

**MEDICAL WASTE MANAGEMENT SYSTEM IN DHAKA CITY
CORPORATION: SOUTH, BANGLADESH**

A Thesis

Submitted to the Department of Geography & Environment, University of Dhaka in Partial
Fulfillment of the Degree of Masters of Philosophy

M.PHIL THESIS-2014

AYSHA AKTHAR RUMI

Registration Number: 301

Session: 2008-2009



November, 2014

Supervisor

Professor Dr. Rejuan Hossain Bhuiyan

Department of Geography & Environment

University of Dhaka

DECLARATION

Academic Research Title:

MEDICAL WASTE MANAGEMENT SYSTEM IN DHAKA CITY CORPORATION:
SOUTH,
BANGLADESH

I hereby declare that the dissertation submitted for the degree of M.Phil. is my own original work and is the result of my own research has not yet previously been submitted to any other or quoted and are acknowledged by means of a comprehensive list of references.

AYSHA AKTHAR RUMI

Signature :

Author :

Date :

CERTIFICATE

I hereby certify that this thesis entitled “MEDICAL WASTE MANAGEMENT SYSTEM IN DHAKA CITY CORPORATION: SOUTH, BANGLADESH” was carried out by Aysha Akthar Rumi under my guidance and supervision. It is further certified that the work presented here is suitable for submission as a M. Phil. thesis.

Wholeheartedly, I wish her grand success.

Supervisor

Dr. Rejuan Hossain Bhuiyan
Professor
Department of Geography and Environment
University of Dhaka

ACKNOWLEDGEMENT

First, I would like to give graces to Almighty Allah for endless blessings to enable me the courage to complete this research work given just in time.

I would like to express my sincere thankfulness to my academic supervisor Professor Dr. Rejuan Hossain Bhuiyan for his invaluable guidance and enthusiasm throughout this dissertation, as well as for the support and confidence he give me from every meeting and point of contact that occurred from start to finish.

I dedicate this research to my parents, my husband and my child and wish to thank them for the continual support they gave me during my studies.

Finally I want to thank others junior students Debnath, Miju, Hridee, Shimu as well as for the support and enthusiasm they give me during the field survey.

ABSTRACT

The study has designed to assess the collection, handling, storage, and treatment and disposal system in healthcare providing organizations of the Dhaka South City Corporation area. Medical waste is dangerous because of its hazardous contamination, which may responsible for dreadful diseases like hepatitis B and HIV/AIDS. It poses serious threats to environmental health, requires specific treatment and management prior to its final disposal. The problem is mainly taking worse in Dhaka South City Corporation area for the high generation of waste from adequate number of hospitals, clinics, diagnostic centers and small healthcare centers. Although medical waste presents a high risk to doctors, nurses, technicians, sweepers, visitors, patients and general public due to its inadequate waste management practices.

This study has been conducted to achieve the present situation of medical waste management system in Dhaka City Corporation: South, Bangladesh, to find out the sources, types and current amount of generated wastes and to assess the existing waste management practices including collection, storage, treatment and disposal in this area.

The methodology of the study is includes empirical field observation and field level primary data collection through inventory, secondary data collection from published and unpublished sources, questionnaire survey and formal and informal interviews. This study was carried out in the twenty different healthcare establishment in Dhaka South City Corporation area. The field observation with questionnaire survey was implemented to collect latest information from 104 different respondents such as medical staffs, technicians and waste handlers/workers. All the obtained data has been analyzed by SPSS software (Version-16) and related statistical test also has been used to quantify data for making result. A laboratory analysis has been done to investigate the impact of medical waste. The location map of study area has been created by Arc GIS 10.1 version.

This study tried to obtained the current information about surveyed healthcare establishments and shows that the surveyed all healthcare establishments generate total 8425 kgs waste of which about 6869 kgs non-hazardous and 1556 kgs hazardous and the average waste generation rate from all healthcare establishment. The study assess that, there was a lack of dedicated waste management system in all level. Lack of proper collection and segregation practices, storage facilities, proper treatment and disposal methods, trained waste handler,

safely transportation and absence of plan, policy, laws and regulation are responsible for this poor management of medical waste.

It is evident from the overall study that all types of surveyed healthcare establishments of Dhaka South City Corporation need to undertake some essential strategies such as a good trained waste management team with a dedicated budget, formulation of written plan, policy and guideline document for best management practices, segregation, packaging, labeling and marking with appropriate manner, proper storage system, ensure protective clothing and hygiene practices, ensure cost effective available treatment and disposal technologies for sound management etc. which may be responsible to achieve an efficient medical waste management system for all healthcare establishments in this area.

TABLE OF CONTENTS

DECLARATION.....	II
ACKNOWLEDGEMENTS.....	IV
ABSTRACT.....	V
ABBREVIATION.....	XIII
TABLE OF CONTENTS.....	VII
LIST OF TABLES.....	XI
LIST OF FIGURES.....	X
LIST OF PHOTOGRAPH.....	XII

CHAPTER-1: ITRODUCTION

1.1) Background of the study.....	01
1.2) Problem statement and Justification.....	02
1.3) Rationality and importance of the study.....	03
1.4) Research Aims and Objectives.....	03
1.5) Structure of the research study.....	04
1.6) Conclusion.....	05

CHAPTER-2: REVIEW OF LITERATURE

2.1) Introduction.....	06
2.2) Definition of Medical Waste and its Management.....	06
2.3) Types and categories of Medical Waste.....	08
2.4) Sources of Medical Waste.....	11
2.4.1) Associated risk.....	11
2.4.2) Transmission Pathways.....	11
2.4.3) Person at Risk.....	12
2.5) Issues Associated with Medical Waste and its Management.....	12
2.6) Healthcare Waste Statistics in DSCC, Bangladesh.....	14
2.7) Healthcare Waste Management Situation in DSCC, Bangladesh.....	14
2.8) Conclusion.....	18

CHAPTER-3: RESEARCH METHODOLOGY

3.1) Introduction.....	19
3.2) Study Area	19
3.3) Sample Size	20
3.4) Study Design.....	20
3.5) Data Types	23
3.5.1) Primary Data Collection.....	23
3.5.2) Secondary Data Collection.....	23
3.5.3) Data Analysis by SPSS.....	23
3.5.4) Statistical Test.....	24
3.6) Field Observation.....	24
3.7) Laboratory Analysis.....	24
3.8) Mapping Method.....	24
3.9) Conclusion.....	25

CHAPTER-4: ANALYTICAL RESULT OF THE STUDY

4.1) Introduction	26
4.2) Types, location and inventory of surveyed HCE in DSCC area.....	26
4.3) General information of surveyed HCE and its waste management.....	27
4.4) General profile of respondents.....	30
4.5) Medical waste generation, composition and quantification by sources types and categories.....	32
4.6) Existing Scenario of Medical Waste Management in DSCC Area.....	37
4.6.1) Waste segregation.....	37
4.6.2) On-site Storage of Waste.....	40
4.6.3) Liquid waste generation and discharge system.....	42
4.6.4) On-site treatment and disposal.....	43
4.6.5) Medical Waste recycling in surveyed HCE.....	44
4.6.6) Off-site transportation and final disposal.....	45
4.6.7) Result of laboratory analysis	48
4.7) Waste transporting, disposing and MWM management.....	49
4.8) Training of MWM staffs.....	50
4.9) Conclusion.....	51

CHAPTER-5: CRITICAL DISCUSSION

5.1) Introduction.....	52
5.2) Medical waste management practices in surveyed HCEs in DSCC area.....	53
5.2.1) Generation of wastes by sources and types.....	54
5.2.2) Lack of segregation practices.....	55
5.2.3) Collection of waste.....	55
5.2.4) Temporary storage.....	56
5.2.5) On-site treatment or disposal practices.....	56
5.2.6) Off-site transportation and final disposal.....	56
5.2.7) Liquid waste Discharge system.....	57
5.2.8) Protective clothing.....	57
5.2.9) Medical Waste plan, policy and guidelines.....	57
5.3) Advanced Methods of Medical Waste Management.....	58
5.4) Training and awareness program.....	59
5.5) Financial constrains for MWM.....	60
5.6) Conclusion.....	60

CHAPTER-6: SUMMURY FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1) Introduction.....	61
6.2) Summary Findings.....	61
6.3) Recommendations.....	64
6.4) Conclusions.....	65

REFERENCES.....66**APPENDIX.....72**

LIST OF FIGURES

Figure 2.1 Types of medical waste.....	8
Figure 2.2 Categories of waste.....	9
Figure 3.1 Flow chart of conceptual framework.....	21
Figure3.2 Schematic diagram of the Research Methodology.....	22
Figure4.1 General Profile about bed and bed occupancy rate of surveyed HCE.....	29
Figure4.2 Total patients of surveyed HCE.....	29
Figure4.3 General Profile of manpower of surveyed HCE.....	30
Figure4.4 General Profile of respondents of all surveyed HCE.....	31
Fogure4.5 General Profile of the opinions from different staffs about hazards of MW.....	32
Figure4.6 Waste generation by types and categories from surveyed HCE.....	34
Figure4.7 Average waste generation from surveyed HCE.....	36
Figure4.8 Types of waste containers of surveyed HCE.....	40
Figure4.9 Liquid waste generation rate	42
Figure4.10 Water usage rate.....	43
Figure4.11 On-site treatment and disposal practices methods of all surveyed HCE.....	44
Figure 4.12 Figure Off-site collection of waste.....	47
Figure4.13 Transporting and disposing cost in surveyed HCE.....	49
Figure4.14 The MWM cost in surveyed HCE.....	50
Figure4.15 Training issue of surveyed HCE.....	51

LIST OF TABLES

Table 4.1 Types & Inventory of surveyed HCE in DSCC area.....	27
Table4.2 General Information of surveyed HCE.....	28
Table4.3 General Profile of the respondent.....	30
Table4.4 General Profile about the knowledge about the hazards of MW.....	32
Table4.5 Waste generation by types and categories.....	33
Table4.6 Total Generation of Hospital Waste in DSCC.....	34
Table4.7 Total hazardous and non-hazardous waste generation profile by all Surveyed HCE.....	36
Table4.8 Amount of generation waste of different categories of surveyed HCE.....	37
Table4.9 Different colors of bins.....	37
Table4.10 Type of waste containers in all surveyed HCE.....	39
Table 4.11 Temporary storage system of surveyed HCE.....	41
Table 4.12 Liquid waste generation and water usage amount.....	42
Table4.13 On-site treatment and disposal practices methods of all surveyed HCE.....	43
Table4.14 Waste collectors	46
Table 4.15 The analysis of solid Waste showed diseases from different pathogens.....	48
Table-4.16 BOD and DO data.....	48
Table 4.17 MWM cost in all surveyed HCE.....	49
Table-4.18 General profile of training.....	50
Table 5.2: An overview of the amount of generated waste.....	54

LIST OF PHOTOGRAPHS

Photograph4.1 Different colors of bins in surveyed HCE.....	38
Photograph 4.2 Temporary storage system of MW in healthy	40
Photograph 4.3 Recyclable waste were handled by scavengers	45
Photograph4.4 Off-site transportation of MW.....	47
Photograph4.5 Different off-site treatment and disposal system by PRISM Bangladesh.....	48

LIST OF MAP

Map 1: Study Area Map (Hospital Location DSCC).....20

ABBREVIATION

MW-Medical Waste

MWM-Medical Waste Management

HCE-Healthcare Establishment

HCW-Healthcare Waste

HCWM-Healthcare Waste Management

DCC- Dhaka City Corporation

DSCC-Dhaka South City Corporation

DNCC-Dhaka North City Corporation

WHO-World Health Organization

NGO- Non Government Organization

CHAPTER 1

INTRODUCTION

1.1 Background

‘Healthcare Centre’ or ‘Medical Centre’ can be used to refer to field hospitals, outpatient clinics and any other location where medical consultation, diagnosis or treatment is conducted (Harvey, Baghri and Reed, 2002). A modern hospital is a complex, multidisciplinary system which consumes thousands of items for delivery of medical care and a part of physical environment. These health care products leave various unusable leftovers which are termed as medical waste or clinical waste or healthcare waste (Chandra, 1999); (Wahab and Adesanya, 2011); (Razzak, Chowdhury and Chowdhury, 2014). It is generated during patient’s diagnosis, treatment or immunization. If the waste is not properly managed, it can result in a massive collapse of health of healthcare staffs (doctors, nurses, technicians, etc.), workers (sweeper/cleaner/handler), the patients and the general public or visitors (Robert and Ananias, 2013). Medical waste is highly infectious as well as hazardous and thought to be a mode for transmission of diseases. It poses serious threats to environmental health, requires specific treatment and management prior to its final disposal (Hassan, 2006); (Mia et al., 2012).

It is important that medical waste should be managed separately from general solid waste and its management systems also should be controlled strictly (Harvey, Baghri and Reed, 2002). In developing countries, medical waste has not received much attention and it is disposed of together with domestic waste. The management of healthcare is still receiving improper attention in spite of its potential health risk. The healthcare services are inadequate in the developing world and hence the rapid growth of healthcare facilities is accentuating the problem to a large extent (Rahman, Rahman & Patwary, 2008).

Medical waste contains highly toxic metals, toxic chemicals, pathogenic viruses and bacteria, which can lead to pathological dysfunction of the human body (Hassan, Ahmed, Rahman and Biswas, 2008). The hazards of exposure to hospital waste can range from gastro-enteric, respiratory, and skin infections to more deadly diseases such as Hepatitis B & C (Jaundice), and HIV/AIDS. Additionally, medical waste contains potentially harmful micro-organisms, which can infect public health and may present a high risk to human and environment

(Babanyara, et. al., 2013). Although medical waste is a source of contamination and pollution to both humans and the environment, is capable of causing diseases and illness to people, either through direct contact or indirectly by contaminating soil, ground water, surface water and air. Wind from these dumps can also carry pathogens and hazardous materials. Where domestic animals are allowed to graze in open dumps, there is a risk of reintroducing pathogenic microorganisms into human body through food chain. Thus medical waste poses a risk to individuals, communities, and the environment if not properly and carefully handled. One estimate shows that some 5.2 million people (including 4 million children) die each year from waste-related diseases in Bangladesh. Poor medical waste management causes environmental pollution, unpleasant smell, growth and multiplication of insects, rodents and worms, which may lead to transmission of waste related diseases (Akter, Chowdhury and Kazi, 1999) ; (Akter, 2000) ; (Akter, Hussain, Trankler and Parkpin, 2005).

Hospital waste management is an important and necessary component of environmental health protection (Adsavakulchai, 2002), where healthcare waste has the higher priority due to their hazardous nature (Akum, 2014). Poor management practices of healthcare waste can present significant inconveniences and health risk to the inhabitants (Robert and Ananias, 2013). Level of knowledge, attitude of the waste generator and their better practice are the key issues for effective waste management (DGHS, 2001).

1.2 Problems statement & Justification

The mismanagement of healthcare waste engenders considerable risks to people and the environment. Healthcare staffs, workers, patients, waste handlers & pickers, and the visitors are exposed to health risks from infectious waste, (particularly from sharps) chemical and other special healthcare waste if they are not correctly handled, storage and disposed of. The transmission of diseases generally occurs through injuries from contaminated sharps. The proper disposal of healthcare waste is therefore of utmost importance if diseases such Acquired Immune Syndrome (AIDS) and Hepatitis are to be prevented or controlled (Mosia, 2006). Dhaka is one of the fastest growing cities of the world ranked 11th in terms of its population which is about 16.5 million. The city is divided into two corporation area, naming Dhaka North City Corporation (DNCC) & Dhaka South city Corporation (DSCC). A huge number of researches on this issue have been conducted in Dhaka city, but research work in DSCC area is very limited. Only a survey was carried out by PRISM Bangladesh (NGO) for treatment & disposal of medical waste in 2005 for the Dhanmondi area and in 2013 for the

entire DCC area. Otherwise no individual research has been conducted for DSCC area. The present research will help to find out the deficiency of proper management of medical waste and furthermore is attempted to fill up the gaps of the previous research works.

1.3 Rationality and importance of the research

To improve medical waste management at first it is needed to quantify of medical waste generation. The rapid expansion of HCEs in DSCC area resulted that a huge amounts of medical waste are being generated every day and creates the potential health hazards. The present study has identified the estimation of medical waste generation of DSCC area through a survey. The overall estimate is obtained by surveying twenty HCEs, including Public/Govt. hospitals, clinics, diagnostic centers and small healthcare centers to achieve a quantitative assessment which may discover about waste management system from different HCEs background in DSCC area.

This research also assessed the current situation about best management practices such as waste collection, segregation, storage, treatment and disposal in surveyed HCE. Furthermore this research identified the weakness of waste management system in surveyed HCE and recommended the ways how to prevent from the mismanagement system.

This study obtained information about the lack of knowledge, awareness, guideline and training of healthcare workers, plan or policy of HCWM in DSCC area. These are initial for a dedicated waste management team. The obtained information would help to undertake essential strategies for the development of rules and regulation, guideline, plan or policy of HCWM in study area. Although MW is responsible for health and environmental effects, the authorities, staffs, workers and patients should be concern about the hazardous and non-hazardous materials of MW to manage the waste properly and the study also investigated their opinion about the hazards of MW. These information are essential for understanding and developing the level of knowledge and awareness about MW.

It is expected that the overall study findings would provide a better understanding about the present situation of MWM system in DSCC, Bangladesh.

1.4 Research Aim and Objectives

Broad objective of the study is to evaluate the medical waste management system of Dhaka south city corporation area.

The specific objectives are:

- to identify the types of generated medical wastes in DSCC area
- to discover the sources of medical wastes of DSCC area
- to compute the amount of generated medical wastes in DSCC area
- to assess the existing waste management practices in DSCC area.

1.5 The Structure of the Research

The research is arranged according to the following sequence and the contents of each chapter are summarized below:

Chapter one

This chapter the introductory chapter which includes the issues of medical waste management in DSCC, Bangladesh as well as the medical waste that may be generated by different healthcare services due to rapid urbanization, increasing number of HCEs and the population. The chapter also provides an overview of the problem statement and justification, rationale and the research objectives.

Chapter two

Chapter two consists of the theoretical and conceptual framework and the definitions, the review of previous literatures relevant to this research topic and also provides an overview of the current literatures about MWM.

Chapter three

In chapter three the research methodology is elaborately discussed that is used achieve the research objectives. This chapter includes the study site and sample, research design, field observation and field level primary data collection method which are done by questionnaire survey and interviews, secondary data collection method and finally the data processing, analyzing and mapping methods.

Chapter four

The findings and the ultimate outputs of the research are elaborately discussed in this chapter through interpretation, evaluation and analysis.

Chapter five

Chapter five is an analytical chapter where the findings are critically analyzed by comparing with the findings of other relevant researches.

Chapter six

Chapter six provides a concluding framework of the research along with some effective recommendations in order to improve the medical waste management system in the DSCC area.

1.6 Conclusion

From the above all introductory description about medical waste and related literature on this critical issues, medical waste is getting more serious condition in DSCC area, only for the lack of its inappropriate and inadequate management practices. According to ICRC,2011, (International Committee of the Red Cross), “poor waste management can jeopardize care staffs, employees who handle medical waste, patients and their families, and the neighboring population and the inappropriate treatment or disposal of that waste can leads to environmental contamination or pollution”.

CHAPTER 2

Review of Literature

2.1 Introduction

In literature the terms ‘Healthcare waste’, ‘Infection waste’ and ‘Medical/Hospital waste’ are typically encountered, they may have similar meanings or be subsets of one another, which substantially inhibits using and comparing data from different countries (Muduli & Barve, 2012). Safe healthcare waste management is required owing to massive economic growth which is primarily responsible for waste generation from all sources and the phenomenon has increased dramatically over the last decades. The waste management sector is in charge of waste treatment and disposal, has become an independent economic sector, as waste management becomes an environmental problem of growing concern (Aziz, 2011).

The health system is under pressure dispose of HCW in such a way as to avoid unnecessarily high levels of environmental damage. Healthcare facilities worldwide are beginning to subscribe to the social goals of a cleaner and safer environment. To manage healthcare waste optimally, healthcare providers should consider all stages of the medical product’s life cycle, by looking at the medical products up stream and down-stream activities (Gabela and Knight, 2010).

Proper management of HCW can minimize the risks both inside and outside healthcare centers. There are four key steps to HCWM: 1) segregation at the point of generation into various components, including reusable and safe storage in appropriate containers; 2) transportation to waste treatment and disposal sites; 3) treatment and 4) final disposal (World Bank, 2000).

2.2 Definition of Medical Waste and its Management

Medical Waste Definition

Definitions of medical waste vary in different countries and institutes as well, based on different categories as wastes (Akter, Rahman, and Sharmin, 2005). Medical waste definition has historically been used to describe waste produced from healthcare and similar activities that pose a risk of infection or that may prove hazardous. According to Health Regulations Northern Ireland, 2003, “Any other waste arising from medical, nursing, dental, veterinary,

pharmaceutical or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion, being waste which may cause infection to any person coming into contact with it” (Elgitait, Sarshar and Gee, 2009). The term “medical waste” covers all wastes produced in health-care or diagnostic activities”. In general, medical wastes are wastes generated from diagnosis, monitoring and preventive, curative or palliative activities in field of the veterinary and human medicine and more elaborately medical waste can be defined as “any solid or liquid waste that is generated in the diagnosis, treatment or immunization of human beings or animals, in research pertaining there to, or in production or testing of biological” (BAN, 1999). According to World Bank, 2000, “Healthcare waste is defined as the total waste stream from a healthcare establishment research facilities, laboratories, and emergency relief donations.”

A legal definition by the EPA is, “any waste or combination of wastes of a solid, liquid, contained gaseous, or semisolid from which because of its quantity, concentration, or physical, or chemical, or infectious characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed”(Vesilined, Worrell and Reinhart, 2008).

According to World Health Organization (WHO), 2013, “The term healthcare waste includes all the waste generated within healthcare facilities, research centers and laboratories related to medical procedures. In addition, it includes the same types waste originating from minor and scattered sources, including waste produced in the course of health care undertaken in the home (e.g. home dialysis, self-administration of insulin, recuperate care).”

Medical Waste Management Definition

Medical Waste Management means the management of waste produced by medicals or hospitals using such techniques that will help to check the spread of diseases through it (Elgitait, Sarshar and Gee, 2009).The medical wastes include all types of wastes produced by health facilities such as general hospitals, private clinics, dialysis centers, medical centers and dispensaries. The waste management is defined as collecting, transporting, processing and disposing of waste material (Aziz, 2011). Initial handling, collecting, transporting, disposing and monitoring of waste materials and reducing the amount and hazards of waste are collectively called waste management (Tabasi and Marthandan, 2013). According to

Rushbrook, “Good management of healthcare waste in hospitals means the effective segregation of waste and the separate handling and disposal of each segregated waste category. This cannot be achieved without the commitment of senior directors and the motivation of medical and support staff.

