



## Healthcare waste management in developing countries

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HEALTHCARE WASTE (HCW) is here defined as the total waste originating from all healthcare establishments; laboratories and research facilities (both human and animal); blood banks and collection centres; funeral and ambulance services; and, also the waste arising from treatment in the home. A major fraction of the total waste generated in healthcare establishments is essentially similar to that of residential, general institutional and catering establishments since certain areas of healthcare institutions render the same type of basic services. However, some waste generated in healthcare establishments is too hazardous to be treated negligently, and carelessness in the management of this waste may spread infections and contaminate the surrounding environment (Rahman, et al, 1999). Thus HCW has become a global public health problem. The hazardous portion of HCW can present occupational health risks but their improper disposal present overall environmental hazards. Therefore, proper management of healthcare waste is essential to minimise health hazards of local communities, particularly those working with HCW.

This study presents a brief overview of the socio-economic and health impacts of existing HCW management practices in developing countries in general with special emphasis on existing practices in Bangladesh. Information about existing HCW generation rates and their composition is also included. An attempt has been made to provide appropriate guidelines for potential practical solutions based upon the lessons learned from international case studies.

### Categories of HCW

A number classification systems of HCW are available in different literature (Rahman, 2000; Prüss, et al, 1999; Coad & Christen, 1999; LWRA, 1989; Coad, 1994; USEPA, 1986), but the HCW in the poorer part of the developing world can be classified into two broad categories:

- Non-hazardous (general) waste - domestic type waste. For example, waste from catering services, waste from administrative establishments, packing materials, etc. that do not pose special handling problems to human health or the environment but involves similar risks associated with domestic waste.
- Hazardous waste - includes infectious (contains pathogens in sufficient concentrations that exposure to it could result in disease, can include infected sharps and pathological waste) waste; sharps, pathological, pharmaceutical, genotoxic, chemical, and radioactive wastes; pressurised containers; and, waste with a high concen-

tration of heavy metals. This waste poses particular dangers as they can be toxic, reactive, radioactive, poisonous, carcinogenic, irritant, mutagenic, teratogenic, corrosive, explosive, and flammable.

### Quantity of HCW

The quantity and composition of HCW is the most important data for their proper management. At the present state of development, poorer parts of the developing world lacks information on the rate of generation of HCW. Several methods are used to express the quantity of HCW, and therefore, one should take special care when considering the rate of generation to know whether it is a figure derived as the amount per bed existing in the establishment, per total population served or per in-patient only. The extent of HCW generation in selected cities/countries and countries of different income level is presented in Table 1. This generation is affected by a number of factors commonly: size of establishments, proportion of in- and out-patients; type of institution and specialisation; available waste segregation options; proportion of use of reusable items; wealth of user; and, also the prosperity of the country. Therefore, in planning and designing a waste management system, proper attention should be paid to collect recent and relevant field specific information to make the system sustainable. The quantities in Dhaka city are estimated using data collected from 8 hospitals/clinics which were intensively surveyed over 7 to 10 days during the March to May 1998 period (Rahman et al, 1999), and includes both government and private hospitals/clinics. Coad & Christen (1999) collected data from Mumbai, India by questionnaire survey from 106 healthcare establishments including large private, municipal and government hospitals. The information from Tanzania includes data from both rural and urban healthcare establishments. The quantities of HCW in Karachi, Pakistan was estimated from the data reported by Ahmed (1997) for relatively large 3 medical college, municipal, private healthcare establishments.

### Existing waste management practices

The healthcare services in developing world are inadequate (Table 2). In recent years expansion of the private health sectors, both non-profit and for-profit (Fig.1, Gaag, 1996), have tended to alleviate this problem to some extent. For example, in Thailand the proportion of beds in private hospitals grew from 5.4% in 1970 to 13.7% in 1989, and about half of hospitals in Indonesia are private (Gaag, 1996).

