Journal of Civil Engineering (IEB), 38 (2) (2010) 203-210

Journal of
Civil Engineering
IEB

Database preparation for improved healthcare waste management in Dhaka city with GIS

Md. Mahbubur Rahman[1] and Md. Mafizur Rahman[2]

[1]*Food for Works, Bangladesh Water Development Board, Dhaka-1000*
[2]*Department of Civil Engineering, BUET, Dhaka-1000*

Received 09 October 2010

Abstract

Healthcare establishments generate a huge quantity of both hazardous and non-hazardous wastes. These wastes are generated as a result of diagnosis, treatment and research on human and animal diseases. The hazardous wastes pose serious occupational health risks to those who generate, handle, package, store, transport, treat, and dispose them. These wastes may enhance environmental pollution and the spread of infectious diseases including acquired immunodeficiency syndrome (AIDS), hepatitis, tuberculosis, diphtheria, cholera, and many others. Proper management of healthcare wastes can prevent cross infection, and the spread of epidemics of infectious diseases. Unfortunately, this aspect is completely ignored in Bangladesh. There are no proper healthcare waste-management facilities in the government sector in Dhaka city or even in the country. There is also lack of available budget to implement the schemes of collection, treatment and disposal of hospital wastes separately. However most recently, an NGO, PRISM Bangladesh, has started handling the heath care wastes in small scale in Dhaka city (ward no. 49 and 57) (December, 2007) and Khulna city. But yet, they are much far from the achievement of the aimed goals and objectives of proper handling, treatment and disposal of hazardous hospital wastes. From this study the mean total waste generation rate in Dhaka city has been found to be 0.122 kg/Bed/Day and separately 0.10, 0.0076, 0.0132 and 0.0034 kg per bed per day for Infectious, Plastic, Sharp and Liquid waste respectively. There are a number of treatment and disposal methods like incineration, Autoclaving, Microwaving, Deep burial, chemical treatment etc. But no method is capable of eliminating all risks completely to human health and environment Although it has been thought that incineration is the best technological option (volume reduction is 95% to 96%) for the treatment of healthcare waste, awareness is growing against this technology due to its intense adverse effect on the air quality. So management of health care waste is not an easy job in a developing country like Bangladesh without the usages proper technologies and allocation of enough money. GIS technology can be used to assess waste generation, generation variation, collection system and selection of transportation routes and consequently successful management of healthcare wastes in Dhaka city can be ensured.

Keywords: Health, disease, hospital, waste generation, waste management, Dhaka City.

1. Introduction

The rapid increase of hospitals, clinics, diagnostic laboratories etc in Dhaka city exerts a tremendous impact on human health ecology. More than 600 clinics and hospitals exist in the Dhaka City Corporation (DCC). These facilities generate an estimated 200 tons of waste a day (Ullah, 1999). Only a few have the necessary means to dispose the waste safely. It is reported that even body parts are dumped on the streets by these Health Care Establishments (HCEs) (Rahman, 2006).

The prevalence of diseases that may be transmitted by hospital wastes is alarming in Bangladesh. There is evidence of hepatitis B infection among 10 percent of children (5-10 age group) and 30 percent adults. About 5 per cent of the total population in Bangladesh is thought to suffer from chronic hepatitis B infection. Although cases of HIV/AIDS are low in Bangladesh (about 13,000 cases estimated in 2001) in comparison to neighboring countries, nevertheless the numbers are rising. It is noted here that much of the clinical wastes (e.g. syringes, needles, saline drips, discarded food, gauze, vials, and ampoules) are collected by women and children who re-sell it despite of the deadly health risks (Roteb, 1998).

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. In a report from the World Bank (2003), only 10-25 percent of the hospital wastes are infectious or hazardous. The amount of such hazardous waste is quite small in figure and until recently this is not handled properly (WHO, 2001). Mixing with the domestic solid wastes, the total waste steam becomes potentially hazardous (Rahman, 1999).