2.3 Types and Categories of Medical Waste

Types of Medical Waste

There are different types of healthcare wastes (such as sharps, infected syringes, animal and human tissues, drugs and medicines) generated as a result of different activities in healthcare facilities (Abbasi, 2013). Between 75-90% of the waste produced by healthcare providers is comparable to domestic waste and usually called “non-hazardous” or general HCW and the remaining 10-25% of healthcare waste is regarded as “hazardous” and may pose a variety of environmental and health risks (WHO, 2013).

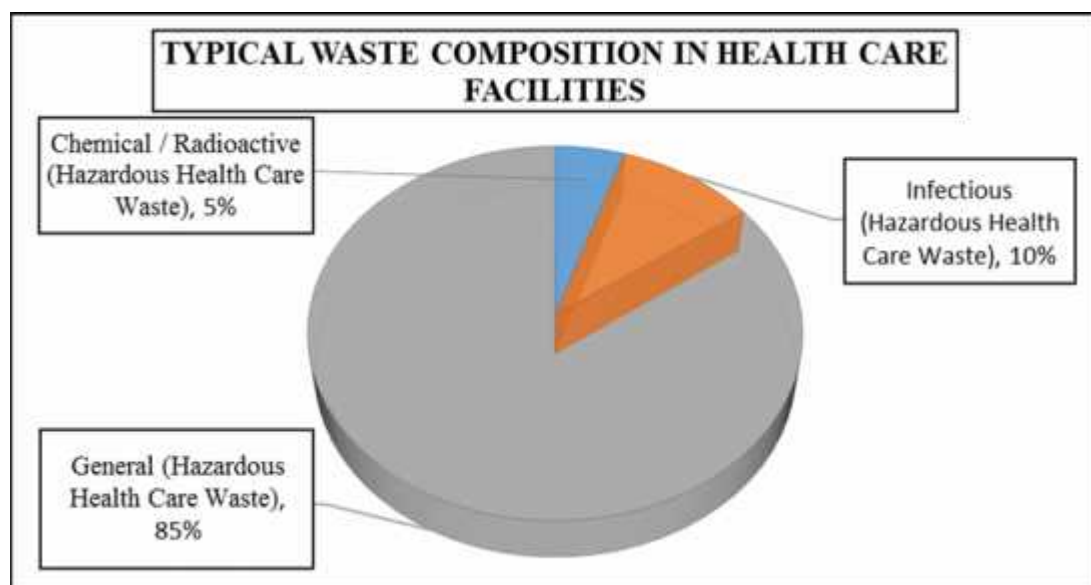


Figure 2.1 Types of medical wastes (WHO, 2013)

Categories of Medical Waste according to WHO, 2013:

Medical waste can be further divided into the following categories:

• **Sharps waste:** Used or unused needles, syringes, infusion sets scalpels, pipettes, knives, blades and broken glass.

• **Infectious waste:** Blood and other body fluids, Lab cultures and microbiological stocks, waste from isolation ward used dressings.

• **Anatomical waste:** Human tissues, organs, or fluids, body parts, fetuses, placentas, unused blood products.

Pharmaceutical waste with toxic waste: Unwanted drugs expired or no longer needed

drugs, toxic waste which may contain substances with genotoxic/cytotoxic properties.

Chemical waste: Chemicals from lab and diagnostic work, cleaning materials.

Radioactive waste: Radioactive substances from radiotherapy and lab work.

Pressurized containers: Gas cylinders, cartridge and aerosol cans.

High heavy metal content: Batteries, broken thermometers, blood pressure gauges.

or General healthcare waste: Paper, cardboard and plastics, discarded food waste from kitchen, metal, glass, textiles, plastics/polythene and wood.

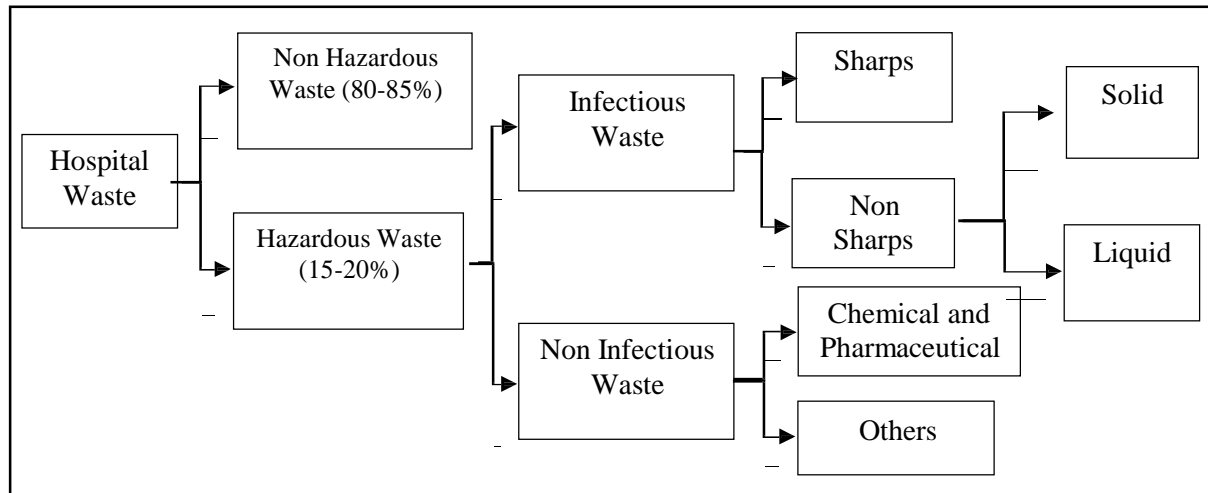


Figure 2.2 Categories of medical waste (WHO, 2001)

Following are different types of HCW according to WHO 2013:

a) Sharp Waste

In healthcare facilities different types of items are used like needles, scalpels, or blades, knives, infusion sets, saws, broken glass and pipettes. These items are usually considered highly hazardous and infections. Because of their sharpness these items could cut or puncture wounds and hence, should be treated as if they were potentially infected.

b) Infectious waste

Infectious waste is material suspected to contain pathogens (bacteria, viruses, parasites or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts. These include cultures and stocks of infectious agents from laboratory work; waste from surgery and autopsies on patients with infectious diseases, e.g. tissues and materials or equipment that have been in contact with blood or other body fluids, waste from infected patients in isolation

wards, e.g. excreta, dressings from infected or surgical wounds, cloths heavily covered with human blood or other body fluids; waste that has been in contact with infected patients undergoing hemodialysis, e.g. dialysis equipment, such as tubing and filters, disposable towels, gowns, aprons, gloves, and laboratory coats; infected animals from laboratories; any other instruments or materials that have been in contact with infected persons or animals.

c) Pathological waste:

Pathological waste consist of human tissues, organs, body parts, blood, body fluids, and other similar wastes from surgery, biopsies, and autopsies on patients with infectious diseases. It also includes human fetuses and infected animal carcasses.

d) Pharmaceutical waste:

Pharmaceutical waste includes expired, unused, spilt and contaminated pharmaceutical products, prescribed and proprietary drugs, vaccines and sera that are no longer required, and due to their chemical or biological nature, need to be disposed of carefully. The category also includes discarded items such as bottles, vials and boxes containing pharmaceutical residues, gloves, masks and connecting tubes. In addition sometimes this waste item includes toxic drugs such as genotoxic and cytotoxic drugs should be disposed of very carefully and after disposal this should be given special attention.

e) Chemical waste:

Chemical waste consists of discarded solid, liquid and gaseous chemicals, such as solvents, film developer from diagnostic and experimental work and from cleaning and disinfecting procedures, chemical waste also includes toxic, corrosive, flammable, explosive, or carcinogenic, reactive and oxidizing and considered to be hazardous.

f) Radioactive waste:

Radioactive wastes are materials contaminated with radionuclides. They are produced as a result of procedures such as in vitro analysis of body tissue and fluid, in vivo organ imaging and tumor localization and various investigative such as x-ray and therapeutic practice.

g) Pressurized containers:

Various types of gas are used in healthcare and are often stored in pressurized cylinders, cartridges and aerosol cans. Many of these, once empty or of no further use (although they may still contain residues), are reusable, but certain types-notably aerosol cans-must be disposed of.

h) Waste with high content of heavy metals:

These types of wastes are highly toxic. Mercury wastes are typically generated by spillage from broken clinical equipment, but their volume is decreasing with the substitution of solid-state electronic-sensing instruments, such as batteries, broken thermometers, blood pressure gauges, etc.

2.4 Sources of healthcare waste

According to WHO, (2013) the primary sources of medical waste are given as follows:

- University, General and district hospitals
- Clinics
- Emergency medical care services
- Healthcare centers and dispensaries
- Research laboratories/dialysis center
- Blood banks and blood collection services
- Nursing homes for the elderly

2.4.1) Associated Risk

General, non-hazardous waste from HCE poses the same hazards as general solid waste, but medical or clinical waste poses significantly increased hazardous. The most obvious of these is the transmission of infectious diseases (e.g. Hepatitis B and HIV/AIDS) through direct contact with infected waste items such as used needles, discarded dressings and human tissues or fluids. Non-direct risks include disease transmission by vectors and pollution of water sources and the environment. Less common potential risks include the risk of cancer, burns and skin irritation from radioactive waste or toxic chemicals (Harvey, Baghri and Reed, 2002)

2.4.2) Transmission Pathways

- Direct contact
- Contact through vector
- Airborne transmission
- Pollution of water sources
- Pollution of the environment
- Contamination of soil (dump/disposal site)

2.4.3) Person at Risk

- Medical authorities/staffs
- Medical waste workers/handlers
- Waste pickers/sanitation labors
- Children (around the disposal sites)
- Drug addicts (who scavenger for used needles and disposed medicine)
- Patients/visitors/general public

2.5 Issues Associated with Medical waste and it's Management

Globally, HCW issues have been seriously considered and many efforts have been given and several initiatives have been already taken at international level to minimize hazards associated with HCW (Muduli and Barve, 2012). But in several developing countries include Bangladesh, medical waste management has not received sufficient attention (Hassan, Ahmed, Rahman and Biswas, 2008). Health issues, in this countries are very often treated and managed with very limited resources (Aziz, 2011). While in developed countries, legislation and good practices guidelines define medical wastes and state the various possible ways for collection, transport, storage and disposal of such wastes (Kheradpisheh and Salehii, 2013). On the other hand, in many countries, hazardous and medical waste are still handled and disposed of together with domestic wastes, and creating a great health risk to municipal workers, public as well as the environment. So it has become a critical issue from the last three decades as it poses potential health risks and damage to the environment and this issue has taken a central place in the national health policies of many countries.

However, if the waste management is not planned properly it could be dangerous and give additional risk especially for the workers and patients. When hazardous healthcare wastes are

not properly managed, exposure to them could lead to infections, infertility, genital deformities, hormonally triggered cancers, mutagenicity dermatitis, asthma, Aids and etc. After that, infections from the waste also can spread any bacteria, viral parasites and fungi especially for the patients (Aziz, 2011). Lack of awareness regarding health hazards are related to healthcare waste, inadequate training in proper waste management, absence of waste management and disposal systems, insufficient financial and human resources and these are the most common problems which are connected with the management of healthcare waste. An essential issue is the clear attribution of responsibility for the handling and disposal of waste (Nwachukwu, Orji and Ugbogu, 2013).

Healthcare waste management includes all activities involved in waste generation, segregation, transportation, storage, treatment and final disposal of all types of waste generated in the healthcare facilities, stages of which require special attention (Muduli and Barve, 2012) Management of healthcare waste is inevitable to avoid health hazard. Many countries are facing this problem mainly developing countries (Abbasi, 2013). Management of healthcare waste should be sustainable, environmentally safe, economically affordable and socially acceptable (Robert and Ananias, 2013). WHO recommended that healthcare waste management should put into a systematic, comprehensive framework, and should become an essential feature of healthcare services and WHO has advocated that medical waste should be treated as special waste (Tiong, Latiff and Karuppanan, 2012). The inadequate knowledge of waste management in the hospital would result in poor attitude of the practitioners towards waste management and its proper management will help to minimize the amount of waste that has the potential to cause disease (Adumanya, Ebinyasi and Nwachoko, 2013).

In Bangladesh, proper medical waste management is a new phenomenon and the government is trying to develop a new and modern approach to deal with the medical waste properly. PRISM Bangladesh (Project in Agriculture, Rural Industry, Science and Medicine), a reputed national NGO in Bangladesh, with the financial support from Canadian International Development Agency (CIDA) has recently developed a disposal facility for low cost medical waste treatment and management in Dhaka City (Shareefdeen, 2012). There is no particular national policy on medical waste management in Bangladesh. For a proper and scientific management of medical waste, the government should give priority in formulating a policy (Dana, 2011). Proper management of healthcare wastes can prevent cross infection, and 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 and at the same time there is also lack of available budget to implement the schemes of collection, treatment and disposal of hospital wastes separately (Rahaman & Rahman, 2010).

2.6 Healthcare waste statistics in DSCC, Bangladesh

Bangladesh is one of the most densely populated south Asian countries with more than 150 million population overburdened with medical wastes, industrial wastes, municipal solid wastes, sanitation congestion, lack of water supply, air pollution, traffic jam, and with all, an obvious unsustainable environment (Biswas, Amanullah & Santra, 2011). Dhaka is the capital city of Bangladesh, divided into two city corporation areas such as DNCC and DSCC, is also one of the fastest growing cities in terms of its rapid urbanization and population. Expansion of the city is limited due to physical constraints. According to the Directorate General of Health (DG Health), Government of Bangladesh, there are more than 1200 HCEs situated in Dhaka city, generating an estimated 200 tons hospital waste a day and 40 tons of which are infectious waste. And only 377 HCEs situated in DSCC area and generating 26 tons/day where 19 tons/day are non-hazardous and near 7 tons/day are hazardous and only 635 HCEs situated in DNCC area is generating 22 tons/day where 17 tons/day are non-hazardous and about 5 tons/day are hazardous (PRISM Bangladesh, 2013). In this estimate the hazardous waste generation of DSCC area is higher than DNCC area, where the HCEs of DNCC area is again higher than DSCC area.

2.7 Healthcare waste Management Situation in DSCC, Bangladesh

As a part of the developing world, Bangladesh is facing rapid growth of population, extensive health problems and low educational status which have a significant impact on its environmental health. Heavy influx of migrants; hospitals, private clinics and individual practitioners, dental clinics, diagnostic centers or pathology and big or small healthcare centers are a growing feature of healthcare provision. But the facilities for waste disposal from these increasing numbers of healthcare establishments cannot cope with the growing demands (PRISM Bangladesh, 2013). The country has some 460 Upzilla level Hospitals and 9722 community level clinics and about 1449 outdoor health facilities at Union level that falls under DGHS. From some study it has been found that at district level there are about 117 hospitals that are currently functioning. Among the private hospitals, there are about 2501 registered hospitals and 5122 registered diagnostic center throughout the country. In

addition there are many clinics, including about 5000 Government and NGO run clinics and doctor's chambers where health care waste is generated (Dana, 2011).

Waste management and especially medical waste management is not only a big issue but it is now a big concern in many parts of the world including Bangladesh. About 89,945 kgs of medical waste are generated every day in Bangladesh and out of these about 22,486 kgs are highly infectious. Medical waste, which is also referred as clinical waste, has to be handled and disposed in a proper manner to eliminate the possibility infection and safe guarding the environment (Hamid et. al., 2013). There are no guidelines for the wastes handler. There is no segregation of wastes at the point of generation. Most HCEs dispose of their wastes to the nearest municipal dustbins without any hesitation. Some medical staffs earn income by selling used syringes and other healthcare wastes. There is a lack of awareness, concern, and knowledge of appropriate handling and disposal methods of hospital wastes at all levels. This low level of knowledge can elicit detrimental consequences at all levels. Most healthcare staffs are not aware of the proper management of wastes. Adequate and effective waste-management facilities are absent. Besides, the budget is meager for an effective implementation of safe disposal of hospital wastes. There is no specific clause pertaining directly to the handling, transportation, or disposal of healthcare wastes in Bangladesh Environmental Protection Act, 1995 (Nessa, Quaiyum, Khuda, 2001).

However, the situation is especially serious in Dhaka city the capital of Bangladesh. According to the Directorate General of Health (DG Health), Government of Bangladesh, there are more than 1200 HCEs situated in Dhaka city, generating an estimated 200 tons hospital waste a day and 40 tons of which are infectious waste (PRISM Bangladesh, 2013). According to DCC research report, only in Dhaka city, waste generated per person per day is about 0.5 kg and other research report found that, 4,500-5000 tons of wastes are disposed of everyday which include domestic, construction and only 1% of which is dangerous medical and bio-medical garbage. The unorganized disposal and improper dumping of such huge wastes has resulted in a serious threat for the city's environment (Zerin, & Ahmed, 2009). When this small amount (1%) is not handled properly, it gets mixed with domestic solid waste, and the whole stream become potentially hazardous. 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 HCEs (PRISM Bangladesh, 2005). Until recently, there was no effective system for proper medical waste management in Bangladesh to protect environmental health

hazards. A good number of national and international studies reported that, there have been very limited good practices of dumping or of disposal of healthcare wastes in Bangladesh. While healthcare facilities in industrially developed countries have followed certain safety standers to minimize the health risk resulting from medical waste, the situation of risk minimization is not satisfactory at all in Bangladesh (Biswas, Amanullah and Santra, 2011). Wastes are usually stored inside the hospital without brothing the dire consequences. The present mode of hospital wastes disposal is to dump the waste in the dustbin in or outside hospital premises and out skirts of the city for onward disposal by municipal authority. The municipal authority generally dumps those hazardous alone with other wastes stream on vacant land in the name of disposal but this improper disposal of medical waste may include damaged to humans by sharp instruments, diseases transmitted to humans by infectious agents, and contamination of the environment by toxic and hazardous chemicals (Hassan, Ahmed, Rahman and Biswas, 2008); (Biswas, Amanullah and Santra, 2011). But very recently, government is trying to develop a system handle medical waste properly. Now-a-days, the attitudes of the operators of HCEs in Dhaka city have been changed to incorporate proper HCWM practices in their daily operations. Awareness has been created among the stakeholders that, HCWM are essential to improve hospital management practices (Hassan, 2006); (Razzak, Chowdhury and Chowdhury, 2014). The DCC is responsible for maintaining public health, sanitation and collection and disposal of municipal solid waste although, it is in shortage of sufficient capacity. Currently, DCC is working with a non-profit organization naming 'PRISM Bangladesh' to collect and dispose of medical waste (Hamid et. al., 2013).

There will be very few hospitals where medical waste is properly managed. There are no particular guidelines of the proper management of hospital wastes and no perfect segregation of wastes at the point of generation. Most of the healthcare establishments (HCEs) dump their wastes to the nearest municipal dustbins. Some medical staffs earn income by selling used syringes, saline bags and other healthcare wastes. There is a lack of awareness, concern and knowledge of appropriate handling, storage and disposal methods of hospital wastes at all levels and no specific rule or law pertaining directly to the handling, transportation, treatment or disposal of healthcare waste in the Bangladesh Environmental protection Act. 1995. Consensus among the owners of private clinics and the policy-makers of the government and non-government organizations (NGOs) is also scarce which is crucial for healthy environment in the healthcare facilities (Visvanathan and Adhikari, 2006); (Nessa, Quaiyum and Khuda, 2001).

Neither the government nor hospital authorities pay proper attention to the matter of healthcare waste. Recently a law has been proposed to handle medical waste properly, but it needs to be adopted and enforced as soon as possible. The department of Environment has developed a Hospital Waste Pocket Book in 2004 which was revised in June, 2010. This book is supported by Medical Waste Management Rules 2008. The Pocket book includes all standard procedures for proper management system for all healthcare establishments (HCEs) and clearly indicates types of hospital waste along with the color codes for waste segregation and it also includes who should handle the waste and ways in which the waste should be transported and stored the hospital premises. However, it does not include an appropriate, safe and cost-effective strategy and only concerns itself with treatment, recycling, transport and disposal options (Dana, 2011). But 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 workers for infection control; or an operational infection control committee to monitor or prevent infection even in their premises (Rahman and Muyeed, 2010).

Improper medical waste management is alarming in Bangladesh and it poses a serious threat to public health. The collection, storage and disposal of medical wastes are a growing environmental problem in Bangladesh. However, research on this critical issue has been very limited and there is a serious dearth of practical and accurate information (Hassan, 2006).

This study reviews the current situation of HCWM and practices in Dhaka South City Corporation and fill up the gap of HCWM of this area, where all of data has collected from latest accurate information through proper research, statistical analysis of the data and establishment of data base has conducted to find out all the deficiency and strategy for developing the management of medical waste. Similar type of study also held on previous time for Dhanmondi area of Dhaka city, DCC North and South area surveyed by PRISM Bangladesh (NGO) in 2013, but no particular research has been conducted in Dhaka south city corporation (old Dhaka) area.

2.8 Conclusion

However, a good number of researches were conducted regarding this issue and in this chapter an effort is given to enumerate those studies for a better understanding regarding this issue. All the information and listings are made in this chapter are collected from different books, articles, journals, papers, thesis reports and internet to help assessing the issue critically.

CHAPTER-3

Research Methodology

3.1 Introduction

Methodology is an assembled form of some systems or manners to achieve the importance of a research. The methodology of the study included empirical field observations, field level quantitative data collection through inventory, questionnaire survey, formal and informal interviews, secondary data collection by published-unpublished sources, using SPSS software for primary data analysis, related statistical test for analyzing/quantifying data, and laboratory analysis also conducted for understanding the impact of MW.

