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AN ASSESSMENT OF GENERATION OF MEDICAL WASTES IN A PUBLIC HOSPITAL OF A TERTIARY LEVEL MEDICAL INSTITUTE IN BANGLADESH

A.S.M. Saifullah[1], S.M.A. Jabber[1], M.G. Morshed[2] and Mahbub-E-Sobhani[3*]

[1]*Dept. of ESRM, Mawlana Bhashani Science and Technology University, Santosh, Tangail 1902, Bangladesh*

[2]*Department of Cardiology, BIRDEM, Dhaka, Bangladesh*

[3]*Biotechnology & Genetic Engineering Discipline, Khulna University, Khulna 9208, Bangladesh*

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Abstract: This study assessed different types of sharps and pathological waste generated from 10 major wards of a tertiary level hospital (Chittagong Medical College Hospital, CMCH). Among the sharps, vials and ampoules were identified as the most frequently disposed items; which constitute almost 45% of the total sharps' waste load. This was followed by syringe and needle, and saline bag with infusion set with a share of 42% and 13% respectively. The disposal rates of sharp wastes were found to very significantly among wards. Among various wards the daily mean disposal rate of vials and ampoules, for example, found to range from 0.57 to 5.25 individuals bed^{-1} day^{-1}. Likewise, it was 0.09 to 3.00 individual bed^{-1} day^{-1} and 0.41 to 4.96 individuals bed^{-1} day^{-1} for saline bag with infusion set and syringe and needle respectively. Of the pathological wastes, such as dressing, amputations, body fluids and featuses. Gynecology ward generates the highest quantity of 14.75 g bed^{-1} day^{-1} which was followed by Surgery unit 3 (4.05 g bed^{-1} day^{-1}) and Surgery unit 2 (3.63 g bed^{-1} day^{-1}). Orthopedic surgery unit generates the lowest quantity of 1.91 g bed^{-1} day^{-1}.

Key words: Waste disposal, medical waste, tertiary care hospital

Introduction

The medical waste is potentially capable of causing diseases and illness to man (Anon, 1986; Green, 1987; Anon, 1999), either through direct contact or indirectly by contaminating air soil, ground water, surface water, etc. There is also risk of introduction of pathogenic microorganisms in a variety of ways from medical wastes (Mobarak, 1998). Medical waste, therefore, causes a risk to individual, community and environment if not properly handled. In Bangladesh, there are around 645 public and 288 private sector health care establishment (Rahman, 2000), in addition to 83 government hospitals. According to the Dhaka City Corporation 3,700 mt of wastes are generated daily in Dhaka city, of which 200 tons are hospital wastes and 40 tons are infectious wastes. Hospital wastes are classified in a number of ways by different institutions and by different countries (Thu Tha, 1990; Akter *et al.*, 1997; Bhuiyan, 2000). Generally on an average, 85% of hospital wastes are non-hazardous and 15% are hazardous including infectious waste (10%) and non-infectious wastes (5%) (Kazi, 2000). The management of hazardous wastes

* Corresponding author. Tel: 880-41-720171-3, Ext.: 252; Fax: 880-41-731244; E-mail: mahbubsobhani@yahoo.com.

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generated by the hospitals in Bangladesh is inadequate, which may cause detrimental consequences to public health, environmental quality and sustainability to the ecosystem.

Chittagong Medical College Hospital (CMCH) is a tertiary level hospital, which provides wide range of treatment to the patients. The hospital has a capacity of about 1,000 beds and it runs several departments and wards like Medicine, Paediatrics, Psychiatry, Skin and Venereal Diseases, Clinical Pathology, General Surgery, Ophthalmology, Obstetrics, Gynaecology, Radiotherapy, Radiology and Dentistry with an average turnover of 2,000 extra patients daily. All the generated wastes are disposed off in open bins due to lacks in proper management system. There is paucity of information on the quality or volume of the generated wastes by the hospitals in Bangladesh. However, a few studies have been conducted in Dhaka (Rabbani, 1997; Mobarak, 1998; Uddin, 1999). Therefore, the present study was undertaken to assess the quality and quantity of medical wastes generated by different wards of the CMCH.