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. The liquid and solid wastes containing hazardous materials are simply dumped into the nearest drain or garbage heap respectively where they are prone to contaminate the rag-pickers that sift through the garbage dumps. The chances of infection are very high to the cleaners, concerned people in the HCEs and to the general population. The improvement of waste management for the HCEs in Dhaka city will have significant long-term impact on keeping the spread of infectious diseases to a minimum and result in a cleaner and healthy environment. (PRISM Bangladesh, 2007)

Like other industries and institutes, healthcare facilities generate various kinds of wastes as a result of a variety of medical treatment and research. In the past 10 years, due to the increased number and size of healthcare facilities, medical services, and use of medical disposable products, the generation rate of healthcare wastes has increased rapidly. And so the problem is requiring an urgent attention toward achieving the objectives of safe collection, separation, transportation, treatment and disposal of hazardous hospital wastes (Kazi, 2000).

However, this study has been carried out with the following objectives:

- To assess the present state of health care waste management (HCWM) system as a whole in Dhaka city as per World Health Organization (WHO) guidelines.
- To plot the HCEs positions at Dhanmondi area on a Base Map of Dhaka city with the help of Geographical Information System (GIS).
- To identify waste rate in Kg/Bed/Day

- To make a comparable assessment of different types of hazardous wastes generated in different hospitals and diagnostic centers at Dhanmondi, a part of Dhaka city, with the help of GIS technology.
- To identify the waste-management practices and technologies those are safe, efficient, sustainable, economic, and culturally acceptable in the context of Dhaka city.
- To analyze the suitable treatment options and costs related for such technology.
- To suggest recommendations for the proper treatment and or management and finally safe disposal of the health care wastes (HCW).

2. Study design

A GIS map was prepared showing about 80 hospital/clinic/diagnostic centers at Dhanmondi (Dhaka) area. For the collection of data and photographs those hospitals were visited.

3. Mapping

The ground co-ordinates (Latitudes and Longitudes) of different HCEs in the study area were collected by field survey with the help of Geographical Positioning System (GPS). After that, those positions were shown on a base map of Dhaka city.

4. Spatial data for GIS mapping

For spatial analyses and mapping, GIS supporting data were collected during the field survey. The data for spatial analyses were collected from primary and secondary sources such government organizations and non government organizations (NGO) like PRISM Bangladesh etc. The attribute data of map features were imported into the GIS environment

5. Data mapping and analysis

The study has been carried out in Dhanmondi and nearby areas in Dhaka city. Dhanmondi is mainly a residential area and also some commercial areas have developed there due to the general public requirements. But hospitals should not be considered as commercial commodity. People are undoubtedly benefited by the modern hospital facilities, but those health care facilities pose a serious health hazard when waste produced in these facilities are not managed with care.

The map showing in Figure 1 has been produced by plotting the ground co-ordinates (Latitude and Longitude collected with GPS) on a GIS base map of Dhaka city. The map illustrates that most of the health care facilities in the study area have been developed in the crowded areas of Science Laboratory, along Mirpur Road, Satmasjid road and Green Road. These health care establishments are not environmentally safe for passers-by using the roads as well as for patients taking treatments in these health care facilities.

In Figure 2, observation of hazardous waste generation rates of 31 HCEs by PRISM in Dhanmondi and nearby areas has been analyzed and compared graphically. Generation rates of different components of hazardous waste in kg per day have been observed separately. The total hazardous waste generation rate for individual hospital has been divided by the number of beds of the same facility to find the waste generation rate in kg per day per bed. Then the waste generation rates of 31 HCEs have been summed out and

then the resultant has been divided by 31 to find out the average hazardous waste generation which is 0.12 kg per day per bed.