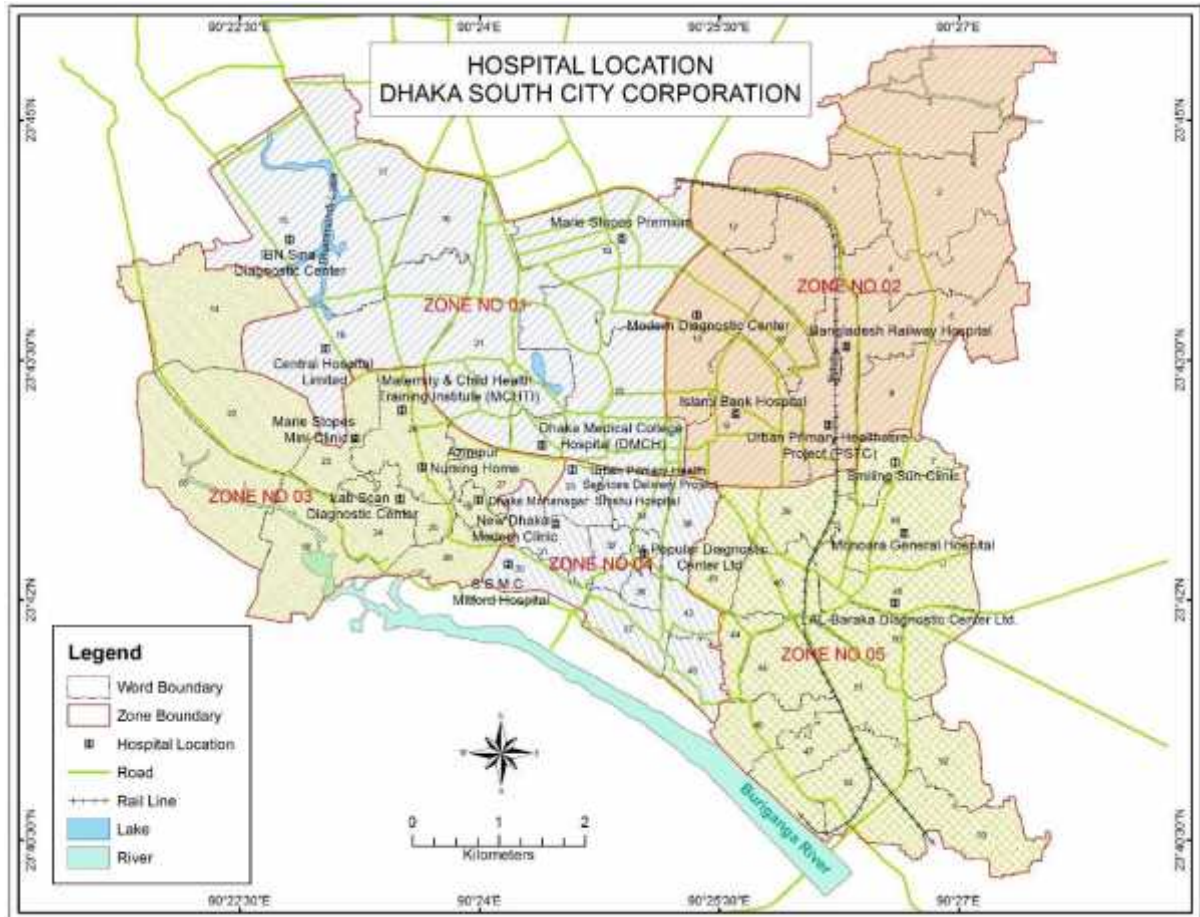
The questionnaire was selected as a means of collecting information from HCEs by a field survey of DSCC area and the information was also collected from different staffs of the selected 20 HCEs in this area.

Close and in-depth-interviews were also conducted for understanding the problem and issue related to the study.

After the data collection they were analyzed by using SPSS software (version-16) and another statistical test included for analyzing.

3.2 Study Area

Five zones of south DCC Were selected for the study. South DCC is a densely populated area and the generation of hospital waste of this area is also higher than any other area of Dhaka city. The DMCH and S.S.M.C Mitford located in this area and these are the largest hospitals in Bangladesh and the significant share of hospital wastes were generated from DMCH and S.S.M.C Mitford.



Map 1: Study Area Map (Hospital Location DSCC)

Source: Field Survey and GPS (Hospital Location) value plotting Using ArcGIS 10.1

3.3 Sample Size

The Government and private medicals, hospitals and clinics, diagnostic centers and small healthcare centers of south DCC were purposively included in the study and overall 20 HCEs has been selected for the survey, where 5 hospitals, 5 private clinics, 5 diagnostic centers and 5 small healthcare centers were included as well.

3.4 Study Design and Methodology

An overall study design has been conducted in order to achieve the aims and objectives of the recent study. The following chart is showing the conceptual framework of the study:

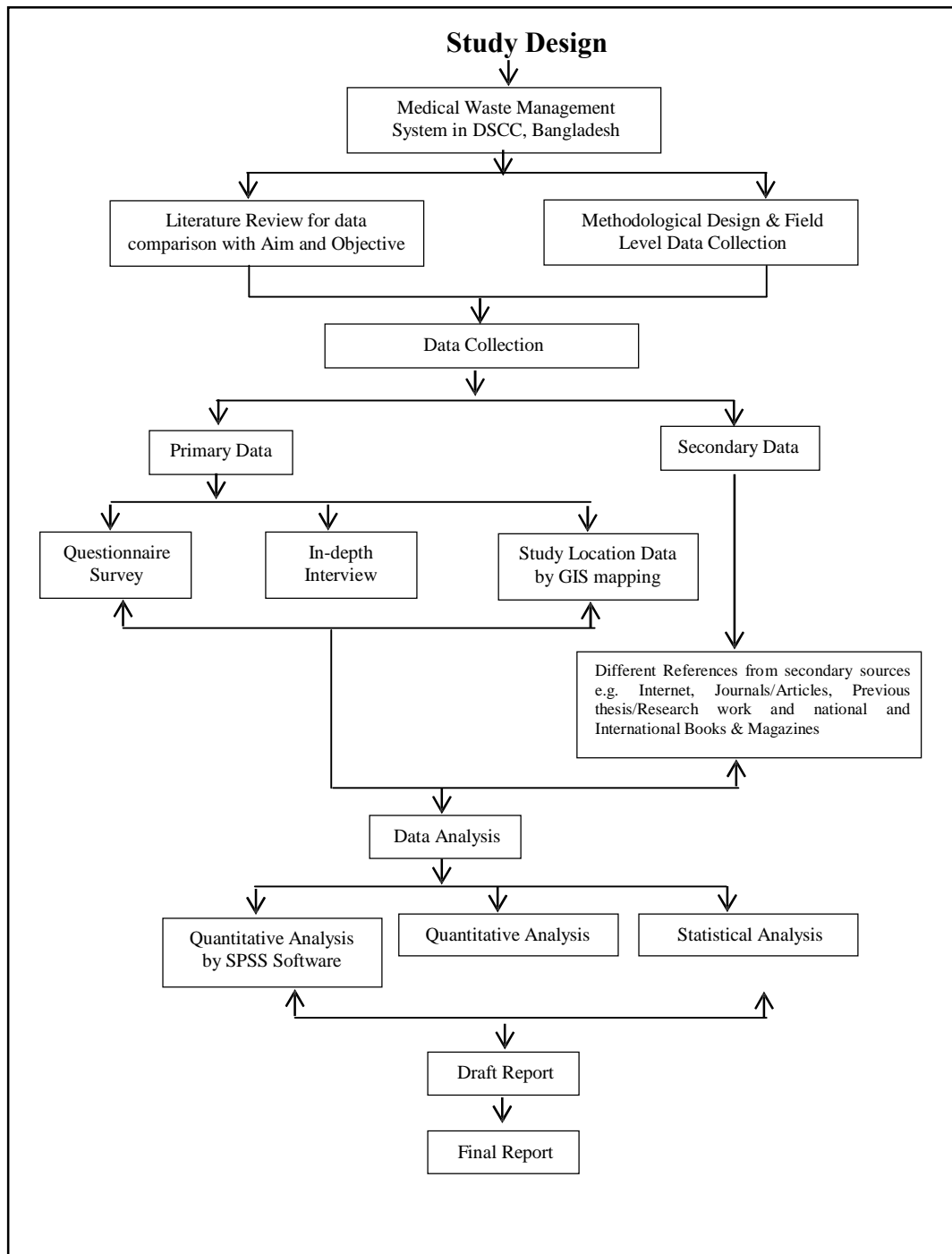


Figure 3.1 Flow chart of conceptual framework

The methodology of the research framework is given below:

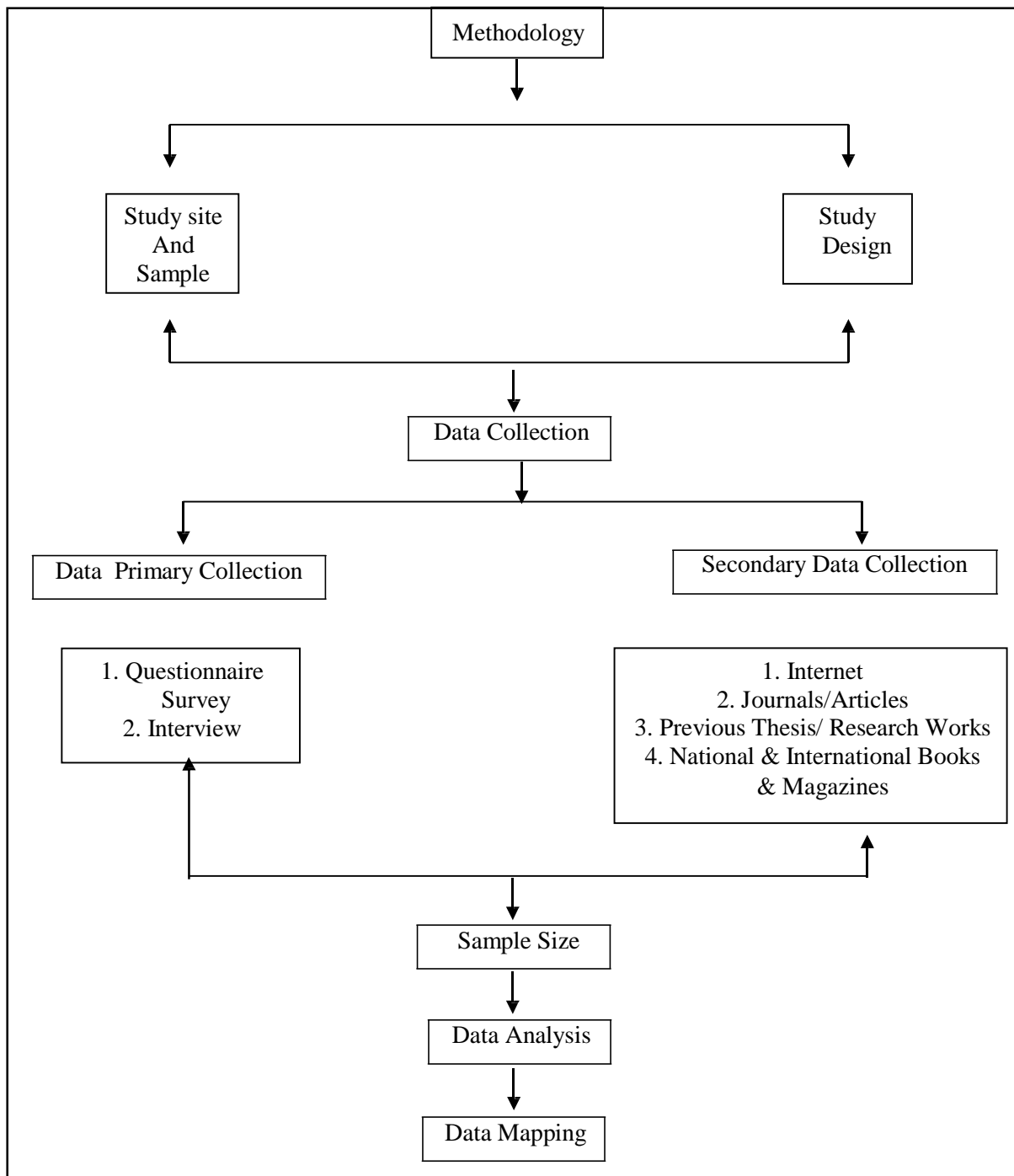


Figure 3.2: Schematic Diagram of the Research Methodology

3.5 Data Types

The data has been collected by two ways such as primary data collection method and secondary data collection method. The primary data has been collected by quantitative and qualitative approaches. And the secondary data has been collected from secondary sources and literature survey. All these data have been collected between August, 2013 and December, 2013.

3.5.1 Primary Data Collection

The primary data was collected from different sources and approaches, such as quantitative & qualitative. A semi-structured and self-administered questionnaire survey has conducted to obtain quantitative data about the waste generation, collection, segregation, storage, and treatment and disposal by interviewing 20 respondents who were associated with medical waste management such as waste manager, staffs, labors and workers. They were questioned in order to understand the approximate amount of daily waste generation, waste types & sources, handling, storage, treatment and disposal. Similarly, several questionnaire surveys have been done for comprehending the best waste management practices in the HCEs in DSCC area. Close and in-depth formal-informal interviews were conducted with 84 different respondents for interpreting the severity of health hazard due to medical waste and to understand their beliefs, experiences, attitudes, behaviors interactions and awareness among the problem and issue. This survey involved the directors, ascenders, in charges, administrative officers, doctors, medical officers, pathologists, lab technicians, matrons, nurses, paramedical staffs, and patients. In qualitative approach the waste manager was questioned to evaluate the healthcare guidelines and document, plans or policies. Overall 104 questionnaires have been conducted for field survey and primary data collection.

3.5.2 Secondary Data Collection

The methods used for collecting non-statistical data is known as secondary data, which has collected from secondary sources such as official documents, internet, journals or articles, previous thesis or research works, national and international books and magazines. It has discussed elaborately while reviewing the literatures.

3.5.3 Data Analysis by SPSS

The obtained quantitative data from questionnaire surveys were analyzed using SPSS software and statistical tools. Those data were recorded in SPSS software (Version- 16) and analyzed by descriptive statistical methods. Followed by this, they were illustrated and interpreted with a range of qualitative mode of analysis.

3.5.4 Statistical test

The gathering data has analyzed by some statistical tests. Which were also carried out for making the results.

3.6 Field observation

Field observations were done using a check list which included the inside and outside environment of the surveyed HCEs, the type and colors of bins/containers used for segregation and collection of waste, temporary and central storage facilities, on-site and off-site transportation, on-site treatment and final disposal etc. The waste generation sites both on-site and off-site dustbins, treatment and disposal sites were observed. The current waste management systems and practices of all surveyed HCEs were also analyzed.

3.7 Laboratory analysis

A laboratory analysis has been conducted for investigating the impact of hospital waste including solid and liquid. Liquid from the hospital drains and River and solid from hospital dustbins (where hospital wastes were dumped). The solid waste samples were collected from the dustbins inside and outside, and liquid from the different sources of the HCEs (drains and river).

3.8 Mapping Methods

GIS (Geographical Information System) was used as a spatial tool in this research in order to portray the study area and the locations of surveyed HCEs through a map. The hospital location map of Dhaka South City Corporation has been created by Arc GIS 10.1 version. The base map is collected from Dhaka South City Corporation and hospital locations are pointed out in the map based on their absolute location which is collected via a GPS (Global Positioning System) survey during field work. Hospital location is plotted by the WGS (World Geodetic System) x (Longitude) and y (Latitude) data. The spatial and attribute data are also involved in this technique. Some other statistical data was processed by using GIS tools and techniques.

3.9 Conclusion

This chapter mentioned the methodological plan and procedure to achieve the goal of the recent study and highlighted the techniques and tools for conducting the research systematically.

CHAPTER-4

ANALYTICAL RESULT OF THE STUDY

4.1) Introduction:

The management of waste, especially hospital waste, poses a major health problem in many countries. It is an ongoing problem mainly for the developing countries like Bangladesh. The scenario of medical waste management in different types and categories of hospitals is not satisfactory in this country because it is polluting the environment with toxic substances contributing to public health problem (DG Health, Training Manual, 2007). The generation of hospital waste will depend on factors such as the “type of healthcare establishment and the proportion of patients of treated on a day-care basis” (Mosia, 2006). When medical waste is generated as a result of treatment or diagnostic, it becomes necessary to manage those wastes systematically. The process of management ranges from separation to temporary storage to final disposal. So, separation of hazardous MW from non-hazardous is crucial. Because mixing of hazardous MW with non-hazardous may turn the whole waste stream into hazardous, and thus can increase the volume of waste that needs special treatment (Hamid et. al., 2013).The amount of waste generated by its sources, types and categories, their collection, handling, storage, treatment and disposal, plan, policy or guideline and best management practices has been investigated properly from four different categories HCE of DSCC area in this study and has been collected various data and information which may help to achieve the aim and objective of this study to make an acceptable result, which will fill-up the previous research gap.

4.2) Types and inventory of surveyed HCE in DSCC area:

A total of 20 different HCE have been investigated during the field survey of the study (Table-4.1). These HCEs have been selected from different wards of 5 different zones of DSCC area.

Table-4.1 Types and Inventory of surveyed Health care in DSCC area

Serial No.	Types of Healthcare Establishment				
	Hospitals	Clinics	Diagnostic Center	Small healthcare Center	Total
1.	Dhaka Medical College Hospital (DMCH)	Azimpur Nursing Home	AL-Baraka Diagnostic Center Ltd.	Marie Stopes Mini Clinic	4
2.	Bangladesh Railway Hospital	Central Hospital Limited	IBN Sina Diagnostic Center	Marie Stopes Premium	4
3.	Dhaka Mohanagar Shishu Hospital	Islami Bank Hospital	Lab Scan Diagnostic Center	Smiling Sun Clinic	4
4.	Maternity & Child Health Training Institute(MCHTI)	Monoara General Hospital	Modern Diagnostic Center	Urban Primary Health Care Project(UPHCP)	4
5.	S.S.M.C. Mitford Hospital	New Dhaka Modern Clinic	Popular Diagnostic Center Ltd.	Urban Primary Healthcare Project(PSTC)	4
Total	5 (25%)	5(25%)	5(25%)	5(25%)	20(100%)

Source: Field Survey 2013

Of this 20 HCEs, 5 government hospitals, 5 private clinics, 5 diagnostic centers and 5 small healthcare centers have been selected, and 4 different categories of HCE have been selected from each/per zone of DSCC area for different data collection and information. Their waste management has been observed also. It is noted here that there is no government owned hospital in zone five of DSCC area. The DMCH and SSMC Mitford, the biggest HCE and major sources of MW are not only in DSCC area but also in whole Bangladesh, which have been included in this study.

4.3) General information of surveyed HCE and its waste management:

This field survey shows that all the surveyed HCE offer medical facilities for about total 9264 patients per day resident or non-resident for about total 3127 facilities bed per day and the average bed occupancy rate is 70% with about total 6649 staffs or manpower (Table-4.2).

Table-4.2 General information of surveyed HCEs

Sl. No.	Name of Hospital/ Health care	Total Beds/day	Bed occupancy rate per day/%	Total Patients/day	Total Staffs
1	Dhaka Medical College Hospital (DMCH)	1700	96%	3600	2000
2	Central Hospital Limited	220	75%	400	874
3	IBN Sina Diagnostic Center	-	-	1050	464
4	Marie Stopes Premium	25	80%	37	34
5	Bangladesh Railway Hospital	75	75%	125	78
6	Islami Bank Hospital	106	94%	906	581
7	Modern Diagnostic Center	-	-	200	83
8	Urban Primary Healthcare Project(PSTC)	-	-	35	18
9	Dhaka Mohanagar Shishu Hospital	100	80%	420	90
10	Maternity & Child Health Training Institute(MCHTI)	200	80%	520	1000
11	Azimpur Nursing Home	10	70%	20	11
12	Lab Scan Diagnostic Center	-	-	20	8
13	Marie Stopes Mini Clinic	3	90%	18	6
14	S.S.M.C. Mitford Hospital	600	90%	1100	1000
15	New Dhaka Modern Clinic	50	90%	310	185
16	Popular Diagnostic Center Ltd.	-	-	200	80
17	Urban Primary Health Care Project(UPHCP)	5	80%	65	18
18	Monoara General Hospital	30	95%	55	67
19	AL-Baraka Diagnostic Center Ltd.	-	-	150	40
20	Smiling Sun Clinic	3	90%	33	12
	Total=	3127	70%	9264	6649

*Bed occupancy rate= (Total bed-Inpatient) *Total Patients = (Total bed+ Outpatients)

Source: Field Survey, 2013

It was observed during the field survey that of all surveyed HCEs, DMCH is the highest with its total beds (1700), bed occupancy rate (96%), total patients (3600), and its total manpower (2000), (Table-4.2) and (Figure-4.1; 4.2; 4.3 accordingly). It was also observed that, the surveyed all govt. HCEs were highest by their total beds/day, bed occupancy rates/day, total patients/day and total manpower/staffs.

