

Epidemiological Issues of Hazardous Medical Waste Management from Private Healthcare Facilities- Case Study from Dhaka City of Bangladesh

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Abstract

Medical waste constitutes a special category of hazardous waste because they contain potentially harmful infectious materials and it needs special care for its management. Most of the hospitals in Bangladesh are built up here and there without any environmental study and provision for its waste management. The team has conducted a research study on the location of selected private health care facilities in Dhaka City with their waste management provisions. Medical waste generation data for the selected healthcare facilities were collected from PRISM Bangladesh. Also, questionnaire survey was performed among the selected hospital's employees and residents living near the Matuail landfill and dumping site. This research has found out that most of these healthcare facilities lack proper provisions for hazardous medical waste management – such as inappropriate handling and disposal of medical waste. Such actions poses health risks to health workers who may be directly exposed and to people near health facilities, particularly children and scavengers who may become exposed to infectious wastes and a higher risk of diseases like hepatitis, HIV/AIDS and various types of skin diseases. The study thus focuses on how to use relevant chemicals, tools, techniques, materials and machineries etc. and what's their potential threats to the stakeholders with their epidemiological issues like mortality and other such sufferings. Also the study has generated hazardous medical waste generation rates on $\text{kg}^{-1}\text{bed}^{-1}\text{day}^{-1}$ basis for the private healthcare sector of Dhaka city. Finally the study proposes some recommendations and sustainable management approach towards medical waste management in light of socio-economic condition of Bangladesh.

Keywords: Epidemiological issues, Infectious materials, Sustainable Management Approach, Hazardous waste generation rate.

1. INTRODUCTION

Unfortunately, in most developing countries, proper waste management system does not exist. Currently, for risk or hazardous waste management on small scale, some methods are in use such as on-site incineration, steam disinfection and autoclaving. The countries where the incineration practice is common are Brazil, Argentina, India, Pakistan, Bangladesh and Peru. Especially in developing and poorer countries, the performance of incinerators is very bad and mostly nonoperational. Normally, medical institutions focus on the installation of waste disposal technologies such as incineration but remain unable to enforce the waste management practices within the hospital. Globally, there are some techniques which are used in different countries such as Incineration, microwave disinfection, autoclave disinfection and chemical/mechanical disinfection. Other methods are also used to dispose of medical waste, e.g. burial, burning, dumping, removal of municipal bins and selling etc. (Akter et al, 2000).

Medical waste may contain highly toxic chemicals and can present a mechanism for transmission of diseases (Silva et al 2005). The growth of the medical sector around the world over the last decade (WHO, 2002) combined with an increase in the use of disposable medical products has contributed to the large amount of medical waste being generated (Silva et al, 2005).

Bangladesh is a developing country with a rapidly growing urban population, extensive health problems, low educational status and environmental pollution (Kabir et al, 2003). In Bangladesh, hospital waste is collected by sweepers, and then transported to the city's open waste dumping sites. In Government hospitals, there are no special techniques for waste handling, and due to lack of awareness, hospital staff normally treat all solid wastes carelessly. Municipal transport is used to collect and dispose of the hospital waste in any open dumping site alongside city garbage (Ahmed et al, 1997). Normally, hospital waste and domestic waste are mixed together on the roadside and then disposed of. Sometimes, to get rid of this waste, it is simply buried without complying with any rules and regulations. The bitter reality behind such actions is that although the necessary technologies and equipment are available to ensure proper hospital waste management within the country, the unawareness among staff and local people regarding effective disposal techniques and policies hinders their implementation. However, Bangladesh is at a crucial stage where there is an urgent need to create awareness about the hazardous impacts of waste on human health as well as the environment. Moreover, strict measures are needed to implement hospital waste management technologies.

2. DEFINING MEDICAL WASTE

There are different concepts of waste management. However, in this research the concepts proposed by WHO (2014) such as classification of medical waste, the nature of medical waste, and hospital waste management techniques and methods are described.

World Health Organization (WHO, 2014) defines medical waste as Waste produced by health care activities including a wide range of materials, from used syringes and needles to soiled dressings, diagnostic samples, body parts, pharmaceuticals, chemicals, blood, medical devices and radioactive materials. All types of wastes which are produced by hospitals, doctor's clinics or offices, medical and research departments are considered as medical wastes (Srishti et al, 1998).

