



Medical Waste Management System: An Alarming Threat (A Case Study on Jessore Municipality, Bangladesh)

M. S. Rahman, C. Moumita and K. Rikta

Department of Environmental Science and Technology, Jessore University of Science and Technology, Jessore-7408, Bangladesh

Abstract: Medical waste has a dangerous effect on environment. The mismanagement of it may be a significant risk factor for diseases transmission, in developing countries. This factor rose up with the increasing generation rate of medical waste. The study was conducted from October to December 2012 on one public hospital, twelve private hospitals and clinic and seven diagnostic centres of Jessore municipality of Bangladesh, where there has been no rigorous estimation of medical waste generation on the basis of scientific way. The study includes generation rate, existing management system and problem of medical waste. A convenience random sampling technique was followed to collect data. Actual measurement was done by digital weight machine to know about waste generation from the different sections of HCE's and a pre-structured questionnaire about the existing medical waste management. Visual field observation was also done to acquire the actual information. The research focused on the average generation rate of the studied HCE's was 1.59 kg/bed/day, 0.49 kg/patient/day and 0.11 kg/test/day. The generation rate in public hospital was 2.02 kg/ bed/ day, 0.49 kg/patient/day and 0.133 kg/test/day. The generation rate was 1.36 kg/bed/ day, 0.54 kg/patient/ day and 0.086 kg/test/day and 0.33 kg/patient/day and 0.168 kg/test/day in private clinic and diagnostic centre respectively. Result prevailed that unsatisfactory management practice observed on the basis of environmental safety. Adequate amount of selected colored dust bin, regular monitoring, arrangement of training, regular assessment of HCEs by government through the specialist, implementing of rules and regulations will be needed for improving existing medical waste management in the study area.

Key words: Generation Rate, Health Effects, Medical Waste, Management, Diseases

Introduction

Bangladesh is a developing country with a rapidly growing urban population, extensive health problems, low educational status and high environmental pollution (Kabir *et al.*, 2003; Rahman *et al.*, 2007). Healthcare waste management (HCWM) is still a major challenge for health facilities in developing countries where the health care staff and surrounding population is exposed to risks due to poor handling of waste (Hossain *et al.*, 2011). Globally hospital waste is regarded as a hazardous, therefore, it has to be treated accordingly (Ross, 2011). In Bangladesh, medical waste management systems to reduce the environmental and public health risk are grossly inadequate (World Bank, 2002; PRISM Bangladesh, 2005). Medical waste is composed of waste that is generated or produced as a result of any of the following actions: diagnosis, production or testing of biological, accumulation of properly contained home-generated sharps waste, and removal of a regulated waste from a trauma scene by a trauma waste management practitioner (Matin, 2006). Any waste management plan should be based upon a reliable estimate of the amount of waste generated (Karamouz *et al.*, 2007). The characteristics of waste generation depends on number of factors such as established methods of waste management, type of healthcare establishment, degree of health facility specializations, proportion of reusable items employed in health care, seasonal variation and patient work load. In middle and low-income countries, healthcare waste generation is usually lower than that of high-income countries (WHO, 2004). When segregated and properly managed,

medical waste streams are usually very small in quantity (WHO, 1999). Medical waste may carry germs of diseases such as hepatitis B virus and AIDS. In developing countries, medical waste has not received much attention and it is disposed of together with domestic waste (Almuneef and Memish, 2003; Patil and Pokhrel, 2005). Medical waste presents a high risk to doctors, nurses, technicians, sweepers, hospital visitors and patients due to arbitrary management (Massrouje, 2001; Becher and Lichtnecker, 2002). The collection of disposable medical items (particularly syringes), its resale and potential re-use without sterilization could cause a serious disease burden (WHO, 2002). Improper disposal of medical waste may include damage to humans by sharp instruments, diseases transmitted to humans by infectious agents, and contamination of the environment by toxic and hazardous chemicals (Lee *et al.*, 2002; Jang *et al.*, 2006; Abdulla *et al.*, 2008). The mismanagement of the biomedical waste poses grave risk to people and the environment. It is important to dispose off such waste properly to avoid its dangerous effects (Saini *et al.*, 2004). The effects of mismanaged hospital waste are said to be enormous and drastic (Ross, 2011). Acharya and Singh (2000) identified the medical waste management process to include, handling, segregation, collection, disinfection, storage, transportation and final disposal. They suggest that these are vital steps for safe and scientific management of medical waste in any establishment. Medical waste should be segregated into containers/ bags at the point of generation. The best medical waste management practice for medical waste is to prevent and minimize the generation of waste (Jang *et al.*, 2006). A public

