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A Case Study of Waste Management System of Different Hospitals

Md. Mahir Asif, Musfira Rahman, Farhana Chowdhury

Abstract— Although understanding the medical waste categories and existing waste management practices is important, this area of study is less focused in Civil and Environmental Science. This research focuses on the present status of the medical waste management practices in the two selected hospitals in Dhaka city which are Sir Salimullah Medical College and Hospital and Sumona Hospital. The daily average waste generation in Sir Salimullah Medical College (3885.5 kg) was found greater than Sumona Hospital (442 kg), in which non-hazardous wastes (79.96% - 73.11%) were greater in amount than hazardous waste (20.04% - 26.89%). The study also shows that existing medical waste management practices is not up to the mark. So, there is a need for improvement of handling and disposal methods of medical waste in all the health care facilities in Bangladesh.

Index Terms— Medical waste, Waste management, Sir Salimullah Medical College and Hospital, Sumona Hospital, Waste generation, Non-hazardous waste, Hazardous waste.

1 Introduction

The problem of hospital waste disposal and other toxic hazardous waste is growing rapidly throughout the world as a direct result of rapid urbanization and population growth possessing serious threats to environmental health which requires specialized treatment and management prior to its final disposal. Developing countries are suffering financial and many constraints to manage these wastes [1]. A huge quantity of hazardous and non-hazardous are carried out by hospital and diagnostic centers which is generated from used syringes, needles, blood, body parts, pharmaceuticals, sharps, chemicals, radioactive materials etc as a result of treatment and diagnosis.

The prevalence of diseases that may be transmitted by hospital waste is alarming in Bangladesh. Hospital hazardous wastes are highly infectious as they may carry the germs of dreadful diseases. Only 5-25 percent of the hospital waste is infectious or hazardous. But unlike the ordinary household waste, health care wastes are highly infectious and hazardous. At the current time, there are more than 900 health care establishment situated in Dhaka City Corporation areas generate an estimated 250 tons of waste a day [2].

Almost all of these hospitals are disposing every kind of wastes in nearby municipal dust bins without any pretreatment what so ever. An unhealthy, filthy and hazardous environment exists in and around these hospitals, affecting patients, hospital staff and other people [3]. A great health risks is also posed to city corporation workers, scavengers, city dwellers, waste recycle operator and the environment [4]. The health care waste management's requires a systematic approach. The improvement of waste management for the hospitals and other 'Health Care Establishments (HCE)' in Bangladesh will have significant long-term impact on keeping the spread of infectious diseases to a minimum and result in a cleaner and healthy environment [5].

The aim of this study is to investigate the present hospital waste generation, sources, types, management, treatment facilities and final disposal pattern. It will cover not only the technical aspects related to hospital waste management, such as waste handling, storage, transportation, treatment and disposal, but also other factors which are essential components in sustaining the operation of hospital waste management system. The major objective of this study deals with the analysis of existing waste management system and physical components of waste generated from one government and one non-government hospitals of Dhaka city and the comparison of the existing in-house and external waste management system.

2 Hospital Waste

WHO defined the hospital waste as a waste that includes all the waste generated by hospital establishments, research facilities, laboratories (both human and animal), blood banks, collection centers, funeral and ambulance services. Sometimes it is known as clinical waste which is defined as any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals or in the production or testing of biological materials.

2.1 Sources of Hospital Waste

According to the quantities produced the sources of healthcare waste can be classified as 'Major' and 'Minor'. Major sources of wastes are from University hospital, general hospital and district ho. Minor sources of wastes are from Physicians' offices, dental clinics, acupuncturists, chiropractors.

2.2 Classification of Hospital Waste

Medical waste consists of a major part of non-hazardous

- *Md. Mahir Asif is currently pursuing masters degree program in civil engineering in Bangladesh University of Engineering and Technology, Bangladesh, PH-01674907431. E-mail: md.mahirasif92@gmail.com*
- *Musfira Rahman is currently pursuing masters degree program in civil engineering in Bangladesh University of Engineering and Technology, Bangladesh, PH-01772785571. E-mail: musfira108rahman@gmail.com*
- *Farhana Chowdhury currently works as an Assistant Professor in civil engineering in Stamford University Bangladesh, Bangladesh, PH- 01712653404, E-mail: shumi_buet@yahoo.com*

wastes and a minor proportion of hazardous wastes .There are also many kinds of medical waste divided in many portions:

I. **Infectious waste:** waste that may contain pathogens. This includes used dressings, swabs and other materials or equipment that has been in contact with infected patients or excreta. It also includes liquid waste such as urine, blood and other body secretions.

II. **Pathological waste:** human tissues including placentas, body parts, blood and fetuses. Anatomical waste is a subgroup of pathological waste and consists of recognizable body parts.

III. **Sharps:** needles, infusion sets, scalpels, blades, syringes and broken glass.

IV. **Pharmaceutical waste:** expired or no longer needed pharmaceuticals; items contaminated by or containing pharmaceuticals (bottles, boxes).

V. **Plastic waste:** includes saline bags, plastic containers

VI. **Genotoxic waste:** substances with genotoxic properties (meaning they can cause genetic damage) such as certain drugs and genotoxic chemicals.

VII. **Chemical waste:** wastes containing chemical substances such as laboratory reagents, film developer, disinfectants that are expired or no longer needed, and solvents.

