

**FACTORS AFFECTING IMPLEMENTATION OF CENTRALIZED WASTE  
MANAGEMENT SYSTEM IN PRIVATE HEALTHCARE FACILITIES IN  
NAIROBI COUNTY**

**By**

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FOR THE MASTER OF ARTS DEGREE IN PROJECT PLANNING AND  
MANAGEMENT OF THE UNIVERSITY OF NAIROBI**

**2012**

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## DECLARATION


This research project report is my original work and has not been presented for a degree award in any other university.

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This research project report has been submitted for examination with my approval as university supervisor.

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## **DEDICATION**

This research project report is dedicated to private healthcare institutions and all stakeholders interested in safe healthcare waste management practices. It is my hope the study will shed some light into factors affecting centralized waste management in private healthcare facilities in Nairobi County. I also hope the study will foster a broader and more effective policy and regulatory framework and encourage public private partnerships and investment in healthcare waste management in the private sector in a developing country setting.

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## **ABBREVIATIONS AND ACRONYMS**

<b>CWTFs</b>	<b>Centralized Waste Treatment Facilities</b>
<b>ECSA</b>	<b>East Central &amp; Southern Africa Health Community</b>
<b>HCW</b>	<b>Health Care Waste</b>
<b>HIV AIDS</b>	<b>Human Immunodeficiency Virus Auto Immune Deficiency Syndrome</b>
<b>NEMA</b>	<b>National Environment Management Authority</b>
<b>NWH</b>	<b>Nairobi Women's Hospital Ngong' Road Branch</b>
<b>SPSS</b>	<b>Statistical Package for Social Sciences</b>
<b>UNEP</b>	<b>United Nations Environment Program</b>
<b>WHO</b>	<b>World Health Organization</b>

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## ABSTRACT

It is estimated that half the world's population is at occupational, environmental or public health risk from poorly treated medical waste and this problem is particularly serious in the developing world where improvements in healthcare services are not matched by strengthening of the waste management infrastructure. Successful implementation of centralized waste management could be used to address this problem. The researcher looked at various literature reviews on implementation of centralized waste management system and found out that in Kenya private healthcare facilities account for about 36% of healthcare waste volume generated. Whereas provincial and district hospitals act as centralized waste treatment facilities for public sector, there is no structured centralized waste management system for the private healthcare facilities in Kenya despite its many benefits. The concept of centralized waste management system has been successfully documented in private healthcare sector settings in India and some developed countries. The researcher also established that there are no documented studies on factors affecting centralized waste management system in private healthcare facilities in Nairobi County. This study therefore was to examine factors affecting implementation of centralized waste management system in the private healthcare facilities in Nairobi County.

The study adopted descriptive research design and purposive sampling of private healthcare facilities that have their waste centrally treated at the Nairobi Women's Hospital Ngong' Road branch. The researcher used both qualitative and quantitative sampling methods and data was collected using both personal interviews and drop and pick procedure. Data was analyzed and presented using descriptive and inferential statistical techniques. The study found out that there was positive correlation among all factors affecting implementation of centralized waste management system under study. The significant p-values observed between Availability of finance and Revenue stream was  $p=0.958$  was the highest followed by that between Technical preparedness and Availability of finance at  $p=0.949$ . Government policy and regulations, and Technical preparedness also had a strong correlation with significant at p-value of  $p=0.905$ . The regression results revealed that there is a positive relationship between the dependent variable and independent variables with a coefficient of determination ( $R^2$ ) of

$R^2 = 0.843$ , implying that the independent variables (Availability of finance, Revenue stream, Technical preparedness, Government policy and regulation, Management of healthcare facility) could explain 84.3% of variation on the dependent variable (implementation of centralized waste management system). From the study findings the most significant factor that influence implementation of centralized waste management system in private healthcare facilities in Nairobi County was Management of healthcare facility with un standardized Beta coefficient of  $\beta = 0.753$ , followed by Availability of finance ( $\beta = 0.575$ ), Technical preparedness ( $\beta = 0.251$ ), Revenue stream ( $\beta = 0.17$ ), and Government policy and regulation ( $\beta = 0.131$ ). Further, it was observed that majority (65%) of healthcare facilities under study did not have any form of waste treatment equipment and majority (81%) of waste handlers were not insured against any injuries arising from handling of healthcare waste. It also emerged that majority (94.6%) of the respondents interviewed were not aware of existence of policy and regulatory enforcement for waste management.

The study recommends that healthcare facilities should ensure their healthcare workers and waste handlers are properly insured against injury arising from handling healthcare waste. Finance institutions and the government should address finance factors affecting implementation of centralized waste management in Nairobi County. The study also recommends the need for all stakeholders including healthcare managers, the Government, the National Environment Management Authority (NEMA) and other regulatory authorities, to ensure awareness and compliance with waste management policies and regulations in private healthcare facilities in Nairobi County.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of the study

Health care waste is defined as the total waste stream from health care and includes all the waste generated by health care establishments, research facilities and laboratories (Coulson and Magner, 2004). It is estimated that half of the world's population is at occupational, environmental or public health risk from poorly treated medical waste and this problem is particularly serious in developing world, where improvements in healthcare services are not matched by strengthening of the waste management infrastructure (Harhay *et al.* 2009). Between 75% and 90% of the waste produced by healthcare providers is non-risk while the remaining 10% to 25% of healthcare waste is regarded as hazardous and may create a variety of health risks (Prüss and Giroult, 2004). The lack of national policies or guidelines on health-care waste management in many developing countries exacerbates this problem. The World Health Organization issued a policy paper calling on developing countries and countries in transition to develop national policies, guidance manuals, and implementation plans for the sound management of health-care waste (WHO, 2004).

Poor healthcare waste management can lead to downstream reuse of contaminated syringes and needles. In 2000, contaminated injections caused an estimated 21 million hepatitis B infections, two million hepatitis C infections and 260,000 HIV AIDS infections, accounting for 32%, 40% and 5% respectively of new infections worldwide according to a study by Hauri, Amstrong and Hutin (2004). The study also indicates that in Kenya the proportion of infections associated with unsafe injections is 9.2% for hepatitis B, 13% for hepatitis C and 2.5% for HIV AIDS. The East, Central and Southern Africa (ECSA) Health Community conference in March 2007 held in Arusha, Tanzania recognized the health burden caused by unsafe healthcare waste management and resolved to implement, support or scale up healthcare waste management programs and encourage private sector involvement in appropriate management and disposal of infectious healthcare waste (ECSA, 2007).

#### 1.2 Statement of the problem

World Health Organization (2005) estimates that about 10% - 25% of health-care waste is regarded as hazardous and may create a variety of health risks. Health care waste is considered the second most hazardous waste after radioactive waste in the United Nations listing as quoted in the Basel Convention to which Kenya is a member. There is particular concern about infection with Human

Immunodeficiency Virus (HIV) and hepatitis viruses B and C, for which there is strong evidence of transmission via health care waste through injuries from syringe needles contaminated by human blood which therefore calls for proper management of health care risk waste (Coulson and Caminsky, 2004). A study on waste management in Kenya recognizes the challenges of implementing centralized waste management and indicates that only about 25 per cent of the estimated 1,500 tons of waste generated daily in Nairobi gets collected (Ikiara et al, 2004). The Kenya National Healthcare Waste Management Plan (2008 – 2012) indicates that health care services in rural or urban settings in Kenya inevitably generate wastes that may be hazardous to health or have harmful environmental effects. The study also indicates inadequate capacity for handling health care waste among private firms and that no private firm or council has incinerators that could be commercialized.

In Kenya private healthcare facilities provide 36% healthcare services and generate equivalent amount of waste volume (Kenya National Health Accounts Report, 2010). Private healthcare facilities include privately owned and operated hospital, health clinic, laboratory, dispensary or healthcare service providing institution within the Nairobi County. Whereas provincial and district hospitals act as centralized waste treatment facilities for public sector, there is no structured centralized waste management system for the private healthcare facilities in Kenya despite its many benefits. The concept of centralized waste management system has been successfully documented in private healthcare sector settings in India and some developed countries (Onursal, 2003). The researcher also established that there are no documented studies on factors affecting centralized waste management system in private healthcare facilities in Nairobi County. This study therefore was to examine factors affecting implementation of centralized waste management system in the private healthcare facilities in Nairobi County.

### **1.3 Purpose of the study**

The purpose of the study was to establish factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County.

### **1.4 Objectives of the study**

The specific objectives of the study were to:

1. Examine how availability of finance influences implementation of centralized waste management system in private healthcare facilities in Nairobi County.

2. Establish how revenue stream affects implementation of centralized waste management system in private healthcare facilities in Nairobi County.
3. Determine how technical preparedness affects implementation of centralized waste management system in private healthcare facilities in Nairobi County.
4. Examine how government policy and regulation affects implementation of centralized waste management system in private healthcare facilities in Nairobi County.
5. Establish how management of healthcare facilities affects implementation of centralized waste management system in private healthcare facilities in Nairobi County.

### **1.5 Research questions**

The research questions for this study were as follows:

1. How does availability of finance influence implementation of centralized waste management system in private healthcare facilities in Nairobi County?
2. What effect does revenue stream have on implementation of centralized waste management system in private healthcare facilities in Nairobi County?
3. To what extent does technical preparedness affect implementation of centralized waste management system in private healthcare facilities in Nairobi County?
4. What effect does government policy and regulation have on implementation of centralized waste management system in private healthcare facilities in Nairobi County?
5. How does management of healthcare facilities affect implementation of centralized waste management system in private healthcare facilities in Nairobi County?