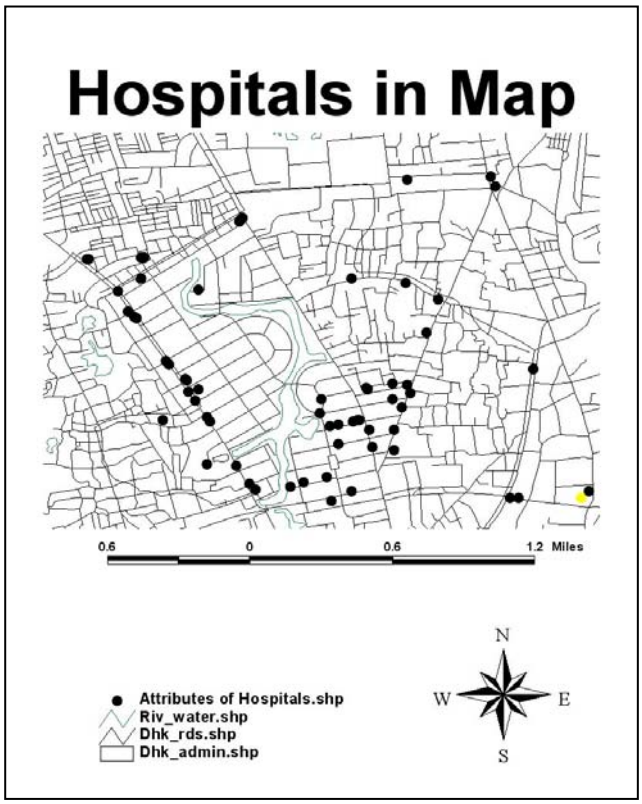

Figure 1. Map of Dhanmondi and nearby areas (Dhaka) showing HCEs

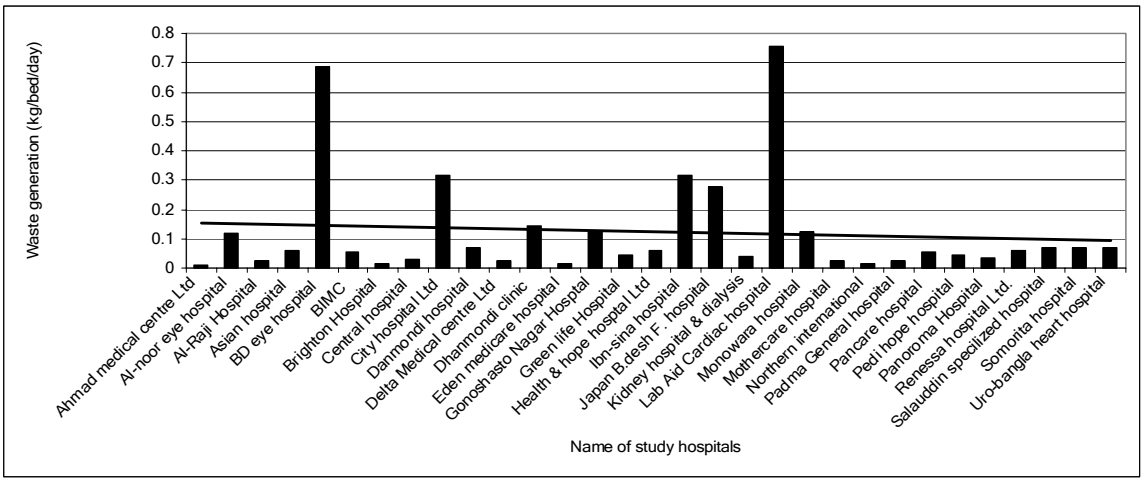

Figure 2. Hazardous waste generation in 31 HCEs in kg/day/bed in Dhaka city (PRISM, 2006)

Map (Figure 3) shows the spatial distribution of hospitals in Dhaka city and legend shows the number of beds or number of patients taking the treatment facilities per hospital. Here five limiting ranges have been introduced as 0-10, 11-30, 31-60, 61-150, and 151-325 beds. This classification highlights the areas of Science Laboratory,

Panthapath and Satmasjid Road to be the most densed locations with respect to hospital beds. Figure 4 describes the spatial distribution of Infectious waste in kg per month in the study area. The limits of ranges have been selected as 0-82, 82-244, 244-380,380-155 and 1550-12705 kg per month. Here in the map five areas have found to be vulnerable. Figure 5 illustrates the spatial distribution of liquid waste such as blood, liquid from potentially infectious components of the waste et cetera in the study area with the ranges of 0-0.5, 0.5-3.25, 3.25-15, 15-80 and 80-157 kg per month. In these analysis four places, two near Science Laboratory and two along Satmasjid Road have been found to be risky with respect to liquid waste. Figure 6 shows the spatial distribution of plastic waste in kg per month in five limiting ranges as 0-0.75, 0.75-4.25, 4.27.75, 7.75-16.25 and 16.25-37.5. In this respect Science Laboratory and Satmasjid Road have been found as the higher generating areas of Plastic waste.