**Table 1. Quantities of HCW in selected city/ country**

City/ country	Total (tot.), range	non-hazardous		hazardous	
	average(av.)	range	av. (% of tot)	range	av. (% of tot.)
Dhaka <sup>1</sup> , kg/bed/d	0.80-0.67 (1.17)	0.66-1.52	1.00(85)	0.10-0.30	0.17(15)
Mumbai <sup>2</sup> , kg/cap/d	0.19-1.10 (0.64)	0.07-0.60	0.31(48)	0.10-0.74	0.33(52)
Tanzania <sup>2</sup> , kg/cap/d	0.02-0.14 (0.07)	0.01-0.06	0.03(43)	0.01-0.08	0.04(57)
Karachi <sup>3</sup> , kg/cap/d	0.28-0.99 (0.62)	0.10-0.61	0.31(50)	.0.18-0.38	0.31(50)
High-income country <sup>4</sup> , kg/cap	1.1-12.0	-	-	0.4-5.5	-
Midd.-income country <sup>4</sup> , kg/cap	0.8-6.0	-	-	0.3-0.4	-
Low-income country <sup>4</sup> , kg/cap	0.5-3.0	-	-	-	-

Data source: <sup>1</sup>Rahman et al (1999); <sup>2</sup>Coad & Christen(1999); <sup>3</sup>Ahmed(1997); <sup>4</sup>Prüss, et al (1999)

**Table 2: Healthcare services in selected countries**

	population per physician		population per hospital bed	
	1980	'90-'97	1980	'90-'97
Bangladesh	10,000	5,000	5,000	3,330
India	2,500	2,500	1,225	1,225
Nepal	10,000	10,000	5,000	5,000
Pakistan	3,330	2,000	1,670	1,430
China	1,110	625	500	420
Zimbabwe	5,000	10,000	322	2,000
Tajikistan	420	500	100	115
Haiti	10,000	10,000	1,430	1,250
East Asia & Pacific	1250	715	500	475
Europe & Central Asia	330	280	95	100
South Asia	3,330	2,500	1,430	1,430

Data source: The World Bank (WB),1999

In Bangladesh, the share of for-profit healthcare establishments in two large cities (Dhaka, the capital city; and, Khulna, the third largest city) are approximately 90% and 95% respectively.

There are about 250 healthcare establishments in Dhaka city and about 60 healthcare centres in Khulna city including, public; non-profit; and, for-profit healthcare establishments. Of these, more than 98% simply dispose of their waste into the dustbins of city corporations. It is important to note that a large number [in Dhaka only 46 of them obtained registration from the Directorate of Health Services (Staff Report, the Daily New Nation, 6 February 2000, Internet Edition)] of private sector establishments are operating without registration.

A majority of healthcare establishments 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; dedicated manpower for infection control; or, an operational infection control committee to monitor or prevent infection even in their premises. Therefore, inadequate HCW management practices in the poorer parts

of the developing world often pose a serious threat to public health and the environment.

An extensive recycling of HCW carried out by informal sectors in Bangladesh, which is also common in the poorer parts of developing world, is not a part of national/municipal waste management plan. The waste pickers collect the waste at all stages (from bins/ communal collection points, sweeping accumulation points and even from the final disposal sites, when a fresh batch of waste is unloaded by a municipal truck.) of solid waste stream (Rahman, 2000).

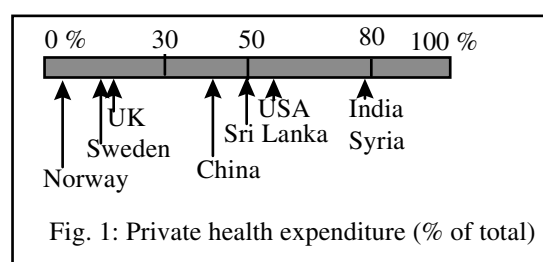


Fig. 1: Private health expenditure (% of total)

### Socio-economic and health impact

The primary concern related to this hazardous portion of healthcare waste is the risk of transmission of hepatitis viruses and the human immunodeficiency virus (HIV), particularly in developed countries. 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). It is evident from Turnberg (1996) that in USA, waste handlers handling healthcare waste outside the healthcare structure will have between 2.7 to 4 times more chance of getting infected by HIV compared to staff working inside the healthcare structure. Therefore, in the poorer parts of the developing world, the urban poor are potentially at serious risk - because of malnutrition and poor living environment; and, particularly the poorest of the poor, the waste pickers, are in direct contact with the hazardous waste as they are forced to work with this waste for their livelihood. Some reports

identified a higher rate of injuries by sharps among HCW handlers compared to their colleagues handling municipal waste (Table 3; Bostoen, 1997). 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 (Warner, 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. Most often these countries lack regulation, and the knowledge about associated health hazards of the personnel involved in handling the HCW are very poor.