VIII. **Waste with high content of heavy metals:** includes batteries, broken thermometers, blood-pressure gauges, etc.

IX. **Pressurized containers:** gas cylinders, gas cartridges and aerosol cans.

X. **Radioactive waste:** containing radioactive substances from radiotherapy or laboratory research.

2.3 Composition of Hospital Wastes

The composition of wastes is often characteristic of the type of source. The approximate compositions of various wastes generated in health card establishments are shown in Table 1. The wastes generated in health care establishments is extremely heterogeneous in composition; however it can be generally described as a mixture of paper and cardboard, plastic, path logical waste, food waste, glass, and metal [6].

TABLE 1
WASTE COMPOSITION

Type of Operation	% Papers	% Plastic	% pathological	% Metal	% Glass	% Food waste	% other
Administrative/ Clerical	100	-	-	-	-	-	-
Cafeteria	20	20	-	-	-	60	-
Surgery	60	30	10	-	-	-	-
Emergency Room	60	35	5	-	-	-	-
Intensive Care	60	35	5	-	-	-	-
Renal Dialysis	10	85	5	-	-	-	-
Laboratory	35	30	25	-	10	-	-
Nursery	45	35	-	-	15	5	-
Pharmacy	50	30	-	-	20	-	-
General Patient Care	60	35	-	-	-	5	-
Research	50	-	30	-	-	-	20*
Sharps	-	90	-	10	-	-	-

2.4 Hospital Waste Generation

Generally, health-care waste generation differs not only from country to country but also within a country. Waste generation depends on numerous factors such as established waste management methods, type of health-care establishment, hospital specializations, Proportion of reusable items employed in health care, Proportion of patients treated on a day-care basis. WHO suggested that developing countries having not per formed their own surveys of health-care waste may find some estimates for average distribution of health-care wastes useful for preliminary planning of waste management. It includes 80% general health-care waste dealt with the normal, domestic and urban waste management system, 15% pathological and infectious waste, 1% sharps waste, 3% chemical or pharmaceutical waste, Less than 1% special waste like radioactive waste, pressurized containers, broken thermometer, used batteries etc.

2.5 Health Hazard

Generally, Medical doctors, nurses, health-care auxiliaries, hospital maintenance members and visitors are the main victim to exposed medical wastes. Between 75% and 90% of the waste produced by health-care providers is non-hazardous or "general" health-care waste, comparable to domestic waste.The remaining 10 to 25% or healthcare waste is regarded as hazardous and may create a variety of health risks and need special attention. [7]. Medical waste can affect exposure to hazardous diseases. Character of the hazardous of medical waste may be caused one or more of the following type:

2.5.1 Through Infectious Waste and Sharps

Infectious waste contains different type of pathogenic microorganism such as viruses and bacteria [8] entering the human body through a number of routes like puncture, abrasion, cut in skin, mucous membranes; inhalation and ingestion. Sharps are not only responsible for cuts and puncture but also reason for infection, if those are contaminated by pathogens [9].

2.5.2 From Chemical and Pharmaceutical Waste

Different types of hazardous chemicals and pharmaceuticals such as toxic, corrosive, flammable, reactive, explosive shock-sensitive are present in medical waste in small quantities [10]. Sometimes larger quantities are found if unwanted or expired chemicals and pharmaceuticals are disposed of. This is cause of intoxication, either by acute or by chronic exposure and injuries including bums. Intoxication is result of absorption of a chemical or from inhalation or ingestion [11]. Injuries of the skin, eyes or the mucous membranes of the airways is caused by contact with flammable, corrosive, or reactive chemicals such as formaldehyde and other volatile substances. Moreover it may be happened by pharmaceuticals residues which is consists of antibiotics, drugs, heavy metals such as mercury, phenols, derivatives, disinfectants and antiseptics.

2.5.3 From Geotaxis Waste

The individuals who are working with geotaxis waste man-

agement combination of the toxic substance in risk or hazards. It may be happened during treatment or management period through specific drugs or chemicals. The main common route is inhalation of dust or aerosols, absorption through the skin, ingestion of food accidentally contaminated with cytotaxis drugs, chemicals, or waste. However it is occurred through contact with the bodily fluids and secretions of patients undergoing chemotherapy.

2.5.4 From Radioactive Waste

The category of diseases such as headache, dizziness, vomiting, respiratory function disorder which is caused by radioactive waste is firmed by the type and extent of exposure [12]. It can affect genetic materials in human body function [13]. Managing of extremely active sources such as sealed sources from diagnostic equipments can occur of serious injuries. Furthermore, radioactive waste can destruct of tissues, necessitating, and amputation of human body parts. Low hazard of radioactive waste is able to affect the containers during the period of waste storage [14].

2.6 Transmission Pathways

The first step in waste management is to identify the potential routes for disease transmission possible pathways between medical waste and the population includes direct contact, airborne transmission, contact through vectors, pollution of water sources and pollution of the environment [15]. The risks, pathways and hazards of medical waste are listed on Table 2.