awareness campaign for proper management of medical waste would be effective in keeping up the city environment safe. Awareness is essential to solve this problem, particularly with regards to the reuse of syringes and needles and other sharps contaminated with human blood or body fluids (Hassan *et al.*, 2008). The colour codes recently introduced by the GoB should be followed at all HCE for this purpose. Keeping the above information in mind the study was conducted with the objective to determine the generation rate, to investigate the existing management practice of medical waste and to identify the problem associated with the existing management of medical waste and provide some suggestions.

Methodology

Study area

It lies between 89° 10' and 89° 16' East and latitude are 23° 6' and 23° 11' North. Its elevation is 8 meters above mean sea level and the area is nearly slope from north to south. Jessore is the oldest, biggest and important municipal area of south west Bangladesh.

Determination of sample size

No statistically rigorous sampling procedure could be followed for this study. Those Health Care Establishment (HCE) who were willing to provide us information were selected for this study. It was not easy to collect relevant medical waste data from HCE since most of the HCE did not follow the existing rules and regulation to run them properly. For this reason some of the HCE authorities were not interested to give permission in collecting data from their own institutions. A total of 20 out of existing 49 HCE in the study area gave permission to collect data.

Primary data were collected through direct field observation, Interview, actual measurement and questionnaire survey. A face-to-face direct questionnaire interview was performed among the different respondent group. Before entering a HCE, a number of formal meetings being arranged with the concerned authority of each HCE to explain the purpose of the study and seek their cooperation. After receiving consent, fieldwork was started from October to December 2012.

Table 1: Location of the studied Health Care Establishment (HCE)

Selected Health Care Establishment name	Latitude	Longitude
250 beded General hospital, Jessore	23°10'6.78"	89°12'31.12"
Queens Hospital (pvt.) Ltd.	23°10'5.58"	89°12'41.16"
Doratana Hospital	23°10'3.48"	89°12'35.64"
Ekota Hospital and Diagnostic COMPLEX (Pvt) Ltd.	23°10'4.5"	89°12'33.9"
Modern Hospital and Diagnostic Centre	23°10'4.68"	89°12'33.06"
Unique Hospital and Diagnostic Centre	23°10'5.28"	89°12'41.16"
Rotary Health care center	23°09'34.92"	89°12'22.74"
Central Hospital and Diagnostic complex	23°10'5.34"	89°12'38.22"
Ad-din Shakhina medical college Hospital (Ad-din ma)	23°09'47.94"	89°12'46.8"
Ad-din Shisu Hospital	23°10'2.64"	89°11'40.26"
Lab Aid Hospital and Diagnostic Centre	23°09'44.7"	89°12'26.28"
Jonokollan Hospital	23°09'41.88"	89°12'50.82"
Ibn-Sina Hospital and Diagnostic Centre	23°10'4.62"	89°12'32.28"
Squaire Diagnostic Centre	23°10'5.1"	89°11'34.92"
PopularDiagnostic Centre	23°10'6.66"	89°12'31.08"
Sunrise Diagnostic Centre	23°10'4.74"	89°12'36.18"
Comtech Diagnostic Centre	23°10'5.28"	89°12'41.16"
Jhorna Clinic	23°09'47.16"	89°12'37.02"
Nova medical Center	23°09'49.98"	89°12'40.62"
Prime Diagnostic Centre	23°10'4.38"	89°12'34.98"

Actual measurement

Waste generation data were recorded one time a day at 8.00 a.m. on each of three days in a week (two week days and one weekend) in each HCE. A designated bin-bag was placed in each ward and department at the start of the day. There were three shifts almost all HCEs for the collection of wastes. After the collection of the bin-bag of waste replacing it with a new one to continue of the survey program. The bin-bag was individually

weighted using a weight machine. Then the waste was manually separated (following appropriate safety precautions) into two categories such as hazardous and non hazardous as designated in WHO guideline (Pruss *et al.*, 1999) and weight again.