World Health Organization (WHO, 2014) has classified medical wastes into eight different categories, which are as follows;

- 1) Pathological waste
- 2) Chemical waste
- 3) Sharps
- 4) Pharmaceutical waste
- 5) Pressurized containers
- 6) Radioactive waste
- 7) Infectious waste and potentially infectious waste
- 8) General waste

3. HOSPITAL WASTE MANAGEMENT SYSTEMS IN DIFFERENT DEVELOPING COUNTRIES

In developing countries, some processes e.g. on-site incineration, steam disinfection, microwave disinfection, autoclave disinfection, and mechanical/chemical disinfection are currently in use for managing harmful waste but on a very small scale. Normally, incineration practices are found in Argentina, Brazil, Peru, Pakistan, India and Bangladesh. In developing countries, hospital waste incinerators operate under sub-optimal conditions and mostly incinerators are non-functional due to different reasons. For example, hospital's administrations focus mostly on installing incinerators but they do not pay attention to its functioning and maintenance.

A study done by Subramani et al (2014) showed that in India, 420461 kg of biomedical waste is generated per day in which only 240682 kg of waste per day is treated. Asante et al (2014) also reported that, in Ghana, 6851 beds are available for patients and each bed is generating 1.2 kg of waste per day. Moreover, around 83% of the selected health care institution (total were 120 Health care institutions) in Ghana did not segregate their waste of which only 17% were segregated. A study done by Joshi et al (2013) indicated that in Nepal, around 1.7kg/person/day hospital waste was produced whereas 0.48kg/person/day health care risk waste was generated. This study also illustrated that in Nepal, mostly government and private hospitals do not systematically segregate the waste at the point of waste generation. Moreover, the guidelines of color coding and labeling of waste containers are not strictly followed by the hospitals. Normally, hospital waste is being collected in a big container then mixed with municipal waste, as a result the entire waste become hazardous and pollute the environment. Improper management of health care waste can badly affect the health of the hospital's staff, patients, waste workers and general public.

4. METHODOLOGY

At present, PRISM Bangladesh, a renowned NGO based in Dhaka city, has been operating at a large scale to collect hospital waste from healthcare facilities and to subsequently processing and treatment of these hazardous waste. Under their medical waste management program, currently 602 private healthcare facilities are registered. From these 602 HCF's, we have randomly selected 50 HCF's while maintaining the percentage of different types of HCF's. The overall categories of HCF's was 5. The duration of time for which the data was collected was April-May-June of 2015. We also attempted to perform case study analysis in 3 randomly selected hospitals. Personal visits were made to hospitals and waste disposal site to record the actual conditions.

5. CALCULATION OF WASTE GENERATION

For the purpose of estimation of hazardous waste generation from private HCF's, we modified the formula used by Patwari et al (2009). The final steps of the calculation are below:

$$\hat{y} = T_{hb} W_{hb} + T_{cb} W_{cb} + T_{dt} W_{dt} \quad (1)$$

- \hat{y} = Total hazardous waste generated per day
- T_{hb} = Total no. of hospital beds in Dhaka city (13650)
- W_{hb} = Avg. hazardous waste per hospital bed per day in sampled hospitals (0.15 Kg bed⁻¹ day⁻¹)
- T_{cb} = Total no. of clinic beds in Dhaka city (6102)
- W_{cb} = Avg. hazardous waste per clinic bed per day in sampled hospitals (0.11 Kg bed⁻¹ day⁻¹)
- T_{dt} = Total no. of diagnostic center test per day in Dhaka city (15100)
- W_{dt} = Avg. waste per diagnostic test in sampled diagnostic centers per day (0.27 Kg test⁻¹ day⁻¹)
- $\hat{y} = (13650 * 0.15) + (6102 * 0.11) + (15100 * 0.27)$
 $= 6795.72 \text{ kg day}^{-1}$

Total solid waste generated in Dhaka city per day = 5000 metric tons
 = 5000000 kgs

So, hazardous healthcare waste generation percentage = $(6796 / 5000000) * 100$
 = 0.14 %

Total healthcare waste generated in Dhaka city per day = 42 metric tons
 = 42000 kgs

Hazardous healthcare waste percentage of the total healthcare waste = $(6796 / 42000) * 100$

=16.18 %

Our result shows that hazardous healthcare waste generation rates of private HCF's is 0.17 Kg bed⁻¹ day⁻¹. This is lower than other research results. Because in Bangladesh, economically solvent people often visit private HCF's for minor health issues which results in lower waste generation. Also, our result for hazardous healthcare waste percentage of total healthcare waste (**16.18 %**) is within WHO specified range(**10% – 25%**).