TABLE 2
SUMMARY OF THE RISKS, PATHWAYS AND HAZARDS

Risk	Pathway	Hazard
Contraction of disease/ infection	Direct or Indirect contact through a carrier	Pathological wastes and infectious wastes may transmit disease and infection through direct contact or via vectors
Cuts	Direct contact	Sharp wastes including needles, glass and scalpels may cause cuts which provide entry into the body for infection
Ineffective medical care	Direct	Consumption of expired pharmaceuticals possible through inappropriate prescription by unscrupulous medical practitioner
Cancer	Direct or indirect contact	Radioactive Wastes
Burns and skin irritation	Proximity to Waste	Toxic chemicals, Radioactive wastes
Injury from explosion	Being within the vicinity when explosion occurs	Pressurized containers
Pollution of water (ground or surface) and air	Direct or indirect contact with polluted water	Toxic chemical wastes, Pharmaceuticals, Waste with heavy metal contact.

3 EXISTING TREATMENT AND DISPOSAL TECHNOLOGIES

There are several treatment and disposal technologies for health-care waste. Their name according to WHO 1999, with advantages and disadvantes are showed in Table 3:

TABLE 3
SUMMARY OF MAIN ADVANTAGES AND DISADVANTAGES OF TREATMENT AND DISPOSAL OPTION

Treatment/ disposal method	Advantages	Disadvantages
Rotary kiln	Adequate for all infectious waste, most chemical waste, and pharmaceutical waste.	High investment and operating costs
Pyrolytic incineration	Very high disinfection efficiency.	Incomplete destruction of cytotoxics.
Single chamber incineration	Good disinfection efficiency.	Significant emissions of atmospheric pollutants. Relatively high investment and operating costs.
Drum or brick incinerator	Drastic reduction of weight and volume of the waste. Very low investment and operating costs.	No destruction of many chemicals and pharmaceuticals.
Chemical disinfection	Highly efficient disinfection under good operating conditions.	Requires highly qualified technicians for operation of the process.
Wet thermal treatment	Environmentally sound. Relatively low investment and operating costs.	Shredders are subject to frequent breakdowns and poor functioning.
Microwave irradiation	Good disinfection efficiency under appropriate condition.	Relatively high operating costs. Potential operation problems.

4 METHODOLOGY

This chapter consists of the data sources, data collection procedure, selection criteria of sample size, type, collected information and survey outline in order to have a comparable representative scenario of the existing hospital waste management system. The methodology of the survey consists of practical field observation and field based data collection through structured and non-structured questionnaire and formal and non-formal interviews.

4.1 Project Design

The project survey of this study was based on the aim and objectives. The aim of this project is to analyze the existing hospital waste management system and find out the scope and need for future improvement. In order to assess the present system of handling, collection, storage, transportation, treatment and disposal of hospital waste generated in Dhaka city, the project was designed in such a way that the study can encircle nearly all possible sectors involving with hospital waste management. Collection of medical waste data was employed multiple methods. The process is showed in Fig 1:

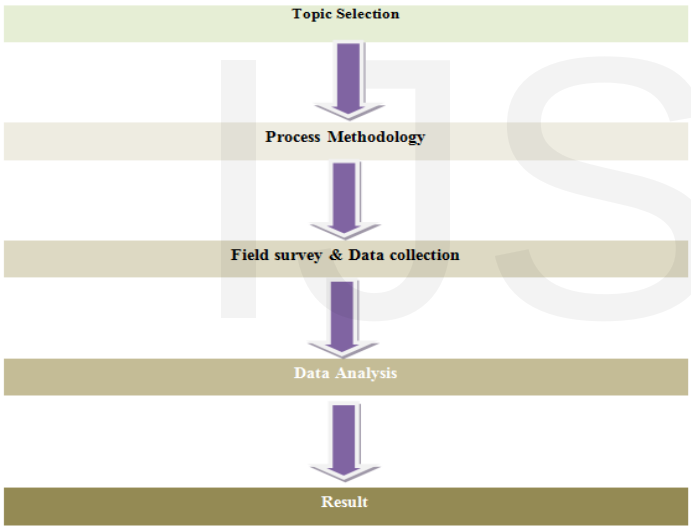


Fig 1: Flow Chart of Methodology

4.2 The List of Hospital Covered in the Project

All the available data & information were collected compiled & analyzed. The study area was covered with two hospitals including a government and a non-government, namely, 'Sir Salimullah Medical College (Mitford)' and 'Sumona Hospital' respectively.

4.3 Field Survey and Data Collection

This part were designed and conducted to characterize the hospital waste. Government and private hospitals were visited for the project work. Questionnaires were used to survey the hospital waste in terms of collection, transportation and treatment of hospital waste and to collect available information for analysis of the system. At the beginning of the project formal questionnaires were prepared to interview different personnel attached with health care sectors as well as hospitals like hospital authorities, managing directors, doctors, coordinators, doctor students, ward masters, waste cleaners and other health care occupants. Alternatively library, internet, journals, newspaper and published academic research and reports were used as sources of this study.

4.4 Information Assortment Preparation

A number of formal and informal approaches were adopted in order to accumulate data. Before entering into medical establishments a number of formal meetings have been arranged with the concern authority to each hospitals and clinics. After obtaining positive sign from different healthcare establishments, the data collection procedure was started. A series of meetings with the concerned authority were contucted according to the need.

