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A Case Study of Biomedical Waste Management in Hospitals

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Abstract

Biomedical waste management is receiving greater attention due to recent regulations of the Biomedical Wastes (Management & Handling Rules, 1998). Inadequate management of biomedical waste can be associated with risks to healthcare workers, patients, communities and their environment. The present study was conducted to assess the quantities and proportions of different constituents of wastes, their handling, treatment and disposal methods in different health-care settings. Various health care units were surveyed using a modified survey questionnaire for waste management. This questionnaire was obtained from the World Health Organization (WHO), with the aim of assessing the processing systems for biomedical waste disposal. Hazards associated with poor biomedical waste management and shortcomings in the existing system were identified. The development of waste management policies, plans, and protocols are recommended, in addition to establishing training programs on proper waste management for all healthcare workers.

Keywords: Biomedical waste, Waste disposal, Waste management, Infectious waste, Segregation, Health care unit, Regulation, Hazard

1. Introduction

The recent developments in healthcare units are precisely made for the prevention and protection of community health. Sophisticated instruments have come into existence in various operations for disease treatment. Such improvement and advances in scientific knowledge has resulted in per capita per patient generation of wastes in health care units. Waste generated in the process of health care are composed of variety of wastes including hypodermic needles, scalpels, blades, surgical cottons, gloves, bandages, clothes, discarded medicine and body fluids, human tissues and organs, chemicals etc., Other wastes generated in healthcare settings include radioactive wastes, mercury containing instruments, PVC plastics etc., These are the most environmentally sensitive healthcare by products and needs a greater attention which has to be monitored (Remy, 2001).

World Health Organization states that 85% of hospital wastes are actually non-hazardous, whereas 10% are infectious and 5% are non-infectious but they are included in hazardous wastes. About 15% to 35% of Hospital waste is regulated as infectious waste. This range is dependent on the total amount of waste generated (Glenn and Garwal, 1999).These wastes now threatens the public since, the health care foundations are situated in heart of city and therefore medical waste, if not properly managed can cause dangerous infection and posses a potential threat to the surrounding environment, persons handling it and to the public. Health and environmental effects, uncertainty regarding regulations and negative perceptions by waste handles are some important concerns in health care waste management in a country

(Freeman, 1998). Globally this issue has been seriously considered and appropriate waste management systems are being developed and installed. A number of difficulties are being faced at many places in implementation of this plan in practice. The waste disposal is governed by the Government agencies and regulations including private organizations.

At present, there is no available information that describes the actual practice of handling the health care waste products. The proposed hospital waste management plan is consistent with the biomedical waste (management and handling) (second Amendment) Rules, 2000, Ministry of environment and forests. As a result this study aims to asses the biomedical waste handling and treatment in different health care settings.

2. Research analysis

The Government has formulated the Bio-Medical Waste (Handling and Management) Rules in 1998 (hereafter referred to as the Bio-Medical Waste Rules) in order to specify procedures that have to be followed in the management and disposal of waste.[4] The rules regulate the disposal of bio-medical waste including human anatomical waste, blood, body fluids, medicines, glassware, soiled, liquid & biotechnology waste and animal waste. The rules have been formulated as framework for handling & management of biomedical wastes. The rules are applicable to all hospitals, nursing homes etc in the country and also apply to all persons who generate, collect, receive, store, transport, treat, dispose or handle biomedical waste in any form.

2.1 Biomedical Waste Management Process

Some of the waste management process that is applied till now is summarized as beneath. Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedical waste in any establishment (Acharya and Singh Meeta, 2000). The key to minimization and effective management of biomedical waste is segregation (separation) and identification of the waste. The most appropriate way of identifying the categories of biomedical waste is by sorting the waste based on color. This has to be segregated into containers/ bags at the point of generation in accordance with Schedule II of Biomedical Waste (management and handling) Rules 1998 as given in Table I.

General waste like garbage, garden refuse etc. should join the stream of domestic refuse. Sharps should be collected in puncture proof containers. Bags and containers for infectious waste should be marked with Biohazard symbol. Highly infectious waste should be sterilized by autoclaving. Cytotoxic wastes are to be collected in leak proof containers clearly labeled as cytotoxic waste (Acharya and Singh Meeta, 2000). Needles and syringes should be destroyed with the help of needle destroyer and syringe cutters provided at the point of generation. Infusion sets, bottles and gloves should be cut with curved scissors.