Table 2: Comparison of healthcare waste generation rate of Bangladesh with other countries

Countries	Hazardous Health-Care Waste Generation Rate (Kg bed ⁻¹ day ⁻¹)
Bangladesh, Patwary et al (2009)	0.28
Jordan, Bdour et al (2007)	0.07
Norway, Bdour et al (2007)	0.68
UK, Bdour et al (2007)	0.57
Greece, Komilis et al (2011)	0.24
Brazil, Silva et al (2005)	0.57
Taiwan, Cheng et al (2009)	0.19
Iran, Mosferi et al (2009)	0.30

6. MEDICAL WASTE TREATMENT AND DISPOSAL METHODS FOLLOWED IN DHAKA CITY

The collected information through interviews with the hospital staff and visual examination by the researcher demonstrated that in private healthcare facilities SWM (Solid Waste Management) system comprises of separate waste storage area at dedicated places within hospital vicinity. Sanitation staff including sweepers and waste collectors clean the hospital's individual area, collect the hospital waste and dispose of this waste at identical garbage heaps. PRISM Bangladesh collect this waste in covered vans and transport the waste to their waste disposal and treatment site in Gazipur. In these private HCF's, color coding scheme for the collection of plastic, paper, glass and other infectious waste was observed by the researcher.

For effective onsite segregation of medical waste, Kumar et al (2010) suggested a color coding scheme which is given below;

- Green: For organic waste
- Red: For risk waste with sharps
- Blue: For risk waste without sharps
- Black: For non-risk/General waste
- Yellow: For radioactive waste

6.1 Storage, Transportation and Final Disposal of Hospital Waste

In private healthcare facilities respondents told to the researcher that after collection of waste from each ward, for temporary storage we have separate container and trolley outside the hospital building, sweepers throw-off all of the hospital waste in "Blue color" container and "Yellow color" PRISM

trolley". Respondents also told that, every early morning PRISM Bangladesh vans collect all of these wastes from these containers from the private hospitals, then transport this waste to PRISM Bangladesh's waste disposal and treatment site.

6.2 Burning of Hospital waste

In private hospitals researcher also observed that behind the hospital buildings, big holes were found. On asking from sweepers about the reality of these holes, they replied that, on the instructions of the hospital's administration, they filled these holes with infectious and hazardous waste which they got rid of by burning. On asking the reason of burning this hazardous waste, respondent replied that hospitals lack onsite incineration plant. Therefore, for hospital waste management there is no other option than burning to get rid of this infectious and hazardous waste.

6.3 Recycling of waste

Researcher came to know that empty glass/plastic bottles, containers and tins were mainly re-used by doctor's assistants and compounders without sterilizing them. However, recyclable products such as glucose bags, urine bags, tins, used syringes, paper, cardboard, plastic bottles and infusion tubes were collected and sorted by the sweepers and scavengers within hospitals premises and outside the hospital boundaries respectively. Sweepers and scavengers perform these duties without realizing the serious health issues such as Hepatitis B, C, HIV/AIDS and many other allergic issues which can be caused by handling and due to contact with these infectious/toxic wastes. On asking about the reason for the collected and sorted recyclable waste, respondents mostly replied that these recyclable products can be easily sold on for good prices at scrape yards.

7. CONCLUSIONS

From this study, the following conclusions can be drawn:

- Our result for hazardous healthcare waste percentage of total healthcare waste (**16.18 %**) is within WHO specified range (**10% – 25%**)
- Per day, 6795 kg of hazardous waste generated from private healthcare facilities in Dhaka city which poses significant health risks to the people associated with waste disposal & treatment.
- Absence of government guideline and application of environmental law aided by the people's ignorance and reluctance to the conservation of environment along with economical insolvency has acted as the major catalyst behind the failure of waste management system of Dhaka city. Awareness and education on medical waste issues should be raised among the general people. The government has the responsibilities of formulating appropriate policy that needs to be followed by all the HCF's in Bangladesh.
- Participation on this aspect by NGOs like PRISM Bangladesh should be encouraged by the government. Also, through training and guidance supported by DGHS and NGOs, the application of guidelines and procedures associated with effective enactment of the law through DoE needs to be promoted.

8. IMPROVEMENTS RECOMMENDED FOR PRESENT HEALTHCARE WASTE MANAGEMENT FRAMEWORK IN BANGLADESH

- Training of personnel associated with healthcare waste collection, transportation & disposal.
- Formulation of national framework by government.
- Use of methods like 'Composting' & 'Vermiculture' for disposal of biological waste.

- Implementation of Energy from Waste (EfW) technology can generate electricity at low cost while providing zero discharge of waste.
- To increase mass awareness about the risk of exposure to healthcare waste.

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