Materials and Methods

Sample collection and segregation*:* Ten buckets were provided to ten wards of the hospital (Skin and Venereal Diseases, Radiotherapy, Paediatric Surgery, Paediatric Medicine, Nephrology, Orthopedic Surgery, Neurosurgery, Gynaecology, Surgery (Unit 2 and Surgery Unit 3) with a questionnaire having query about chemicals and drugs used in those wards. The buckets were replaced with other set of (10) buckets every evening. From the questionnaire provided to the wards, a list of drugs and chemicals used was prepared. The wastes were disposed in those buckets and samples were collected everyday. Collected samples were segregated into different categories following WHO guidelines (Anon, 1997).

Assessment of wastes: Daily disposal of wastes from the 10 wards was assessed for one year between January 2005 and December 2005. Except the pathological wastes, other wastes were enumerated in number. The generated wastes deposited in the supplied buckets were counted every evening and corresponding number of patients were counted from the patients' registration books. A cross reference was made for the collected sharps with the registration book to ensure accuracy of the collected data.

Results

The composition and physical nature of medical wastes reflect the basic components present in the wastes. Basically, medical wastes include general and hazardous waste. However, the hazardous wastes present in the disposed wastes were the main concern of the study. Different types of wastes that were disposed off from the CMCH are shown in the Table 1.

Table 1. Categorization of medical waste disposed off from the CMCH.

Categories	Description of the waste	Responsible wards
Sharps	Ampoules of drugs, vials from drugs and chemicals, saline bags with infusion sets, syringes and needles	Paediatric Surgery, Radiotherapy, Skin/VD, Paediatric Medicine, Nephrology, Orthopedic Surgery, Neurosurgery, Gynaecology, Surgery Unit 2 and 3
Pathological	Dressings with body parts, amputations, body fluids; dialysis fluid; clothes soiled with blood; swabs, fetuses from gynaecology ward; cottons with bloods and other liquids	Paediatric Surgery, Orthopedic Surgery, Gynaecology, Surgery Unit 2 and 3
Radioactive	^{60}Co (half-life 5.3 years) ^{161}Cs (half-life 30 years)	Radiotherapy
Genotoxic and cytotoxic	Nyrin, Cisplatin, Endoxen, Doxorubicin, Vincristin, Taxotere, Camustin, Daunorubicin and Bleomycin	Radiotherapy
Chemical	Hexisol, Hexitane, Hexicub, Formaldehyde, Lysol, Paraffin wax, Tr. Iodine, Spirit and Savlon.	Skin/VD, Paediatric Medicine, Nephrology, Orthopedic Surgery, Neurosurgery, Gynaecology, Surgery unit 2 and 3

The sharps included syringe and needle, vial and ampoule, saline bag with infusion set. Sharp materials not only cut and puncture but also infect the wounds by contamination with pathogens. Sharps, therefore, have double role as injury and disease transmission, commonly viral blood infection. Viral diseases are very common among workers working at disposal sites and rag pickers. Sharps were found to be more hazardous which were carelessly disposed off from every ward of the CMCH.