### **1.6 Scope of the study**

The study endeavored to establish factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County. The study looked at how availability of finance, revenue stream, technical preparedness, government policy and regulation, and management of healthcare facilities affect implementation of centralized waste management system in private healthcare facilities in Nairobi County. The study included the Nairobi Women's Hospital Ngong' Road branch, which provided the centralized waste treatment facility, and satellite private healthcare facilities in Nairobi County that take their waste to the Nairobi Women's hospital for treatment and final disposal.



### **1.7 Significance of the study**

The study is significant since it will reveal the factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County. The study is expected to benefit healthcare facility managers, entrepreneurs, academicians and researchers interested in understanding centralized waste management system, its challenges, how to improve it and factors that affect its implementation in the private healthcare facilities. Future researchers in the field of healthcare waste management could benefit from the study as the findings will be used as reference material.

### **1.8 Limitations of the study**

It was expected that the study would be limited by financial budget and time available to support study proposal approval, data collection, collation and analysis, study findings report compilation and dissemination. The geographic location of the target healthcare facilities under the study in relation to their proximity with the Nairobi Women's Hospital was also expected to limit the study. However to counter these the researcher mobilized his own funds and prepared a team of research assistants to help with timely data collection. One of the research assistants works with a waste transporter and this made it possible to identify and collect data from respondents within Nairobi County.

### **1.9 Delimitation of the study**

The study was delimited by accessibility and proximity to Nairobi Women's Hospital. The study used a sample drawn from private healthcare facilities within about thirty kilometers radius of the Nairobi Women's Hospital and which already treat their waste centrally at the Nairobi Women's Hospital. The sample healthcare facilities for the study were located within the Nairobi County.

### **1.10 Basic assumptions of the study**

For the purpose of this study it was assumed that the respondents were knowledgeable, available and able to provide accurate information to the researcher. The study found that the respondents were very cooperative and provided 97.4% response rate.

### **1.11 Definition of significant terms as used in the study**

This section contains definition of significant terms as used in the study.

#### **Implementation of centralized waste management system:**

In this study this includes planning of centralized healthcare waste management system with private healthcare facilities taking their healthcare waste to a centrally located facility (which was the Nairobi Women's Hospital at Adams Arcade, Ngong Road), collection and transportation of healthcare waste, centralized treatment of healthcare waste (reclaiming healthcare waste to recovery or re use and to accumulate, incinerate, bulk, blend, and package waste for treatment, recovery, or disposal either on site or at approved off-site facilities), and centralized final disposal of healthcare waste, all at a cost. Waste under this system refers to healthcare waste and includes all the waste that can be considered dangerous or hazardous to either human health or the environment (also referred to as health care risk waste e.g. needles, razors, scalpels, pathological waste, pharmaceutical waste, biological waste, and hazardous chemical waste) and healthcare general waste which contains no products or potential properties that are known to have either a reactive or toxic effect, either to humans or the environment and includes waste from food preparation, cleaning and sweeping, repair and replacement, clerical and office services, packaging, cardboard, damaged containers, discarded flowers, bags, tins, wrappings and plastics generated at satellite healthcare facilities under the study.

#### **Availability of finance:**

This includes capital cost to procure healthcare waste treatment equipment, operational cost of healthcare waste treatment equipment, and financial liability of healthcare waste treatment within Nairobi County.

#### **Revenue stream:**

This entails factors impacting on revenue generated from the centralized healthcare waste management system including the client base of waste generators, affordability of treatment and disposal of waste, quality and type of waste, and regulatory enforcement for waste treatment within Nairobi County.

#### **Technical preparedness:**

In this study it refers to permitting (preparing environmental impact assessment and obtaining requisite licenses to operate a waste treatment facility), site selection, pre acceptance procedures (ascertaining waste quantity and composition, preparing waste

manifests), waste collection, waste treatment, and operations (collection, treatment, storage and disposal of waste) within the Nairobi County.

**Government policy and regulation:**

These are policies, regulations and legislations that govern, regulate, control, direct or impact on healthcare waste management.

**Management of healthcare facility:**

This includes planning, organizing, staffing, controlling, communication and administration of the healthcare facility.

**1.12 Organization of the study**

The study contains five chapters and an appendix section. Chapter One is the introduction and contains background of the study, statement of the research problem, purpose of the study, research objectives and questions, scope of the study, significance of the study, basic assumptions, limitations and delimitations of the study and definition of significant terms as used in the study. Chapter Two contains the literature review with discussion on implementation of centralized waste management system from a global, regional, national and Nairobi County perspective. The chapter reviews the literature available on concept of centralized waste management system. Finally the chapter provides a conceptual framework and a summary.

Chapter Three provides a description of the methodology used for the study and explains the research design, target population, sampling techniques, and method of sample selection and determination used. It discusses methods of data collection, analysis and presentation used. It also provides the operationalization of variables which attempts to associate the objectives with the methodology and provides a map to the expected results. Chapter Four outlines the data analysis, presentation and interpretation of the study. Chapter Five gives summary of findings, discussion, conclusions and recommendations of the study. The appendix contains the transmittal letter, the letter for request for study research, the interview guide, the table for sample size for a given population.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter contains a comprehensive literature review available on centralized healthcare waste management system from a global, African and local perspective. It also provides a conceptual framework on concept of implementation of centralized waste management system in Nairobi County.

#### **2.2 Implementation of centralized waste management system**

To provide a centralized waste management system, the local authority, a group of health facilities, a private healthcare facility or a waste disposal contractor, may establish a centralized plant to receive waste from healthcare facilities within its region (Christen, 1996). Centralized regional facilities could provide the following advantages, namely; greater cost-effectiveness for larger units, through economies of scale; spare capacity can be provided more economically; future modifications or expansions (relating to flue-gas cleaning systems of incinerators, for example) are likely to be less expensive. Where privatization of facilities is seen as a desirable option this can be achieved more easily on a regional basis than for numerous small units (WHO, 1997). In addition, it will be easier for the relevant government agencies to supervise and monitor the facilities; efficient operation can be more easily ensured in one centralized facility than in several plants where skilled workers may not be readily available; air pollution may be more easily kept to a minimum at a centralized plant (costs of monitoring and surveillance and of flue-gas cleaning, for example, will be reduced); and, hospitals will not have to devote time and personnel to managing their own installations.

The location of regional facilities for the treatment of healthcare waste should be carefully chosen (WHO, 1995). Catchment areas should be defined on the basis of estimated waste production by the healthcare establishments involved, and the location of the treatment plant within each catchment area should then be based on the following considerations, namely; accessibility for the hospitals and healthcare facilities to be served (road conditions, distances, and transportation times); quantities of healthcare waste expected from the various establishments within the identified catchment area; whether or not transfer stations are needed (daily transfer of waste direct from hospitals to the regional facility, with no need for transfer stations, would be optimal, avoiding double handling of

waste); likely changes in the capacity or function of each hospital and hence in the quantity or nature of its waste; preliminary environmental considerations, adequacy of the land area for the facility at a proposed site; public attitude towards the treatment method. Minimizing total times for transportation of healthcare wastes to the regional facility should be an important factor in the choice of site and in determining appropriate transportation routes. Allotting adequate numbers of collection vehicles to the various routes in the region will ensure regular collection of waste and contribute to overall cost effectiveness (WHO, 1997).

The successful experience in India with privately built, owned, and operated Centralized Waste Treatment Facilities (CWTFs) has led to increasing acceptance of CWTFs as the way to manage hazardous healthcare waste (HCW) in urban areas (Onursal and Setlur, 2002). Coupling the current HCW management knowledge base with effective use of information technology, training and advocacy, can assist health care facilities internalize good HCW management practices as an essential component of their operation.

### **2.2.1 Centralized waste management implementation success factors**

Implementation of a centralized waste management system can be looked at from a project implementation perspective. Cleland and Kerzner (1985) define a project as a combination of human and nonhuman resources pulled together in a temporary organization to achieve a specified purpose. The project implementation process, including that for centralized waste management system, is complex and usually requires simultaneous attention to a wide variety of human, budgetary, and technical variables (Schultz, Pinto and Slevin, 1987). A centralized waste management project is generally considered to be successfully implemented if it comes in on-schedule (time criterion), comes in on-budget (monetary criterion), it achieves basically all the goals originally set for it (effectiveness criterion), and if it is accepted and used by the clients for whom it is intended (client satisfaction criterion). Adams and Barndt (1983) and King and Cleland (1983) suggest such project implementation to follow project life cycle with four distinct phases, namely; conceptualization, planning, execution and termination. Beck (1983) emphasizes need for top management for authority, direction, and support for such a project to succeed while Slevin and Pinto (1987) encourage involvement of service provider and users of the centralized waste treatment facility for it to succeed.

Slevin and Pinto (1986) identified top ten success factors for project implementation which also apply to implementing a centralized waste management system. These success factors include, first,

defining project mission with initial clearly defined goals and general directions. Secondly, securing top management support and willingness to provide the necessary resources and authority for project success. Thirdly, establishing a project schedule and plan with detailed specification of the individual actions steps for project implementation. Fourthly, ensuring client consultation, communication and active listening to all impacted parties. Fifthly, carrying out personnel recruitment, selection, and training of the necessary personnel for the project team. Sixthly, procuring technical capacity, technology and expertise to accomplish the specific technical action steps for the project. Seventhly, seeking client acceptance and "selling" the final project to its ultimate intended users. Eighthly, ensuring monitoring and feedback mechanism is put in place for timely provision of comprehensive control information at each stage in the implementation process. The ninth factor is establishing a communication system for provision of an appropriate network and necessary data to all key actors in the project implementation. The tenth factor is creating a troubleshooting mechanism to be able to handle unexpected crises and deviations from plan.

