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Health Care Waste Management Issues in Bangladesh

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Abstract: *Health care sector in Bangladesh has been metamorphosed to service based business sector very recently. Foreign and local entrepreneurs are investing millions of dollars in this sector and the number of health care establishments is growing increasingly but waste management is getting impromptu attention. Only a few percentages of health care establishments do segregation for proper management of hazardous portion. Through there is a health care waste management project running in some part of Dhaka and Khulna cities but wastes are not managed and treated up to the satisfactory level in many cases. The treatment site of the project is likely to have undesirable environmental effect. The stealing of wastes has not been totally stopped from the health care establishments and there is a strong probability of reusing those used items. It is stark clear that the management practice does not seem to improve unless a well synthesized law concerning health care waste management is being enacted. This study aims to explore the present health care waste management issues in Bangladesh with particular attention to Dhaka city with special concentration on the growth pattern of health care establishments, waste generation and waste management practices. And then attempt has been made to provide practical guidelines for potential solutions based upon lessons learned from different case studies and management practices currently being operating in a few areas in Dhaka and Khulna cities.*

Keyword: *Health care waste, hazardous waste, health hazardous, waste management, Bangladesh.*

Introduction

The management of health care waste (HCW) is an emergent public health and environment problem in many countries of the world including Bangladesh. In developed countries, there are strictly different management protocol and treatment options to minimize health hazards, but in developing world it is still receiving improper attention in spite of its potential health risk. The health care services are in adequate in developing

world (Rahman and Ali, 2000) and hence the rapid growth of health care facilities is accentuating the problem to a large extent. Every year large quantities of potentially infectious and hazardous wastes are generated from these health care establishments (HCEs). So the proper management of HCW is urgently required to minimize its potential health risks. The main objective of this study was to assess the issues related to the HCW management in Bangladesh with particular attention to growth of HCEs, production of hazardous HCWs, and management system currently practicing in Dhaka and Khulna cities.

Health Care Waste

Defining HCW is important because it determines the extent of risks, required treatment and disposal options and costs associated with the management of wastes. HCW can be defined as the total waste generating from all healthcare establishments including patient care service, laboratories, research facilities, blood bank, ambulance services and also from treatment in a home (Rahman and Ali, 2000). It can be categorized into non-hazardous and hazardous wastes. Non-hazardous waste consists of: packing materials; waste from administrative activities, foods, etc. and hazardous waste consists of: infectious waste, pathological waste, sharps, pharmaceutical waste, genotoxic waste, chemical waste, heavy metals and pressurized waste (Askarian *et. al.*, 2004). Hazardous waste poses particular dangers as they can be toxic, reactive, radioactive, poisonous, carcinogenic, irritant, mutagenic, teratogenic, corrosive, explosive and flammable (Rahman and Ali, 2000).

In developed countries, there are strictly maintained different treatment options to minimize the risks related hospital waste. However, in developing countries it is an emerging concern related to risks. Bangladesh, a developing country, already has a variety of pollution issues with solid waste, hospital waste may add a new dimension of potential health hazards. It is estimated that hospital wastes account for a very small fraction, notably, only about 1 percent of the total solid wastes generated in Bangladesh (PRISM, 2004). Generally, 10-25 percent of the hospital wastes are infectious or hazardous (World Bank, 2003). The amount is quite small but mixing with the non-hazardous wastes, the total waste stream becomes potentially hazardous which is a threat to the public health and to the overall environment (Rahman and Ali, 2000).

Health Care Establishments in Bangladesh

The health care services in Bangladesh are not adequate and cannot cope with the growing demands of patients' service. Current bed capacity in Bangladesh is only 10% of the norm proposed by WHO (Table 1). As a result of heavy demand, hospitals, clinics and diagnostic centers are growing features of health care provision in Bangladesh.