4.5 Qualitative Information

Qualitative kind of research is especially valuable for the investigation and innovation of natural issue. For various philosophical approaches it is an umbrella term to interpretive research [16]. Generally, qualitative research could be defined as an effort to obtain an in-depth understanding of the meanings and 'definition of the situation' [17] delivered by informants, rather than the 'qualification' of their characteristics.

4.6 Method of Analysis

Most of the analysis has been done using statistical method. Simple averages and percentages were used to compare the variables with one another. The analysis of data contains four correlated process (a) data reduction; (b) data display; (c) conclusion drawing; (d) verification.

4.7 Quantitative Analysis

This study was conducted for a period of time starting from January 2014 to August 2014. All hazardous wastes generated from health care establishment were weighed before disposal. The described data for this study with the questionnaire was analyzed applying various statistical methods. A number of statistical graphs in terms of histogram, pie diagram, bar chart, etc. were used to clearly point out the project.

4.8 Qualitative Analysis

Methodology also consisted of surveys and interviews with the authorities of the healthcare establishments and with personnel involved in the management of the generated wastes. Site visits were conducted to support and supplement information gathered in the survey. Interviews and site visits were helpful in obtaining information about common practices in the management of the wastes.

5 DATA COLLECTION AND ANALYSIS

The waste management scenario has been enhanced to a large extent when PRISM, Bangladesh has started its operation. PRISM, Bangladesh is now collecting hazardous waste from selected hospitals. The improved waste management system may be analyzed into two systems: (a) In house/ Internal

management including segregation at sources, safe internal transportation, temporary storage etc. (b) Outside/ External management including waste collection, safe transportation, final treatment and disposal, supervision & monitoring etc.

5.1 In House/Internal Management

Hospital waste management system in Sir Salimullah Medical College and Hospital (SSMC) and in Sumona Hospital (SH) is decbribed below:

5.1.1 Sir Salimullah Medical College and Hospital

Sir Salimullah Medical College Hospital was established in 1875 in Dhaka near the Buriganga River. It has the capacity for 920 beds patients. . Among the total no of about 920 beds are divided into 35 wards. Its occupancy rate is about 120%. It provides both indoor and outdoor services and serves about 920 resident patients, 450 floor patients and 1500 outdoor patients daily. Occupants and capacity of in Sir Salimullah Medical College and Hospital are showed in Table 4.

TABLE 4
OCCUPANTS AND CAPACITY OF SSMC

Occupants categories	No of occupants	Capacity categories	Capacity
Full-time doctors	165	No of departments	28
Teachers	105	No of wards	35
Internee Doctors	270	No of operation theater	8
Students	825	No of beds	920
Nurses	330	No of cabins	60
Paramedics	18	No of inpatients	920
Other staff	900	No of outpatients	1500

Compositions of different categories of waste generated in SSMC on different dates are showed in Table 5.

TABLE 5
COMPOSITION OF DIFFERENT CATEGORIES OF WASTE GENERATED IN SSMC

Wastes observation day	General wastes (kg)	Infectious wastes (kg)	Plastic wastes (kg)	Sharp wastes (kg)	Grand total (kg)	Avg. wastes generation (kg)
Day-01 17-4-2014	3050	647	65	64	3826	3885.5
Day-02 19-4-2014	2963	658	55	67	3743	
Day-03 30-8-2014	3140	642	62	73	3917	
Day-04 31-8-2014	3123	651	58	70	3902	
Day-05 20-9-2014	3278	663	53	68	4062	
Day-06 21-9-2014	3086	638	64	75	3863	

Details statistical datas are represented below in figure 2:

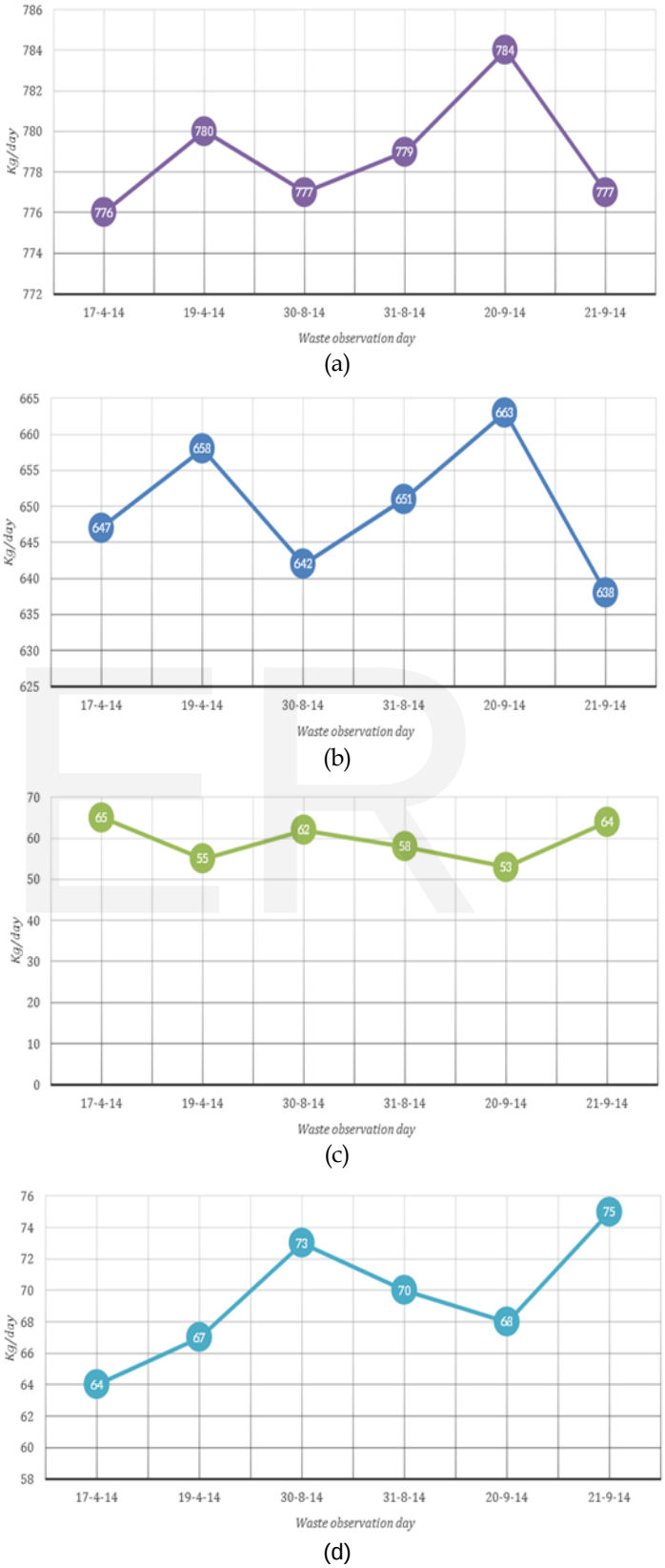


Fig 2: (a) Hazardous Waste; (b) Infectious Waste; (c) Plastic Waste; (d) Sharp Waste Generation in SSMC

We can observe that the portion of general waste, infectious waste, sharp waste and plastic waste were 79.96%, ,16.72%, 1.79% and 1.53% respectively. Details percentages are expressed in figure 3:

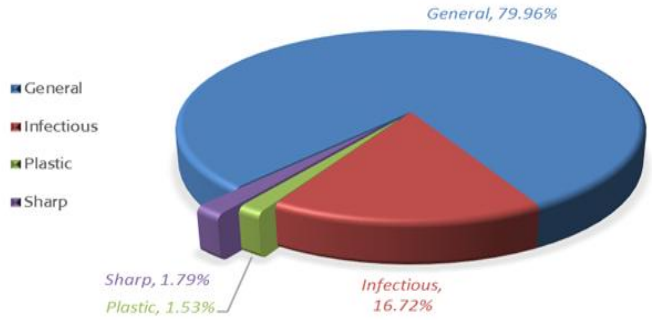


Fig 3: Waste Composition of SSMC

Differenet steps of hospital waste management system in Sir Salimullah Medical College and Hospital are:

5.1.1.1 Collection

A bowl with capacity 2.5-3.0 kg kept below the bed of various wards of SSMC for collecting general waste. This general waste includes plastic, packaging, paper, food, vomit etc. Even the pharmaceutical waste both liquids and tablets are disposed of in the bowl making the total waste hazardous for normal disposal. These wastes are then collected by cleaners and aayas twice a day to the internal dustbin or waste collection container for temporal storage as shpwed in figure 4.

Fig 4: SSMC Waste Collection Container

5.1.1.2 Separation and Segregation

Syringes, needles and saline bags are claimed to be separated for the interchange with the new products from the suppliers by the ward masters and cleaner like figure 5.

Fig 5: Separation of Waste in SSMC

But some swindle cleaners with the help of nurses and ward masters manage to mishandle the bags and syringes for further selling to the dishonest recycling vendors supplying the improperly treated syringes and bags to the market again.

5.1.1.3 Disinfection and Treatment

Doctor's gowns, scissors, masks, operational instruments, blades, patient's cloths, gauzes etc. are autoclaved regularly. Chemical disinfection such as chlorination is also performed in this hospital to disinfect surgical instruments. There was an on-side incinerator for treatment of pathological and infectious waste. Basically infectious wastes are now disposed of to the DCC bin without any prior treatment.

5.1.1.4 International Temporal Storage Bin

Waste collected from different wards, cabins, departments and operation theaters are then stored in a temporal storage bin like showed in figure 6 located in the hospital premises for a whole day until they are finally disposed of to the nearest DCC bin outside the hospital boundary. DCC waste collector vehicles then collect waste to the landfill site.

Fig 6: SSMC Temporal Storage Bin

5.1.1.5 Recycling and Reuse

Some cleaners are involved in separating plastic, glass bottles and pharmaceuticals containers for selling to the recyclers after throwing off into the internal bin as showed in figure 7.

Fig 7: Collection of Wastes for Selling to the Recyclers

5.1.1.6 Disposal

Wastes are then transported by the hospital authorities to the nearest DCC bin outside the boundary as showed in figure 8. As no segregation and separation of hazardous infectious waste is performed, the waste thus disposed of to the open DCC bin causes health hazard to the scavengers, tokais, waste handling personnel and the public as well as to the environment also.