Figure-4.1 General profile about total bed and bed occupancy rate of surveyed HCE

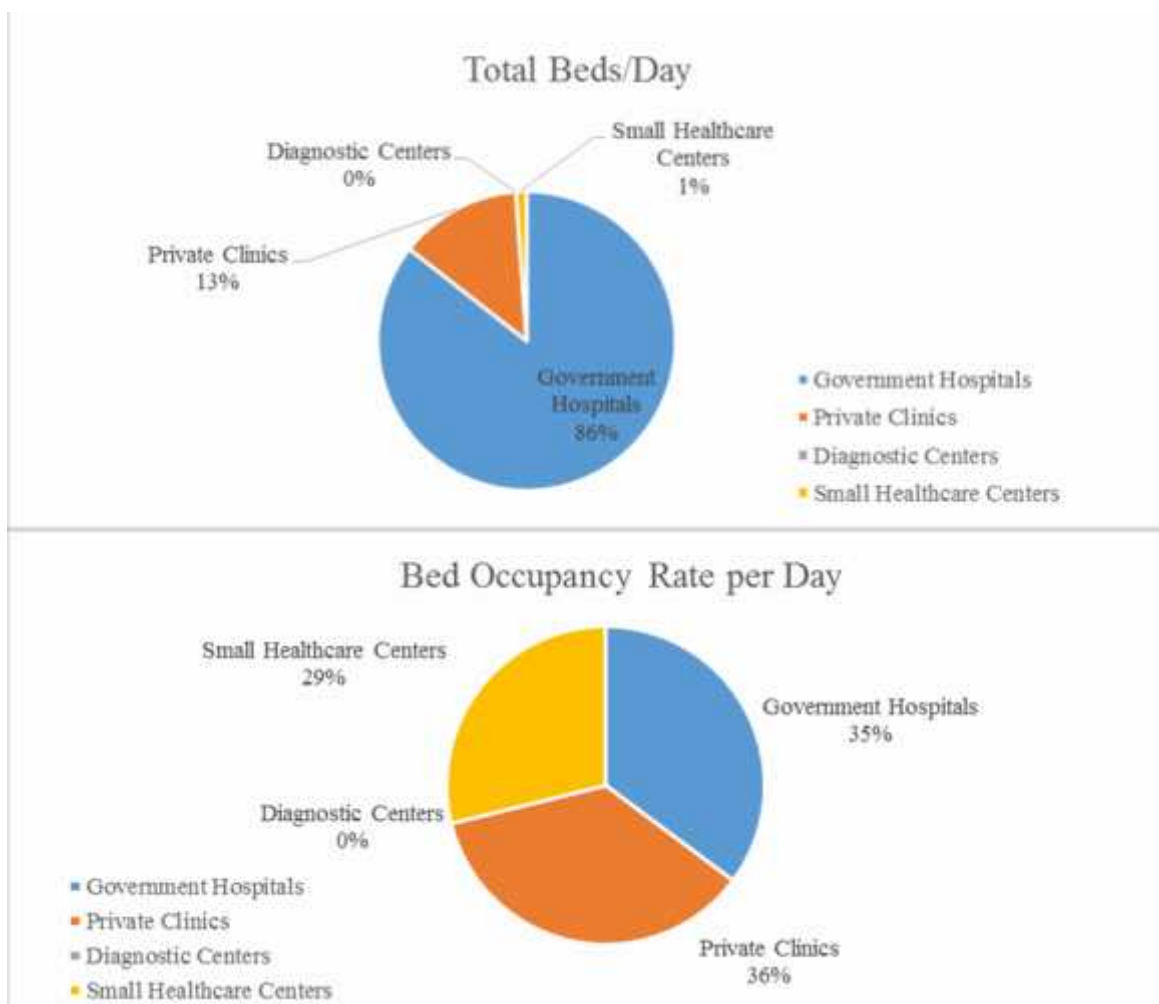


Figure 4.2 Total patients of the surveyed HCE

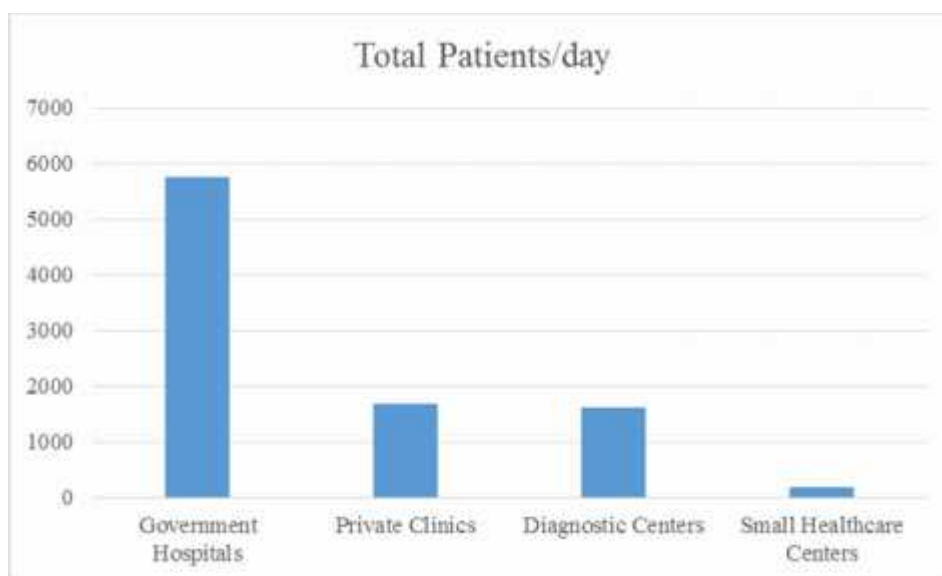
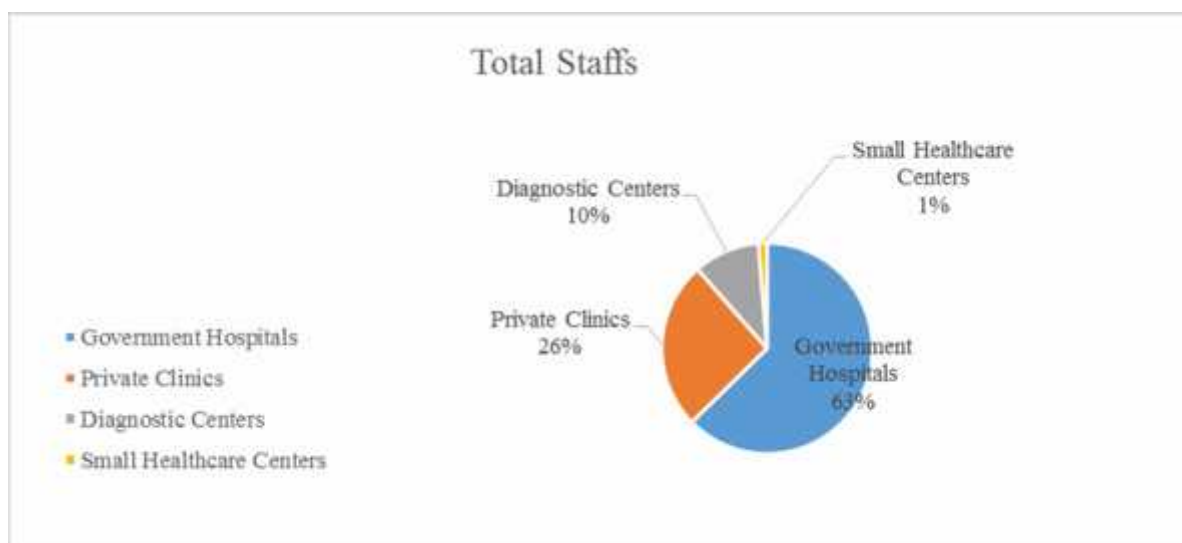


Figure-4.3 General profile of manpower of surveyed HCE



4.4) General profile of respondents:

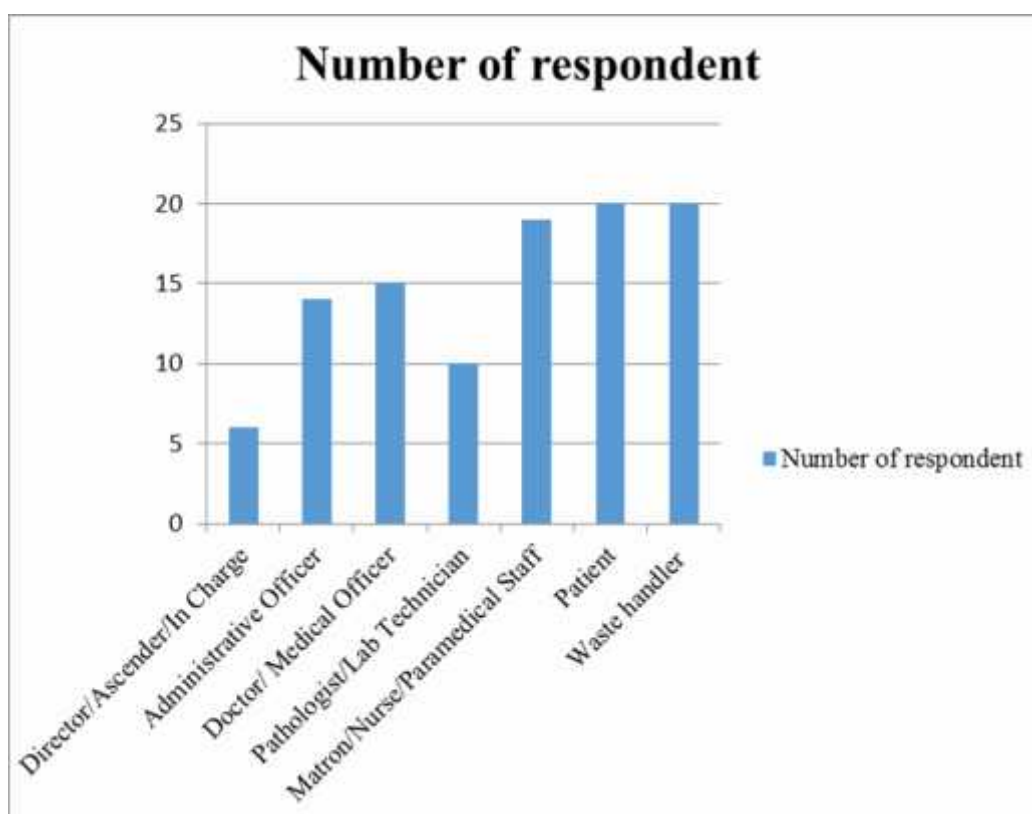
Two types of questionnaire survey with some in-depth interview with 104 different respondents have been conducted for field level data collection from all categories of HCE, where there are authority and management related persons, administrative related persons, doctors, pathologists, matrons or nurses, laboratory technicians, patients and waste related staffs (waste manager, ward master, ward boy, sweeper/cleaner/ayah) has been included (Table-4.3 & Figure-4.4).

Table-4.3 General profile of the respondent

Sl. No.	Designation of the respondent	Gender		Average age(Years)	Total respondent
		Male	Female		
1	Director/Ascender/In Charge	4	2	52	6(5.77%)
2	Administrative sector	12	2	46	14(13.46%)
3	Doctor/ Medical Officer	6	9	41	15(14.42%)
4	Pathologist/Lab Technician	9	1	36	10(9.62%)
5	Matron/Nurse/Paramedical Staff	0	19	39	19(18.27%)
6	Patient	7	13	41	20(19.23%)
7	Waste handler	8	12	42	20(19.23%)
		46	58	42.43	104(100%)

Source: Questionnaire Survey, 2013

Figure-4.4 General profile of respondent of all surveyed HCE



Source: Questionnaire survey, 2013

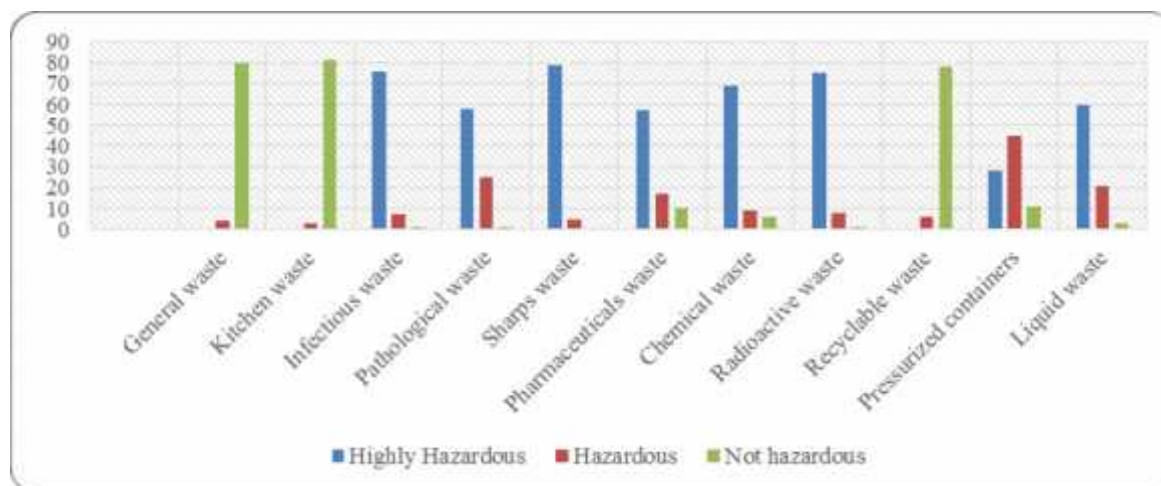
20 waste related staffs were interviewed out of 104 (Figure-4.4) for the information of MW generation, collection, storage, treatment and disposal. Due 84 respondents including the authority, management, administrative and other general staffs who were interviewed in this study for understanding their opinions about the hazards of different types of hospital waste, where 38 male respondents and 46 female respondents were included and 54.33% said highly hazardous, 16% said hazardous and 29.44% said not hazardous (Table-4.4 & Figure-4.5).

Table 4.4 General Profile about the knowledge about the hazards of MW

Sl. No.	Waste Type	Highly Hazardous	Hazardous	Not hazardous	Responses		Total Respondent
					Male	Female	
1.	General waste	0	4	80	38	46	84
2.	Kitchen waste	0	3	81	38	46	84
3.	Infectious waste	76	7	1	38	46	84
4.	Pathological waste	58	25	1	38	46	84
5.	Sharps waste	79	5	0	38	46	84
6.	Pharmaceuticals waste	57	17	10	38	46	84
7.	Chemical waste	69	9	6	38	46	84
8.	Radioactive waste	75	8	1	38	46	84
9.	Recyclable waste	0	6	78	38	46	84
10.	Pressurized containers	28	45	11	38	46	84
11.	Liquid waste	60	21	3	38	46	84
	Total=	502	150	272	418	506	N= 84
	%	54.33%	16.23%	29.44%	45.24%	54.76%	100%

Sources: Different respondents by interviews, 2013

Figure 4.5 General profile of the opinions from different staffs about hazards of medical waste



Sources: Different respondents by interviews, 2013

4.5) Medical waste generation, composition and quantification by sources, types and categories:

Medical waste, due to its contents of infectious materials and other hazardous substances, poses serious threats to environment and related health (Hassan M.M., 2006). Medical wastes, which are generated from total activities performed in the different HCEs, were in two categories such as the small component of hazardous waste is risk for public and environmental health and the large component of non-hazardous waste is similar to municipal waste and should not pose any higher risk (WHO, 2013). The waste generation depends on variable hazard of HCE such as hazardous and non-hazardous (Table-4.5 & 4.6).

Table-4.5 Waste generation by types and categories

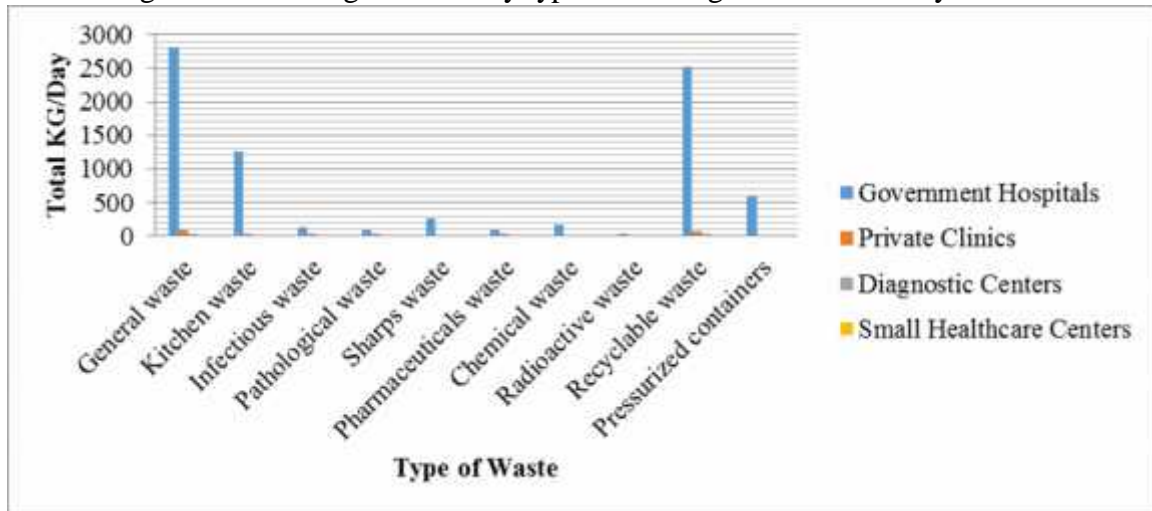
Sl. No.	Types of waste	Type of HCE				Total kg/day
		Government Hospitals(kg/day)	Private Clinic(kg/day)	Diagnostic Centers(kg/day)	Small Health care center(kg/day)	
1	General waste	2816	86	27	16	2945
2	Kitchen waste	1254	33.5	-	3.5	1291
3	Infectious waste	127	39.5	6	4.5	177
4	Pathological waste	96	25.5	6.5	1	129
5	Sharps waste	253	19.5	5.5	4	282
6	Pharmaceuticals waste	86.5	34.5	-	-	121
7	Chemical waste	166	22.5	3.5	3	195
8	Radioactive waste	32	2	-	-	34
9	Recyclable waste	2515	76.5	28.5	13	2633
10	Pressurized containers	594	18	5	1	618
***	Total generation	7939.5	357.5	82	46	8425
A	Total hazardous waste	1354.5	161.5	26.5	13.5	1556
B	Total non-hazardous waste	6585	196	55.5	32.5	6869

Sources: Different respondents by interviews, 2013

The non-hazardous waste includes general kitchen and recyclable categories e.g. wool, paper, box, carton, bandage, plastic/polythene and food items. The hazardous waste includes infectious, pathological, sharps with used and unused needle and syringes, pharmaceutical, chemical, radioactive and pressurized container (Figure-4.6).

The highest component of waste in all HCEs has been found general waste (total 2945kgs/day of 6869 kgs) , where included paper, box, carton, newspaper, plastics, polythene, wool, bandage, textile, vegetable-rubbish and other general materials as non-hazardous category and the lowest component of waste has been found radioactive waste (total 34kg/day of 1556 kgs) as hazardous category(Figure-4.6).

Figure-4.6 Waste generation by types and categories from surveyed HCE



The total waste generation has been found 8425 kgs/day. The total hazardous waste generation rate obtained 1556 kgs/day (18.47%) and non-hazardous 6869 kgs/day (81.53%) from surveyed HCE, (Table-4.6) where the government hospitals generated hazardous waste 1354.5 kgs/day (16.07%) and non-hazardous waste 6585 kgs/day (78.16%); the private clinics generated hazardous waste 161.5 kgs/day (1.92%) and non-hazardous waste 196 kgs/day (2.33%); the diagnostic centers generated hazardous waste 26.5 kgs/day (0.13%) and non-hazardous waste 55.5 kgs/day (0.66%) and the small healthcare centers generated hazardous waste 13.5 kgs/day (0.19%) and non-hazardous waste 32.5 kgs/day (0.39%)(Table-4.7).

Table 4.6 Total Generation of Hospital Waste in DSCC

Sl. No.	HCE	Hazardous wastes Kg/day								Non-hazardous wastes Kg/day				Total Kg/day
		Infectious waste	Pathological waste	Sharps waste	Pharmaceutical waste	Chemical waste	Radioactive waste	Pressurized containers waste	Total (%)	General waste	Kitchen waste	Recyclable waste	Total (%)	
1	Dhaka Medical College Hospital (DMCH)	60	50	150	50	100	20	500	930	2000	1000	1100	4100	5030(59.70%)
2	Central Hospital Limited	20	20	10	15	10	1	10	86	50	15	45	110	196(2.33%)
3	IBN Sina Diagnostic Center	2	2	2	0	1	0	3	10	15	0	20	35	45(0.53%)
4	Marie Stopes Premium	1	0.5	2	0	1	0	1	5.5	5	1	5	11	16.5(0.19%)
5	Bangladesh Railway Hospital	1	0.5	0.5	0.5	0	0	2	4.5	6	2	10	18	22.5(0.27%)
6	Islami Bank Hospital	15	3	2	10	10	1	3	44	13	10	12	35	79(0.94%)
7	Modern Diagnostic Center	2	2	1	0	1	0	1	7	4	0	3	7	14(0.17%)
8	Urban Primary Healthcare Project(PSTC)	2	0	0.5	0	0.5	0	0	3	4	0.5	2	6.5	9.5(0.11%)
9	Dhaka Mohanagar Shishu Hospital	1	0.5	0.5	2	1	0	2	7	10	2	5	17	24(0.29%)
10	Maternity & Child Health Training Institute(MCHTI)	30	20	2	4	15	2	10	83	300	50	500	850	933(11.07%)
11	Azimpur Nursing Home	0.5	0	0.5	0.5	0	0	0	1.5	3	0.5	1.5	5	6.5(0.08%)
12	Lab Scan Diagnostic Center	0.5	0.5	0.5	0	0.5	0	1	3	2	0	1.5	3.5	6.5(0.08%)
13	Marie Stopes Mini Clinic	0.5	0	0.5	0	0.5	0	0	1.5	2	0.5	1	3.5	5(0.06%)
14	S.S.M.C. Mitford Hospital	35	25	100	30	50	10	80	330	500	200	900	1600	1930(22.91%)
15	New Dhaka Modern Clinic	2	2	4	4	2	0	3	17	5	3	8	16	33(0.39%)
16	Popular Diagnostic Center Ltd.	1	1	1	0	0.5	0	0	3.5	3	0	2	5	8.5(0.10%)
17	Urban Primary Health Care Project(UPHCP)	0.5	0	0.5	0	0.5	0	0	1.5	3	1	3	7	8.5(0.10%)
18	Monoara General Hospital	2	0.5	3	5	0.5	0	2	13	15	5	10	30	43(0.51%)
19	AL-Baraka Diagnostic Center Ltd.	0.5	1	1	0	0.5	0	0	3	3	0	2	5	8(0.09%)
20	Smiling Sun Clinic	0.5	0.5	0.5	0	0.5	0	0	2	2	0.5	2	4.5	6.5(0.08%)
	All surveyed HCE	177 (2.10%)	129(1.53%)	282 (3.35%)	121 (1.44%)	195 (2.31%)	34(0.40%)	618(7.34%)	1556 (18.47%)	2945 (34.96%)	1291 (15.32%)	2633 (31.25%)	6869 (81.53%)	8425(100%)

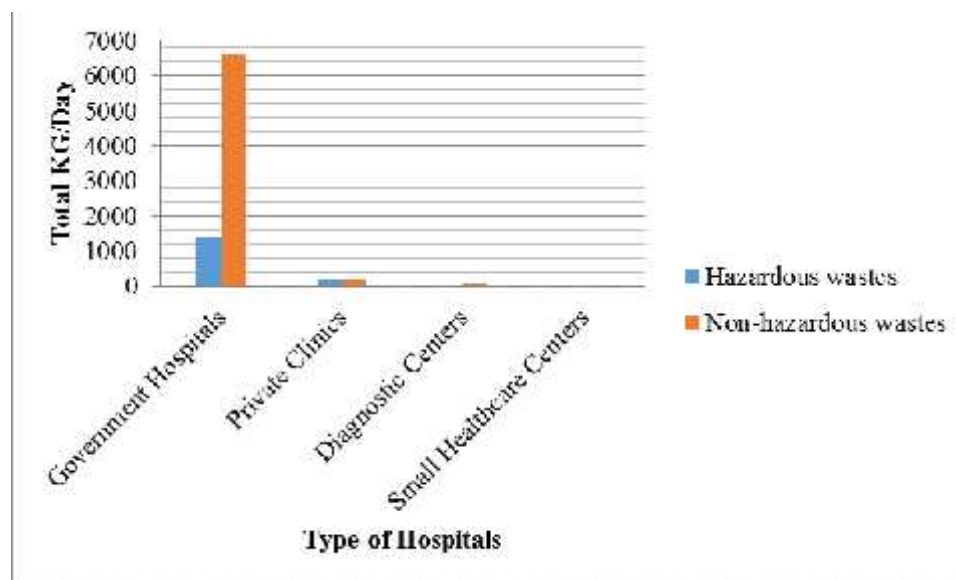
Table-4.7 Total hazardous and non-hazardous waste generation profile by all surveyed HCE

Type of wastes	Amount (in Kg)				Total (%)
	Government Hospitals	Private Clinics	Diagnostic Centers	Small Health care centers	
Hazardous wastes	1354.5(16.07%)	161.5(1.92%)	26.5(0.31%)	13.5(o.19%)	1556(18.47%)
Non-hazardous wastes	6585(78.16%)	196(2.33%)	55.5(0.66%)	32.5(0.39%)	6869(81.53%)
Total=	7939.5(94.23%)	357.5(4.25%)	82(0.97%)	47(0.68%)	8425(100%)

Source: Field survey, 2013

The government hospital is highest by their waste generation (94.23%) and the small healthcare is lowest by their waste generation (0.68%) (Figure-4.7).