### **2.3 Availability of finance for centralized waste management system**

The three financial issues that must be addressed in implementing centralized waste management system are capital cost, operational cost, and liability (Higgins, 1999). Each of these factors directly impact on the implementation of centralized waste management system and diminishes the main goal of the business venture, that of profitability, and therefore each factor must be carefully managed. The capital cost to construct a centralized waste treatment facility will depend on the size and type of treatment process initially incorporated into the system. A phased construction will allow for developing a revenue stream and minimizing initial capital requirements. Operational costs are influenced by the type of waste, treatment process, and ultimate disposal. Of these three factors, ultimate disposal is the largest cost and the one that is the least controllable. Financial liability and financial responsibility are necessary cost issues that must be incorporated into the cost model and the magnitude and the type of guarantees required are of most concern to the business venture. Owning and operating a hazardous waste treatment facility involves the potential for significant liability to the business venture if accidents occur. The business venture must protect itself financially from the impacts of an accident through the purchase of insurance.

All healthcare facilities involved in centralized waste management need to establish accounting procedures to document the costs they incur in managing healthcare waste (Prüss, Giroult and Rushbrook, 1999). Accurate record-keeping and cost analysis must be undertaken by a designated

individual. Health-care waste costs should be the subject of a separate budget line as this allows costs for different periods to be compared and helps to reduce management costs. If a centralized waste treatment facility is undertaken by a private concern, charges to satellite healthcare facilities should reflect the full cost of operations, maintenance, depreciation, debt amortization, and interest. The inclusion of an amortization factor ensures the availability of funds for future plant and equipment replacements. If the charges levied do not cover all costs, the system will need to be subsidized and a financing plan should be designed accordingly.

#### **2.4 Revenue stream from centralized waste management system**

Waste is the raw material of a hazardous waste treatment facility. The revenue stream generated by the waste treated allows the operator to pay for operations, pay back capital, and make a profit. Revenue stream alone does not ensure a profitable business as profitability depends on efficiency of operations. Several key issues affect the revenue stream including client base (waste generators), affordability of treatment and disposal of hazardous waste, and regulatory enforcement (Higgins, 1999). The client base for a disposal facility includes many large and small businesses that generate different quantities and types of waste. A waste generation feasibility study is necessary to determine the potential quantity and type of waste, the number of healthcare facilities generating hazardous waste, quantity of waste generated by each facility, type of waste generated, rate of healthcare sector growth, location of generators, ability of waste generator to properly store and package waste, and ability of the healthcare facility to pay. The information developed from this type of study provides a business with the knowledge needed to determine the magnitude of capital required to finance the project. Affordability of treatment and disposal of hazardous waste is the second element that affects the revenue stream. The cost of treatment and disposal of hazardous waste should be considered just another operating cost to the waste generating healthcare facility.

Centralized waste treatment facilities have been increasingly adopted in a number of countries as an alternative method of financing healthcare waste management (Prüss, Giroult and Rushbrook, 1999). Under such an arrangement a private entity finances, designs, builds, owns, and operates the treatment facilities and sells its collection and disposal services to government and private healthcare establishments. It is a desirable option for satellite private healthcare facilities due to their inability to raise the needed capital; expected greater efficiency in the private centralized waste treatment facility; transfer of responsibility for proper operation and maintenance to a centralized waste treatment facility with more resources for minimizing risk.



## **2.5 Technical preparedness for centralized waste management system**

Technical issues that are required for implementing centralized waste management system include site selection, pre acceptance procedures, collection, treatment, and operations (Higgins, 1999). The selection of site for a hazardous waste treatment facility requires consideration of regulatory (environment, public health and safety), sociopolitical (social impact and benefit) and geographic (physical location) factors. The purpose of pre-acceptance procedures is to allow the hazardous waste treatment facility to ascertain the quantity and composition of the waste so the facility can determine whether it can treat/dispose of that particular waste. These procedures require that all wastes must be characterized, collection of waste materials must be pre-scheduled with the facility, all waste containers delivered to the facility are weighed or volumetrically measured upon arrival, and that all waste manifests must be verified prior to acceptance into the facility.

According to Prüss, Giroult and Rushbrook (1999) waste collection requires manifesting and transporting. A schedule of pickups should be developed to minimize storage of waste at their sites and the primary collection vehicle should have a spill and emergency response kit. All waste received by the facility should arrive in small or bulk containers. In addition, the collection vehicles should be registered as required under Hazardous Waste Transport Act or its equivalent. Waste treatment facilities should manage waste by storing and treatment. For effective waste treatment operations to take place, an overall operational plan, including collection, treatment, storage, and disposal, must be developed. The operational plan must address hazardous waste management plan, preparation of an operation and maintenance manual, staffing, and training. A hazardous waste management plan addresses health and safety, secured accumulation and storage, recordkeeping and manifesting, materials handling procedures, and most important, emergency response. All staff operating the centralized waste treatment require extensive training on waste management and safety.

## **2.6 Government policy and regulations**

In Kenya, according to the National Healthcare Waste Management Plan 2006-2015 ([www.health.go.ke](http://www.health.go.ke)), policy and legal framework on healthcare waste management is found in the following statutes, namely; the Public Health Act, Chapter 242; the Environmental Management and Coordination Act, 1999 (which necessitates the need for Environmental Impact Assessment); and the Medical Practitioners and Dentists Act, Chapter 253. Additionally there are efforts to develop regulations specifically dealing with health care waste management, and the National Environment



Management Authority (NEMA) has drafted the Bio-Medical Waste Management and Handling Regulations of 2004. Kenya is a signatory to a number of international environmental agreements guiding waste management practice. The agreements relevant to HCW are Stockholm Convention on Persistent Organic Pollutants, Basel Convention on the Control of Trans-Boundary Hazardous Wastes, and Rotterdam Convention on Procedures for Hazardous Chemicals and Pesticides in International Trade. In 2007 the Ministry of Health published National Policy on Injection Safety and Medical Waste Management together with National Guidelines on Injection Safety and Medical Waste Management.

National legislation on healthcare waste management establishes legal controls and permits the national agency responsible for the disposal of health-care waste. The law should be complemented by a policy document, and by technical guidelines developed for implementation of the law (UNEP, 1997). This legal package should specify regulations on treatment for different waste categories, segregation, collection, storage, handling, disposal, and transport of waste, responsibilities, and training requirements; it should take into account the resources and facilities available in the country concerned and any cultural aspects of waste-handling. The law should include a clear definition of hazardous healthcare waste and of its various categories, a precise indication of the legal obligations of the healthcare waste producer regarding safe handling and disposal; specifications for record-keeping and reporting, specifications for an inspection system to ensure enforcement of the law and, designation of courts responsible for handling disputes arising from enforcement of or noncompliance with the law.

According to WHO (1997), the technical guidelines associated with the legislation should be practical and directly applicable. They should include the following specifications, with sufficient detail to ensure that safe practices are observed and appropriate standards achieved, namely; legal framework covering safe management of healthcare waste, hospital hygiene, and occupational health and safety; the responsibilities of public health authorities, of the national environmental protection body, of the heads of health-care establishments, of the scattered and smaller producers of health-care waste; and of the heads of any private or public waste-disposal agencies involved; safe practices for waste minimization; separation, handling, storage, and transport of health-care waste; recommended treatment and disposal methods for each category of healthcare waste and for wastewater. For ease of application, the definitions of health-care waste categories included in the law should be repeated in the technical guidelines.

## **2.7 Management of healthcare facilities**

Kela, Nazareth, Goel and Agarwal (1999) emphasize that medical waste is a management issue and not a technological one. Technology can help but has to be part of a larger solution. This requires that planning, organizing, directing, staffing and controlling efforts and objectives at the healthcare facility be aligned to realize best healthcare waste management outcomes. The upper management of each healthcare facility has overall responsibility for healthcare waste management. However, routine healthcare waste management is often delegated to an engineering or waste collection department. The handling of healthcare waste at the ward or department level is usually the responsibility of the person in charge of each ward or department. Training for segregation, local housekeeping and disinfection, safety practices for healthcare workers and waste handlers from occupational hazards, and waste minimization, can only help and ultimately solve the problem of healthcare waste management.

Johannssen et al (2000) recommend that, to realize best waste management practice, each healthcare facility should clearly address the following critical issues, namely to establish: who is responsible for waste management; what units or departments are involved in waste generation; what the current operational standards for HCW and what are the applicable national, regional, and local policies are; how many people are involved in waste collection and are special skills required by the healthcare facility; what sort of worker safety measures are in place; if procurement of new healthcare materials reviewed to reduce the waste stream and to avoid potential waste treatment problems; what are the daily waste collection routines, including waste packaging; what are the transportation needs and costs and how much it costs the HCW management facility and also if budget provision cover these costs. Outside parties may be hired to help with the facility's waste collection, treatment, transportation, or disposal. However it is important to define what aspects of waste management the outside parties are responsible for, and who is accountable for their performance. The healthcare facility should conduct regular training and public awareness programs on HCW management and ensure all healthcare workers are trained on safe handling and minimization of healthcare waste.

2.8 The conceptual framework

This section presents the conceptual framework of the study arising from the literature review on factors affecting centralized healthcare waste management system as outlined in Figure 1.