Disinfection of sharps soiled linen, plastic and rubber goods are to be achieved at point of generation by usage of sodium hypochlorite with minimum contact of one hour. Fresh solution should be made in each shift. On site collection requires staff to close the waste bags when they are three quarters full either by tying the neck or by sealing the bag. Kerb side storage area needs to be impermeable and hard standing with good drainage. It should provide an easy access to waste collection vehicle (Srivastava, 2000).

Biomedical waste should be transported within the hospital by means of wheeled trolleys, containers or carts that are not used for any other purpose. The trolleys have to be cleaned daily. Off site transportation vehicle should be marked with the name and address of carrier. Biohazard symbol should be painted. Suitable system for securing the load during transport should be ensured. Such a vehicle should be easily cleanable with rounded corners. All disposable plastic should be subjected to shredding before disposing off to vendor. Final treatment of biomedical waste can be done by technologies like incineration, autoclave, hydroclave or microwave (Rao, 1995). Biomedical waste categories and their disposal methods are tabulated in Table II.

2.2 Study sample

A study was conducted in different health care settings. Data were collected from various areas of hospitals. Among the hospitals studied, all of them were considered to be large hospitals based on the number of beds, as each had more than 150 beds.

2.3 Quantities

The quantity of waste generated in health care settings should be known while making a good waste management system. Hence, the quantities of different categories of waste have to be estimated by discussions, interviews and by physical checks. The quantities generated vary from hospital to hospital and depend on the type of health-care facility and local economic conditions. The waste quantities were physically weighed in different hospitals having specialized units. The average values are presented in Table III. The waste quantities are estimated by assuming 100% bed –occupancy in the hospital. Health care wastes are categorized into two types such as infectious and non-infectious (Saini and Dadhwal, 1995). Infectious waste includes all those medical wastes, which have the potential to transmit viral, bacterial or parasitic diseases. It includes both human and animal infectious wastes and waste generated in laboratories

and veterinary practice. These wastes are hazardous in nature. Non infectious wastes are generated from packaging, food preparations and visitors activities. This waste is large compared to infectious waste. A large fraction is potentially recyclable but may be contaminated with infectious agents. This has to be separately stored and sterilized before sending for recycling (Sandhu and Singh, 2003). The proportion of solid waste generated in various hospitals is given in Table IV. The composition of various constituents varies widely depending on the type of facilities provided by the health care units. A detailed field survey was conducted for solid-waste composition; the average values with standard deviation are presented in Table V.

2.4 Current scenario

Of the total hospital waste generated, approximately 10% is hazardous, 85% is general (non risk) waste while a small percentage (5%) is labeled as highly hazardous. Currently, all the hospital biomedical waste is being disposed along with municipal solid waste. The untreated liquid waste from the health institutions is let into drainage. Normally the waste is collected in open containers without disinfection. Bandages, cotton and other items used to absorb body fluids are collected in plastic or other non-specified containers. Waste is collected in mixed form. Some hospitals in the country have developed their own system of color coding. Waste sharps are discarded without disinfection and mutilation, which may result in their being, re-used thus spreading an infection. The waste collection and transportation workers in the hospital segregate the recyclable material for sale. In a similar way, all disposable plastic items are segregated by the waste pickers, from where the waste is deposited either inside the hospital grounds, or outside in the community bin for further transportation and disposal along with municipal solid waste. Since the infectious waste gets mixed with municipal solid waste, it has potential to make the whole lot infectious in adverse environmental conditions (Info Nugget, 1996).

Most biomedical waste generated from health care facilities are at present, collected without segregation into infectious and non-infectious categories and are disposed in municipal bins located either inside or outside the facility premises. Wastes from operation theatres, wards and pathological laboratories are disposed of without any disinfection/sterilization. Amputated body parts, anatomical wastes, and other highly infectious wastes are incinerated wherever incinerators are available; the remainder is burnt in some corner of the hospital grounds, mostly in open pits.

3. Analysis Result

3.1 Short comings in the existing system

Medical facilities in urban centers 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. The 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.
- 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.

3.2 Treats 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 through 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 reheating 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.

3.3 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 in air pollution and other annoyance problem.