Fig 8: SSMC Bin for Dumping Waste

5.1.2 Sumona Hospital

Sumona Hospital was established in 1988 at Patuatuli, Dhaka. It has the capacity for 260 beds patients. The hospital provides average 120-150 indoor patients per day from various depart ments and wards and outdoor advice 90-100 in a day. . Occupants and capacity of Sumona hospital are showed in Table 6.

TABLE 6
OCCUPANTS AND CAPACITY OF SH

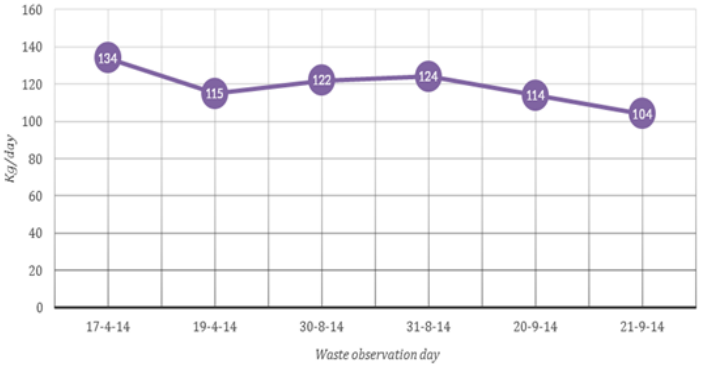
Occupants Categories	No of occupants	Capacity Categories	Capacity
Full-time doctors	35	No of departments	20
Teachers	0	No of wards	10
Intermediate doctors	0	No of operation theater	3
students	0	No of beds	260
Nurses	65	No of cabins	25
Paramedics	4	No of inpatients	150
Other staff	210	No of outpatients	100

Compositions of different categories of waste generated in SH on different dates are showed in Table 7.

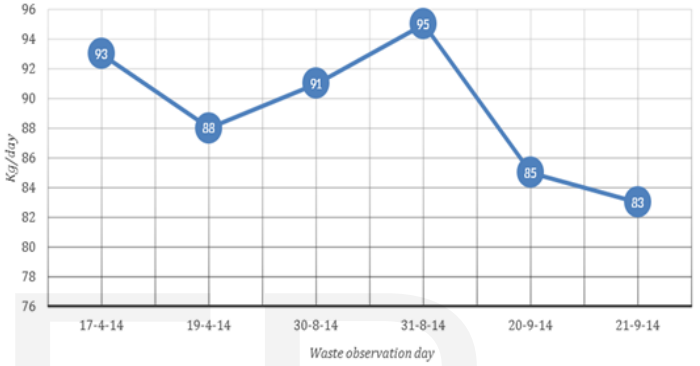
TABLE 7
COMPOSITION OF DIFFERENT CATEGORIES OF WASTE GENERATED IN SH

Wastes observation day	General wastes (kg)	Infectious wastes (kg)	Plastic wastes (kg)	Sharp wastes (kg)	Grand total (kg)	Avg. wastes generation (kg)
Day-01 17-4-2014	308	93	18	23	442	
Day-02 19-4-2014	313	88	11	16	428	
Day-03 30-8-2014	325	91	13	18	447	
Day-04 31-8-2014	330	95	09	20	454	442
Day-05 20-9-2014	336	85	15	14	450	
Day-06 21-9-2014	327	83	10	11	431	

Details statistical datas are represented below in figure 9:



(a)



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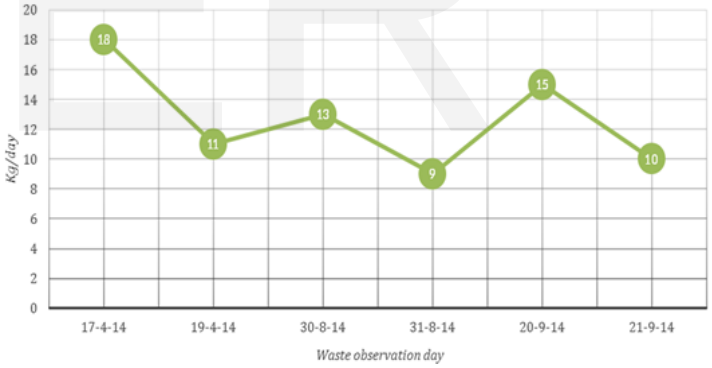

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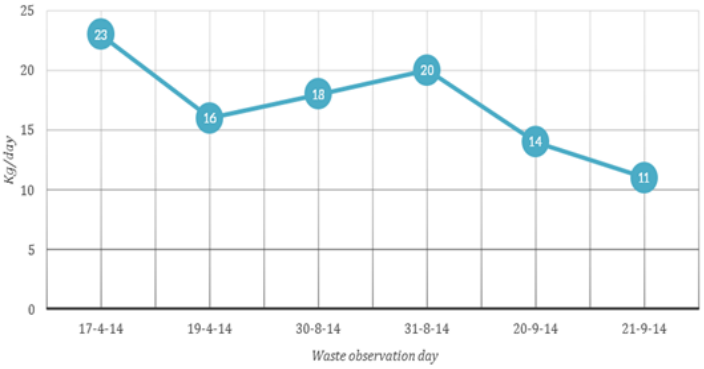

(d)

Fig 9: (a) Hazardous Waste; (b) Infectious Waste; (c) Plastic Waste; (d) Sharp Waste Generation in SH