In addition a large number of private HCEs existing in most large cities/towns in Bangladesh are without legal registration. Table 2 indicates that in 2003 the total number of hospitals in Bangladesh has increased from 424 numbers (in 1978) to about 1,464 numbers (i.e. 3.45 times than that of 1978). But total number of private hospitals in Bangladesh has increased much more (22.50 times) when compared with them with public hospitals (1.69 times). In Dhaka city, the total number of HCEs has increased from 87 numbers to about 400 numbers (4.60 times) from 1985 to 2007. These are the private

clinics/hospitals (most of these are for-profit establishments) that are increasing at a very faster rate. Not only local but also enterprises from America, Thailand, India and Malaysia are investing in building large hospitals in Dhaka city. Apollo hospital Bangladesh is the largest of their other hospitals in South Asia (Huq, 2005). **Actually Health sectors have reformed to a profitable business sector from service sector in Bangladesh.**

Table 1: Health Care Facilities in Selected Countries

Country	Nos. of beds per 10,000 population
Bangladesh	3.2
India	34.4(16 selected states)
Thailand	22.4
Indonesia	4.9
EU 15 average	50
WHO norm	33

Table 2: Health Care Establishments in Bangladesh

Type of Facility	1978	1983	1988	1993	1998	2003	
	Nos.	Nos.	Nos.	Nos.	Nos.	Nos.	% Increased
Total Hospitals	424	724	875	903	1,273	1,464	245
Govt. hospitals	388	560	608	611	647	654	69
Private Hospitals	36	164	267	292	626	810	2,150

Table 3: HCEs in Dhaka City

Year	No. of hospitals and clinics*	% Increased
1985	87	-
1990	165	190
1995	250	187
2005	289	232
2007	400	360

Note: * does not include diagnostics center without beds.

Quantity of Health Care Waste

The hazardous HCW generation rates of selected **different** categories of hospitals/ private clinics in Dhaka and Khulna cities are estimated on the basis of the collected information extending for three months during January to March 2007 and are shown in Tables 4 and 5 respectively. It is apparent from Tables 4 and 5 that the quantities of hazardous portion of HCW in Dhaka and Khulna cities are around 0.2 kg/bed/day to 0.15 kg/bd/day respectively. These wastes are collected once a day and include both government and private hospitals/ clinics, and are in agreement with the quantities of HCW in selected city/ country are presented in Table 6 (Rahman and Ali, 2000). Although the difference in quantities in Table 4 may be due to availability of treatment facilities and the way in which wastes are define/ categories, but it is apparent from field survey that the low quantities of hazardous portion of HCW in three private hospitals (Bangladesh Medical

College Hospital, Central Hospital and Shamorita Hospital) are mainly because of the fact that a large portion of reusable hazardous items in these hospitals are recycled illegally by hospital workers/ waste collectors. However, mandatory staff education for clear information of hazardous material for proper segregation, treatment of selected hazardous materials (for reuse), and other such efforts in HCEs can further minimize quantity of hazardous waste in some situation.

Table 4: Quantity of Hazardous HCW in Dhaka City

HCEs	Number of beds	Hazardous waste (kg/bed/day)	Average (kg/bed/day)
Dhaka Medical College Hospital	1,400	0.14	0.20
Sir Solimullah Medical College Hospital	600	0.14	
Bangladesh Medical College Hospital	300	0.02*	
Central Hospital	210	0.12	
Ibne Sina Clinic	125	0.38	
Shamorita Clinic	100	0.07*	
MediAid Clinic	54	0.08*	
*Note: not considered for calculating average value			

Table 5: Quantity of Hazardous HCW in Khulna City

HCEs	Number of beds	Hazardous waste (kg/bed/day)	Average (kg/bed/day)
Khulna Medical College Hospital	500	0.18	0.15
Khulna Government Hospital	150	0.15	
Mother and Child Care Center	10	0.16	
Khulna Shishu Hospital	100	0.15	
Garib Newaz Clinic and Diagnostic Center	50	0.16	
Islami Bank Hospital	40	0.14	
Dabs Clinic	30	0.13	
Khalishpur Clinic	25	0.16	