Disposal of vials and ampoules showed a marked of variation among different wards (Table 2). The highest monthly mean disposal of vials and ampoules was recorded at 8,284 in the Orthopedic Surgery Ward following the Surgery Unit 3 (7,852), Neurosurgery (7,180), Surgery Unit 2 (2,987), Radiotherapy (2,355), Paediatric Surgery (2,122) and Paediatric Medicine (2,088), with the lowest disposal of 373 in the Skin/VD Ward. The monthly mean disposal was recorded 2.06 individuals bed^{-1} over the study period. The disposal rate was observed highest in the Surgery Unit 2 (5.25 individuals bed^{-1} day^{-1}) followed the Radiotherapy Ward (4.66 individuals bed^{-1} day^{-1}), Neurosurgery Ward (3.42 individuals bed^{-1} day^{-1}), Orthopedic Surgery Ward (3.00 individuals bed^{-1} day^{-1}). The lowest disposal rate was recorded in the Nephrology Ward (0.57 individuals bed^{-1} day^{-1}). Percentage of disposal of vials and ampoules was found as 45.09%, the largest portion of the total sharps.

Table 2. Mean disposal rate (individuals bed^{-1} day^{-1}) of sharps from different wards of the CMCH.

Name of ward	Mean no. of patient/ ward	Vial and ampoule		Saline bag with infusion set		Syringe and needle	
		Disposal rate	% of total waste	Disposal rate	% of total waste	Disposal rate	% of total waste
Skin/VD	549	0.68		0.09		0.41	
Radiotherapy	505	4.66		3.00		4.45	
Paediatric Surgery	2607	0.81		0.73		0.75	
Paediatric Medicine	2527	0.83		0.74		0.75	
Nephrology	655	0.57		0.48		0.42	
Orthopedic Surgery	2760	3.00		0.11		2.89	
Neurosurgery	2097	3.42	45.09	0.41	12.71	3.26	42.20
Gynaecology	1820	0.74		0.40		0.66	
Surgery Unit 2	1959	1.52		0.37		1.37	
Surgery Unit 3	1496	5.25		1.08		4.96	
Total	16974	21.48		7.41		19.92	
Mean	1697.4	2.148		0.741		1.992	

The highest monthly mean disposal of saline bags and infusion sets was recorded at 1,902 in the Paediatric Surgery Ward followed by the Pediatric Medicine (1,861), Surgery Unit 3 (1,614), Radiotherapy (1,514), Neurosurgery (870), with the lowest disposal of 47 in the Skin/VD Ward. The monthly mean disposal rate was recorded at 0.58 individuals bed^{-1} over the period of study. The disposal rate was observed highest in the Radiotherapy Ward (3.00 individuals bed^{-1} day^{-1}) followed by the Surgery Unit 3 (1.08 individuals bed^{-1} day^{-1}), the Paediatric Medicine Ward (0.74 individuals bed^{-1} day^{-1}), the Paediatric Surgery Ward (0.73 individuals bed^{-1} day^{-1}). The lowest disposal of solid waste was recorded at 0.09 individuals bed^{-1} day^{-1} in the Skin/VD Ward. Percentage of disposal of saline bags and infusion sets was found at 12.71% of the total sharps.

The highest monthly mean disposal of syringe and needles was recorded at unit 7,987 in the Orthopedic Surgery Ward following the Surgery Unit 3 (7,421), Neurosurgery Ward (6,838), Surgery Unit 2 (2,677), Radiotherapy Ward (2,249), with the lowest disposal of 226 in the Skin/VD Ward. The monthly mean disposal was recorded 1.93 individuals bed^{-1} over the period of study. The disposal rate was observed highest in the Surgery Unit 3 (4.96 individuals bed^{-1} day^{-1}) followed by 4.45 individuals bed^{-1} day^{-1} in the Radiotherapy Ward, 3.26 individuals bed^{-1} day^{-1} in the Neurosurgery Ward, 2.89 individuals bed-1 day-1 in the Orthopedic Surgery Ward. While the

lowest disposal of syringe and needle was recorded at 0.41 individuals bed^{-1} day^{-1} in the Skin/VD Ward. The percentage of syringe and needles was found at 42.20%, the second largest portion of the total sharps.

Table 3. Mean disposal of pathological wastes from different wards of the CMCH.