Questionnaire survey

An empirical questionnaire survey was carried out for the collection of primary data about the existing management system of medical waste in the study

area and the experience of the respondent about it. Different set of pre-structured questionnaire were used for different level of respondents. The occupation segmentation with gender heterogeneity was considered to select our respondents. The respondents included authority personnel, nurses, pathology technician, cleaners and room service employees (ayas). Questionnaire survey was conducted for 263 respondents among them 20 authority personnel, 114 nurses, 20 pathology technicians, 19 ward boys, 50 ayas and 40 cleaners. The main purpose of this questionnaire survey was to assess the level of awareness, probable health effects of improper disposal of waste & also for

identifying factors which limit proper disposal of medical waste in Jessore Municipality.

Results and Discussion

Generation rate of medical waste

Medical waste generated from the daily activities of the patients, cleaners, sweepers, nurses, doctors and administrators etc. that are discarded as useless. Medical wastes are generated from the ward, cabin, Operation theatre, outpatient department, pathology etc. Volume of the waste mainly depends upon the beds and outdoor patients that represent the waste generation sources.

Table 2: Waste generation rate in surveyed HCEs

HCEs	Size of HCE				Waste generation rate	
	No. Beds	Kg day ⁻¹ (%)	No. Test day ⁻¹	Kg day ⁻¹ (%)	Average	
					Kg bed ⁻¹ day ⁻¹	Kg test ⁻¹ day ⁻¹
Public Hospital	278	562.2 (40.2)	50	6.65 (0.5)	2.02	0.133
Private Hospital/ Clinic	500	678.51 (48.5)	869	74.6 (5.3)	1.36	0.086
Pathology/ Diagnostic Centre	0	0	455	76.59 (5.5)		0.168

Source: Field survey, 2012

Among the studied health care establishment the generation rate of the 250 bedded general hospital was highest that was 2.02 kg/bed/day. The average generation rate within the private hospital or clinic was 1.36 kg/bed/day. So the average waste generation rate in the studied health care establishment was 1.59 kg/bed/day. This was lower than Dhaka, where the waste generation rate was 1.93 kg/bed/day (Hassan et al., 2008). Bdour et al. (2007) reported the average waste generation in European HCEs to be 3.9 kg bed⁻¹ day⁻¹ (Norway), 4.4 kg bed⁻¹ day⁻¹ (Spain) and 3.3 kg bed⁻¹ day⁻¹ (UK and France). In middle and low-income countries, healthcare waste generation is usually lower than that of high-income countries (WHO, 2004). These statuses support the present findings.

The waste generation rates of the pathology or diagnostic centre of the public and private organization were 0.133, 0.086, and 0.168 kg/test/day respectively (Table 2). The average

waste generation rate was 0.11 kg/test/day. This was higher than Jordan, where the rate of generation was 0.034 to 0.102 kg test⁻¹ day⁻¹ (Bdour et al., 2007) because of coming a lot of outdoor patients in the studied diagnostic centres.

In the study it was found that the waste generation rate (kg patient⁻¹ day⁻¹) in the private clinic was higher than the public hospital and other diagnostic centre. The generation rate (Kg patient⁻¹ day⁻¹) in the public hospital, private clinic and diagnostic centre were 0.49, 0.54 and 0.33 kg patient⁻¹ day⁻¹ respectively (Table 3). The average waste generation rate in the studied HCE's was found 0.5 kg patient⁻¹ day⁻¹. This was lower than Dhaka, where the waste generation rate was 0.52 kg/patient/day (Hassan et al., 2008). The generation rate in the private clinic was highest because of high percentage of the outdoor patient was come in there to get the immediate and better technological services.

Table 3: Waste generation rate per patient

HCEs	No. of In patients	No. of Out patients	Total generated waste (kg)	Waste generation rate (Kg patient ⁻¹ day ⁻¹)
Public Hospital	378	790	568.85	0.49
Private Hospital/ Clinic	353	1028	753.11	0.54
Pathology/Diagnostic	0	230	76.59	0.33

Source: Field survey, 2012

Existing Management System of Medical Waste

Safety measure of medical waste handlers

Safety measure is very much important for the handling of the medical waste for avoiding the threat of it and health problems. All of the staff

must be required to use the safety measure during waste collection and segregation. Medical wastes carry different kind of infectious pathogens which can cause serious diseases as well as it can puncture by the sharp waste.