Figure-4.7 Average waste generation rate from surveyed HCE



The quantities of medical waste generation depend on the status of the HCE, level of instrumentation and sometimes the location of medical facilities (Hassan, 2006). The surveyed all government HCEs generates total 7939.5 kgs/day, 2.97 kg/bed/day and 1.38 kg/patient/day, (Table-4.8). The surveyed all private HCEs generates total 357.5 kgs/day, 0.86kg/bed/day and 0.21 kg/patient/day. The surveyed all diagnostic centers generates total 82 kgs/day and

Table-4.8 Amount of generated waste of different categories of surveyed HCE

HCE	Patients			Waste generation rate		
	Beds	Out patients	Total Patients	Kg/Day	Kg/bed/day	Kg/patient/day
Govt. Hospitals	2675	3090	5765	7939.5	2.97	1.38
Private Clinics	416	1275	1691	357.5	0.86	0.21
Diagnostic Centers	-	1620	1620	82	-	0.05
Small Health care centers	36	152	188	46	1.28	0.24
All surveyed HCE	3127	6137	9264	8425	2.69	0.91

Sources: Questionnaire survey, 2013

0.05 kg/patient/day. The surveyed all small HCEs generates total 46 kgs/day, 1.28 kg/bed/day and 0.24 kg/patient/day. This study also observes that the average waste generation rate is 2.69/bed/day and 0.91/patient/day of all surveyed HCE on the basis of bed and patient.

4.6) Existing Scenario of Medical Waste Management in DSCC Area:

Medical waste management is a branch of the waste management field which focuses on medical and clinical waste generated in medical facilities like hospitals, clinics, nursing homes and pathology. A responsible medical waste management includes the generation, handling, storage, removal, transport and destruction or safe disposal of medical waste (<http://www.wisegeek.com>). In this study all of the waste management of surveyed HCE have been observed to obtain the best waste management practices.

4.6.1) Waste segregation:

Waste segregation is emergency at the point of generation by its categories. But during the field survey, there has not been found correct segregation practices in most of the surveyed HCE. There has also been found that maximum HCEs store their hazardous waste in the same containers of the general waste, and for this incorrect segregation practices the authorities are not getting any controlling measures.

Table-4.9. Different colors of waste bins

Color of Bins	Type of waste
Black	General waste/non-hazardous
Yellow	Infectious, Pathological, Anatomical /highly hazardous
Red	Sharps, needles and syringes
Blue	Liquid waste/chemical /hazardous
Green	Recyclable /non-hazardous

Source: Field survey, 2013

During the field survey, it is observed that most of the HCEs use 3 to 4 different colors of bin to segregate their waste; and after total survey it has been found that total 5 different colors of bin are used for segregating the wastes such as black bin for general waste; yellow bin for infectious, pathological and anatomical; red bin for sharps with used or unused needles and syringes; blue bin for liquid waste and green bin for recyclable (Table-4.9 & Photograph-4.1). There has not been found any color coded bin/container for segregating the radioactive waste. The DG Health and WHO select silver color coded bin for radioactive waste, which has not seen in any HCE during the field survey.

Photograph 4.1 Different colors of bins in surveyed HCE



Source: Field survey, 2013

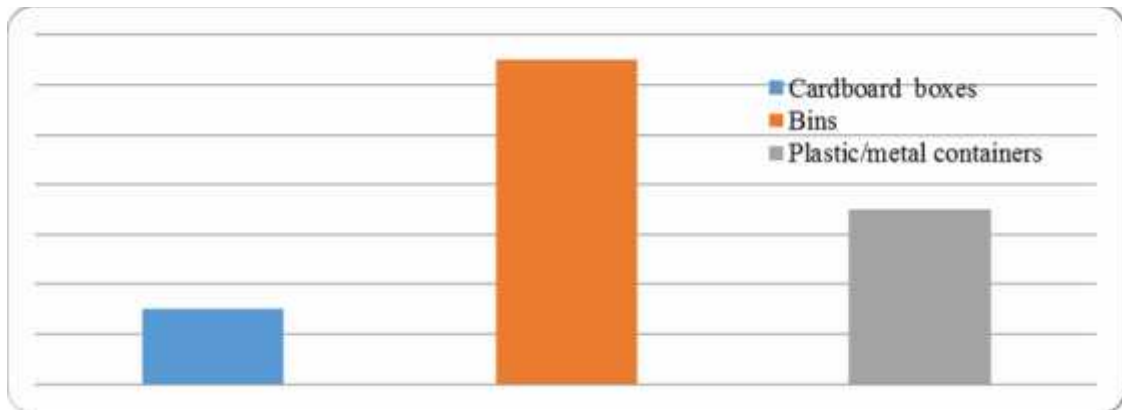
Table: 4.10 Type of used waste containers in all surveyed HCE

Sl. No.	Name of Hospital/ Health care	Type of containers for segregation		
		Cardboard boxes	Bins	Plastic/metal containers
1	Dhaka Medical College Hospital (DMCH)	-	-	Plastic/metal containers
2	Central Hospital Limited	-	-	Plastic/metal containers
3	IBN Sina Diagnostic Center	-	-	Plastic/metal containers
4	Marie Stopes Premium	-	-	Plastic/metal containers
5	Bangladesh Railway Hospital	-	Bins	-
6	Islami Bank Hospital	-	Bins	-
7	Modern Diagnostic Center	-	Bins	-
8	Urban Primary Healthcare Project(PSTC)	-	Bins	-
9	Dhaka Mohanagar Shishu Hospital	-	-	Plastic/metal containers
10	Maternity and Child Health Training Institute(MCHTI)	-	-	Plastic/metal containers
11	Azimpur Nursing Home	-	Bins	-
12	Lab Scan Diagnostic Center	-	Bins	-
13	Marie Stopes Mini Clinic	-	Bins	-
14	S.S.M.C. Mitford Hospital	-	-	Plastic/metal containers
15	New Dhaka Modern Clinic	-	Bins	-
16	Popular Diagnostic Center Ltd.	-	Bins	-
17	Urban Primary Health Care Project(UPHCP)	Cardboard boxes	Bins	-
18	Monoara General Hospital	Cardboard boxes	Bins	-
19	AL-Baraka Diagnostic Center Ltd.	-	Bins	-
20	Smiling Sun Clinic	Cardboard boxes	Bins	-
	Total=20	15%	65%	35%

Source: Field survey, 2013

The present study found mainly 2 types of waste containers during the field survey for segregating of waste such as different color coded bins and plastic/metal containers. Another has found card board boxes which use only for short time in few ECE. After total survey, it is found that color coded bin user HCE is 65%, plastic/metal containers user HCE is 35% and 15% HCE found with bins or container they also use reusable cardboard boxes for segregating general waste which uses only for short time (Table-4.10 & (Figure-4.8).

Figure-4.8 Types of waste containers of surveyed HCE



4.6.2) Storage of waste:

The place/storage where the hospital waste is kept before transporting to DCC bin is termed as a temporary waste storage (PRISM Bangladesh, 2005). The present study found all of the surveyed HCE has no secured temporary storage system. Without few, most of the HCE stored their waste temporarily in open space inside or outside of the hospitals, clinics, diagnostic centers and small healthcare centers. Although it is observed that all of the surveyed HCE has temporary storage system, but the system is improper (Table-4.11 & Photograph-4.2).

Photograph 4.2 Temporary storage system of MW in healthc



Source: Field survey, 2013

Table-4.11 Temporary storage system of surveyed HCE

Sl. No.	Name of Hospitals	Storage method		
		In healthcare waste container	In healthcare dustbin	Dustbin(outside)
1	Dhaka Medical College Hospital (DMCH)	In healthcare waste container	-	Dustbin(outside)
2	Central Hospital Limited	In healthcare waste container	-	-
3	IBN Sina Diagnostic Center	In healthcare waste container	-	-
4	Marie Stopes Premium	In healthcare waste container	-	-
5	Bangladesh Railway Hospital	In healthcare waste container	-	Dustbin(outside)
6	Islami Bank Hospital	In healthcare waste container	-	-
7	Modern Diagnostic Center	In healthcare waste container	-	-
8	Urban Primary Healthcare Project(PSTC)	In healthcare waste container	-	-
9	Dhaka Mohanagar Shishu Hospital	In healthcare waste container	-	-
10	Maternity & Child Health Training Institute(MCHTI)	In healthcare waste container	In healthcare dustbin	Dustbin(outside)
11	Azimpur Nursing Home	In healthcare waste container	-	-
12	Lab Scan Diagnostic Center	In healthcare waste container	-	-
13	Marie Stopes Mini Clinic	-	-	Dustbin(outside)
14	S.S.M.C. Mitford Hospital	In healthcare waste container	In healthcare dustbin	-
15	New Dhaka Modern Clinic	In healthcare waste container	-	-
16	Popular Diagnostic Center Ltd.	-	-	Dustbin(outside)
17	Urban Primary Health Care Project(UPHCP)	In healthcare waste container	-	-
18	Monoara General Hospital	In healthcare waste container	-	-
19	AL-Baraka Diagnostic Center Ltd.	In healthcare waste container	-	-
20	Smiling Sun Clinic	-	-	Dustbin(outside)
	Total=	70%	10%	30%

Source: Field survey, 2013

Most of the HCEs keep their waste in different types and shaped or designed of containers for storing, where most of these were kept in open place inside or outside the yard of HCE and few are kept in secured place. During the survey it has been found that total 70% of HCE stored in healthcare waste container, 10% of HCE stored inside the healthcare dustbin and 30% of HCE stored in the dustbin (outside).

4.6.3) Liquid waste generation and discharge system:

The field survey found that the liquid waste generation rate is total 759 liters/day, where the government hospitals generate 576 liters/day; the private clinics generate 139 liters/day; the diagnostic centers generate 30 liters/day and the small healthcare centers generate 14 liters/day (Table-4.12 and Figure-4.9 & 4.10). The water usage amount is total 28820 liters/day, where govt. hospitals 15000 liters/day; private clinics 8400 liters/day; the diagnostic centers 4300 liters/day and small healthcare centers 1100 liters/day.

Table-12. Liquid waste generation and water usage amount

HCEs	Liquid waste Generation Total/Liter/day	Water usage Amount Total/Liter/day
Govt. Hospitals	576	15000
Private Clinic/ Hospitals	139	8400
Pathology/ Diagnostic Centers	30	4320
Small Health care center	14	1100
Total= 20	759	28820

Source: Field survey

Figure-4.9 Liquid waste generation rate

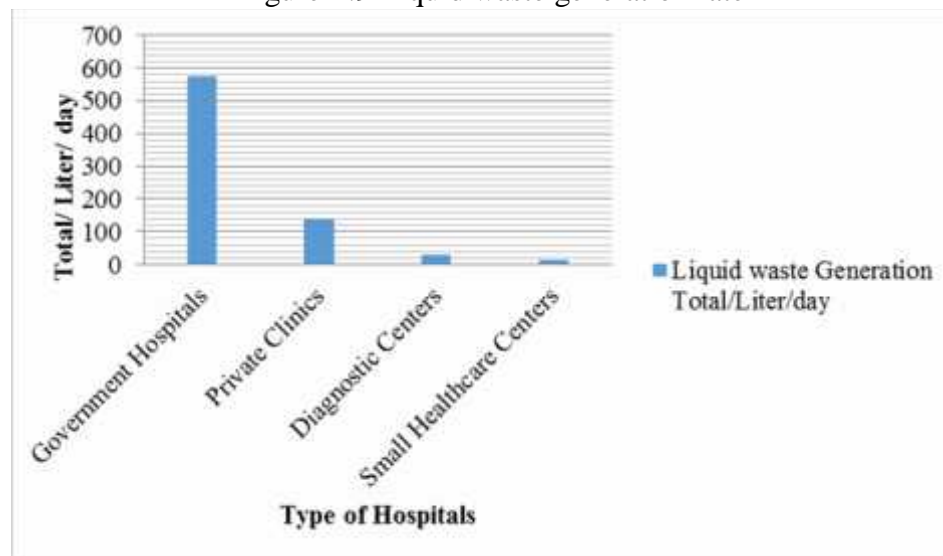
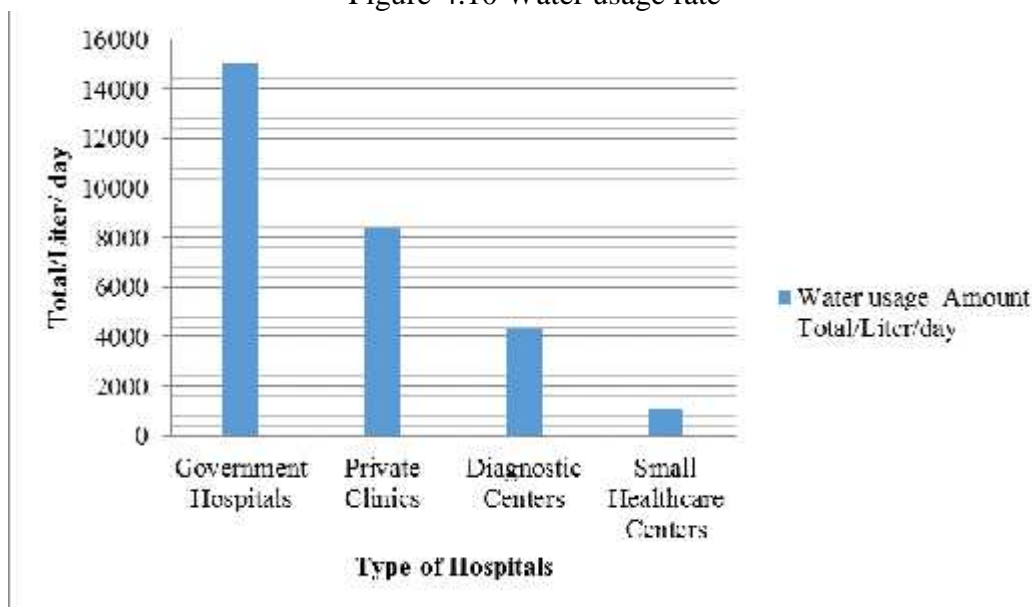


Figure-4.10 Water usage rate



Source: Field survey, 2013

4.6.4) On-site treatment and disposal

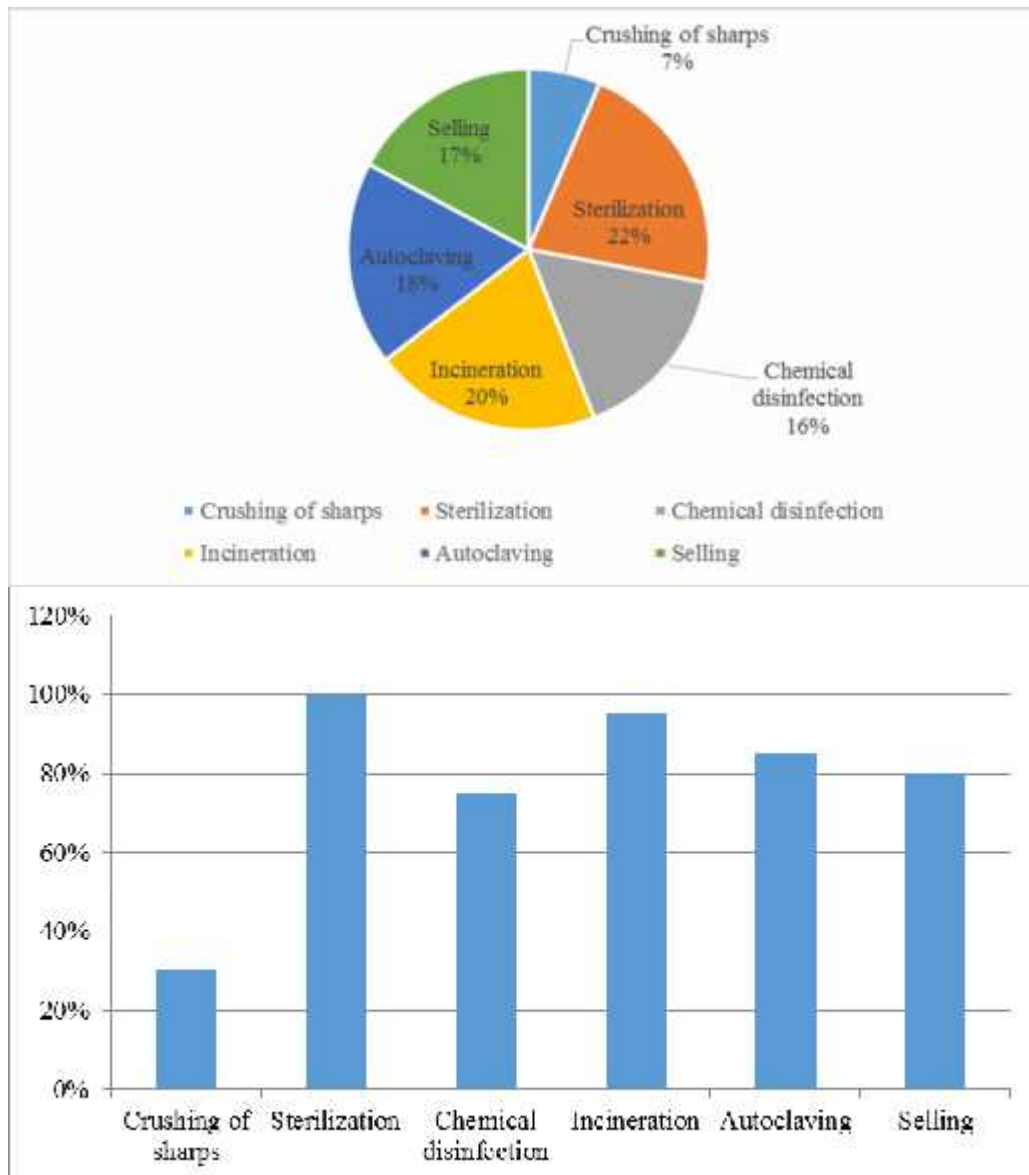
The on-site treatment or disposal practices/methods from total surveyed HCE have found crushing of sharps-30%; sterilization-100%; chemical disinfection-75%; incineration-95%; autoclaving-85%; and sold -80%(Table-4.13 & Figure-4.11)

Table-4.13 On-site treatment and disposal practices methods of all surveyed HCE

No	Type of practices methods	Total Uses (%)
1	Crushing of sharps waste	30%
2	Sterilization	100%
3	Chemical disinfection	75%
4	Incineration	95%
5	Autoclaving	85%
6	Selling	80%

Source: Questionnaire survey, 2013

Figure-4.11 On-site treatment and disposal practices methods of all surveyed HCE



4.6.5) Medical waste recycling in surveyed HCE:

It has been found that the 2nd highest generation rate is recyclable waste (total-2633kgs/day), which are collected by waste pickers and poor scavengers without taking any protective measure. It is almost a major threat to medical waste handler and scavenger, but action is not taken by the authority or management, and currently no facility has been established for operating with proper program for correct recycling (Photograph-4.3). Although, no extra color coded container has been selected by any organization or authority, most of the surveyed HCE collected their recyclable waste together with general waste container.



Photograph 4.3 Recyclable wastes were handled by scavengers (Source: Field survey, 2013)

4.6.6) Off-site transportation and final Disposal:

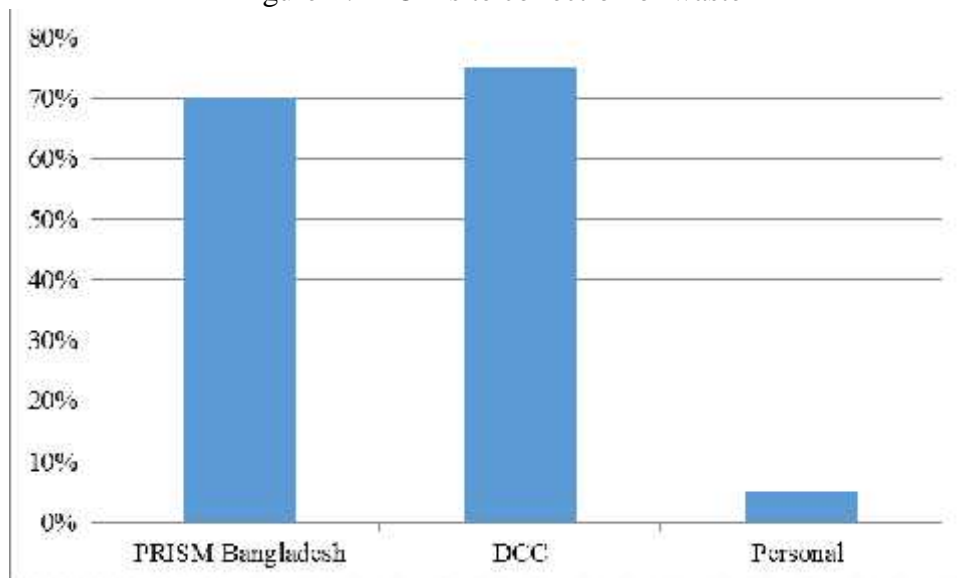
All of the waste from the surveyed HCE have been collected everyday two times. The DCC is responsible for collecting all of the general/non-hazardous waste from 75% surveyed HCE in everyday morning. The PRISM Bangladesh collects only the clinical waste from 70% surveyed HCE in everyday evening (Table-4.14 & Figure-4.12). Only 5% of HCE waste is collected by their own employees, and the frequency of waste collection of surveyed HCE is observed every day during the survey.