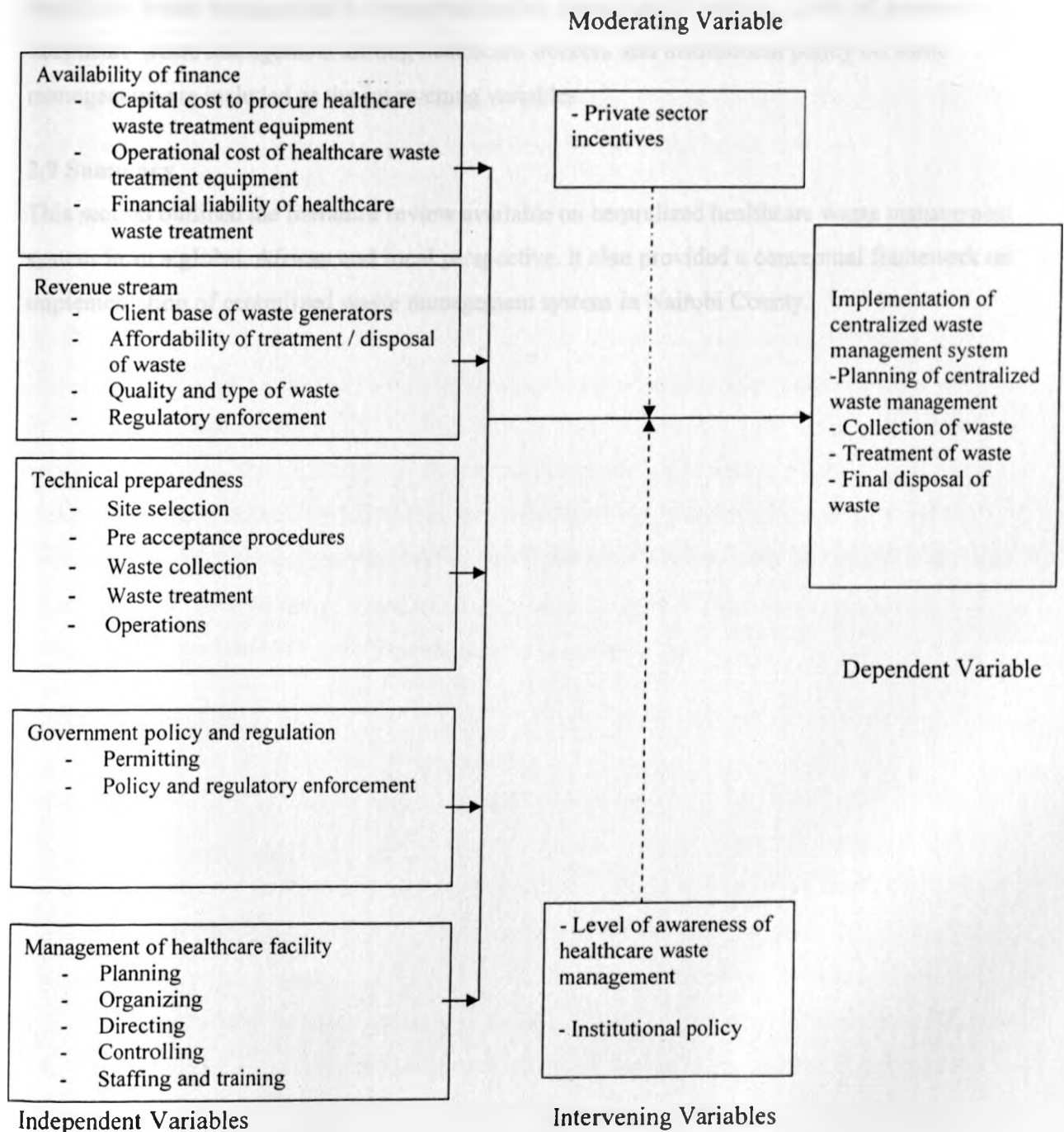


Figure 1: Conceptual framework

The conceptual framework has five independent variables which impact the dependent variable. The independent variables are availability of finance, revenue stream, technical preparedness, government policy and regulation, and management of healthcare facility. The dependent variable is implementation of centralized waste management system. Private sector incentives to invest in healthcare waste management is conceptualized as a moderating variable. Level of awareness of healthcare waste management among healthcare workers and institutional policy on waste management are included as the intervening variables.

**2.9 Summary**

This section outlined the literature review available on centralized healthcare waste management system from a global, African and local perspective. It also provided a conceptual framework on implementation of centralized waste management system in Nairobi County.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter describes the methodology that was used to conduct the study. This includes research design, location of study, target population sample, sample size in sampling procedure, sample selection, research instruments, data collection procedures and data analysis techniques. The chapter also describes ethical issues consideration and operational definition of variables.

#### **3.2 Research design**

The study adopted a descriptive research design. A descriptive study is undertaken to ascertain and be able to describe the characteristics of the variables of interest in a situation (Sekaran, 2006). Kothari (2004) defines descriptive research studies as those studies which are concerned with describing the characteristics of a particular individual or of a group. They are concerned with specific predictions, with narration of facts about groups or individuals and with the aim of getting complete and accurate information. Descriptive studies are also undertaken to understand the characteristics of organizations that follow certain practices. The goal of a descriptive study is to offer the researcher a profile or describe relevant aspects of the phenomena of interest from an individual, organizational, industry oriented or other perspective.

#### **3.3 Target population**

Shao (1999) defines a population as the aggregate of all elements while Sekaran (2006) defines population as the entire group of people, events, or things of interest that the researcher wishes to investigate. The study population was private healthcare facilities in Nairobi County that use the Nairobi Women's Hospital centralized waste treatment facility located at their Ngong' road branch. The Nairobi Women's Hospital has 45 private healthcare facilities within Nairobi County (including its Ngong' road branch) that use its treatment facility. Of these, 3 private healthcare facilities were used for pre testing the questionnaire and were left out of the target population. The researcher therefore assumed 42 private healthcare facilities that use the centralized treatment facility to be the population elements.

### 3.4 Sample size and sample procedure

The researcher adopted purposive sampling in this study. Purposive sampling can be more realistic than randomization in terms of time, effort and cost needed in finding knowledgeable informants especially useful when there is not enough funds and other resources (Godambe 1982, Karmel & Jain 1987, Bernard 2002, Topp *et al.* 2004), and can be applied to research in a number of ways such as sampling informants with a specific type of knowledge or skill (Li *et al.* 2006, Prance 2004, Vargas & van Andel 2005), case studies (Dolisca *et al.* 2007, Parlee & Berkes 2006), and when the population is too small for a random sample (Tran & Perry 2003). Under purposive sampling the researcher applies judgment sampling which involves the choice of subjects who are most advantageously placed or in the best position to provide information required (Paton, 1990).

The researcher used both qualitative and quantitative sampling methods through structured and unstructured questionnaires, observations and interviews. Both qualitative and quantitative sampling methods may be used when samples are chosen purposively such as questionnaires (Zhen *et al.* 2006), direct observations (Martinez-Romero *et al.* 2004) and interviews (Anderson 2004, Li *et al.* 2006, Ramihantaniariyo *et al.* 2003). Statistical analyses such as frequencies, analysis of variance (Belcher *et al.* 2004), cross tabulation (Bah *et al.* 2006), have been used with purposive sampling and were adopted by the researcher. The researcher assumed normal distribution and confidence level of 95% ( $t=1.96$ ).

There are several approaches to determining the sample size and these include using published tables, and applying formulas to calculate a sample size (Israel 1992, Smith 1983). In this study the researcher used published tables by Krejcie and Morgan (1970) as indicated in Table 1 in Appendix IV where  $N$  = total number of elements in the population,  $S$  = sample size of the population. Based on sample size for a given population size tabulations in Table 1, the researcher used purposively selected target population of 42 private healthcare facilities and obtained a sample population size of 38 private healthcare facilities.

### 3.5 Research instruments

Questionnaires which contain structured and unstructured questions were used in the study. Data was collected from healthcare workers and waste handlers in 37 private healthcare facilities in Nairobi County that formed the sample population. Each healthcare facility was represented by one healthcare worker respondent. The questionnaires were used because of their simplicity in

administration, scoring items and analysis of data (Mugenda and Mugenda, 2003). The purpose of the questionnaires was to capture core information and supplementary information. Qualitative data was collected using in depth interviews with open ended questions. Site visits were conducted to validate information obtained from the interviews.

Secondary data was collected from records available at the private healthcare facilities, data residing with the transporters, the ministry of health, the Nairobi Women's Hospital, the Nairobi City Council, and the National Environment Management Authority (NEMA). Each questionnaire contained seven schedules. Schedule A of the questionnaire sought general information of all the respondents. Schedules B, C, D, E and F addressed the independent variables while Schedule G was about the dependent variable. Schedule B sought information relating to availability of finance while Schedule C asked information on revenue stream. Schedule D was about technical preparedness while Schedule E requested information on government policy and regulations. Schedule F focused on management of healthcare facilities while Schedule G sought information on implementation of centralized healthcare waste management system. Schedules C and D were administered only to Nairobi Women's Hospital Ngong' Road branch.

### **3.6 Validity of the research instruments**

The instruments were tested for their validity by correlating the findings with the study objectives as non-probability methods such as purposive sampling are not free from bias as informants may be chosen out of convenience or from recommendations of knowledgeable people (Lopez *et al.* 1997, Smith 1983, Godambe 1982). The researcher ensured systematic selection of informants to ensure reproducibility of the study is not reduced and to improve the quality and robustness of the data (Bussman 2006, Banack *et al.* 2004, Delang 2005, Ross-Ibarra & Molina-Cruz 2002, Sundriyal & Sundriyal 2004). The questions were shared by the study supervisor for review and comments and appropriate adjustments or revisions made before administering them to the target respondents. Both content and construct validity was evaluated prior to the use of the instruments. This process ensured the questions in the questionnaire were appropriate for the accomplishment of the study and that they were well constructed to avoid misconception or misinterpretation by the respondents. Input of healthcare waste management experts and the study supervisor was sought to further ensure that the instruments were adequately validated.