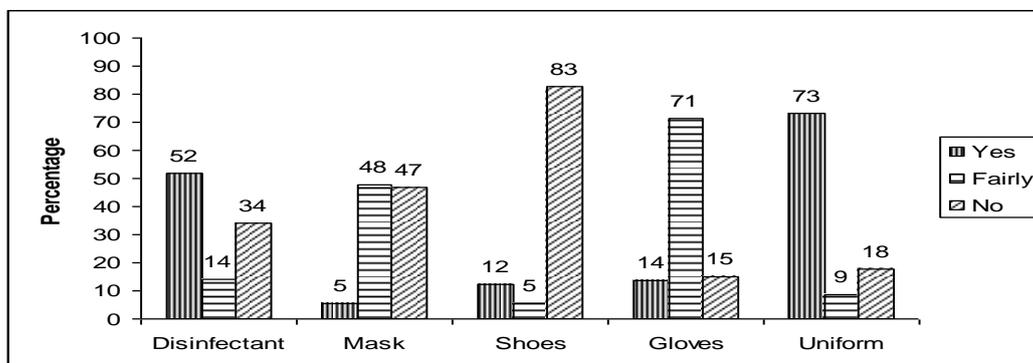


Fig. 1: Use of safety measure in the surveyed HCEs for waste handling

Fig. 1 shows that higher percentage of the respondents used uniform (73%) but they used gloves when it was required especially for biohazard waste. Most of the respondents did not use specific shoes (83%) during the waste handling and they did not use mask most of the time. Respondents did not either use mask 48% or fairly 47%. About 52% of the respondents used disinfectant after collecting their waste (Fig. 1).

Frequency of the collection and disposal of medical waste

Most of the studied HCE's collected and dumped waste three times a day. Some private hospitals or clinic collected their waste more than three times but they dumped it in a lower frequently. Most of the private diagnostic centre collected and dumped their waste for one or two times a day (Table 4). Storage of the waste was done very indiscriminately and in unscientific way.

Table 4: Frequency of collection and disposal of waste in the Jessore municipality

Frequency	Percentage (N=263)	
	Frequency of collection	Frequency of disposal
One time a day	12.93	25.86
Two times a day	12.93	12.93
Three times a day	53.61	49.81
More than three times a day	20.53	11.41

Source: Field survey, 2012

On site segregation system of medical waste

Onsite segregation is the most important step for the medical waste management. In our national guideline it is said that all the HCE's should be

segregated in six different color coded bins. During the survey it was found that any HCE did not segregate their waste in different six bins.

Table 5: Onsite Segregation of waste in different HCEs of Jessore Municipality

	Use of six bin (Perfect)	Use of five bin (Acceptable)	Use of four bin (Moderate)	Use of three bin (Below Moderate)	Use of two bin (Bad)	All in one bin (Terrible)
N	0	1	33	86	19	124
Percentage	0 %	0.38 %	12.55 %	32.70 %	7.22 %	47.15 %

Source: Field survey, 2012

Only 0.38% of the respondents used five bins for waste segregation. Higher percent of the respondents used only one bin for the storage of the waste (Table 5). So they did not segregate their waste and not followed our national guideline.

Disposal frequency of the infectious waste under the bed

Most of the HCEs did not follow the proper method of the segregation of waste. All kind of waste kept under bed. During the study it was found that 49% of the respondents dispose the infectious waste under the bed and 44% respondents did not dispose the infectious waste in the bowl under the bed. The

remaining 7 % disposed it partially (Fig. 2). For these reasons the other kind of waste converted to

infectious waste by gathering pathogens.

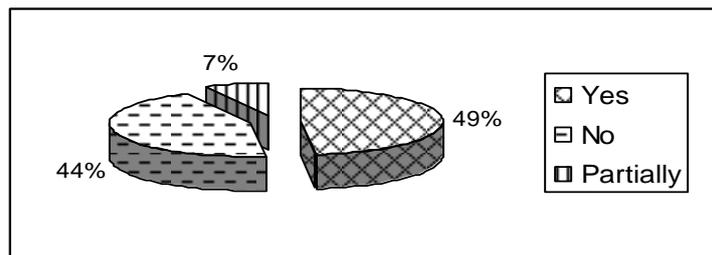


Fig. 2: Disposal of infectious in bowl under bed

Practice of destroying needles in the surveyed HCEs

From the study it was observed that almost all the HCE’s did not follow the method of proper sharp waste management. It was also found that 80% of the respondents did not destroy the needles of the syringe. They disposed it in the bowl under the patient bed directly. The remaining sharp was

destroyed by breaking and cutting. Together 20% of the respondents were destroyed needles of which 81% broke physically and 19% used cutter to cut needles (Fig. 3). Most of the respondents were not aware about the hazard of the needles, for which they disposed it with the other types of waste. In spite of having cutter machine of the needles they did not used it for cutting needles.