Table-4.14 Waste Collectors

Sl. No.	Name of Hospital/ Health care	Frequency of Waste collection	Waste Collectors		
			DCC workers	PRISM Bangladesh(NGO) operators	Personal employees
1	Dhaka Medical College Hospital (DMCH)	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
2	Central Hospital Limited	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
3	IBN Sina Diagnostic Center	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
4	Marie Stopes Premium	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
5	Bangladesh Railway Hospital	Everyday	-	PRISM Bangladesh(NGO) operators	-
6	Islami Bank Hospital	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
7	Modern Diagnostic Center	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
8	Urban Primary Healthcare Project(PSTC)	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
9	Dhaka Mohanagar Shishu Hospital	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
10	Maternity & Child Health Training Institute(MCHTI)	Everyday	DCC workers	-	-
11	Azimpur Nursing Home	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
12	Lab Scan Diagnostic Center	Everyday	DCC workers	-	-
13	Marie Stopes Mini Clinic	Everyday	-	-	Personal employees
14	S.S.M.C. Mitford Hospital	Everyday	DCC workers	PRISM Bangladesh(NGO) operators	-
15	New Dhaka Modern Clinic	Everyday	DCC workers	-	-
16	Popular Diagnostic Center Ltd.	Everyday	-	PRISM Bangladesh(NGO) operators	-
17	Urban Primary Health Care Project(UPHCP)	Everyday	DCC workers	-	-
18	Monoara General Hospital	Everyday	-	PRISM Bangladesh(NGO) operators	-
19	AL-Baraka Diagnostic Center Ltd.	Everyday	-	PRISM Bangladesh(NGO) operators	-
20	Smiling Sun Clinic	Everyday	DCC workers	-	-
	Total=20	100%	75%	70%	5%

Source: Field survey, 2013

Figure-4.12 Off-site collection of waste



Photograph: 4.4 off-site transportation of MW
PRISM Van



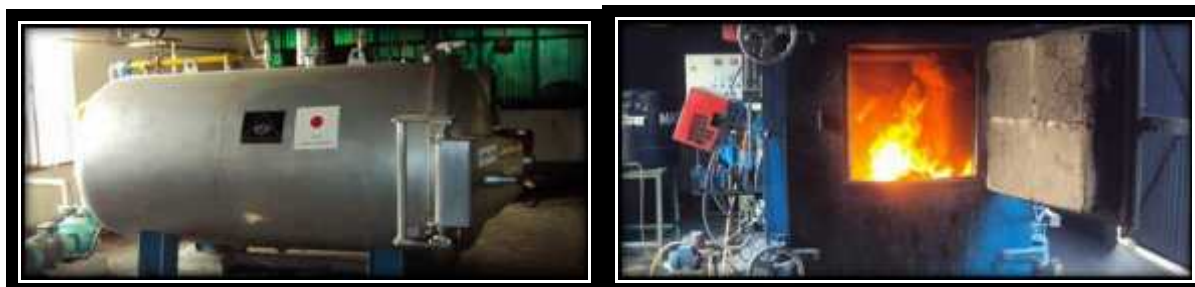
DCC Van



Source: Field survey, 2013

The DCC is also responsible for off-site transport of all general waste for final disposal by own van (photograph-4.4). It is noted that PRISM Bangladesh (NGO) is now responsible only for clinical waste and also off-site transport by PRISM's special covered van to Mutuail plant their dump site for final disposal. The on-site transportation has been done by the HCE itself and the on-site transportation has been done by two different methods such as manually and cart/trolley.

Photograph 4.5 different off-site treatment and disposal by PRISM Bangladesh



Autoclave

Incinerator

(Source: PRISM Bangladesh)

The PRISM Bangladesh is responsible for all treatment and disposal of clinical waste from surveyed HCE as they collected from selected 14 HCE (photograph-4.5). They have different disposal plant in Mutuail dumping site. Their different treatment and disposal methods are autoclave, incinerator, chemical disinfection, deep burial and shredding.

4.6.7) Result of laboratory analysis:

A laboratory analysis has been conducted for testing some selected pathogens to investigate the impact of hospital waste including solid and liquid. Solid samples were collected from hospital dustbins and liquid waste (waste water) from hospital drains and River of Buriganga (where hospitals liquid waste discharged by direct drainage link). The pathological solid tests are given in (Table-4.15). The analysis of solid waste showed diseases from different pathogens which were responsible for improper disposal of medical waste.

Table-4.15 The analysis of solid waste showed diseases from different pathogens

Sl. No.	Pathogens	Diseases
A	Bacteria	
1.	Escherichia	Diarrhoea, vomiting, urinary tract infection etc.
2.	Pseudomonas	Nosocomial infections such as pneumonia, bacteremia, folliculitis (skin infection), fever etc.
B	Fungus	
1.	Candida	Fungul infection

Table-4.16 BOD and DO data

Parameters	Bangladesh Standard Limit	Buriganga River	Drainage water from SSMC Mitford Hospital
BOD	3%	1.8%	1.3%
DO	6.5%	2.4%	1.9%

Source: Laboratory Analysis, 2014

The chemical analysis of waste water showed BOD (biological oxygen demand), DO (oxygen demand) to investigate the pollution level of waste water and its bad effect to human health and environment (Table-16). Liquid waste is generated from HCE, which contained with genotoxicity and this liquid waste is normally polluted with BOD (biological oxygen demand), COD (chemical oxygen demand), TSS (total suspended solids), fecal coliform, and total coliform content above tolerable limit (Hassan, 2006).

4.7.) Waste transporting, disposing and MWM management cost:

From the survey the average transporting and disposing cost is about tk.36500/- in government hospitals; tk. 27500/- in private clinics; tk. 20500/- in diagnostic centers and tk. 14500/- in small healthcare centers. The MWM average cost of all surveyed HCEs is accordingly tk. 2870000/- ; tk. 828000/-; tk. 417000/- and tk. 223000/- (Table-4.17 and Figure-4.13 & 4.14).

Table-4.17 MWM cost in all surveyed HCE.

	Transporting & Disposing cost	HCW management cost
Government Hospitals	36000	2870000
Private Clinic/ Hospitals	27500	828000
Pathology/ Diagnostic Centers	20500	417000
Small Health care center	14500	223000

Source: Field survey, 2013

Figure-4.13 Transporting and disposing cost in surveyed HCE (DUE)

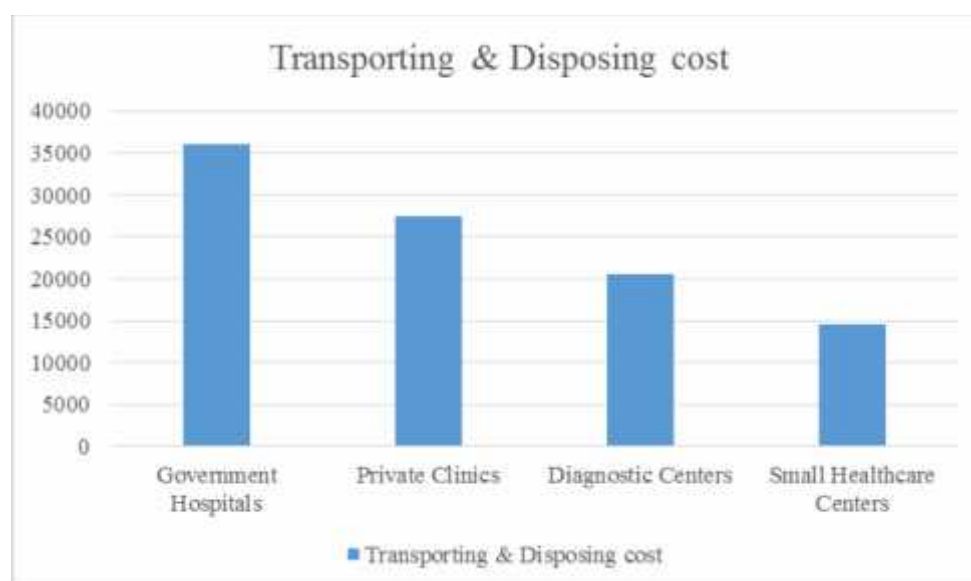
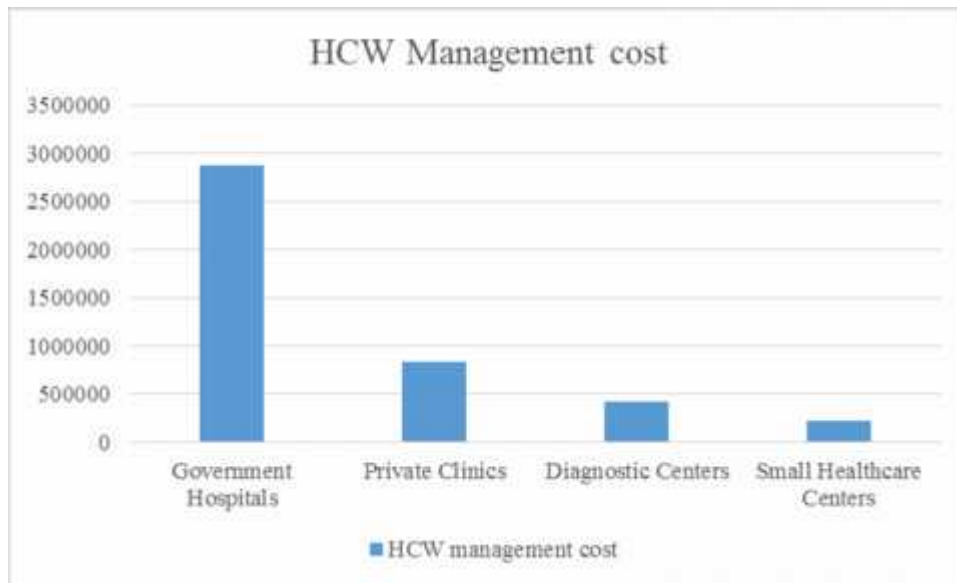


Figure 4.14 The MWM cost in surveyed HCE (DUE)



4.8) Training of MWM staffs:

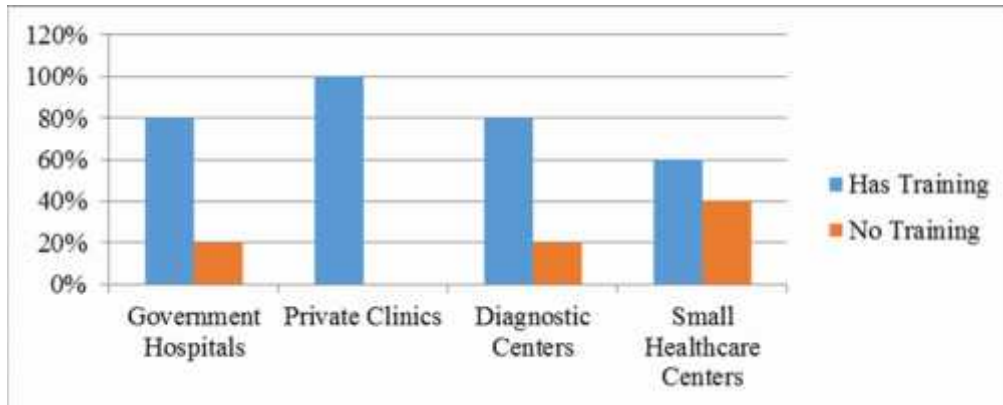
It has been found that total about 80% has training, where 80% of government. Hospitals, 100% of private clinics, 80% of diagnostic centers and 60% small healthcare centers. Seventy five percent of surveyed HCE has found trained in yearly one time by PRISM Bangladesh, and five percent by own authority. Twenty percent has found no training (Table-4.18 and Figure-4.15).

Table-4.18 General profile of training

Types of HCEs	Has Training	No training
Government Hospitals	80%	20%
Private Clinic/ Hospitals	100%	0
Pathology/ Diagnostic Centers	80%	20%
Small Health care center	60%	40%
Total	80%	20%

Source: Field survey, 2013

Figure-4.15 Training issue of surveyed HCE



4.9) Conclusion

From the above results it is clear that a dedicated waste management in a healthcare can change the irregular systems of MWM in DSCC area. But during the field survey it is found that there is serious dearth of original data collection and improper MWM system in waste generation to its final disposal. This recent study has tried to collect the real data information and its better analysis to achieve the specific and overall objectives which may fill up the previous researcher's gap about MWM system in DSCC area.

CHAPTER-5

CRITICAL DISCUSSION

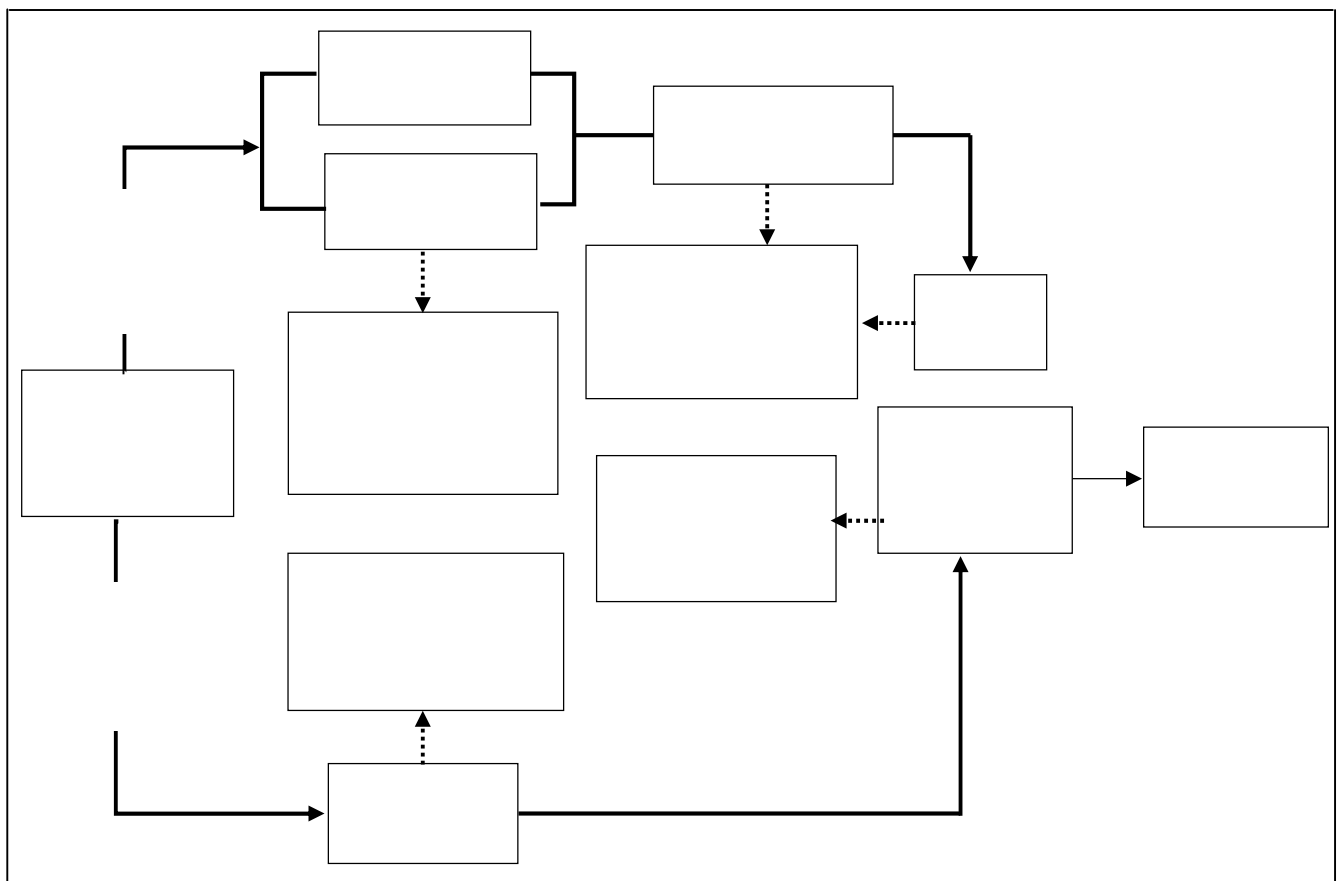
5.1 Introduction

The chapter indicates a critical analysis through discuss and compare the findings of the previous works. This research is illustrated elaborately regarding the problem of medical waste management. Medical waste management is an integral part of hygiene and infection control within a healthcare facility and proper management of waste helps in controlling healthcare related infectious (Samarakoon and Gunawardena, 2011). Transmission of disease through infectious waste is the greatest and most immediate threat from medical waste which may start from careless handling of healthcare waste (Asante, Yanful and Yaokumah, 2014). Safe handling, segregation, storage, subsequent distribution and disposal of healthcare waste ensure mitigation and minimization of the concerned health risks involved through contact with the potentially hazardous material, and also in the prevention (Goddu, Duvvuri and Bakki, 2007). Management of medical waste must be given special attention because of the potential risk to health or pollution to the environment and should be disposed of at a licensed disposal facility (Tiong, Latiff and Karuppanan, 2012). Knowledge on waste characteristics is an input to the proper design and identification of technical tools of waste management (Azage and Kumie, 2010). To manage healthcare waste optimally, health care providers should consider all stages of the medical product's life cycle, by looking at the medical product's up-stream and down-stream activities (Gabela and Knight, 2007). Medical wastes in developing countries face challenges because of the sheer volume of waste materials generated from the use of disposal items. On the other hand, medical waste problems in the developing world are as associated poor funding and the lack of national regulations for the sanitary disposal of waste (Rudraswamy, Sampath and Doggalli, 2013). Bangladesh is one of the developing countries where, medical waste is neglected and put millions of lives at risk because of ineffective waste management. Lack of awareness and knowledge, appropriate guidelines, planning or policy, law or legislation, apathy of authorities are responsible for improper management of medical waste.

5.2 Medical waste Management Practices in surveyed HCEs in DSCC area

The medical waste management practices in DSCC area comprises of different components that includes types and sources of medical waste and its generation, temporary storage system, on-site treatment and disposal, off-site transportation and finally the ultimate disposal. The waste management practices of all (20) surveyed HCEs has observed prospectively by different data collection through questionnaire survey and in-depth interview, which resulted that a poor and improper waste management has been taken place in overall surveyed HCEs only without very few private HCEs. Most of the authorities of different HCEs do not have any proper attention regarding the concerns associated to medical waste management system and its planning, policy or guideline. The Government also gives a very few attention within this sector. Our Government is more concerned to improve the healthcare sectors and the waste management sector is virtually ignored, which is resulting in a continuous poor and mismanagement system of medical waste in all level within the country. If this situation continues and proper attention is not given in the waste management sector then health hazard problems will continue to increase rapidly and hence, restoration as well as improvement in the health sector will become impossible to achieve.

Figure 5.1: Previous waste management practice in Dhaka City, particularly before December, 2005.



Source: Hassan, Ahmed and Rahman, 2008

5.2.1 Generation of wastes by sources and types

In the present study, medical waste was classified and categorized according to WHO (2013) guidelines, and sources of medical waste generation was collected from 4 different categories of HCEs such as Government hospital, private clinic, diagnostic centers and small healthcare centers. Overall 20 HCEs were surveyed and among 8425 kgs/day of total generated waste, 2.69kg is from each bed/day and 0.91 kg is generated by each patient/day and among these 1556kgs(18.47%) are hazardous and 6869kgs (81.53%) are non-hazardous waste. This proportion of the types of HCEs and composition of medical waste generation rate is comparable to those observed by other studies in Dhaka city such a study done by PRISM Bangladesh, (2005). They have conducted a survey and resulted the total waste generation was 6.4 tons/day of which only about 5.2 tons/day were non-infectious and about 1.2 tons /day were infectious and the average waste generation was 2.63 kg / bed/day. Another survey has been conducted by Hassan, (2006) on some HCEs of Dhaka city which resulted that, the total waste generation rate was 5562 kg/day, 1.93 kg/bed/day and 0.52 kg/patient /day. PRISM Bangladesh, (2013) (NGO) has been conducted another survey about two DCC area (DNCC and DSCC), where the total waste generation rate of DSCC was 26 tons / day of which 19 tons /day were non-hazardous, others 7 tons/day were hazardous and the average waste generation rates were found 1.63 kg / bed/day. The generated different sources and types of hazardous waste from surveyed HCEs were for instance sharps, infectious, pathological, pharmaceutical, chemical, radioactive, pressurized containers etc. and non-hazardous wastes were such as general waste include all paper, box, carton, plastic/polythene and bandage, kitchen waste and recyclable wastes. A table (table 5.2) sums up the above discussion given as follow:

Table 5.2: An overview of the amount of generated waste

Researches	Study Area	Total generated waste/day	Hazardous waste of the total generated waste/day	Non-hazardous waste of the total generated waste/day
This research	DSCC	8425 kg/day	1556 kg/day	6869kg/day
PRISM Bangladesh, (2005)	Dhaka city	6.4 tons/day	1.2 tons /day	5.2 tons/day
Hassan, (2006)	Dhaka city	5562 kg/day	1208 kg/day	4354 kg/day
PRISM Bangladesh, (2013)	DSCC	26 tons / day	7 tons/day	19 tons /day

5.2.2 Lack of segregation Practices

In the present study, there was only 45% HCE, segregated their wastes in a proper manner, where most of the categories of segregated wastes such as hazardous and non-hazardous wastes were subsequently mixed together as they collected from the site of generation or production and taken for disposal. Although the amount of hazardous or infectious waste is very small but lack of proper segregation practices increase the amount of waste by potentially mixing it with the general or non-hazardous waste and thus makes the total waste component become potentially hazardous. It has been observed during the field survey that, this poor and incorrect segregation has started from the point of generation and continued until final disposal which represents a serious health risk for associated persons. Only very few HCEs has found that they segregated their healthcare waste in a correct way. After observation it has been realized that, hospital waste should be separate according to their characteristics and the separation should start from the generation until its final disposal.

5.2.3 Collection of Waste

In the field survey it has found that most of the HCE uses different type of containers such as cardboard boxes, bins and plastic/metal containers to collect and separate their wastes. Most of the surveyed HCEs were found to use 3 to 4 different color coded plastic bins or plastic/metal containers for collecting their wastes. This color coding of bin or containers has developed by PRISM Bangladesh mainly for collecting the segregated hazardous wastes including radioactive wastes. Very few HCEs were found using cardboard boxes as containers for collecting their general wastes. Collection of segregated waste by suitable color-coded bins or containers is necessary for a healthy waste management. But during the field Survey it was found that, most of the surveyed HCEs were not segregated the wastes according to their characteristics at generation site and collected their waste in wrong procedure. Such type of incorrect collection of segregated waste resulted become a hazardous waste stream which may increases the potential health risk and bad effect to the environment. Generally it was found in all HCEs that, their waste are collected every day 1 or two times. The DCC has collected the general or non-hazardous wastes at every morning and the PRISM Bangladesh has collected only the clinical or hazardous waste at every evening.

5.2.4 Temporary Storage

The temporary storage means the place where the medical waste is kept before transporting to DCC bin or PRISM bin. During the field survey it is found that all of the surveyed govt. hospitals, few private clinics and diagnostic centers have temporary storage facility. But all of the surveyed small healthcare centers has not any temporary storage facility and disposed of theirs waste directly into the DCC bin. Most of the previous research's also found similar information about temporary storage. It has observed that most of the HCEs stored their waste in different type of containers, dustbin situated inside the corner of healthcare or outside of the corner of healthcare yard or road side until off-site transportation by DCC and PRISM Bangladesh. Some of the surveyed HCE found that, they have individual central storage system for infectious or hazardous waste and they have not mixed together with general waste container or dustbin. Few have found no separate central storage system for the hazardous or infectious waste.

5.2.5 On-site treatment or disposal practices

During the field survey, it is found that most of the HCEs are used incinerator as on-site treatment or disposal practices. Clinical waste incinerators, particularly in developing and poorer countries, often operate under sub-optimal conditions (Nwachukwu, Orji and Ugbogu, 2013). Although most of the surveyed HECs are located to the DCC bin but the generated wastes of some surveyed HCEs were finally disposed into the DCC bin. Some govt. and private HCEs are found with different on-site treatment practices such as crushing of sharps, sterilization, chemical disinfection and autoclaving.