### **3.7 Reliability of research instruments**

Reliability of the instruments is the degree of consistency with which it measures a variable (Mugenda and Mugenda, 2003). Reliability involves how consistent the information is across the community and may be thought of as a ratio of the number of correct and incorrect pieces of information from an informant (Lopez *et al.* 1997, Medin *et al.* 1997, Reyes-Garcia *et al.* 2005, Romney 1999, Romney *et al.* 1986, Ross and Medin 2005, Zent 2001). Whenever data appear to be incoherent and implausible, the researcher used cross-checking and triangulation to verify the response as recommended by Alexiades (1996). A pretest was conducted amongst three selected private healthcare facilities within Nairobi County. Care was taken to ensure the pretest sample did not form part of the research sample size. The results of the pretest survey helped in the restructuring of the questionnaires by incorporating missing information, omitting irrelevant questions and paraphrasing questions that appear ambiguous to respondents. To ensure that data collected during the field work was reliable, more than one research tool was used including in depth interviews, site visits, observations and review of relevant secondary data for additional information and verification of response from interviews.

### **3.8 Data collection procedures**

Data was collected with the help of research assistants from 37 healthcare facilities through a combination of personal interviews of healthcare workers in those facilities using the questionnaires and also drop and pick procedure where it was not possible to immediately get all the information through interviews. Authority was requested from the healthcare facility management and heads of department or units before questionnaire was given and administered. The heads of department or units were instrumental in identification of the respondents. The process of data collection lasted four weeks.

### **3.9 Data analysis and presentation**

The data collected was coded, keyed into the computer and analyzed using descriptive statistics with the aid of Statistical Package for Social Sciences (SPSS) version 18 and Microsoft Windows software. Qualitative statistical techniques were used during the analysis to describe and summarize data. The results of the analysis was presented and interpreted in the form of descriptive statistics (frequencies, percentages, mean and standard deviation), Karl Pearson's coefficient of correlation and regression analysis. The findings were presented in tables.



**3.10 Ethical consideration**

Authorization to conduct the study was obtained from the management of the Nairobi Women’s Hospital and the sampled private healthcare facilities prior to carrying out the study. A copy of letter of authorization is appended annex. The researcher gave assurance to the respondents regarding confidentiality of the information obtained and an assurance phrase was included in the introductory letter.

**3.11 Operationalization of variables**

An operational definition (or operationalization) of a variables is demonstration of a process or set of validation tests used to determine the variable’s presence and quantity (Sekaran, 2006). It defines the variable’s concept to render it measurable and is done by looking at behavioral dimensions, facets, or properties denoted by the variable. The researcher has shown in detail the various indicators associated with the variables as indicated in Table 3.1.

**Table 3.1 Operationalization of Variables**

Objectives	Variables	Indicators	Measures	Tools of data collection	Measuring scale	Data analysis technique
1. To examine how availability of finance influences implementation of centralized waste management system in private hospitals in Nairobi County.	Independent variable: <b>Availability of finance</b>					
	Capital cost of procuring healthcare waste treatment equipment	Existence of waste treatment equipment	a) Yes                      b) No	Questionnaires Interviews Records	Nominal	Frequencies Means Percentages
		Type of waste treatment equipment	a) Incinerator b) Autoclave c) Microwave d) Other (Specify)		Nominal	
		Cost of waste treatment equipment	a) Below Ksh 500,000    b) Ksh500,001 – 1,000,000    c) Ksh1,000,001- 1,500,000 d) Ksh1,500,001 – 2,000,000    e) Ksh 2,000,001 – 2,500,000 f) Above 2,500,001		Interval	
	Operational cost of healthcare waste treatment equipment	Budget allocation for waste treatment	a) Yes b) No	Questionnaires Interviews Records	Nominal	Frequencies Means Percentages
		Amount of budget	a) Below Ksh 200,000    b) Ksh 200,001 – 400,000    c) Ksh400,001 – 600,000 d) Ksh600,001 – 800,000    e) Above Ksh 800,001		Interval	
		Cost of operating waste treatment equipment	a) Below Ksh 100,000    b) Ksh 100,001 – 200,000    c) Ksh200,001 – 300,000 d) Ksh300,001 – 400,000    e) Above Ksh 400,001		Interval	
	Financial liability of healthcare waste treatment	Insurance for waste handlers	a) Yes b) No	Questionnaires Interviews Records	Nominal	Frequencies Means Percentages
		Category of waste handler insured	a) Healthcare workers    b) Cleaners c) Transporters    d) Waste treatment equipment operators		Ratio	
		Annual insurance cost	a) Below Ksh50,000    b) Ksh50,001-100,000 c) Ksh100,001- Ksh200,000    d) Over Ksh200,001		Interval	
2. To establish how revenue stream affects	Independent variable: <b>Revenue stream</b>					

implementation of centralized waste management system in private healthcare facilities in Nairobi County.	Client base of healthcare waste generators	Existence of waste generating customers	a) Below 10 d) 31-40	b) 11-20 e) Above 41	c) 21-30	Questionnaires Interviews Records	Interval	Frequencies Means Percentages
	Affordability of treatment and disposal of healthcare waste	Cost of waste treatment	Charge in Ksh / Kg b) Ksh21 - 30 d) Ksh41- 50	a) Below Ksh20 c) Ksh31 - 40 e) Above 51		Questionnaires Interviews Records	Interval	Frequencies Means Percentages
	Quality and type of healthcare waste	Presence of quality control procedures	a) Yes b) No			Questionnaires Interviews Records	Nominal	Frequencies Means Percentages
		Type of quality control procedure	a) Waste segregation c) Waste recycling e) Other (specify)	b) Waste minimization d) Waste storage			Ratio	
		Frequency of application of quality control procedure	a) None of the times c) Most of the times	b) Sometimes d) All the time			Ordinal	
3. To determine how technical preparedness affects implementation of centralized waste management system in private hospitals in Nairobi County	Independent variable: <b>Technical preparedness</b>							
	Site selection	Number of waste disposal sites	a) None b) 1 c) 2 d) 3 and above			Questionnaires Records Interviews	Ordinal	Frequencies Means Percentages
	Pre acceptance procedures	Type of pre acceptance procedures	a) Ascertaining of quantity and composition of waste at source b) Pre-scheduling of waste collection c) Waste volume and weight verification upon arrival d) Visual inspection of waste physical characteristics e) Verification of waste manifests from transporters f) Other (specify)			Questionnaires Records Interviews	Ratio	Frequencies Means Percentages
	Waste collection	Presence of transport system for waste collection	a) Yes b) No			Questionnaires Records Interviews	Nominal	Frequencies Means Percentages
		Contracted waste transporters	a) Less than 5 b) 6-10 c) 11-15 d) 16 - 20 e) Above 21				Interval	

	Waste treatment	Presence of waste treatment process	Quantity of waste treated per month a) Up to 500kgs b) 501 – 1000kgs c) 1001 – 1500kgs d) 1501 – 2000kgs e) Above 2001kgs	Questionnaires Records Interviews	Interval	Frequencies Means Percentages
	Operations	Presence of waste operation manual	a) Yes b) No	Questionnaires Records Interviews	Nominal	Frequencies Means Percentages
		Trained waste treatment operators	a) Yes b) No		Nominal	
		Type of training for waste treatment equipment operators	a) Are trained on safety procedures on healthcare waste handling b) Are trained on protective clothing for healthcare waste handling c) Are trained on post infection / injury procedures for healthcare waste handling d) Are trained on proper handling of waste treatment equipment e) Other (specify)		Ratio	
4. To examine how government policy and regulation affects implementation of centralized waste management system in private healthcare facilities in Nairobi County.	Independent variable: <b>Government policy and regulation</b>					
	Permitting	Types of permits	a) Environmental Impact Assessment b) Municipal Council Business License c) Medical Practitioners and Dentists Board License d) Biomedical Waste Management and Handling Permit e) Other (specify)	Questionnaires Records Interviews	Nominal	Frequencies Means Percentages
	Policy and regulatory enforcement	Presence of policies, laws and regulations for healthcare waste management	a) Yes b) No	Questionnaires Interviews Records	Nominal	Frequencies Means Percentages
		Application of policy / regulation	Type of policy / regulation a) The Public Health Act b) Environmental Management and Coordination Act c) Medical Practitioners and Dentists Act d) Biomedical Waste Management and Handling Regulations e) Other (specify)		Nominal	

5. To establish how management of healthcare facilities affects implementation of centralized waste management system in private healthcare facilities in Nairobi County.	Independent variable: <b>Management of healthcare facility</b>					
	Planning	Presence of healthcare waste management plan	a). Yes                      b). No	Questionnaires Interviews Records	Nominal	Frequencies Means Percentages
	Organizing	Existence of waste management department or unit	a). Yes                      b). No			
	Directing	Existence of waste management officer	a). Yes                      b). No			
	Controlling	Existence of monitoring and evaluation mechanism for waste management	a). Yes                      b). No			
		Existence of trained healthcare workers / waste handlers	a)Yes b) No			
	Staffing and training	Type of training for healthcare workers / waste handlers	a) Are trained on safety procedures on healthcare waste handling b) Are trained on protective clothing for healthcare waste handling c) Are trained on post infection / injury procedures for healthcare waste handling d) Transporters are trained on safe transportation of healthcare waste e) Other (specify)		Ratio	Frequencies Means Percentages
To examine the factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County	Dependent variable: <b>Implementation of centralized waste management system</b>					
	Planning of centralized healthcare waste management	Existence of waste management plan	a) Yes b) No	Questionnaires Records Interviews	Nominal	Frequencies Means Percentages