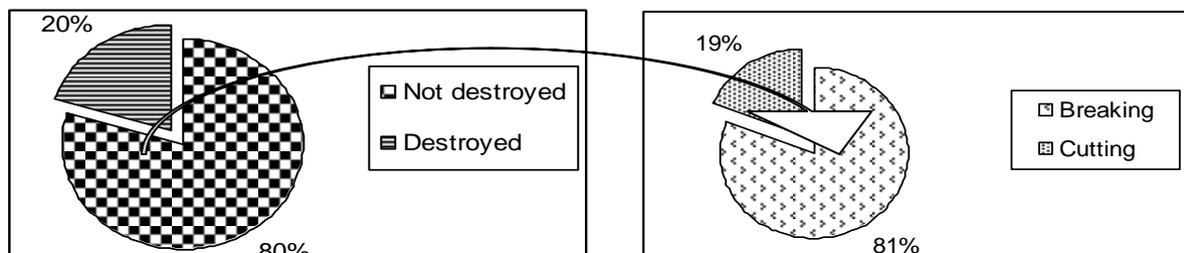


Fig. 3: practices of destroying needle in surveyed HCEs

Problems identified by the respondent for medical waste segregation

Segregation is the most important vital part for medical waste management. There are a number of

different reasons behind this. Some of the problems faced by respondents during segregation are given in Table 6.

Table 6: Problems of waste segregation in Jessore municipality identified by the respondents

Problem faced during the segregation of the waste	Percentage (N=263)
Absence of adequate dustbin	26.62
Waste bins are full	8.15
Inappropriate location of waste bins	16.55
Lack of description or symbols of waste bins	9.35
Due to offensive odor	5.04
Lack of knowledge regarding the constituents of medical waste	23.14
Possibility of the diseases infection	3.48
Don't care much about waste management	6.12
Lack of manpower	1.44
Lack of collective instruments	0.12

Source: Field survey, 2012

Absence of adequate waste bin, lack of knowledge regarding the constituents of medical waste and inappropriate location of waste bin seems to be the most important reason for waste being ending up in wrong bin during segregation. 26.62% of the respondents left that absence of adequate waste and 23.14% of the respondents believed that lack of

knowledge or confusion about the types and constituent of result of waste being ended up in wrong bin. 6.12% of the respondents comment “I don’t care much about waste management” as the prime reason, 9.35% of the respondents also mentioned that the lack of description or symbol of

waste bins is most important reason of waste segregation.

Knowledge of the respondents about MWM

Knowledge is much important for rising working capability and skill. For better medical waste management (MWM) staff knowledge about the

medical waste and its properties is most important. During the survey it was found that most of the respondents don't know about the proper medical waste management. Only 5 % know about it including 9 % partially know (Fig. 4).

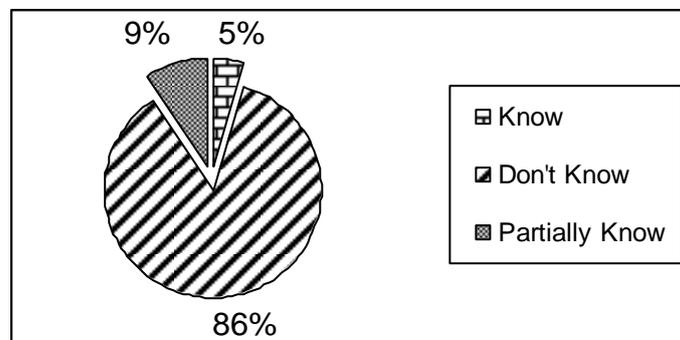


Fig. 4: Ratio of the respondent Knows About proper medical waste management

Problems of the existing waste management identified by the respondent

There were various kinds of problem identified by the respondents for the Jessore municipality to managing the proper waste management. Results of the respondent opinion are summarized in table 7. It is clear that there was a lack of adequate number of bin for the collection and storage of waste. Most of the respondents mentioned that the lack of adequate bin (14.91%), lack of awareness (13.29%), lack of knowledge of the manpower for

handling (12.54%), lack of sufficient and trained manpower (11.29%), and lack of proper segregation system (10.54%) and mishandling of the medical waste (8.92%) are the most important problems for the present vulnerable condition of the medical waste management. Some respondents also said that lack of enforcement of the law (3.06%) and lack of proper guideline (4.62%) also serious problems for medical waste management.