Table 6: Quantities of HCW in selected city/ country (Rahman and Ali, 2000)

City/ Country	Total (tot.), range	Non-hazardous		Hazardous	
	Average (av.)	Range	av.(% of tot)	Range	av. (% of tot.)
Dhaka ¹ , kg/bed/d	0.80-0.67 (1.17)	0.66-1.52	1.00(85)	0.10-0.30	0.17(15)
Mumbai ² , kg/cap/d	0.19-1.10 (0.64)	0.07-0.60	0.31(48)	0.10-0.74	0.33(52)
Tanzania ² , kg/cap/d	0.02-0.14 (0.07)	0.01-0.06	0.03(43)	0.01-0.08	0.04(57)
Karachi ³ , kg/cap/d	0.28-0.99 (0.62)	0.10-0.61	0.31(50)	.018-0.38	0.31(50)
Note: ¹ Rahman et al (1999); ² Coad & Christen (1999); ³ Ahmed(1997)					

Waste Management Practices

Most of private HCEs in Bangladesh are located in crowded residential areas and often housed in renovated residential buildings and the majority of them do not have the facilities for waste handling and for their proper management (Rahman et al, 1999). Many of them lack designated storage areas and onsite transport facilities for HCWs inside the HCEs. They often do not segregate their wastes at source of production and in some HCEs, wastes are separated as non-hazardous and hazardous at source of production but most of them again mixed during disposal period in nearby municipal bins without any pretreatment. Hence an unhealthy and hazardous environment exists in and around these HCEs, affecting patients, hospital staffs and nearby population. Scavengers (Fig. 1) who recycled waste from bins are at serious risk from sharps, infectious materials and other hazardous wastes. The recycling of such infectious wastes poses a serious health hazards to their reusers. Liquid wastes and used chemicals are disposed directly to the municipal sewer system or open water bodies (if available) (Fig. 2). Almost all of HCEs in Bangladesh do not have a waste management policy or plan; a documented waste handling procedure; pre-treatment options before sending the hazardous waste for disposal into the nearby municipal bins or disposal sites; dedicated manpower for infection control; or, operational infection control committee to monitor or prevent infection even in their premises (Rahman, 2000). Unlike developed countries (where HCWs are considered by general public as a major source of infection), the disposal of HCWs in Bangladesh, receives a little public attention. Often HCW sources are unsatisfactorily identified, controlled and managed by government/ municipal authorities. Present Municipal legislation rarely concerns about HCW. Therefore, the common problems of existing HCW management practices can be summarized as:

- indiscriminate waste disposal - often the hazardous portion of HCW finds its way into municipal waste streams;
- most actors are unaware of the hazard of this waste;
- poor commitment/ motivation to manage HCW - generators are reluctant to treat/segregate the hazardous portion of waste as there is inadequate public demand for necessary action;
- resource constraints - lack of skilled manpower in waste management sections to address the issue in a meaningful ways; and,
- poor legislative control - difficulties of enforcement.

There are some good practices, which are being carried out over past 2/3 years in Bangladesh. Awareness is increasing gradually among individuals and government and non-government organizations. Some ground works are being done in government level. The DGHS published a 'Manual of Hospital Waste Management' in 2001 and the subsequently published 'Pocket Book on HCWM' (MOHF, 2004). Some NGOs are engaging themselves in HCW management practices. Prodipon and PRISM Bangladesh are examples of two NGOs engaged in HCW management program (HCWMP) in Bangladesh. Prodipon collects HCWs from about 42 out of around 110 HCEs in Khulna city. At present (November 2007) around 202 HCEs out of around 722 HCEs in Dhaka city are under HCWMP, and around 127 HCEs are provided with final disposal including in-house management by PRISM.