	Collection of healthcare waste	Application of waste storage and transportation procedures	Extent of application b) Sometimes c) Most of the time d) All the time a) None of the times	Questionnaires Records Interviews	Ratio	Frequencies Means Percentages
	Centralized treatment of healthcare waste	How waste is managed	a) On site b) Off site c) Both on site and off site d) Other (specify)	Questionnaires Records Interviews	Nominal	Frequencies Means Percentages
		Frequency of waste delivery to centralized waste treatment facility	a) Once a week b) Twice a week c) Thrice a week d) Four times a week e) More than four times a week		Ordinal	
	Centralized disposal of healthcare waste	Existence of centralized waste disposal procedure	a) Yes b) No	Questionnaires Records Interviews	Nominal	Frequencies Means Percentages

### 3.12 Summary

This chapter described the methodology that was used to conduct the study including research design, location of study, target population sample, sample size in sampling procedure, sample selection, research instruments, data collection procedures and data analysis techniques. The chapter also described ethical issues consideration and operational definition of variables.

## **CHAPTER FOUR**

### **DATA ANALYSIS, PRESENTATION AND INTERPRETATION**

#### **4.1 Introduction**

This chapter contains data analysis, presentation and interpretation. The purpose of the study was to establish factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County.

#### **4.2 Response Rate**

The study targeted 38 healthcare facilities, including Nairobi Women's Hospital Ngong' Road branch which has the centralized waste treatment facility. The total returned and filled questionnaire number was 37, giving a response rate of 97.4%. This response rate can be attributed to purposive sampling technique and the data collection procedure where the researcher was assisted to administer the questionnaires by a team of three well informed personnel who understood the objectives of the study and were familiar with the concept of centralized waste management. This ensured objectiveness in data collection. In addition the respondents were knowledgeable and willing to give information.

#### **4.3 Analysis of general information**

The researcher found it important to determine the general information of the respondents in order to provide a foundation under which the study can generate pertinent information. The findings are outlined in the following sections.

##### **4.3.1 Distance of healthcare facility from the Nairobi Women's Hospital Ngong' Road branch**

Table 4.1 presents findings of distance of health facilities from the Nairobi Women's Hospital Ngong' Road branch.



**Table 4.1: Distance of Healthcare Facility from the Nairobi Women's Hospital Ngong Road Branch**

	Frequency	Percent
Below 5km	7	19.4
6-10km	6	16.7
11-15km	2	5.6
16 - 20km	16	44.4
Above 21km	5	13.9
<b>Total</b>	<b>36</b>	<b>100.0</b>

From the findings 64% of the facilities were located at a distance 10km from Nairobi Women's Hospital. Therefore majority of the health facilities were located at considerable distance to Nairobi Women's hospital which has a centralized waste management system.

#### **4.3.2 Type of healthcare facility**

Table 4.2 presents findings on the type of healthcare facility.

**Table 4.2: Type of Healthcare Facility**

	Frequency	Percent
Hospital with in patient service	12	32.4
Clinic	22	59.5
Laboratory	3	8.1
<b>Total</b>	<b>37</b>	<b>100.0</b>

From the findings the composition of private healthcare facilities which practice centralized waste management system and deliver their waste to Nairobi Women's Hospital were hospitals with in patient department, clinics and laboratories. Of those sampled the majority (59.5%) were clinics.

#### **4.3.3 Number of beds in hospital with in patient department**

Table 4.3 presents the number of beds in the hospitals with in patient department.

**Table 4.3: Number of beds in hospital with in patient department**

	Frequency	Percentage
Below 30	5	41.7
31-60	7	58.3
<b>Total</b>	<b>12</b>	<b>100.0</b>

From the findings, 58.3% have 31-60 beds while 41.7 % have below 30 beds. These findings indicate that majority of private hospitals in Nairobi County which practice centralized waste management system and deliver their waste to Nairobi Women's Hospital have bed capacity of between 31-60 beds.

#### **4.4 Availability of Finance**

The study obtained data on the influence of finance availability on implementation of centralized waste management system in private healthcare facilities in Nairobi County. The analysis included all the private healthcare facilities under study as well as the Nairobi Women Hospital Ngong' Road. The results are as outlined in the following sections.

##### **4.4.1 Availability of waste treatment equipment**

Table 4.4 presents findings on availability of waste treatment equipment in private healthcare facilities in Nairobi County..

**Table 4.4: Availability of Waste Treatment Equipment**

	Frequency	Percent
Yes	13	35.1
No	24	64.9
<b>Total</b>	<b>37</b>	<b>100.0</b>

From the findings, majority (64.9%) did not have any form of waste treatment equipment.

##### **4.4.2 Type of healthcare waste treatment equipment**

Table 4.5 presents findings on the type of healthcare waste treatment equipment in the 13 health facilities which indicated they had waste treatment equipment.

**Table 4.5: Type of Healthcare Waste Treatment Equipment**

	Frequency	Percent
Incinerator	4	30.8
Autoclave	8	61.5
Microwave	1	7.7
<b>Total</b>	<b>13</b>	<b>100.0</b>

From the findings, 61.5% indicated autoclave, 30.8% said they have incinerator while 7.7% stated microwave. Thus majority of the private health facilities with waste treatment equipment use autoclave. The researcher also observed that the Nairobi Women's Hospital Ngong' Road branch, which is providing the centralized waste treatment facility, has installed a commercial incinerator for treatment of waste.

#### 4.4.3 Cost of healthcare waste treatment equipment

Table 4.6 presents the cost of healthcare waste treatment equipment for the 13 healthcare facilities.

**Table 4.6: Cost of Healthcare Waste Treatment Equipment**

	Frequency	Percent
Below Ksh500,000	12	92.3
Above Ksh2,500,000	1	7.7
<b>Total</b>	<b>13</b>	<b>100.0</b>

From the findings majority of the healthcare facilities (92.3%) spent up to Ksh500,000 while 1 healthcare facility (Nairobi Women's Hospital) spent over Ksh2,500,000. The researcher obtained secondary information indicating that procurement and installation costs of the commercial incinerator used by Nairobi Women's Hospital for centralized waste treatment was over Ksh16 million.

#### 4.4.4 Allocation of annual budget for healthcare waste management

Table 4.7 presents findings on allocation of budget for healthcare waste management.

**Table 4.7: Allocation of Annual Budget for Healthcare Waste Management**

	Frequency	Percent
Yes	36	97.3
No	1	2.7
<b>Total</b>	<b>37</b>	<b>100.0</b>

From the findings majority (97.3%) of the respondents indicated they allocate annual budget for waste management while the rest did not. This implies that majority of the private healthcare facilities in Nairobi County that practice centralized waste management system and deliver their waste to Nairobi Women’s Hospital set aside funds for waste management.

**4.4.5 Estimated annual budget for healthcare waste management**

Table 4.8 presents findings on estimated annual budget for healthcare waste management.

**Table 4.8: Estimated Annual Budget for Healthcare Waste Management**

	Frequency	Percent
Below Ksh 200,000	32	86.5
Ksh 200,001 – 400,000	3	8.1
Ksh600,001 – 800,000	1	2.7
None	1	2.7
<b>Total</b>	<b>37</b>	<b>100.0</b>

From the findings, majority (86.5%) of healthcare facilities set aside up to Ksh200,000 as annual budget for healthcare waste management.

**4.4.6 Estimated cost of operating the waste treatment equipment per month**

Table 4.9 presents findings on estimated cost of operating the waste treatment equipment per month.

**Table 4.9: Estimated Cost of Operating the Waste Treatment Equipment Per Month**

	Frequency	Valid Percent
Below Ksh 100,000	12	92.3
Ksh 100,001 – 200,000	1	7.7
<b>Total</b>	<b>13</b>	<b>100.0</b>

From the findings, majority (92.3%) of the 13 health facilities which have waste treatment equipment indicated that they spend below Ksh100,000 per month while only 1 healthcare facility (Nairobi Women’s Hospital) indicated an estimated cost of Ksh100,001 – 200,000 per month.

**4.4.7 Waste handlers insurance**

Table 4.10 indicates findings on whether the waste handlers are insured against any potential injury arising from handling healthcare waste.

**Table 4.10: Waste Handlers Insurance**

	Frequency	Percent
Yes	7	18.9
No	30	81.1
<b>Total</b>	<b>37</b>	<b>100.0</b>

From the findings majority (81.1%) of the private health facilities do not insure waste handlers. The findings means majority of waste handlers working in private healthcare facilities in Nairobi County that practice centralized waste management system and deliver their waste to Nairobi Women's Hospital are not insured.

#### **4.4.8 Waste handlers insured**

Table 4.11 presents findings on the type of waste handlers insured by the various private health facilities.

**Table 4.11: Waste Handlers Insured**

	Frequency	Percent
Healthcare workers	5	71.4
Cleaners	4	57.1
Transporters	3	42.9
Waste treatment equipment operators	3	42.9

This was a multi-response question, respondents gave more than one response. From the findings, most (71.4%) of those insured are health workers while waste treatment equipment operators and transporters are rarely insured.