Table 7: Problems of medical waste management in the Jessore municipality area identified by the respondents

Problems for proper waste management system	Percentage (N=263)
Absences of adequate dustbin	14.91
Lack of trained and sufficient manpower	11.29
Lack of awareness	13.29
Possibility of Disease infection	1.93
Lack of monitoring of the HCEs	2.87
No enforcement of law	3.06
Lack of government budget in this sector	3.18
No chain of command	1.93
Due to offensive odor	4.62
Insufficient technology for waste treatment and disposal	1.50
Mishandling of medical waste	8.92
Lack of proper segregation	10.54
Reuse or resell of waste materials	3.24
Lack of appropriate guideline	4.62
Negligence of the authority	1.56
Lack of knowledge of the manpower	12.54

Source: Field survey, 2012

Waste handlers suffered by different kinds of the health effect due to pathogenic organisms of medical waste. By survey it was observed those respondents were suffering from headache and vomiting in higher percentage 36% and 33%

respectively. Some of the respondents faced heart pain (16%) during the waste handling especially the anatomical waste during the first stage of the services (Fig. 5).

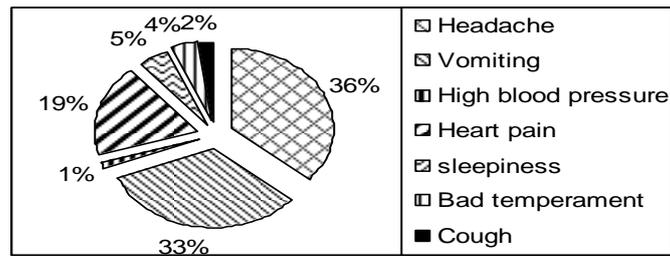
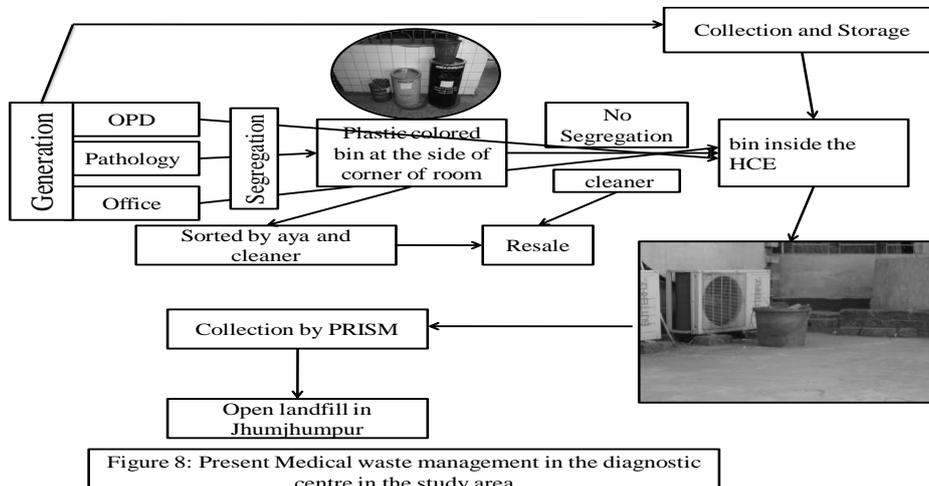
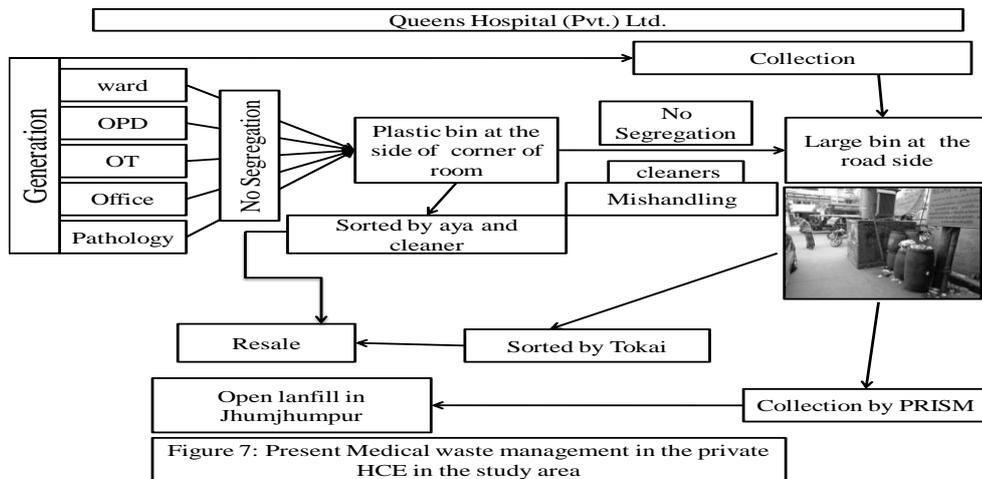
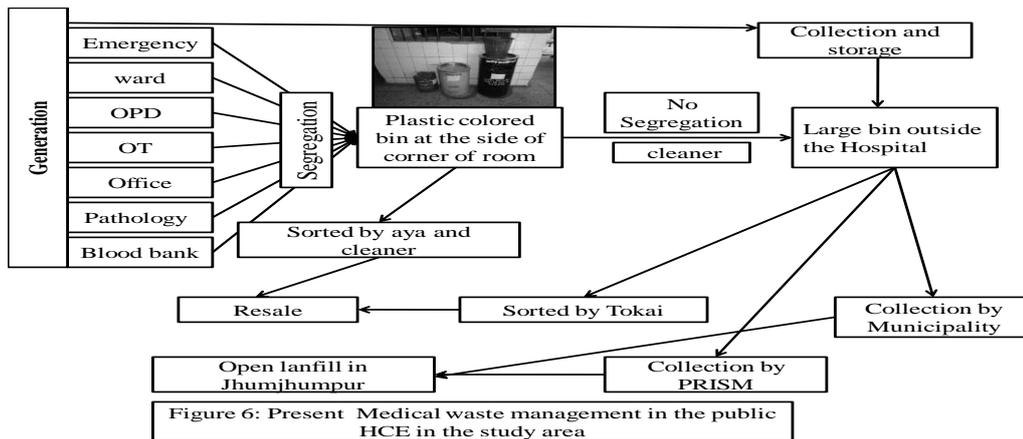