Fig. 1: Scavengers Recycling HCWs



Fig.2: Indiscriminate Disposal of Liquid HCWs

They collect sharps (needles, blades etc), infectious (cottons, cloths soiled with blood, etc) and hazardous plastic wastes from their registered HCEs and transport them to the final disposal sites (Fig. 3). Infectious waste needles are buried in separate pits. Plastic wastes are disinfected in chlorination tank (Fig. 4). The disinfected plastics are then shredded and sold in the recycling shops.

It is evident from field investigation that a large portion of plastic wastes and syringes and other wastes that have established market values are not coming into the management system. The hospital staffs who are in charge of collection and storage of wastes in HCEs often recycle those wastes illegally and sell them to the local recycle shops without any treatment. Many hospitals and diagnostic centers are not using the appropriate color-coded containers that have been standardized for storage of hazardous portion of HCWs in HCWMP. Hence further improvement is urgently needed particularly to monitor the quality and quantity hazardous portion of HCWs that HCWMP regularly collects from their registered hospitals/ clinics to minimize unauthorized/ illegal scavenging of wastes, which is still a regular feature in many of hospitals/ clinics. The quality of the effluent (Table 7) from effluent treatment plant for the liquid waste of chlorination tank (Fig. 4)

that is used to disinfect plastics in HCWMP does not meet the standard (ECR, 1997) of effluent disposal into the environment.



Fig. 3: Hazardous Waste Management Site in Dhaka



Fig.4: Chlorination Tank and Treatment Plant for Effluent from Chlorination Tank

Table 7: Quality of Effluent from Effluent Treatment Plant

Tests	Concentration (mg/l)	Effluent Discharge Quality Requirement (ECR, 1997) (mg/l)	
		Inland surface water	Irrigated land
BOD ₅	480	50	100
COD	2520	200	400

Health Impact

Existing disposal pattern into dustbins (Fig. 1), drains, and canals (Fig.2) or finally dumping to the outskirts of the city causes a serious public health hazard. [The present practice of improper handling of generated hospital wastes in Dhaka city is playing a contributing role in spreading out the Hepatitis and HIV diseases \(PRISM, 2004\).](#) Not only HIV and hepatitis can be transmitted by infected objects, but transmission of other blood-borne pathogens such as malaria, ebola virus infection and haemorrhagic fever viruses are also reported (Bosteon, 1997). Table 8 shows the annual rates of injuries among health care and sanitary service personnel from sharps in medical wastes, within and outside hospitals were estimated by the US Agency for Toxic Substances and Diseases Register (ATSDR) in their report to congress on medical waste (Prüss, et. al, (1999). In June 1994, 39 cases of HIV infection were recognized by the Center for Disease Control and Prevention in USA as occupational infections (Prüss, et. al, 1999). The pathways of transmission were: 32 from hypodermic needle injuries; 1 from blade injury; 1 from broken glass tube containing infected blood; 1 with non-sharp infected item; and, 4 from exposure of skin or mucous membranes to infected bloods. But by June 1996, the cumulative recognized cases of occupational HIV infection had risen to 51. All cases were nurses, medical doctors, or laboratory assistants. WHO (1994) estimated that, in 2000, injections with contaminated syringes caused 21 million hepatitis B virus infections (32% of all new infections); 2 million hepatitis C virus infections (40% of all new infections); and, 260, 000 HIV infections (5% of all new infections). It is evident from Turnberg (1996) that in USA, waste handlers handling HCW outside the healthcare structure will have between 2.7 to 4 times more chances of getting infected by HIV compared to staff working inside the healthcare structure. Some reports identified a higher rate of injuries by sharps among HCW handlers compared to their colleagues handling municipal waste (Rahman and Ali, 2000 and Rahman, 1996). Prüss et al (1999) reported the highest annual rate of occupational injury in cleaning personnel and waste handlers in the USA, 180 per 1,000 compared to that of nurse and housekeeping personnel, whose annual injury rates are 10-20 per 1,000 workers. The annual number of viral hepatitis B infection resulting from exposure to HCW in the USA is between 162 and 321, out of 300,000 cases (Warmer, 2000). Bostoen (1997) estimated 1 per 500,000 to 1 per 750,000 HCW handlers develop AIDS every years in USA as a result of their occupation but the risk appears to be less significant compared with the general AIDS incidents rate of 1 per 7,350. But the estimated risk of infection by hepatitis B (1 per