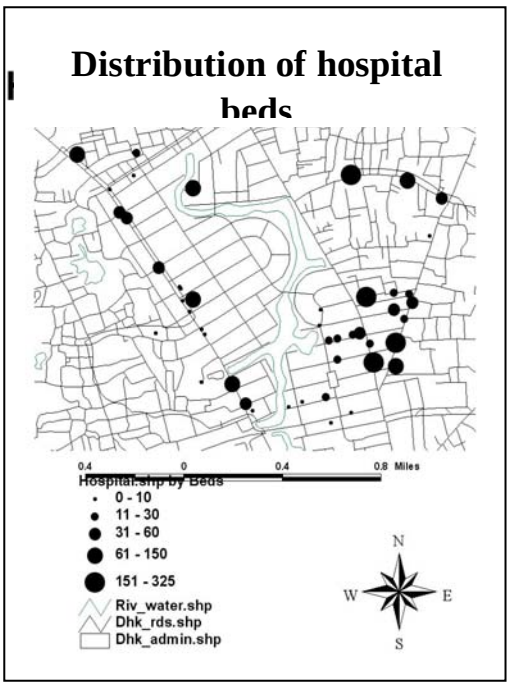

Figure 3. Spatial distribution of hospital beds

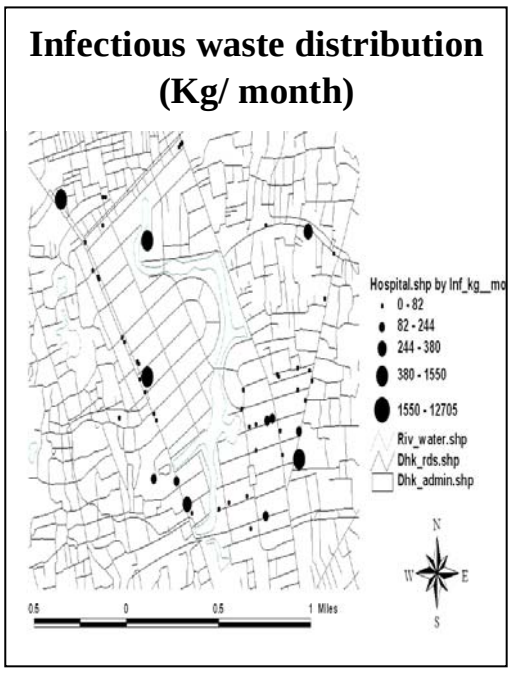

Figure 4. Spatial distribution of infectious Waste

Figure 7 illustrates the spatial distribution of sharp waste such as used needles, broken glass and other metals in the area. The limiting ranges have been selected as 0-5.6, 5.6-16.5, 16.5-39.5, 39.5-98 and 98-534 kg per month. In this analysis five establishmente have been found to be vulnerable. Figure 8 illustrates the spatial distribution of total hazardous hospital waste generated in the study area of Dhanmondi and nearby areas in Dhaka city. Total waste has been calculated in kg per day and other individual waste components have been calculated in kg per month. Geographical classification according to waste generation has been made in the study area in five limiting ranges of 0-0.82, 0.82-2.9, 2.9-15.23, 15.23-38 and 38-75.7 kg per day. Science Laboratory and Satmasjid Road areas have been observed as the most vulnerable areas with high quantities of waste generation rates.

Various components of hazardous waste generation rates are shown in Figure 9. Infectious waste shows the maximum, 0.1 kg per bed per day and the minimum is liquid

waste presenting 0.0034 kg per bed per day on the chart. Others are Plastic waste and Sharp waste showing 0.0076 and 0.0132kg per bed per day respectively.