Fig. 5: Ratio of the health effect caused by medical waste



The safe disposal of Medical waste has been ignored in Bangladesh. Medical waste therefore, poses a risk to individuals, communities, and the environment if not carefully handled (Akter *et al.*, 1998). Their findings support the present situation also.

Suggestion for the improvement of medical waste management situation in Jessore Municipality by the respondents

During the survey the respondents opined for the improvement of the existing medical waste management system. They suggested for the HCE authority for providing adequate amount of dustbin (20%) and regular monitoring (20%) for the wellbeing of the management of the medical waste.

They also suggested for the authority to arrange the training program (14%), recruit the sufficient and trained manpower (10%) and provide the appropriate location of the color coded bin (11%) for different types of waste.

Respondents also provided their opinion for the government activities which should be taken for the improvement of medical waste management system and safe the environment. They also suggested for the government sector for the regular assessment of the monitoring by the specialist (29%) and arrangement of the program for rising awareness. Respondents also hope for the adequate amount of budget (13%) and enforcement of the law (10%).

Table 8: Suggestion for improvement of existing waste management system in the Jessore municipality

	Suggestion	Percentage N=263
For Authority	Provide sufficient amount of waste bin	20.7
	Create waste safety department	5.3
	Regular monitoring	20.1
	recruit the sufficient trained manpower	10.1
	Arrangement of training program	14.2
	Provide appropriate guideline to the worker	4.2
	Conduct with different NGOs for the improvement of the existing waste management	1.3
	Collect the fund from other organization	2.8
	Chain of command should be maintained	10.1
	Provide appropriate location of bin and adequate colored bin and monitoring	11.2
For Government	Provide adequate budget for waste management sector	13.2
	Provide national guideline for waste management to all HCEs	6.9
	Create law and enforce it	10.4
	Regular assessment of HCEs by specialist	29.1
	Arrangement of awareness program	29.1
	Provide proper place for waste disposal	11.3
Infrastructures	Adequate amount of colored waste bin	70.6
	Appropriate technical instrument for waste treatment and disposal	19.2
	More vehicle for disposal	10.2

Source: Field survey, 2012

In the context of infrastructural facilities most of the respondents suggested for the adequate amount of color coded bin (70%) for the improvement of the existing medical waste management system. They also suggested for appropriate technical instrument for waste treatment and disposal (19%) and more vehicles for the transportation of the waste (10%) which is summarized in Table 8.