5.2.6 Off-site Transportation and Final Disposal

Generally the DCC is responsible for off-site transportation of the waste for final disposal or dumping. During the field survey it was observed that all of the general wastes from the surveyed HCEs were collected everyday morning by DCC regular van to bring the waste to different DCC disposal sites located out-site the DCC boundary. The clinical or hazardous wastes from most of the surveyed HCEs were collected by PRISM Bangladesh in everyday evening which has transported by PRISM van to bring this waste to the Mutual plant, their disposal sites. In the surveyed total 20 HCEs, is found that the waste of 14 HCEs disposed of by PRISM Bangladesh and 15 HCE disposed of by DCC. Without few, most of the HCEs waste disposed of by DCC and PRISM Bangladesh. Only one small HCE has found treated and disposed their waste by own waste operator. It is noted that, the HCEs, that are not under

the management of PRISM Bangladesh, are administered by DCC and their all type of wastes include clinical wastes are disposed of by DCC, where infectious and hazardous wastes are mixed up with general waste stream and create the hole waste stream become hazardous and it also indicated by some previous conducted research about Dhaka city.

5.2.7 Liquid waste Discharge system

All the liquid waste of the surveyed HCEs has been discharged directly into the municipal sewer system. During the survey it was found that, the S.S.M.C. / Mitford hospital (in zone four) discharge their liquid waste directly into the river of Buriganga by drainage link. Again some other HCEs (in zone one) are found to be discharged their liquid waste into the Dhanmondi Lake by direct drainage link. Direct disposal of feces and urine of infectious patients' in municipal sewer system may cause outbreak of epidemic diseases (Rahman, Ahmed, and Ullah, 1999).

5.2.8 Protective Clothing

All of the waste handlers and labors are instructed to use protective clothing like gloves, apron, mask, boot, etc. But it was found from the survey that most of them do not use any protective clothing while working with the toxic medical wastes. Only a few numbers of private clinics and diagnostic centers are virtually aware about protective clothing. However, the waste staffs of government hospitals do not use any protective clothing to their work place as well.

5.2.9 Medical waste plan, policy and Guidelines

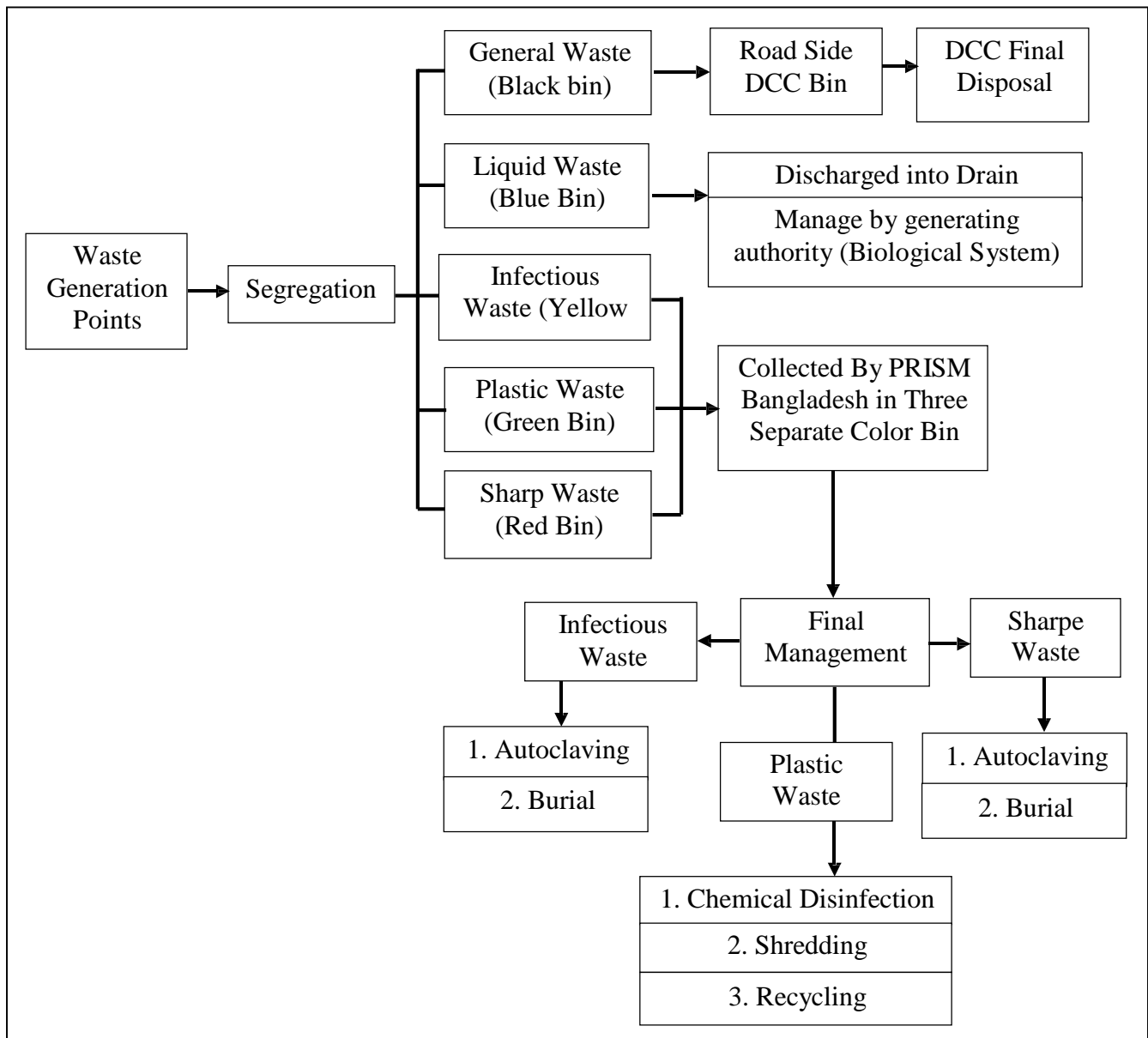
Most of the surveyed HCEs have found that they do not have any clear or individual waste-management plan, policy or guidelines. Some HCEs claimed to have their own planning and guidelines but they could not show any written and formal document. Most of the surveyed HCEs claimed about having national policy but without very few HCEs they could not submit any policy. Some HCEs claimed their oral guidelines and one or two private HCEs shown their written guideline documents, and national policy. It is noted that the problem is getting worse only the absence of proper and particular policy, plan and fixed guideline document.

5.3 Advanced Methods of Medical Waste Management

PRISM (Project in Agriculture, Rural Industry, Science and Medicine) Bangladesh, a reputed (Non- Profit) National NGO in Bangladesh is now working as a licensed private operator for medical waste management in association with the DCC to develop a disposal facility to carry out low cost medical waste treatment and management in Dhaka city. The DCC has allocated one acre (0.405 hectare) of land in Matuail, a dumping site near the city limit for the final disposal of medical waste. It is inadequate to handle all the medical wastes of the city with the limited facilities of final disposal. PRISM Bangladesh established a treatment and disposal plant, which is known as Mutuail plant, where managing the generated medical waste in different forms such as autoclaving, incinerating, chemical disinfection unit, deep burial for amputee body parts and deep burial for sharps and shredding machine for recyclables. It is noted that for MWM they follow the National Policy. Their program runs through:

- (a) *In-house Waste Management*: Segregation at sources, safe internal transportation, temporary storage system.
- (b) *Out- house Waste Management*: Waste collection, safe transportation, final treatment and disposal, supervision and monitoring, institutional support.
- (c) *Human Resource Development*: This is done by training the people who are included within the In-house Management Practices. The nurses, ward boys, cleaners, technologists etc. are under this training program (source: PRISM Bangladesh Program- MWM Program).

Figure 5.3 Existing waste management practices in some HCE of Dhaka City by PRISM Bangladesh, 2005



5.4 Training and awareness program

The study has found that a total of 80% are trained and 20% has no training. Among them 70% training has carried out under the supervision of PRISM Bangladesh and 10% training are given by the own authorities. The rest 20% has no training.

5.5 Financial Constrains for MWM

Financial constraints are essential to consider as it is one of the primary obstacles against a dedicated MWM. It has found from the overall survey that there is not enough financial support in the MWM sector. This is evidenced in all surveyed HCEs without some private HCEs. But an inadequate financial support is not enough to tackle the problem. For developing the MWM sector, our Government should allocate separate budget for this sector. Without adequate financial support the improvement in the MWM sector is never possible.

5.7 Conclusion

This chapter provides an analytical discussion where the overall results and findings are elaborately assessed by comparing with the results and findings of relevant other previous research works. The section also has the details of the responses which are obtained from the respondents by several questionnaires.

CHAPTER 6

SUMMARY FINDINGS, RECOMANDATIONS AND CONCLUTIONS

6.1 Introduction

For many years, healthcare workers, hospital administrators, sanitarians, and other health-related professionals have understood the necessity to protect themselves and the public from exposure to wastes that might be reservoirs of disease-transmitting organisms. However, efforts to manage such wastes have differed between countries, the worse scenario being in developing countries, (Manyele, 2004) like Bangladesh, where the management of medical waste has not received much attention and the associated health effects and environmental pollutions are avoided as well. Waste management, as an important part of environmental hygiene, needs to be integrated with environmental planning and policies. Improper collection storage, treatment and disposal can lead to serious environmental damages of various kinds (Soysal, Simsek and Alyu, 2010). Although infectious and hazardous wastes from hospital occur in small quantity of waste, there is a high potential of serious threat to spread out various diseases and hazardous materials from these wastes due to improper disposal of dumping and burning (Panyaping and Okwumabua, 2006). Now a days the public concern is increasing about this issue on a global basis including Bangladesh. This study has attempted to evaluate the best management practices of medical waste in DSCC area and find out all of the constraints that are needed to eliminate in order to improve the management system of all HCEs in DSCC area with some essential recommendations.

6.2 Summary Findings

The assessment and evaluation of the previous chapters have identified several findings that are summarized below:

The study investigated medical waste management practices in four categories of 20

HCEs and during the field survey, the major sources of hazardous waste individually have been found(1354.5 kgs/day), mainly from the government hospitals and private clinics(161 kgs/day)which are generating huge amount of different clinical wastes. The minor sources were generated by diagnostic centers (26.5kgs/day) and small healthcare centers(13.5 kgs/day) which are particularly very small amount. Although the fraction is very small but this small fraction is not managed in a proper manner. The total average

waste generation is obtained 2.69kg/bed/day and 0.91 kg/patient/day which may be similar to those study such as (1) Rahman M.H. et. al., 1999, (2) Nessa, Quaiyam and Khuda, 2001; (3) PRISM Bangladesh, 2005 and 2013, (4) Hassan, 2006; (5) Hassan, Ahmed, Rahman and Biswas, 2008 and (6) Rahman, Rahman and Patwary, 2008; (7).

This study also identified some weakness of the current MWM system such as trained waste staffs, inadequate budget, lacks of awareness and appropriate guidelines, and also there is absence of rigorous laws in DSCC area, which is essential for a dedicated medical waste management team. Good medical waste management in a hospital depends on a dedicated waste management team, good administration, careful planning, sound organization, underpinning legislation, adequate financing, and full participation by trained staffs (Ferreira and Teixeira, 2009).

The types of healthcare wastes that are generated are found as a mixture of hazardous and non-hazardous components of wastes where the non-hazardous waste is found in big amount- a total of 6869 kgs/day from surveyed HCEs and hazardous waste is found a total of 1556 kgs/day. But most of the HCEs do not segregate actively at the point of generation and the authorities or management sectors have not taken any proper effort to advance this critical situation. Proper segregation of waste is critical for safe management of MW, and helps to control management costs (Elgitait, Sarshar and Gee, 2009). Medical waste must be separated from municipal waste for avoiding risk to municipal workers, public and environment (Abor, 2007).

The recyclable waste is found in a big amount (2633 kgs/day) which is observed to be handled by waste staffs and scavengers without any protecting clothing. Our Government has not taken any extra regulation yet for proper management of recyclable waste. During the survey it was found all over that there was no individual method to separate the mixed recyclable waste based on their different characteristics, for instance, plastic items and paper items, used or even unused sharps with or without needles/syringes and saline bags have been found together in collecting and storing in one color coded containers. Here it is noted that, according to DGHS, “National 3R Strategy for Waste Management”, (2010), “Recycling of medical waste is not the potential health risks and the City Corporation will insist on placing special containers at sorting station, recyclable collecting centers or other public places for the deposit of hazardous waste”.

The main problem obtained from the overall survey is the incorrect segregation practices.

The incorrect segregation practice is the reason for increasing the generation rate of

hazardous waste. A high generation of medical waste needed high treatment and disposal cost, which is very costly for a developing country like Bangladesh. If the hazardous materials and non-hazardous materials are separated properly at the point of generation, the total generation may be decreased, and the high treatment and disposal cost can be reduced. But only 45% of surveyed HCEs are found to segregate their waste according to the waste characteristics. To improve the total system, the waste must be handled and segregated from the hazardous waste, and consequently their treatment cost will be reduced (Aukour, 2008).

The proper labeling of waste bin and containers has been found in 55% HCE.

collection of waste has been found (60%) in wrong bin and (40%) perfect color coded bin. The private clinics are more conscious than the government hospitals about collection of wastes. Although the indication by most of the HCEs management authorities is that clinical waste is collected appropriately, but a large number of HCEs are found not regulating appropriate collection practices with proper labeling.

It has not been found any proper centralized collection area for infectious and highly hazardous waste without few private clinics. They use plastic/metal and special container and drum for collecting infectious and highly hazardous wastes.

There were three types of storage methods that have been found such as (70%) in health container, (10%) in healthcare dustbin and (30%) dustbin (outside).

A few surveyed HCE found that the waste handlers were using protective clothing to handle the wastes and better hygiene practices.

The on-site treatment and disposal practices have found crushing of sharps waste, sterilization, chemical disinfection, incineration, autoclaving and selling used or unused syringes, saline bags, cans etc. From this it is obtained that 25% of HCEs is of high cost, 50% of medium cost and 35% of low cost.

It has been observed that the DCC is collecting (75% of surveyed HCE) hazardous and non-hazardous waste together; mainly DMCH and SSMC Mitford are found in this condition. It has been observed from the personal dustbin of SSMC Mitford that the waste of different hazardous types are mixed up (general and infectious items) in their dustbins, and the DCC van is collecting this mixed waste without any hesitation and this situation is continuing every day although the clinical waste is now collected (70% of surveyed HCE) by a newly emerging reputed NGO the 'PRISM Bangladesh'. Some critical photographs have been given in the previous chapter to understand the situation.

The off-site transportation has been done by DCC van and PRISM special van. The on-site transportation has been done by manually and cart/trolley. But the on-site transportation methods were not found safely in most surveyed HCE.

The liquid waste generation was found total 759 liters/day and water usage amount 28820 liters/day. All of the liquid waste of surveyed HCEs discharged their waste into municipal sewer system and consequently into the rivers mainly in the Buriganga and Dhanmondi lake.

The study has found that the management authorities of all surveyed HCEs (85%) are said to have their National policy, but most of them could not show practically any kind of policy. 15% said have no policy.

Some private clinics have shown their guidelines, but they are very minor (15%) in their quantity.

training and awareness, it has been found that about 70% HCEs have been given training annually under PRISM Bangladesh and 10% by own authorities. But 20% has no training facilities. All of these have been obtained according to the evaluation through the checklist.

6.3 Recommendations

All types of surveyed HCEs in DSCC need to undertake some essential strategies that are inevitable to regulate a sound medical waste management practice in all levels. The recommendations are discussed as follow:

Insufficient budget [*Ensure the creation of a good and trained waste management team with a dedicated budget.*]

implementation of policy [*Formulation of written national, local, or regional policies for best management practices.*]

No implementation of planning of waste management practices [*Documentation of a waste management plan with description of collection, segregation, storage, transportation, treatment and disposal strategies.*]

No implementation of written rules and guidelines [*There must have written rules and guidelines with proper instructions for all waste staffs.*]

segregation, packaging, labeling and marking practices [*Segregation, packaging, labeling and marking must be done in a proper and appropriate manner*]

based on different characteristics of waste at the point (PRISM Bangladesh, 2005) of generation in order to reduce the volume of hazardous waste stream.]

Improper color coding of bin *[Minimum three-bin system with color coding should be introduced for separating the generated waste.]*

proper storage facility *[A temporary storage facility should be available in different locations at the HCEs.]*

No proper central storage for infectious and highly hazardous waste *[Creating a central secured storage system for infectious and highly hazardous waste.]*

of proper treatment and disposal technologies for sound management *[Ensure cost effective available treatment and disposal technologies for sound management.]*

Lack of safe disposal and on-site transportation *[Ensure careful on-site disposal and an appropriate internal transportation of waste.]*

one time scheduled of waste collection *[Frequency for collecting wastes must be intensified, at least 2/3 scheduled time every day.]*

No implementation of protective clothing during the handling of waste *[Ensure the use of protective clothing like masks, gloves, aprons, boots etc.]*

No hygiene practices has been found *[Better hygiene practices for waste handlers.]*

training program for waste staffs *[Arrangement of proper and more trainings and awareness programs for waste staffs.]*

No vaccination for waste handler *[To avoid dreadful diseases such as HIV/AIDS and Hepatitis and other viral or infectious diseases, waste workers should be vaccinated.]*

implementation of safe procedures for recyclable waste *[Introduce and regulate safe procedures for reusing and recycling of waste.]*

6.4 Conclusions

It is noted that a total of 550 HCEs in Dhaka city are given training by PRISM Bangladesh and the training is given each HCE in yearly one time. But that is not sufficient enough against this big issue as there is lack of management consciousness all around like public awareness and staffs awareness, absence of proper rules and legislations, plans/policies or guidelines, adequate financing support, dedicated waste management team or committee, good administrations, full participation by trained staffs which are essential to continue a sound waste management. So, it is high time the government, the private clinics and other healthcare centers took necessary initiatives in order to improve the medical waste management system; otherwise a massive collapse in the health sector might precipitate.

REFERENCE

- Abbasi, M.S., (2013), *Management of Healthcare Waste in Pakistan*, (www.slideshare.net/Msabbasi/health-care-waste-management-in-pakistan.)
- Abor, P.A., (2007), *Medical Waste Management Practices in a Southern Africa Hospital*, ISSN 1119-8362, *Journal of Applied Science Environment Management*, September, 2007, Vol. 11 (3), pp. 91-96. (www.bioline.org.br/ja.)
- Abumanya, OCU, Ebinyasi OC and Nwachoko NC, (2013), *Assessment Studies On Hospital Waste Management In Imo State*, ISSN: 2278-2966, *Indian Journal of Medicine and Healthcare*, Vol: 2, (1), January, 2013. (<http://www.iseeadyar.org/ijmhc.html>.)
- Akter, N, (2000), *Medical Waste Management: A Review*, Environmental Engineering Program School of Environment, Research and Development, AIT, Thailand.
- Akter, N., Chowdhury AMR and Kazi NM,(1998), *Medical Waste Disposal in Bangladesh with Special Reference to Dhaka City and its Environmental Evaluation*, Bangladesh Rural Advancement Committee(BRAC), Research and Evaluation Division, Dhaka, Bangladesh.
- Akter, N., Hussain Z., Trankler J. and Parkpain P.,(2005), *Hospital Waste Management and its Probable Health Effect: A Lesson Learned from Bangladesh*, In: Amin S.M.N. and Baqee A., 'Waste Management Studies in Bangladesh', Alternative Publication Unit (APU), University of Development Alternative, (www.uoda.net.)
- Akter, N., Rahman M. and Sharmin L. (2005), *Medical Waste Management at Rajshahi City Corporation-Public-private Partnership Model Development: A Collaborative Effort on Medical Waste Management in Bangladesh (Baseline and Status Report)*, Institution of Policy Support Unit-Ministry of Environment and Forest Team, BRAC Research Report, BRAC Research and Evaluation Division, Dhaka, Bangladesh.
- Akum F.A., (2014), *An Assessment of Medical Waste Management in Bawku Presbyterian Hospital of the Upper East Region of Ghana*, *Merit Research Journal of Environmental Science and Toxicology*, ISSN: 2350-2266, Vol. 2(2) pp. 027-038, May, 2014.
- Annual Report, (2011), *Medical Waste Management*, International Committee of the Red Cross,
- Asante, O.B., E. Yanful, and E.B. Yaokumah, (2014), *Healthcare Waste Management; Its Impact: A Case Study of The Greater Accra Region, Ghana*. *International Journal of Scientific & Technology Research* Vol. 3(3), March 2014.
- Aukour, F.J., (2008), *Healthcare Waste Management in Jordan King Abdullah University Hospital case study*, *Umm Al-Qura University of Journal Science and Medical Engineering* Vol. 20 (1), pp. 61-77, The University Press.

Azage, M. and Kumie A., (2010), *Healthcare waste generation and its management system: the case of health centers in West Gojjam Zone, Amhara Region, Ethiopia*, Original article, Ethiopian Journal of Health Development, Vol. 24(2), pp. 119-126.

Aziz, A.A.B.A., (2011), *Waste Management In Healthcare Centre, Case Study: Hospital Paris Mas and Kota Bharu Medical Centre (KBMC), Kelantan*, Department of Estate Management Faculty of Architecture, Planning and Surveying University Teknologi Mara (Unpublished Hon's Thesis Work).

Babanyara, Y.Y., Ibrahim D.B., Garba T., Bogoro A.G., Abubakar and M.Y., (2013), *Poor Medical Waste Management (MWM) Practices and Its Risks to Human Health and Environment: A Literature Review*. World Academy of Science, Engineering and Technology, International Journal of Environmental, Ecological, Geometrics, Earth Science and Engineering, Vol. 7(11) 2003.

Basel Action Network (BAN), (1999), *Eleven Recommendation for Improving Medical Waste Management*, Provided to the Technical Working Group of the Basal Convention, April 12-14, 1999, (<http://www.ban.org>.)

Biswas, A., Amanullah ASM and Santra S.C., (2011), *Medical Waste Management in the Tertiary Hospitals of Bangladesh: An Empirical Enquiry*, ASA University Review, Vol.5 (2), July-December, 2011.

Chandra, H., (1999), *Hospital Waste an Environmental Hazard and Its Management*, Vol. 5(3), July 1999. (http://isebindia.com/95_99/99-07-2.html.)

Dana, T., (2011), *Hospital Waste Management: Management*, Ontario International Development Agency, ISSN1923-1923-6654, (<http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html>.)

DCC , The People's Republic of Bangladesh, JICA, The Study on the solid waste management in Dhaka city, 2005, CLEAN DHAKA MASTER PLAN, Draft final report, vol-3, Supporting Report, January 2005, Pacific Consultants International Yachiyo Engineering Co., Ltd.

DGHS, Hospital Waste Management Pocket Book, 2010.

DGHS, Medical Waste Management Rules 2008.