Name of the ward	Monthly disposal (kg)	Daily disposal (g/bed^{-1})
Paediatric Surgery	88.50	2.95
Orthopedic Surgery	57.55	1.91
Gynaecology	441.75	14.75
Surgery Unit –2	109.15	3.63
Surgery Unit –3	121.75	4.05

Disposal of pathological wastes was recorded from five wards such as Paediatric Surgery, Orthopedic Surgery, Gynaecology, Surgery Unit 2 and Surgery Unit 3. Generation of pathological wastes showed a variation from ward to ward (Table 3). The highest monthly mean volume of pathological wastes was disposed off from the Gynaecology Ward (441.75 kg) following the Surgery Unit 3 (121.75 kg), Surgery Unit 2 (109.15 kg) with the lowest amount of 57.55 kg from the Orthopedic Surgery Ward. The disposal rate was found higher in the Gynaecology Ward (8.091 g bed^{-1} day^{-1}) followed by Surgery Unit 3 (2.713 g bed^{-1} day^{-1}), Surgery Unit 2 (1.857 g bed^{-1} day^{-1}) with the lowest rate of 0.695 g bed^{-1} day^{-1} in the Orthopedic Surgery Ward. The daily mean disposal rate was recorded at 2.564 g bed^{-1} over the period of study. The weight of clinical waste generated by different hospitals was recorded to range from 0.5 to 0.7 kg bed^{-1} day^{-1}.

Discussion

Sharps: There is strong epidemiological evidence that main concern of sharps is the transmission of AIDS/HIV virus and more often the Hepatitis B and C viruses (Anon, 1999). It was also evident that used sharps were re- packed in new packet for re-use (Mobarak, 1998). The present study showed, though the highest amount of monthly mean disposal of vial and ampoule and syringe and needle was found in the Orthopedic Surgery ward, it was different for the lowest values, which might be due to the variation in number of patients over the period of study. On the other hand, the lowest amount of monthly mean disposal of all types of the sharps was found in the Skin/VD ward. Again, the rate of disposal of vial and ampoule and syringe and needle was found highest in the Surgery Unit 3, while the lowest amount did not show the same trend. There was a similarity in case of the lowest monthly mean disposal and disposal rate for the Skin/VD ward for the last two types of sharps. The higher portion of different types of the sharps, based on disposal rate, was generated from the Surgery Unit 3 and Radiotherapy Wards. However, disposal of different types of sharps showed a decreasing trend from vial and ampoule followed by syringe and needle and saline bag with infusion set.

Pathological waste: Rahman (2000) reported the average generation of total waste from five different hospitals in Dhaka city as 5 kg day^{-1}. Rabbani (1997) worked on the total generation of solid wastes per bed per day without any categorization of wastes and reported an average rate of solid waste at 1.00 kg bed-1 day-1. Mobarak (1998) reported that waste generation rate was 0.55 kg bed-1 day-1 of which 27% was hazardous wastes. Uddin (1999) found the waste generation rate at 1.16 kg bed^{-1} day^{-1} with hazardous waste about 0.169 kg bed^{-1} day^{-1}. A number of factors affect the rate of hospital waste generation such as geographical location, season of the year, economic status of the patient, standard of living, awareness, collection frequency, attitude of the patient, type of healthcare establishment, hospital management, etc (Akter *et al.*, 1997; Anon, 1998). These factors might affect the variation in waste generation in the present study. The contribution of infectious, sharps and pathological waste were about 10.5%, 3.5%, and 1.5% respectively. As similar data to the present study were not reported earlier, so it was impossible to compare the present findings.

Conclusion

The present study shows that large volume of medical wastes was generated every day as a byproduct of health care delivery systems in hospitals. Further researches are needed to count all the hospitals in Bangladesh. As the medical wastes cannot be mixed with household wastes, the disposal of theses waste should also be brought under research objectives. Because the applied part of these researches would be to adopt selective collection and treatment of municipal wastes, more specifically medical wastes to reduce environmental and health hazards.

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