References

Abdulla, F.; Qdais, A.H. and Rabi, A. 2008. Site investigation on medical waste anagement practices in northern Jordan. *Waste Management*, 28:450-458.

Acharya, D. B. and Singh, M. 2000. *The Book of Hospital Waste Management*, Minerva Press, New Delhi, pp.15-47.

Akter, N. R. E.; Acott, S. A. and Chowdhury, 1998. *Medical Waste Disposal at BRAC Health Centres: An Environmental Study*. BRAC Research, Research and Evaluation Division, 75 Mohakhali C/A, Dhaka 1212.

Almuneef, M. and Memish, Z. A. 2003. Effective medical waste management: it can be done. *American Journal of Infection Control*, 31(3):188-192.

Bdour, A.; Altrabsheh, B.; Hadadin, N. and Al-Shareif, M. 2007. Assessment of medical

- wastes management practice: A case study of the northern part of Jordan. *Waste Management*, 24:746-759.
- Becher, S. and Lichtnecker, H. 2002. Immunological aspects and affections of rubbish collectors caused by Bioaerosols. *Journal of Occupational Health*, 44(3):125-130.
- Hassan, M. M.; Ahmed, S. A.; Rahman, K. A. and Biswas, T. K. 2008. Pattern of medical waste management: Existing scenario in Dhaka City Bangladesh, *BMC Public Health*.
- Hossain, M. S.; Santhanam, A.; Norulaini, N. A. and Omar, A. K. 2011. Clinical solid waste management practices and its impact on human health and environment-A review. *Waste Manag.*, 31:754-756.
- Jang, Y. C.; Lee, C.; Yoon, O. S. and Kim, H. 2006. Medical Waste Management in Korea. *J. Environ. Manage.*, 80:107-115.
- Kabir, Z. N.; Tishelman, C.; Torres A. H.; Chowdhury, A. M. R.; Winblad, B. and Hojer, B. 2003. Gender and rural-urban differences in reported health status by older people in Bangladesh. *Arch. Gerontol and Geriatr.*, 37:77-91.
- Karamouz, M.; Zahraie, B.; Kerachian, R.; Jaafarzadeh, N. and Mahjouri, N. 2007. Developing a master plan for hospital solid waste management: A case study *Waste Management*, 27: 626-638.
- Lee, B.; Ellenbeckerb, M. J. and Moure-Erasob, R. 2002. Analysis of the recycling potential of medical plastic. *Waste Management*, 22:461-470.
- Matin, K. 2006. University of California, Irvine Medical WasteManagement Plan. pp.1-5. April,15.2008.
- Massrouje, H. T. N. Nov. 2001. Medical waste and health care workers in Gaza governorates. *Eastern Mediterranean Health Journal*, 7(6):1017-1024.
- Patil, G. V. and Pokhre1, K. 2005, Biomedical Solid Waste Management in an Indian Hospital: A Case Study, *Waste Management*, 25:592-599.
- PRISM Bangladesh. 2005. Survey Report on Hospital Waste Management in Dhaka City. Unpublished Report Dhaka: PRISM Bangladesh.
- Pruss, A.; Giroult, E. and Rushbrook, P. 1999. Safe management of wastes from healthcare activities, Handbook, World Health Organisation, Geneva. Rahman, M. N.; Islam, M. T. and Baten, M. A. 2007. Waste disposal and management system in rural and municipal areas of Dinajpur district. *Bangladesh J. Environ. Sci.*, 13(1):25-38.
- Saini, S.; Das, B. K.; Kapil, A.; Nagarajan, S.S. and Sarma R. K. 2004. The study of bacterial flora of different types in hospital waste: evaluation of waste treatment at All India Institute of Medical Sciences (AIIMS) Hospital, New Delhi. *Southeast Asian J Trop Med Public Health*, 35:986-9.
- Ross, D. E. 2011. Safeguarding public health, the core reason for solid waste management. *Waste Manag Res.*, 29:779-80.
- WHO (World Health Organization). 2004 "Health-care WasteManagement", policy paper, Department of Protection of the Human Environment Water, Sanitation and Health 20. Geneva 27, Switzerland.
- WHO (World Health Organization). 2002. Reducing Risks, Promoting Healthy Life, World Health Report. Geneva, World Health Organization.
- WHO (World Health Organization). 1999. Safe Management of Wastes from Health-Care Activities. Geneva.
- World Bank. 2002. Health Facility Waste Management Study in Bangladesh Dhaka: World Bank Plc.