DGHS, (2010), *National 3R Strategy for Waste Management*, Ministry of Environment and Forests, Government of the People's Republic of Bangladesh.

DGHS, Training Manual for Medical Waste Management, (2007), Mohakhali, Dhaka. (www.hsmdghs-bd.org.)

- Elgitait, Y., Sarshar M. and Gee I., (2009), *Determining the best practices in clinical waste management*, (https://www.ljmu.ac.uk/BLT/BUE_Docs/BEAN_Conference_2009_GH.pdf)
- Ferreira, V. and Teixeira M.R., (2009), *Assessing the medical waste management practices and associated risk perceptions in Algarve hospital, Portugal*, (https://sapientia.ualg.pt/bistream/10400.1/124/1/1-356_paper-long.pdf)
- Gabela, S.D., and Knight, S.E., (2010), *Health Care Waste Management in Public Clinics in the Ilembe District: A Situational Analysis and International Strategy*, Health System Trust University of KwaZulu Natal National Department of Health. (<http://www.hst.org.za>)
- Goddu, V.K., Duvvuri K. and Bakki V.K., (2007), *A Critical Analysis of Healthcare Waste Management in Developed and Developing Countries: Case Studies from India and England*, Proceedings of International Conference on Sustainable Solid Waste Management, Vol. 5 (7), September, 2007, Chennai, India. pp. 134-141.
- Guidance Manual, (2004) *Preparation of National Health-Care Waste Management Plans in Sub-Saharan Countries*, Secretarial of Basal Convention and World Health Organization. (www.who.int/water...health/medical_waste/en/guidancemanual1.pdf)
- Hamid, A., Sarker M.H., Rahman S.M.A.(1), Haque M.R., Rahman S.M.A.(2) and Hassan S.M.Z., (2013), *Striving for scientific management of medical waste: Challenge for Dhaka City*, International Journal of Development and Sustainability, ISSN: 2168-8662-, Vol. 2(3), Pages 1858-1866. (www.isdsnet.com/ijds)
- Harrey, P., Baghri S. and Reed B., (2002), *Waste management at medical centers', Emergency Sanitation: Assessment and Program Design*, Water, Engineering and Developing Centre, WEDC Loughborough University, UK. (<http://www.lboro.ac.uk>)
- Hassan, M.M., (2006), *Pattern of medical waste management: existing scenario in Dhaka city, Bangladesh*. (Unpublished M.Sc. Thesis).
- Hassan, M.M., Ahmed S.A., Rahman K.A. and Biswas T.K., (2008), *Pattern of medical waste management: existing scenario in Dhaka City, Bangladesh*, BMC Public Health. (<http://www.biomedcentral.com/1471-2458/8/36>.)
- Johannessen L.M., MarleenDijkman, Carl Bartone, David Hanrahan, M. Gabriela Boyer, Candace Chandra, (2010), *Health Care Waste Management Guidance Note*, Hnp Discussion Paper.
- ICRC, (International Committee of the Red Cross), (2011), *Medical Waste Management*, ICRC, Geneva, Switzerland, Nov. 2011. (www.icrc.org.)
- Islam, M.N., (2011), *An Assessment to Research Methods*, UPL, Dhaka.

- Kheradpisheh, Z. and Salehll M., (2013), *Medical Waste Production at Obstetrics and Gynecology Hospital in South of Iran*, Journal of Applied Technology in Environmental Sanitation, Vol. 3(1), pp. 49-54, July, 2013.
- Manyele, S.V., (2004), *Medical waste management in Tanzania: current situation and the way forward*, African Journal of Environmental Assessment and Management, ISSN 1433-7890, Vol.8, pp. 74-99, May 2004. (www.srcosmos.gr/srcosmos/showpub.aspx?aa=4229.)
- Miah, M.Y., Rahman, M.A., Naznin, L., and Hossain M.U., (2012), *Hospital Waste Management in Tangail Municipality*, Journal of Environmental Science and Natural Resources, Vol. 5(1), pp. 121-127, 2012.
- Mosia, M.A., (2006), *Feasibility of A Healthcare Waste Management Strategy in Soshanguve*, Master Technologize: Entrepreneurship (Unpublished Thesis), Tshwane University of Technology, Feb.2006.
- Muduli, K. and Barve A., (2012), *Barriers to Green Practices in Health Care Waste Sector: An Indian Perspective*, International Journal of Environmental Science and Development, Vol.3(4), August, 2012.
- National 3R Strategy for Waste Management, (2010), Department of Environment, Ministry of Environment and Forests, Government of the People's Republic of Bangladesh, December,2010, Dhaka.
- Nessa, K., Quaiyam M. A. and Khuda B. etal., (2001), *Waste Management in Healthcare Facilities: A Review*, ICDDR, B: Centre for Health and Population Research, Working Paper No. 144.
- Nwachukwu, N.C., Orji F.A. and Ugbogu O.C., (2013), *Health Care Waste Management- Public Health Benefits, and the Need for Effective Environmental Regulatory Surveillance in Federal Republic of Nigeria*, (<http://dx.doi.org/10.5772/53196>)
- Panyaping, K. and Okwumabua B., (2006), *Medical Waste Management Practices in Thailand*, Life Science Journal, ISSN: 1097-8135, Vol. 3 (2), pp. 88-93, 2006.
- PRISM Bangladesh: Survey on Quantitative and qualitative assessment of medical waste generation and management in Dhaka North City Corporation and Dhaka South City Corporation, (Unpublished survey report), Dhaka: PRISM Bangladesh; 2013.
- PRISM Bangladesh: Survey Report on Hospital Waste Management in Dhaka City (Unpublished Report), Dhaka: PRISM Bangladesh; 2005.
- Pudussery, K.P., (2011), *A Study on the Medical Waste Management at the Norfolk and Norwich University Hospital*, MS Thesis, School of Environmental Sciences, University of East Anglia.

- Rahman, M.H. and Muyeed A.A., 2010, *Solid Hazardous Waste Management*, ITN-BUET (Center for Water Supply and Waste Management), Dhaka, Bangladesh.
- Rahman, M.H., Ahmed S.N.U.D. and Ullah N.S., (1999), *A study on hospital waste management in Dhaka City*, Integrated Development For Water Supply And Sanitation, 25th EEDC Conference, Addis Ababa, Ethiopia, 1999.
- Rahman, M.H., Rhaman M.A. and Patwary M.A., (2008), *Health care waste management issues in Bangladesh*, ICSW 2008, Philadelphia, March 30- April 2, 2008, Proceedings of the 23th International Conference on Solid Waste Technology and Management, Widener University.
- Rahman, M.M. (1) and Rahman M.M. (2), (2010), *Database preparation for improved healthcare waste management in Dhaka city with GIS*, Journal of Civil Engineering (IEB), Vol. 38 (2), pp. 203-210, 2010.
- Rahman, A.K.M.S., (2001), *Manual for Hospital Waste Management*, Directorate General of Health Service, Ministry of Health and Family Welfare, Government of the Peoples Republic of Bangladesh.
- Razzak, N.R.B., Chowdhury S. and Chowdhury F, (2014), *A Study on Health Care Waste Management in Some Selected Hospitals of Dhaka City*, Science Research Library, Journal of Applied Science And Research, Vol. 2 (1), pp. 161-168, 2014.
- Robert, K., M. and Ananias N., N., (2013), *Management of Health-Care Waste: A Case Study of Two National Teaching and Referral Hospital in Kenya*, Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS), ISSN:2141-7016, Vol. 4(4), pp. 588-593, 2013. (<http://www.jeteas.scholarlinkresearch.org>.)
- Rudraswamy, D.S., Sampath D.N. and Doggalli D.N., (2008), *Global Scenario of Hospital Waste Management*, International Journal of Environment Biology, Vol. 3(3), pp. 143-146, 2013. (<http://www.urpjournals.com>.)
- Rushbrook, P., (2000), *Starting Health Care Waste Management in Medical Institutions*, Health Care Waste Practical Information Series No.1, World Health Organization, Regional Office for Europe, Copenhagen.
- Samarakoon, M.A.S.C. and Gunawardena N.S., (2011), *An Evaluation of Health Care Waste Management Base Hospital of Colombo District*, Journal of the College of Community Physician of Sri Lanka, Vol.16(2), December 2011.
- Shareefdeen, Z.M., (2012), *Medical Waste Management and Control*, Journal of Environmental Protection, Vol. 3, pp. 1625-1628, 2012. (<http://www.SciRP.org/journal/jep>.)

- Soysal, A., Simsek H. and Alyu F., (2010), *Management of health-care waste in Izmir, Turkey*, ANN IST SUPER SANITA, Vol. 46(3), pp. 299-302, 2010.
- Tabasi, R. and Marthandan G., (2013), *Clinical Waste Management: A Review on Important Factors in Clinical Waste Generation Rate*, International Journal of Science and Technology, ISSN 2224-3577, Vol. 3(3), March 2013.
- Tiong, C.S., Latiff P.A., and Karuppannan S., (2012), *Medical Waste Management in Private Medical Clinics Taiping, Perak*, International Conference on Ecological, Environmental and Bio-Sciences (ICEEBS'2012) April 13-15, 2012, Pattaya.
- Vesilined, P.A., Worrell W. and Reinhart D., (2008), *Solid Waste Engineering*, Cengage Learning India Pvt. Ltd.
- Visvanathan, C., and Adhikari, R., (2010), *Health Care Waste Management in South Asia, Promoting Reduce, Reuse, and Recycle in South Asia*, Synthesis Report on 3R South Asia Export Workshop, Kathmandu, Nepal.
- Wahab, A.B. and Adesanya, D.A., (2011), *Medical Waste Generation in Hospital and Associated Factors in Ibadan Metropolis*, Nigeria, Research Journal of Applied Sciences, Engineering and Technology. Vol. 3(8), pp. 746-751, 2011.
- WHO,(2001), *Health-care Waste Management: Rapid Assessment Tool for Country Level*. World Health Organization: Geneva.
- WHO, (2013), *Safe Management of Waste from Health-Care Activities*, 2nd Edition, Department of Public Health, Environmental and Social Determinates of Health, World Health Organization, Geneva, Switzerland. (www.who.int/phe.)
- Yasmeen, T., Islam F., Amin S., Ali S., Abbas F., Virk R. and Majid T., (2013), *Assessment of hospital waste management constraints and related environmental issues in Faisalabad*, International Journal of Advanced Research, Vol. 1(10), pp. 482-494, 2010. (<http://www.journalijar.com>.)
- Zerin, S.A. and Ahmed M.B., (2009), *Hospital Waste Management in Dhaka: A Treat*, Bangladesh Research Publication Journal, ISSN 1998-2003, Vol.3(1), pp. 796-811. 2013.

Appendix

QUESTIONNAIRE-A

Serial No :

Hospital Name :

Date of Interview :

[A] Information of Hospital/Clinic

1. Type of the Hospital (√)

Hospital Center healthcare center

2. Number of inpatients /day :

1-50 50-100 100-500 500-1000 1000-2000 2000-3000 3000+

3. Number of out-patients per day:

1-50 50-100 100-500 500-1000 1000-1500 1500-2000

4. Number of beds (total)/ day:

1-50 50-100 100-500 500-1000 1000-1500 1500-2000 2000+

5. Bed occupancy rate /day:

10-30% 30-50% 50-70% 70-90% 90-100%

6. Number of wards:

1-10 10-50 50-80 80-100

7. Number of staffs of waste management:

1-50 50-100 100-300 300-500

[B] Information of Person(s) responsible for collection, handling, storage and disposal of

Healthcare waste :

1. Designation: Ward boy Head Sweeper/Cleaner/Aya Sweeper/Cleaner/Aya2. Gender: Male Female3. Age: 18-25 26-35 36-45 46-55 56-65 66-75 76-85 86-95 96-1004. Education: Under S.S.C. S.S.C. H.S.C.5. Training: yearly Yearly4 times No one

[C] Generation, Segregation, Collection, Storage and handling of HCW:

1. What are the major sources of healthcare waste?

General Kitchen Pathological Sharps PharmaceuticalsChemical Radioactive Recyclable Pressurized containers All of its

2. What is the amount of total waste generated from your healthcare (kg/day)?

1-50 50-100 100-500 500-1000 1000-2000 2000-3000 3000-5000

3. Amount of different healthcare waste generated per day:

No	Type of healthcare waste	Quantity of generation
1.	General waste	<input type="checkbox"/>/kg
2.	Kitchen waste	<input type="checkbox"/>/kg
3.	Infectious waste	<input type="checkbox"/>/kg
4.	Pathological waste	<input type="checkbox"/>/kg
5.	Sharps waste	<input type="checkbox"/>/kg
6.	Pharmaceuticals waste	<input type="checkbox"/>/kg
7.	Chemical waste	<input type="checkbox"/>/kg
8.	Radioactive waste	<input type="checkbox"/>/kg
9.	Recyclable waste	<input type="checkbox"/>/kg
10.	Pressurized waste	<input type="checkbox"/>/kg

4. Is waste segregated in this hospital/clinic/healthcare facility? Yes No
5. Into which categories are HCW separated?
General HCW Sharps HCW
Liquid HCW Radioactive HCW Recyclable HCW All of its
6. What type of containers are used to segregate waste?
Cardboard boxes Plastic /metal containers
7. Which colors of bin are used to collect waste in your hospital/healthcare?
Black Yellow Red Blue Green
8. Do you use any type of labeling for marking segregated waste? Yes No
9. Is the waste handlers and sanitary laborers use any protective clothing (like masks, boots, gloves and aprons)? Yes No
10. What is the method of waste collection?
Manual Cart/Trolley All of its
11. Indicate how often your healthcare waste is collected?
 Everyday 2nd day Once a week
12. Who collects your healthcare waste?
DCC workers PRISM Bangladesh (NGO) operator's employees

13. Does your hospital have a centralized collection area for sharps, infectious and highly hazardous waste? Yes No
 If yes, please mention one: Plastic/metal container Special container Drum
14. State how healthcare waste is stored at your healthcare facility.
 In healthcare waste container healthcare dustbin (outside) bag

[D] Transportation of healthcare waste

- Which is/are the method(s) of waste transportation in this healthcare?
On-site Off-site one
- Who does the off-site transportation?
DCC Bangladesh (NGO) All of its No one
- What is the method for off-site transportation?
DCC van PRISM van Plastic bag
- What is the method of on-site transportation in this facility?
 Manual Cart/Trolley All of its
- Please indicate the cost of transporting and disposing of health-care waste from your facility (tk./monthly):
100-1000 1000-5000 5000-10000 10000-20000 20000-30000

[E] Treatment and disposal of healthcare waste

- How to treat waste in your healthcare?
On-site Off-site All of its No one
- What are the on-site practices for HCW treatment in your hospital?
Crushing of sharps waste Sterilization Chemical disinfection
Burning/incineration Sold of its No one
- Who does the off-site treatment and final disposal?
DCC PRISM Bangladesh All of its No one
- Have there any practices for on-site disposal like sold, landfilling, dumping, incineration?
Yes No

5. Where is the treated waste finally disposed to?

Municipal Corporation's dustbin plant by PRISM Bangladesh (NGO)

Road side

water/River/Lake/Ditch

6. Does any scavenging of healthcare waste occur at the treatment or disposal sites?

Yes No

[F] Generation and treatment of liquid waste in healthcare facility

1. What are the sources and types of liquid waste in your hospital /healthcare?

Biological

Chemical

Over-date liquid medicine

Radioactive waste

All of above

2. What is the quantity of?

(a) Waste water generated (Liter/day):

1-10

10-50

50-100

100-200

200-300

300-500

(b) Water usage (Liter/day):

1-50

50-100

100-500

500-1000

1000-2000

2000-5000

5000+

3. Are your healthcare liquid wastes often discarded directly to open water bodies?

Yes No

4. Does your hospital connected to a municipal, sewage treatment plant?

Yes No

5. Does your hospital have any sludge treatment plant?

Yes No

[G] Management of Hospital/ Clinic/ Healthcare waste

1. Does your hospital/clinic have an approved Healthcare waste Management?

Yes No

2. Who is the focal point/in charge for HCW management in your healthcare?

Designation :

In Charge

Manager

Doctor (M.B.BS.)

Admin Officer

Program Officer

Housekeeping In Charge

Supervisor

Ward Master/Ward Mistress

3. Gender: Male

4. Age:

5. Level of education:

S.S.C. H.S.C. B.A. /B.SC. /B.com. /B.B.A. M.B.A. M.B.B.S.

6. Have you attended any training program on medical waste management in past 12 months?

Yes No

7. Does your hospital/clinic have a waste management team (or teams)?

Yes No

If yes, please list the members by designation:

	(1)Designation	(2) Number
a. Team leader	:
b. Team member(s)	:
c. Waste handling staff(s)	:

8. What kind of training have they followed?

Yearly/yearly Yearly4 times No one

9. Are instructions/training given to newly hire waste management staff?

Yes No

10. How concerned are you with medical waste management?

Highly concerned Slightly concerned concerned

11. Does your hospital have a waste management plan?

12. What kind of policy are you following? If yes, Please attach a copy:

National policy policy

13. Is there a manual or guideline document on HCWM available in your facility?

Yes

14. Is there budget allocated to medical waste management?

Yes

15. How much does HCW management cost (Tk. /monthly) this healthcare?

1000-10000 | 50000-100000 100000-200000
200000-500000 1000000-1500000

16. Are you satisfied with current medical waste management system in this healthcare institution?

Yes No

QUESTIONNAIRE-B

Serial No :

Hospital Name :

Date of Interview :

1. Designation:

Director Charge

Doctor Pathologist

Admin Officer Officer

Officer Technician

Matron Nurse Paramedical Staff Patient

2. Gender : Male Female

3. Age :

4. State how hazardous do you think the following medical wastes are:-

No	Waste type	(a) Highly hazardous	(b) Hazardous	(c) Not hazardous
1.	General waste			
2.	Kitchen waste			
3.	Infectious waste			
4.	Pathological waste			
5.	Sharps waste			
6.	Pharmaceuticals waste			
7.	Chemical waste			
8.	Radioactive waste			
9.	Recyclable waste			
10.	Pressurized containers			
11	Liquid waste			

5. State what your opinion about the present color coding system of waste bins?

Very comfortable comfortable slightly comfortable uncomfortable difficult

6. Do you think that the present colors of bins are appropriate to use for healthcare wastes in this facility? Yes No

7. State which method is appropriate for segregation?

Cardboard boxes bins plastic/metal containers

8. State which is better to store HCW for this facility?

In the healthcare waste container In healthcare dustbin Specialized container

9. Do you agree to use protective clothing like masks, boots, gloves and aprons for waste collectors and laborers? Yes No

10. Do you think that the present waste management system should to improve in this healthcare facility? Yes No

11. Are you aware about improper management of medical waste? Yes No
If yes, how? Aware highly aware slightly aware neutral

12. Do you give any direction to the waste collectors/handlers about hand hygiene after collecting/handling medical waste? Yes No

13. Do you think that the waste collectors/handlers should to aware about hand hygiene? Yes No

14. Have you attended any training and public awareness program on medical waste management in last 12 months? Yes No

CHECKLIST

Serial No :

Hospital Name :

Date of Interview :

[A] Hospital Information

1. Type of the Hospital: (✓)
Hospital Clinic Center Small healthcare center
2. Number of inpatients per day :
3. Number of Outpatients per day :
4. Number of beds (total) per day :
5. Bed occupancy rate per day :
6. Number of wards :
7. Number of Staffs (total) :

[B] Mention the number of person, their: designation, training and experience involved in the collection, handling, storage and transporting of hospital waste:

Number of person	Designation	Training

[C] Amount of different healthcare waste generated per day:

No	Type of healthcare waste	Quantity of generation
1.	General waste	<input type="checkbox"/>/kg
2.	Kitchen waste	<input type="checkbox"/>/kg
3.	Infectious waste	<input type="checkbox"/>/kg
4.	Pathological waste	<input type="checkbox"/>/kg
5.	Sharps waste	<input type="checkbox"/>/kg
6.	Pharmaceuticals waste	<input type="checkbox"/>/kg
7.	Chemical waste	<input type="checkbox"/>/kg
8.	Radioactive waste	<input type="checkbox"/>/kg
9.	Recyclable waste	<input type="checkbox"/>/kg
10.	Pressurized waste	<input type="checkbox"/>/kg
11.	Liquid waste	<input type="checkbox"/>/liter

[D] Handling, segregation, collection, storage, transportation, treatment and disposal of HCW :

No	Handling, segregation, collection, storage, transportation, treatment and disposal of HCW	Description
1	(a)Is the waste segregated in your healthcare? (b)Do you use any type of labeling or color coding for marking segregated waste?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No
2	(a)Is the waste handlers and sanitary laborers use any protective clothing like masks, boots gloves and aprons? (b)Does the waste pose any risk to waste collectors inside the hospital/healthcare?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No
3	Does your hospital have different color of bins to collect different type of waste? If so, which colors?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Black <input type="checkbox"/> Yellow <input type="checkbox"/> Red <input type="checkbox"/> Blue
4	Does your hospital have a centralized collection area for dangerous waste?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5	(a)Do you have a specific area to store HCW in your facility? (b)Is the area secured? (c)Do your hospital have any type of containers to store infectious and highly hazardous waste?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No
6	(a)Does your hospital have a proper on-site transportation? (b)Does your hospital have an approved off-site transportation?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No

7	<p>(a) Is the waste treated on-site?</p> <p>(b) What are the practices for on-site treatment?</p> <p>(c) Is the waste treated off-site?</p> <p>(d) Who does the off-site treatment and disposal?</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p><input type="checkbox"/> Crushing of sharps <input type="checkbox"/> Sterilization <input type="checkbox"/> Chemical Disinfection Incineration <input type="checkbox"/> Autoclaving <input type="checkbox"/> Sold <input type="checkbox"/> All of its <input type="checkbox"/> No one</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> DCC <input type="checkbox"/> PRISM Bangladesh(NGO) <input type="checkbox"/> All of its <input type="checkbox"/> No one</p>
8	<p>(a) What are the sources and types of liquid waste in Your healthcare?</p> <p>(b) Does your hospital/healthcare connected to a Municipal sewage treatment plant?</p>	<p><input type="checkbox"/> Biological waste <input type="checkbox"/> Chemical waste Infectious waste <input type="checkbox"/> Over-date liquid Medicine <input type="checkbox"/> Radioactive waste Laboratories Waste <input type="checkbox"/> All of above</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>

[E] Plan, policy, budget and awareness of HCWM:

No	Plan, policy, budget and awareness of HCWM	Description
1.	Are there any applicable national, regional and local policies? If so, please attach a copy:-	Yes
2.	Does your hospital/healthcare have a waste management plan?	Yes
3.	Is any budget allocated to waste management?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4.	Does the healthcare conduct any training and Public awareness programs on HCWM?	<input type="checkbox"/> Yes <input type="checkbox"/> No