waste Management, National Guidelines (Draft) prepared for GOI/WHO project IND EHH 001,Lady Hardinge Medical College and Associated Hospitals, New Delhi.
13. Ministry of Health and Family Welfare, Government of India (1998) Health Information of India (1995 &1996) 131–136. New Delhi: Central Bureau of Health Intelligence Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India.
14. OTA Special Report on Medical Waste Treatment Methods, Finding the Rx for Managing Medical Wastes, NTIS order #PB91-106203,October, 1990 Literature on Generation, Management and Potential Health Effects of Medical Waste, Health Assessment Section, Technical Assessment Branch, Office of Solid Waste, U.S. Environmental Protection Agency,November, 1988.
15. Sheth K.N., Purvi Miss., Desai H., Characterization and Management of Bio-Medical Waste in Sae Hospital, Anand – a Case Study, Electronic Journal of Environmental, Agricultural and Food Chemistry EJEAFChe, ISSN: 1579-4377, 5(6), 2006, pp.1583-1589.
16. http://kspcb.kar.nic.in/BMW.
17. http://mpcb.mah.nic.in
18. http://www.cpcb.nic.in