5,000) from the handling of HCW in USA is much higher when compared with their general risk of infection (6 per 100,000). Most of this information is for developed countries with strict regulation on handling and disposal of HCW and the workers involved are fully aware of the health hazards. Thus it is very difficult to use this data to estimate associated risk of HCW handling in the poorer parts of the developing world, particularly Bangladesh. Most often these countries lack regulation, and the knowledge about associated health hazards of the personnel involved in handling the HCW are very poor. The waste pickers in Bangladesh normally salvage every possible item of value from HCW with bare hands and feet and thus have been found the most vulnerable group exposed to serious health hazards. They do not have any access to information on the origin of the hazardous portion of HCW. Therefore, the urban poor in Bangladesh are potentially at serious risk - because of malnutrition and poor living environment; and, particularly the poorest of the poor, the scavengers/ waste pickers, are in direct contact with the hazardous HCW as they are forced to work with this waste for their livelihood (Rahman and Ali, 2000). All these waste pickers provide a valuable service to the society in general and to the HCEs/ municipalities in particular. The percentage of materials recycled by them have a direct contribution towards the saving of waste collection and disposal costs of responsible authorities that would otherwise be required to dispose of those materials. Hence health education and protective clothing can easily be provided with organizational supports of responsible authorities involved in health care sectors.

Table 8: Viral Hepatitis Infection Caused by Occupational Injuries from Sharps in USA

Professional category	Annual number of people injured by sharps	Annual number of HBV infections caused by injury
Nurses		
➤ in hospital	17 700–22200	56–96
➤ outside hospital	28 000–48000	26–45
Hospital laboratory workers	800–7500	2–15
Hospital housekeepers	11 700–45300	23–91
Hospital technicians	12 200	24
Physicians and dentists in hospital	100–400	<1
Physicians outside hospital	500–1700	1–3
Dentists outside hospital	100–300	<1
Dental assistants outside hospital	2 600–3 900	5–8
Emergency medical personnel (outside hospital)	12 000	24
Waste workers (outside hospital)	500–7300	1–15

Management of HCW

This study reveals that only around 0.2 kg/bed/day and 0.15 kg/bed/day in Dhaka and Khulna cities require special attention for its proper segregation and final disposal. It is evident from field investigation that even a few changes in material procurement processes in HCEs (to reduce the quantity of hazardous waste as well as the form of

material such as sharps, pressurized container, etc.), mandatory staff education to have a clear knowledge of hazardous material for proper segregation, treatment of selected hazardous materials (for reuse), and other such efforts can further minimize quantity of hazardous waste in some situation. Once these are properly segregated, the hazardous portion can be treated by different treatment options. [Analysis from the field survey shows that](#) the presently operating HCWMP cost (that includes collection of hazardous HCWs from different HCEs including their final disposal) is around Taka 2/bed/day (US\$ 0.02/bed/day) in both Dhaka and Khulna cities. However, analysis of expenditures incurred (that includes: costs of collection of hazardous portion from different establishments; costs occupational safety items of worker; salary of management staffs involved in collection and final disposal sites; costs of equipments e.g. incinerators, autoclave that is used at final disposal site; costs of chemicals used at final disposal sit; costs of land of final disposal sites; rent of offices required at final disposal sit; and, other expenses for the maintenance of final disposal sites) provided by HCWMP indicates that this cost could even be Taka 0.13/bed/day (Rahman and Uddin, 2007). This management costs appears to be cost effective for both non-profit and for-profit HCEs. Thus each HCE should be given direct responsibility for proper segregation and management of hazardous portion of HCWs it generates.