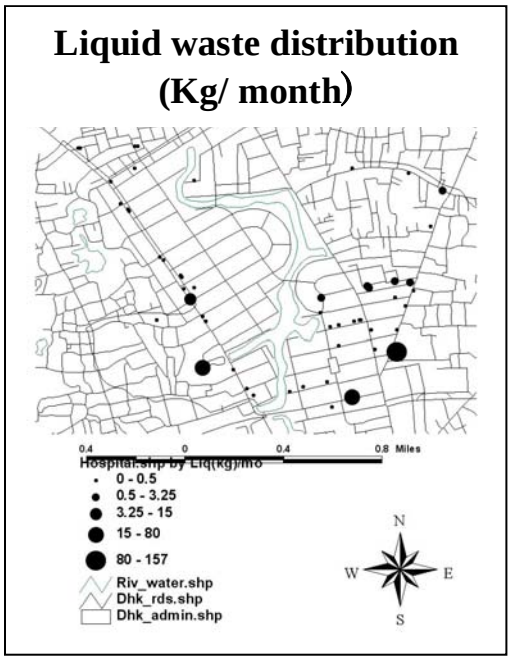

Figure 5. Spatial distribution of liquid waste

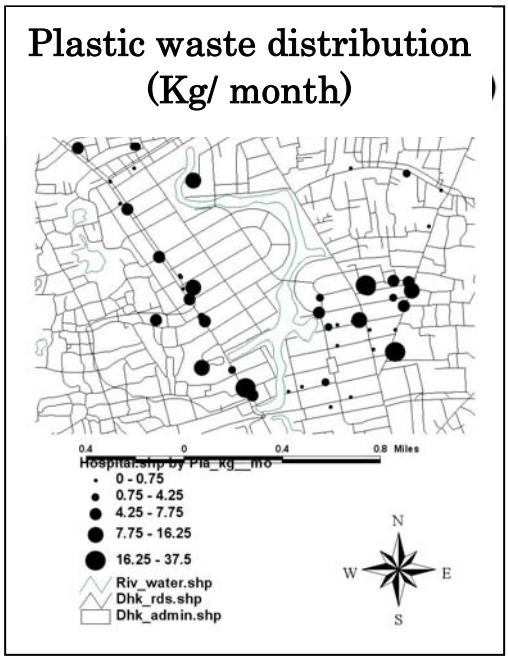

Figure 6. Spatial distribution of plastic waste

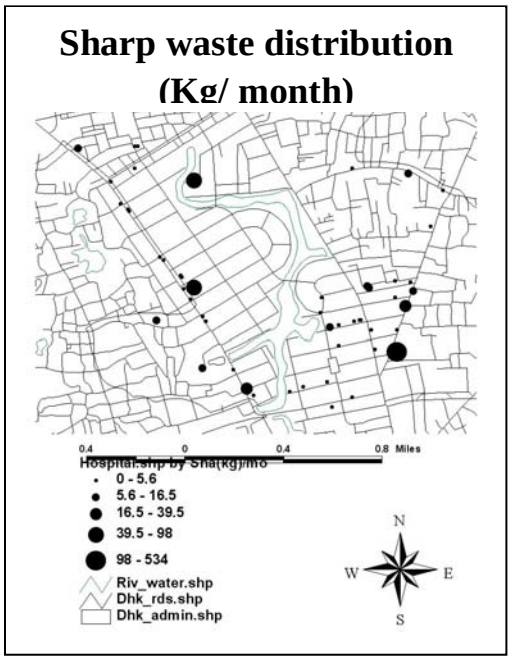

Figure 7. Spatial distribution of sharp waste e

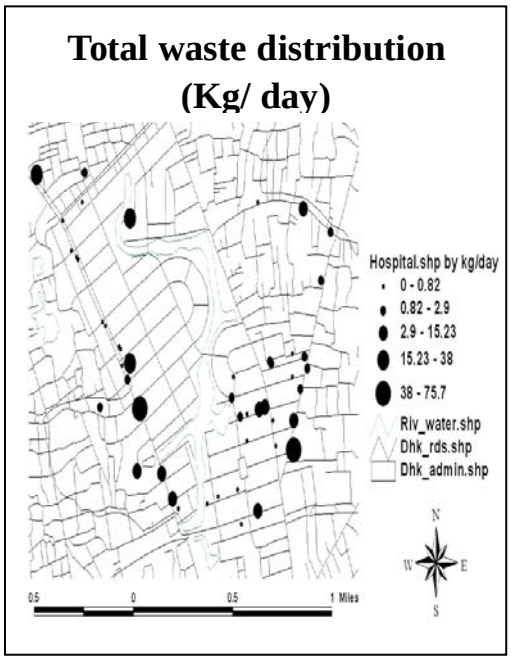

Figure 8. Spatial distribution of total waste

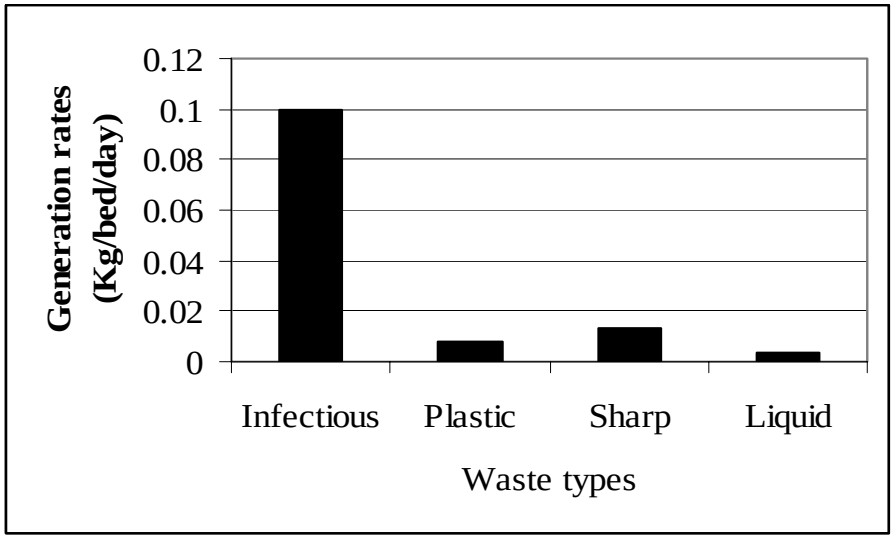

Figure 9. Comparison of component wastes generation rates

6. Results and Conclusions

From the study the average total hazardous hospital waste generation rate was found to be 0.12 kg per bed per day with component wastes' generation rates were 0.1000, 0.0076, 0.0132, and 0.0034 kg per bed per day for infectious, plastic, sharp and liquid waste respectively. It is very apparent that hospital facilities and waste management in Dhaka city is not at all environment friendly, rather degrading the environment with numbers of potential hazards. The unhygienic and unsafe disposal of hospital waste in Dhaka city poses a serious health hazard to the professionals, workers, and waste collectors, persons involved in recycling and mass people in general. There is lack of proper laws and regulations which specifically can regulate bio-medical waste management. Every HCEs should spend a fixed portion of its annual budget for waste management because this phenomena is not anyhow less important than treatment. Few steps are being taken by PRISM Bangladesh to improve the situation. Government has to take initiatives to encourage more NGOs to step forward in this issue. The whole city can be divided into a number of zones and the responsibilities of these zones can be vested to different organizations if we can have more organizations like PRISM