4. Conclusion

The premier hospital is severely lacking in actions to dispose of its waste and uphold its statutory responsibilities. This is due to the lack of education, awareness and trained personnel to manage the waste in the hospital, as well as the paucity of the funds available to proper waste management system. The results of the study demonstrate the need for strict enforcement of legal provisions and a better environmental management system for the disposal of biomedical waste in hospitals as well as other healthcare establishments. A policy needs to be formulated based on 'reduce, recover, reuse and dispose'. The study concludes that healthcare waste management should go beyond data compilation, enforcement of regulations and acquisition of better equipment. It should be supported through appropriate education, training and the commitment of the healthcare staff, management and healthcare managers within an effective policy and legislative framework.

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Table 1. olor coding-biomedical waste (management and handling) rules, 1998 (Schedule II)

Color-coding	Type of container	Waste categories
Yellow	Plastic bags	Cat 1 human anatomical waste, Cat 2 animal waste, Cat 3 microbiology waste, Cat 6 soiled waste.
Red	Disinfected container plastic bags	Cat 3 Microbiological Cat 6 soiled Cat 7 solid waste (Waste IV tubes catheters, etc.)
Blue/White	Plastic bag/puncture proof containers	Cat 4 waste sharps Cat 7 plastic disposable tubings, etc.
Black	Plastic bag/puncture proof containers	Cat 5 discarded medicines Cat 9-incineration ash Cat 10 chemical wastes

Table 2. Waste categories: their treatment and disposal methods

Waste No.	Waste Category (Type)	Treatment & disposal
1	Human Anatomical Waste: (Human tissues, organs, body parts)	Incineration/deep burial
2	Animal Waste: (Animal tissues, organs, body parts, carcasses, bleeding parts, fluids, blood, experimental animals used in research, waste generated by veterinary hospitals colleges, discharge from hospitals, animal houses)	Incineration/deep burial
3	Microbiology & Biotechnology waste: (Waste from laboratory cultures, stocks or specimens of micro-organisms, live or attenuated	Local autoclaving/ incineration and micro waving

	vaccines, human and animal cell culture 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).	
4	Waste sharps: (Needles, scalpels, blades, glass(broken and unbroken) etc. that may cause punctures and cuts.	Disinfection by chemical syringes, treatment/autoclaving, microwaving
5	Discarded Medicines & cytotoxic drugs: (Wastes comprising of outdated, contaminated drugs and discarded medicines)	Incineration/ destruction disposal in secured landfills
6	Soiled waste: (Items contaminated with blood, body fluids including cotton, dressing, soiled plaster casts, linens, bedding, other material contaminated with blood).	Incineration/ autoclaving/ and microwaving.
7	Solid Waste: (Waste generated from disposable items other than treatment, waste sharps such as catheters, intravenous sets, etc).	Disinfection - chemical autoclaving/ micro waving and mutilation/ shredding
8	Liquid Waste: (Waste generated from laboratory and washing, cleaning, housekeeping and disinfecting activities).	Disinfection by chemical treatment and discharge into drain
9	Incineration Ash: (Ash from incineration of any bio- medical waste).	Disposal in municipal landfill.
10	Chemical Waste: (Chemicals used in production biologicals, chemicals used disinfections, as insecticides, etc).	Chemical treatment/dischar- ges into drains for liquids and of secured landfills for solids. in

Table 3. Quantity of solid waste from health-care units (HCUs)

Category of health care unit	Quantity (kg bed $^{-1}$ day $^{-1}$)
Paediatric unit	0.56
Eye unit	0.72
Orthopaedic unit	2.12
Gynaecology unit	1.56
Cardiology unit	0.73
Medicine unit	2.10
Surgery unit	1.52
OPD, burns, X-ray and canteen	2.63
General hospital	1.83
Multi-specialty hospital	2.53

Table 4. Proportion of solid waste from HCUs

Type of waste	Range (%)	Average (%)
Non infectious	60.5-89.8	75
Infectious	15-38	26.5
Pathological	5-20	12.5
Hazardous waste	0.3-3	1.65

Table 5. Constitutions of hospital waste: south Chennai.

Ingredients	Average (% by wet weight)	Standard Deviation
Bandages, cotton clothes etc.	38.23	11.12
Paper	7.86	1.27
Plastics, PVC, and rubber	6.89	1.67
Glass	5.23	2.35
Disposable syringe	2.46	3.48
Inert	5.32	2.31