Concluding Remarks

[Due to very high demand of health care services in Bangladesh, the total quantity of HCW from different HCEs that appeared to be reformed as a profitable business sector is growing at a very fast rate. This needs attention of the government, HCE and other related authority before the risks associated with the wastes become more dangerous and wastes becomes unmanageable. The hazardous portion of HCWs in Dhaka and Khulna cities are around 0.20 kg/bed/day and 0.15 kg/bed/day respectively. But a few alterations in material procurement, staff education particularly for the workers involved in collection, segregation and in-house management in HCEs can minimize the quantity of hazardous portion in many situations.](#)

[Indiscriminate disposal of HCWs poses serious health hazards to city dwellers, particularly to the poorest of the poor, the scavengers. Public awareness and proper health education is essential particularly for the scavengers involved in the recycling processes. As the scavengers have direct contribution towards the savings of costs of waste collection and management system the HCWMP/ HCEs/ responsible authorities can be given liability to educate and to provide protective clothing to downplay health hazards of poor scavengers.](#)

Almost all of HCEs in Bangladesh do not have waste management policies or plans, documented waste handling procedures, pre-treatment options before sending the hazardous waste for disposal into disposal sites or the nearby municipal bins, manpower for infection control or operational infection control committee to monitor or prevent infection even in their premises. Hence a hospital guide on waste management for each individual HCE should be produced.

To improve the overall HCW management system, it is essential that different authorities (both government and private) involved in HCE development, and monitoring and control of the environment should recognize the nature of the problem for the development of legislation to regulate HCW management practices.

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References

1. Ahmed, R., 1997, Hospital waste management in Pakistan, UWEP, Gouda.
2. Bostoen, K., 1997, Landfilling healthcare waste: sustainable method of disposal or threat to public health? M. Sc. Report, WEDC, UK.
3. Coad, A. and Christen, J., 1999, How are we managing our healthcare wastes? SKAT, Switzerland.
4. Environmental Conservation Rule (ECR), 1997, Department of Environment, Government of the Peoples Republic of Bangladesh.
5. Huq N., 2005. 5 joint Venture Hospitals in City by Next Year. The Daily star, March 29, 2005.
6. MOHFW, 2004. Environmental Assessment and Action Plan for the HNP sector Program (2005-2010) (Draft Version). Ministry of Health and Family Welfare, Government of Bangladesh.
7. PRISM Bangladesh, 2004. Survey Report on Hospital Waste Management in Dhaka City (Ward no. 49 and 57).
8. Prüss, A., Giroult, E. and Rushbrook, P. (editor), 1999, *Safe Management of Wastes from Healthcare Activities*, World Health Organization, Geneva.
9. Rahman, M.H, 2000, Healthcare waste management in Dhaka city, J. Sustainable Waste Management. Warner Bulletin, No. 75.
10. Rahman, M. H., 1996, *Hospital Sanitation in Bangladesh*; Proc. of 12th Int. Conf. on Solid Waste Manag. & Secon. Mats., USA.

11. Rahman M. H. and Ali M., 2000. Healthcare Waste Management in Developing Countries. Water, Sanitation and Hygiene: Challenges of the Millennium 26th WEDC conference, Dhaka Bangladesh.
12. Rahman, M.H., Ahmed, S.N. and Ullah, M. S., 1999, A Study on Hospital Waste Management in Dhaka City, in Integrated development for water supply and sanitation, Proc. of the 25th WEDC Conference, Addis Ababa, Ethiopia, edited by J. Pickford.
13. Ramman, M. M. and Uddin, H, 2007, Health Care Waste Management in Dhaka City, B. Sc. Eng. Thesis, Military Institute of Science and Technology, Dhaka.
14. Turnberg, W.L., 1996, Biohazardous waste: risk assessment, policy and management, John Wiley & Sons, Inc. New York, USA.
15. WARMER, 2000, 'Healthcare wastes; guide to safe management, Warmer Bulletin No. 71.
16. World Bank. 2003. Health Facility Waste Management Study in Bangladesh. Dhaka: World Bank Plc.