We can observe that the portion of general waste, infectious waste, sharp waste and plastic waste were 73.11%, 20.17%, 3.85% and 2.87% respectively. Details percentages are expressed in figure 10:

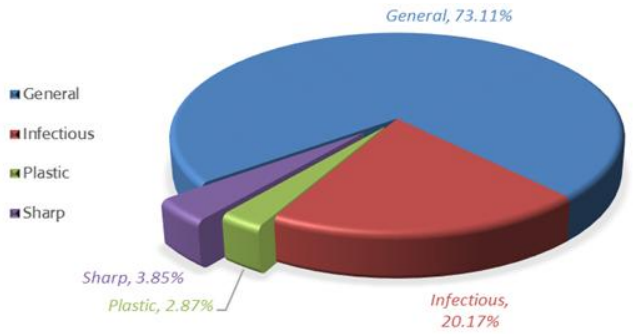

Fig 3: Waste Composition of SH

Differenet steps of hospital waste management system in Sumona Hospital are:

5.1.2.1 Collection

In Sumona Hospital there is a bowl with capacity 2-2.5 kg kept below the bed of various wards for collecting general waste. This general waste includes plastic, packaging, paper, food, vomit etc. Even the pharmaceutical waste both liquids and tablets are disposed off by the patients in the bowl showing illiteracy about hospital waste and making the total waste hazardous for normal disposal.Sometimes wastes are thrown next to the bed cover as showed in figure 11.These wastes are then collected by cleaners once a day to the internal dustbin.

Fig 11: SH Waste Next to Bed Cover

5.1.2.2 Separation and Segregation

Syringes, needles and saline bags are claimed to be separated for the interchange with the new products from the suppliers by the ward masters and cleaner. But present situation is not as it is depicted. Some swindle cleaners with the help of nurses and ward masters manage to mishandle the bags and syringes for further selling to the dishonest recycling vendors supplying the improperly treated syringes and bags to the market again.

5.1.2.3 Disinfection and Treatment:

Doctor's gowns, scissors, masks, operational instruments, blades, patient's cloths, gauzes etc. are autoclaved regularly. Chemical disinfection such as chlorination is also performed in this hospital to disinfect surgical instruments**.**

5.1.2.4 Internal Temporal Storage Bin

Waste collected from different wards, cabins, departments and operation theaters are then stored in a temporal storage bin located in the hospital premises for a whole day until they are finally disposed off to the nearest DCC bin outside the hospital boundary. Sometimes they use external Place for Dumping Waste as showed in figure 12.

Fig 12: SH External Place for Dumping Waste

5.1.2.5 Recycling and Reuse

Some cleaners are involved in separating plastic and glass bottles, drinking and pharmaceuticals containers for selling to the recyclers after throwing off into the internal bin as showed in figure 13.

Fig 13: Collection of Wastes for Selling to the Recyclers

5.1.2.6 Disposal

Wastes are then transported by the hospital authorities to the nearest DCC bin outside the boundary. As no segregation and separation of hazardous infectious waste is performed, the waste thus disposed off to the open DCC bin causes serious health hazard to the scavengers, tokais, waste handling personnel and the public as well as to the environment.

5.2 Outside/External Management

External management consists of the followings:

5.2.1 Identification

Hospital wastes are identified and separately stored according to various components in three different colored containers. Sharp, Infectious and plastic wastes are stored in red, yellow and green colored container respectively.

5.2.2 Collection and Transfer

The hazardous wastes from selected hospitals are collected once a day, preferably in the morning by a two crew pickup van.. Wastes of the 3 different containers has been measured before

loading into the van for the business purpose so that respective values of different types of hazardous wastes can be found and charged money to the hospital authority.

5.2.3 At Site Handling

The waste from the containers of different color has been unloaded from the vehicle after it reaches the site.

5.2.4 Segregation and Separation

The wastes from the 3 different types of containers again also segregated for making sure that they are not mixed up. The metallic sharps and needles are then buried into a concrete tank through a funnel shape inlet.

5.2.5 Treatment and Disposal

There is a treatment plant for the treatment of the plastic waste only. The infectious and sharp wastes are disposed directly in the burial pit.

5.2.6 Chlorination Tank

It is a three compartment chlorination tank. In the first tank belching powder is added in such a way that the concentration of chlorine reaches 100 to 200 ppm but it is not added in the second compartment. It is the residual chlorine in the water while transferring the plastics from the first compartment to second compartment. The concentration of chlorine of the second tank is 20 to 50 ppm. Each chamber has a height of about 4 ft and a surface area of about 2.5 ft by 2.5ft. The plastic are kept in first chamber for about 30 to 60 minutes and then into the second chamber for about 20 min. The third compartment is called ringing tank in which the final wash out of the plastic is done with the 3′ chamber fresh water. In the plant plastics are moved forward from to 3rd chamber gradually whereas the fresh water in the reverse order to ensure reuse of it. Moreover varying chlorine concentration ensures complete destruction of organisms.

5.2.7 Checking the Concentration of Chlorine

5 ml of chlorinated water + 1ml of OT solution yield a yellow color. If the color of sample of the water of the tank hasn't become yellow yet more water/chlorine is added.