#### **4.4.9 Estimated annual insurance cost for waste handlers**

Table 4.12 presents findings on the estimated annual insurance costs for waste handlers.

**Table 4.12: Estimated Annual Insurance Cost for Waste Handlers**

	Frequency	Percent
Below Ksh50,000	4	57.1
Over Ksh200,001	3	42.9
<b>Total</b>	<b>7</b>	<b>100.0</b>

From the findings, majority of the health facilities (57.1%) of those who insure waste handlers, spend below Ksh50,000.

#### **4.4.10 Financial factors affecting implementation of centralized healthcare waste management**

The researcher was also inquisitive to determine the most top three finance factors that affect implementation of centralized healthcare waste management system. Respondents had different opinion regarding this including: interest rates on loans, high maintenance cost of equipment, availability of finance, poor management process, costly practice, high cost of incineration, high transportation cost, high cost of treating equipment, inadequate resources, high cost of disposal, low budget allocation, high cost of outsourcing waste handlers, lack of incentives from government and expensive equipment were some of the factors that respondents stated affects implementation of healthcare waste management system.

#### **4.5 Revenue Stream**

The schedule of questionnaire on revenue stream was limited to the Nairobi Women's Hospital Ngong' Road branch, where the centralized treatment facility is located. From the findings, 37 healthcare facilities (including Nairobi Women's Hospital Hurlingham and Ongata Rongai branches) use the centralized waste treatment facility. The healthcare facilities are charged Ksh31 – 40 per kilogram of healthcare waste treated. Further it emerged that Nairobi Women's Hospital Ngong' road branch have quality control procedures in place which mainly entailed waste segregation, minimization, and waste storage. The quality control procedures were applied most of the times.

Further, failure of contracted waste transporters to deliver full amount of waste collected from various health facilities and inability of waste companies to recycle waste materials were cited by Nairobi Women's Hospital as the main factors that affect revenue stream of centralized healthcare waste management system.

#### **4.6 Technical Preparedness**

The schedule of questionnaire on technical preparedness was limited to the Nairobi Women's Hospital (NWH) Ngong' Road branch. From the findings, NWH indicated that it obtained Environmental Impact Assessment License from the National Environment Management Authority (NEMA), the Municipal Council Business License, and Incineration License in order to operate the centralized healthcare waste management equipment. The NWH has only one final waste disposal site available to it for final landfill waste disposal in Nairobi County.

The study findings indicate that Nairobi Women’s Hospital normally undertakes waste volume and weight verification upon arrival as well as verification of waste manifests from transporters as the pre acceptance procedures implemented. It was also found that NWH has established a transport system for healthcare waste collection through contracting four transport companies. The study further indicates that NWH treats up to 16 tons of healthcare waste per month and they have an operational manual for operating the healthcare waste management equipment. The study revealed that NWH train their waste treatment equipment operators on safe handling of healthcare waste including safety procedures on healthcare waste handling, protective clothing for healthcare waste handling, post infection / injury procedures for healthcare waste handling, and safe transportation of healthcare waste.

**4.7 Government policy and regulation**

This sections provides results on government policy and regulation.

**4.7.1 Type of permits or license for handling waste**

Table 4.13 presents findings on the types of permits or license for handling waste in various healthcare facilities.

**Table 4.13: Type of Permits or License for Handling Waste**

	Frequency	Percentage
Environmental Impact Assessment	10	27.03
Municipal Council Business License	3	8.11
Medical Practitioners and Dentists Board License	2	5.41
Biomedical Waste Management and Handling Permit	27	72.97

From the findings, majority (73%) of the health facilities have Biomedical Waste Management and Handling permit while few have Medical Practitioners and Dentists Board license. Almost a third of the respondents have Environmental Impact Assessment license.

**4.7.2 Policies / regulations for healthcare waste management**

Table 4.15 presents findings on existence of any policies / regulations for healthcare waste management in the healthcare facilities.

**Table 4.14: Policies / Regulations for Healthcare Waste Management**

	Frequency	Percent
Yes	2	5.4
No	35	94.6
<b>Total</b>	<b>37</b>	<b>100.0</b>

From the findings most (94.6%) of healthcare facilities stated non existence of any policies / regulations for healthcare waste management. This indicates that majority of the private healthcare facilities in Nairobi County that practice centralized waste management system and deliver their waste to Nairobi Women's Hospital practice waste management without knowledge of any policies / regulations for healthcare waste management.

#### **4.8 Management of Healthcare Facility**

This section outlines results on management of healthcare facility.

##### **4.8.1 Regularly plan for healthcare facility waste management**

Table 4.15 summarizes the findings on whether healthcare facility regularly plan for waste management.

**Table 4.15: Regularly Plan for Healthcare Facility Waste Management**

	Frequency	Percent
Yes	33	89.2
No	4	10.8
<b>Total</b>	<b>37</b>	<b>100.0</b>

From the findings, majority (89.2%) of healthcare facilities pointed out that their healthcare facility regularly plan for waste management. This shows majority of the healthcare facilities under study are involved in some sort of planning process for waste management.

##### **4.8.2 Existence of system for collecting waste within healthcare facility**

Table 4.16 shows the finding on whether respondents' healthcare facilities have a system for collecting healthcare waste.

**Table 4.16: Existence of System for Collecting Waste within Healthcare Facility**

	Frequency	Percent
Yes	37	100



From the findings, all (100%) of the respondents indicated that their healthcare facility had a system for collecting waste. This implies that all selected healthcare facilities had an organized system for waste collection.

**4.8.3 Regularly treat and dispose of waste**

Table 4.17 presents results of the study finding on whether the healthcare facility ensure their waste is regularly treated and disposed of.

**Table 4.17 Regularly Treat and Dispose of Waste**

	Frequency	Percent
Yes	33	91.7
No	3	8.3
Total	36	100

According to the findings, majority (92%) of the healthcare facilities indicated that they ensured regular treatment and disposal of their waste. This illustrates that most of the selected healthcare facilities regularly directed proper treatment and disposal of their waste.

**4.8.4 Mechanism for final disposal of healthcare facility waste**

Table 4.18 summarizes the study findings on mechanism set by healthcare facility for final disposal of waste.

**Table 4.18: Mechanism for final disposal of Healthcare Facility Waste**

	Frequency	Percent
Yes	24	66.7
No	12	33.3
Total	36	100

Majority (67%) of the healthcare facilities pointed out that there was a set mechanism to ensure final disposal of the waste, meaning there existed some sort of control measures for waste management.

**4.8.5 Availability of policies and guidelines for safe waste disposal**

Table 4.19 summarizes the findings of the study on whether healthcare facilities have policies and guidelines for safe waste disposal.

**Table 4.19: Availability of Policies and Guidelines for Safe Waste Disposal**

	Frequency	Percent
Yes	35	94.6
No	2	5.4
<b>Total</b>	<b>37</b>	<b>100</b>

Majority (97.2%) of the healthcare facilities interviewed had policies and guidelines for safe waste disposal. This means the management had put in place some mechanism to control waste management in majority of the healthcare facilities under study.

**4.8.6 Type of training healthcare workers / waste handlers have undertaken**

Table 4.20 summarizes the findings of the study on type of training healthcare workers / waste handlers have undertaken.

**Table 4.20: Type of Training Healthcare Workers / Waste Handlers Have Undertaken**

	Frequency	Percentage
Are trained on safety procedures on healthcare waste handling	32	86.5
Are trained on protective clothing for healthcare waste handling	35	94.6
Are trained on post infection / injury procedures for healthcare waste handling	37	100.0
Transporters are trained on safe transportation of healthcare waste	30	81.1

From the findings, training on post infection / injury procedures for healthcare waste handling was conducted in many healthcare facilities as indicated by 100% response. Training on protective clothing for healthcare waste handling was second with 94.6%, while training of transporters on safe transportation of healthcare waste was indicated by 81.1%.

**4.9 Implementation of centralized waste management system**

This section provides results on implementation of centralized waste management system.

**4.9.1 Have waste management plan**

Table 4.21 shows result of the study finding on whether the healthcare facility had waste management plan.

**Table 4.21: Have Waste Management Plan**

	Frequency	Percent
Yes	10	27
No	27	73
<b>Total</b>	<b>37</b>	<b>100</b>

Majority (73%), of the healthcare facility had no waste management plan. This means majority of the private healthcare facilities in Nairobi County that practice centralized waste management system and deliver their waste to Nairobi Women’s Hospital Ngong’ road branch have no waste management plan.

**4.9.2 Apply waste storage and transportation procedures**

Table 4.22 summarizes the finding of the study on the extent to which respondents apply waste storage and transportation procedures.

**Table 4.22: Apply Waste Storage and Transportation Procedures**

	Frequency	Percent
None of the times	1	2.8
Sometimes	15	41.7
Most of the time	12	30.6
All the time	9	25
<b>Total</b>	<b>37</b>	<b>100</b>

According to the findings, most (56%) of the respondents pointed that they often apply waste storage and transportation procedures, meaning majority of the healthcare facilities often have their waste collected.

**4.9.3 Managing of Healthcare Waste**

Table 4.23 presents the study finding on how healthcare facilities manage their waste.

**Table 4.23: Managing of healthcare waste**

	Frequency	Percent
On site	4	10.8
Off site	10	27
Both on site and off site	23	62.2
<b>Total</b>	<b>37</b>	<b>100</b>

From the findings, majority (62%) of the healthcare facilities disposed their waste both on site and off site, 27% disposed their waste offsite while 11% disposed their waste onsite. This confirms the common practice that even in the presence of an organized centralized waste treatment system, some healthcare facilities will still dispose o waste within the premise of their facilities. It also shows that at least 27% of the waste is collected and treated centrally.