**Table 3: Percentage (%) of staff affected by sharp injuries in waste handling**

Country	HCW handlers	Municipal waste handlers	Medical staff
Japan <sup>1</sup>	67.3	44.4	-
Peru <sup>2</sup>	50	-	-
USA <sup>3</sup>	18	< 9	1-2

Source: <sup>1</sup>Rahman,1996; <sup>2</sup>Van Herp et al,1996; <sup>3</sup>Coad, 1994

The risks associated with different groups of population involved within, and around the healthcare establishments also depends upon the level of education, awareness and socio-economic condition. The medical doctors, nurses, healthcare workers, workers involved in support services within such establishments, and the municipal workers are exposed to occupational health hazards. But they have access to decision making processes either as a individual or a group leader at their respective organizations which enable their access to healthcare services. Local communities, patients and visitors are also affected by the unhygienic disposal of existing HCW management practices. Present recycling practices of hazardous materials can also pose a serious health hazard to the general public, particularly to their users as they may not be disinfected at all. 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 are the most vulnerable because of their ignorance, illiteracy, low resistance to disease and infection due to poor diet, unhealthy living environment along with appalling sanitary conditions, and poor access to the healthcare services. They also do not have any access to information on the origin of the hazardous portion of HCW. Therefore, proper health education is essential to make them fully aware of possible pathways between the risks and the receptor for changing the traditional habits of the poor people, particularly the scavengers involved in the recycling processes. All these waste pickers provide a valuable service to the society in general and to the healthcare establishments/ 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 be required to dispose of those materials. Therefore, health education can be provided with organisational supports as well as by raising public awareness through mass media.

### Management of HCW

Increased public demand and expanded media coverage (due to fear of spreading HIV) led developed countries to adopt new stringent regulations and strategies to control the disposal of HCW, and most of them discourage sanitary landfilling and encourage on-site incineration. This significantly increases the cost of HCW management. But many professionals believe that such strict legislation may be extreme and unnecessary (Appleton and Ali, 2000). The incinerator is widely regarded as the best solution in facing the problem of HCW and has also been introduced in the developing countries, mostly by the health workers and consultants, without proper attention to the local situation (Bostoen, 1997). About 57% to 92% of the incinerators are functioning poorly or not at all (Coad, 1994). This demands much more attention to acquire clear information on the actual risks of HCW to minimise discrepancies between present knowledge and the regulation to optimise and to adopt available environmentally clean suitable technologies for their sustainable operation.

Often the risks posed by HCW can be effectively minimised by adequate control of the hazardous portion of HCW with the aim of eliminating contact between it and the receptor. It is apparent from Table 1 that the rate of generation (0.04 - 0.33 kg/cap/day) of hazardous HCW in the poorer parts of the developing world is generally low compared to that of high-income countries. In many cases, this quantity of hazardous HCW can easily be further minimised if it is carefully segregated and safely handled. Then a small quantity of segregated hazardous HCW can be treated by a number of satisfactory treatment (Prüss et al, 1999; Coad & Christen, 1999) options, which will be cost-effective and suitable for sustainable operation in the local condition. Thus, the management aspects (proper planning and education of the human element) of healthcare

establishments in developing countries are much more important than the adaptation of available waste treatment technologies. With a few changes in: material procurement process in healthcare establishments (to minimise quantity of hazardous portion); mandatory staff education in waste segregation; mandatory hygiene education to healthcare staff and the scavengers; treatment of selected hazardous materials for safe reuse and recycling; effective surveillance to ensure hygienic handling of HCW; and, such other few efforts, an excellent improvement in HCW management system in developing world can be achieved (Rahman, 2000).

## Conclusion

On a critical examination of the above discussion the following conclusions can be drawn from this study:

- indiscriminate disposal of HCW in developing countries poses a serious health hazard to the community and the environment;
- the poorest of the poor involved in waste picking are most at risk from poor HCW management for they have direct contact with waste at all stages of its disposal;
- the management strategies (mostly adequate control of the hazardous portion of HCW to eliminate contact between it and the receptor) of HCW in developing countries require much more attention than the available waste treatment technologies. But sufficient care should be taken to choose environmentally and economically sustainable (with adequate emphasis on operation and maintenance) technological options; and,
- the healthcare establishments in the poorer part of the developing world require a hygienic systems approach in handling, segregation, storage, transport, treatment, and disposal of their wastes by the methods that at all stages minimise the risk to public health and the environment. Public awareness through mass media, proper hygiene education to the scavengers, mandatory staff education in waste segregation, and legislation to regulate HCW management systems will change the traditional habits of different actors involved in this sector.

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