Bangladesh. Training must be provided to those who are actually involved with the management of hazardous hospital waste National level plans and policies are required in this issue. Basing on our economy and environmental sustainability, the most effective treatment option should be considered after an environmental impact assessment. Creating social awareness regarding hospital waste management through mass media along with proper enforcement is necessary. The rates found can be used to assess the amount of health care waste generated daily in Dhaka city and to design the treatment plant. Also GIS technology can be used to assess waste generation, generation variation, and collection and transportation routes.

Acknowledgement
The authors wish to express special thanks Capt. Md. Mahmudur Rahman, Student of Civil Engineering Department of MIST, Mr. Tarit Kanti Biswas, Project Coordinator, Hospital Waste Management Project, PRISM Bangladesh.

References

Kazi, N.M. (2000). "Hospital Waste Management in Khulna city", Published by Environmental Development Associates.

Rahman, M.M. (2006). "Current Health Care Waste Management in Dhaka City",B.Sc. Engineering Thesis, Military Institute of Science and Technology (MIST), Dhaka.

Rahman. M.H. et. al.(1999). "A Study on Hospital Waste Management in Dhaka City", A consolidated report presented in the 25th WEDC Conference.

Roteb (1998). "Waste Land Filling and Hospital waste Incineration in Dhaka, Bangladesh", A draft report prepared for DCC by Solid Waste Consultancy Firm of Netherlands.

Ullah M.S. (1999). "Hospital Waste Management in Dhaka City", M.Sc. Engineering Thesis, Department of Civil Engineering, BUET, Dhaka-1000.

http:// www.prismbd.org/Hospital "waste management in Dhaka city"/May, 2007