5.2.8 Effluent Treatment Plant

There is an effluent treatment plant in which the effluent comes from the chlorination tank after the treatment of hazardous plastics. The effluent of the treatment plant is then driven to a sand filter of two chambers for further treatment. In the first chamber sand works as filtration bed whereas charcoal does the work in the second chamber..

5.2.9 Treatment of Plastics

Plastic wastes are first put into the first chlorination tank after the water of the tank has been added with BP and kept there for 1/2 hours. Then they are transferred to the second tank and also kept here for another 1/2 hours. The plastics are then put into the third tank called ringing tank to wash with fresh water. The plastics after treated by chlorine are than placed into the dry house. After some time they are spread over a concrete surface to dry in the sun. And then they are shredder in small pieces to sell in the recycle market or factory.

5.2.10 Treatment of Sharps

The sharp are buried into a concrete tank through a funnel shape inlet. The tank has a lid and it is kept locked after burial. Small amount of chlorine solution is added to the tank to enhance rate of metal erosion and volume reduction.

5.2.11 Treatment of Infectious Wastes

Infectious wastes are placed into a burial pit/waste house and a soil cover is spread over the waste so that no contamination can spread out from wastes. This process is continued until the pit got filled. A final layer of soil is laid over the pit before the pit is closed finally. Recently an incinerator has been installed.

6 Lacking of Existing Waste Management System in Surveyed Hospitals

From the conducted survey the following lackings of the existing health care waste management system were discovered:

6.1 Segregation at Source

Very poor segregation at the point of origination, e.g. at beside bowls pharmaceuticals are thrown off together with general waste, no particular separation for needles and sharps are performed. Wastes are not fractioned as infectious or sharp for special treatment.

6.2 Sharps Management

Used needles and syringes are not always destroyed or disposed of property in a standard method specified by any guideline.

6.3 Waste Collection and Containerization

No puncture proof container is used for sharp wastes collection. Many different types of bins and containers are used for collection of waste which is unsuitable for such jobs. Color coding is rarely practiced but not in a standardized way.

6.4 Intermediate Storage

Intermediate storage is not secured enough for scavengers or waste pickers.

6.5 Internal Transport

Trolleys are hardly used for internal transportation of waste.

6.6 Occupational Health and Safety Measures

Safety gowns, masks, gloves or protective clothing are not worn by the cleaners and different workers.

6.7 Recycling and Reuse

No legal segregation of wastes is performed by the hospital authorities for recycling. Some cleaners are involved in separating plastics and papers in the temporal storage or DCC bin for recycling without having the knowledge of handling the wastes and causing severe hazards to their health.

6.8 Treatment

Treatment of plastics for recycling under PRISM is performed in the open place in Matuail land fill site which is not healthier enough for such act as flies roam around the site. No proper treatment is done in any medical.

6.9 Transportation and Ultimate Disposal

Hospital wastes are dumped in the outside DCC bin without much segregation of infectious and anatomical wastes. Wastes are transported by open DCC collector vehicle without any cover at irregular time period during day at pick hour causing health hazard to city people.

7. Conclusion and Recommendations

The study covered the waste management system of Sir Salimullah Medical College (SSMC) and Sumona Hospital (SH).

In Sir Salimullah Medical College (SSMC), the current bed capacity is 920. The daily average generated waste is 3885.5 kg. Hazardous wastes are 778.83 kg (20.04%) and Non-Hazardous wastes are 3106.67 kg (79.96%). Hazardous are sectioned by Infectious 16.72%, Plastic 1.53% and Sharp 1.79%.

In Sumona Hospital (SH), the current bed capacity is 260. The daily average generated waste is 442 kg. Hazardous wastes are 118.83 kg (26.89%) and Non-Hazardous wastes are 323.17 kg (73.11%). Hazardous are sectioned by Infectious 20.17%, Plastic 2.87% and Sharp 3.85%.

There is an existing law in Bangladesh regarding waste and pollution but a definite law against medical waste is yet to be formulated. It is about time that concerned authorities propose, pass and enact a law and add courses to the existing medical curriculum to fight this increasingly dangerous menace to national environment and health. Medical wastes are needed to be segregated separately according to its characteristics. Some valuable recommendations are:

- Careful segregation, handling and storage of hospital waste must be done by the hospital at the point of generation for the safe collection, treatment and disposal.
- The hospital authorities should arrange program to increase awareness concerning the health risk of hospital wastes and the appropriate handling procedure among the nurse, matrons and other workers of the hospitals.
- Waste must be carried out at the point of generation by the person producing the waste such as doctors, nurses, pharmacists, theatre assistants or dispensers.
- To avoid the risk of health effect from the wastes, it needs to formulate proper policy regarding this issue.
- WHO permitted color-coded, high-density polyethylene bags for easy identification and segregation of bio medical solid waste. Non-infectious and domestic type of waste and the infectious wastes should be collected in black and red polyethylene bags respectively.
- Deceitful businessmen theft material such as plastics, bags, syringes, blades etc. and sell or refill them without a treatment. So, The market values of these stolen materials must be minimized by the authority of hospital.
- The treatment and disposal technology of the only existing treatment system should be improved to a large extent and the quality of the effluent of the treatment plant must be maintained according to the standard set by ECR'97.

In case of breakdown of the existing facility it is recommended to dispose the hazardous waste inside the HCE premises and in that case open air/in situ burning of the hazardous waste should be dumped.

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