**4.9.4 Frequency of delivering healthcare waste to the centralized healthcare waste management facility**

Table 4.24 summarizes the finding on the healthcare facilities that disposed waste offsite.

**Table 4.24: Delivering Healthcare Waste to the Centralized Healthcare Waste Management Facility**

	Frequency	Percent
Once a week	7	70
Twice a week	3	30
Total	10	100

From the findings, majority (70%) of those who manage waste offsite deliver waste to the centralized healthcare waste management once a week while 30% deliver waste twice a week. This implies that most of the healthcare facilities put together their waste for a period of one week then deliver at the centralized treatment facility for disposal.

**4.9.5 Existing procedure for centralized healthcare waste management**

Table 4.25 illustrates the finding of the study on an existence procedure for centralized healthcare waste management.

**Table 4.25: Existing Procedure for Centralized Healthcare Waste Management**

	Frequency	Percent
Yes	25	67.6
No	12	32.4
Total	37	100

According to the findings, majority (68%) indicated that their healthcare facility had an existing procedure for centralized healthcare waste management. Thus majority of healthcare facilities ensure centralized disposal of healthcare waste.

**4.9.6 Effect of institutional policy on implementation of centralized waste management system**

Table 4.26 shows the finding of the study on the extent to which institutional policy affects implementation of centralized waste management system.

**Table 4.26: Effect of Institutional Policy on Implementation of Centralized Waste Management System**

	Frequency	Percent
Very significantly	15	40.6
Significantly	14	37.8
Not significantly	4	10.8
Not at all	4	10.8
Total	36	97.3

From the findings, most healthcare facilities (89.2%) were of the opinion that institutional policy on healthcare waste management affects implementation of centralized waste management system. Respondents who thought institutional policy on healthcare waste management affect centralized waste management system stated need to involve all stakeholders in the healthcare facilities to ensure successful centralized waste management; need for institutional policy to support compliance with the National Environment Management Authority (NEMA) regulations; need create awareness of waste management policies among healthcare workers, waste handlers and healthcare facility administrators.

**4.9.7 Effect of workers level of awareness of healthcare waste management**

Table 4.17 depicts extent to which level of awareness of the healthcare waste management among healthcare workers affects implementation of centralized waste management system.

**Table 4.17: Effects of Level of Awareness of Healthcare Waste Management among Healthcare Workers on Implementation of Centralized Waste Management System**

	Frequency	Percent
Very significantly	17	46
Significantly	18	48.6
Not significantly	1	2.7
Not at all	1	2.7
Total	37	100

According to the findings, most (97.3%) of the respondents indicated that their awareness on waste management affects implementation of centralized waste management system. To explain this, respondents argued that once proper training has been done, informed workers are execute their work efficiently, and trained workers are more effective. They stated that when workers are trained it's easier to follow through the waste management plan where applicable and that level of workers awareness affects quality of waste segregation.

**4.9.8 Extent to which private sector incentives for waste management affects implementation of centralized waste management system**

Table 4.18 provides the information on the extent to which private sector incentives for waste management affects implementation of centralized waste management system.

**Table 4.18: Effect of Private Sector Incentive on Implementation of Centralized Waste Management System**

	Frequency	Percent
Significantly	4	27
Not significantly	14	37.8
Not at all	13	35.2
Total	37	100

Most (73%) of respondents indicated that private sector incentives for waste management does not affect implementation of centralized waste management system. To explain this, most of respondents pointed out that even in the absence of incentives the healthcare facilities were still able to treat their waste centrally. However 27% of the respondents generally indicated that private sector incentives such as accessibility of finance, zero rating and tax incentives of consumables / packaging for waste management would improve quality of centralized waste management.

**4.10 Correlation and the coefficient of determination of the Data**

To quantify the strength of the relationship between the variables, the researcher used the Karl Pearson’s coefficient of correlation (or Pearson product-moment correlation) which is a measure of the strength of a linear association between two variables and is denoted by *r*. The Pearson correlation coefficient, *r*, can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables. A value greater than 0 indicates a positive association, that is, as the value of one variable increases so does the value of the other variable. A value less than 0

indicates a negative association, that is, as the value of one variable increases the value of the other variable decreases. Table 4.29 is the results of correlation and coefficient of determination.

**Table 4.29: Correlation and the Coefficient of Determination**

	Availability of finance	Revenue stream	Technical preparedness	Government policy and regulation	Management of healthcare facility
Availability of finance Sig. p-Values	1				
Revenue stream Sig. p-Values	0.958	1			
Technical preparedness Sig. p-Values	0.949	0.814	1		
Government policy and regulation Sig. p-Values	0.461	0.64	0.905	1	
Management of healthcare facility Sig. p-Values	0.435	0.461	0.502	0.779	1

From the findings, it was clear that there was a strong positive correlation between Availability of finance and Revenue stream as shown by a correlation figure of 0.958. There was also a strong positive correlation between Availability of finance and Technical preparedness with a correlation figure of 0.949. Again there was also a positive correlation between Availability of finance and Government policy and regulation with a correlation value of 0.461. There was also strong positive correlation of 0.814 between Revenue stream and Technical preparedness, positive correlation between Revenue stream and Government policy and regulation (of 0.64) and Management of healthcare (of 0.461). Also Technical preparedness and Government policy and regulation had strong positive correlation of 0.905. Technical preparedness also had a positive correlation of 0.502 with Management of healthcare facility. Government policy and regulation had a strong positive correlation of 0.779 with Management of healthcare. These findings show that there was positive

correlation among factors affecting implementation of centralized waste management system, namely: Availability of finance, Revenue stream, Technical preparedness, Government policy and regulations, and Management of healthcare in private healthcare facilities in Nairobi County.

4.11 Regression Analysis of the Data

Regression analysis is the statistical technique that identifies the relationship between two or more quantitative variables: a dependent variable, whose value is to be predicted, and an independent or explanatory variable (or variables), about which knowledge is available. The technique is used to find the equation that represents the relationship between the variables. Multiple regressions provide an equation that predicts one variable from two or more independent variables. The relation between the variables can be illustrated graphically, or more usually using an equation. The study adopted multiple regression guided by the following model:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$

Where:

Y= Implementation of centralized waste management system

$\beta_0$  - Constant Term (when  $\beta_1, \dots, \beta_5 = 0$ )

$\beta_1, \dots, \beta_5$  (Beta coefficients )

$X_1$ - Availability of finance

$X_2$ - Revenue stream

$X_3$ - Technical preparedness

$X_4$  - Government policy and regulation

$X_5$  -Management of healthcare facility

Implementation of centralized waste management system was regressed against the five variables (Availability of finance, Revenue stream, Technical preparedness, Government policy and regulation, and Management of healthcare facility). The results are presented in the following tables;

Table 4.30: Regression Analysis Model Summary

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate
1	.918 <sup>a</sup>	0.843	0.805	0.51038
a. Predictors: (Constant), Availability of finance, Revenue stream, Technical preparedness, Government policy and regulation, Management of healthcare facility				



In this case, the coefficient of determination (the percentage variation in the dependent variable being explained by the changes in the independent variables)  $R^2$  equals 84.3, that is, Availability of finance, Revenue stream, Technical preparedness, Government policy and regulation, and Management of healthcare facility explain 84.3 percent of the variance in implementation of centralized waste management system.

**Table 4.31: ANOVA of the Regression**

Model		Sum of Squares	Degree of freedom	Mean Square	F	Sig.
1	Regression	2.113	5	0.528	1.012	0.00407
	Residual	15.554	30	0.522		
	Total	16.667	37			
a. Predictors: (Constant), Availability of finance, Revenue stream, Technical preparedness, Government policy and regulation, and Management of healthcare facility						
b. Dependent Variable: implementation of centralized waste management system						

In this case, the significance value of the F statistic is 0.00407 indicating that all the predictor variables (Availability of finance, Revenue stream, Technical preparedness, Government policy and regulation, and Management of healthcare facility) explain variation in implementation of centralized waste management system.

**Table 4.32: Regression Coefficients Results**

Model		Un-standardized Coefficients		Standardized Coefficients	t	Sig.
		Beta ( $\beta$ )	Std. Error	Beta ( $\beta$ )		
1	(Constant)	0.26	0.46		3.243	0.003
	Availability of finance	0.575	0.048	0.254	2.729	0.001
	Revenue stream	0.17	0.045	0.3	3.778	0.002
	Technical preparedness	0.251	0.023	0.113	2.217	0.004
	Government policy and regulation	0.131	2.074	0.056	2.444	0
	Management of healthcare facility	0.753	0.088	-0.167	1.379	0.0041
a. Dependent Variable: implementation of centralized waste management system						

Based on the above results the regression equation can be written as follows;

$Y = 0.260 + .575X_1 + 0.170X_2 + 0.251X_3 + 0.131 X_4 + 0.753 X_5$

The multiple linear regression models indicate that all the independent variables have positive coefficients. The regression results above reveal that there is a positive relationship between dependent variable (implementation of centralized waste management system) and independent variables (Availability of finance, Revenue stream, Technical preparedness, Government policy and regulation, and Management of healthcare facility).

4.11 Summary of the Findings

From the findings the order of significance of the influence on implementation of centralized waste management system in private healthcare facilities in Nairobi County is as follows; Management of healthcare facility, Availability of finance, Technical preparedness, Revenue stream, and Government policy and regulation.

4.12 Summary

This chapter provided data analysis, presentation and interpretation arising from the study.

## CHAPTER FIVE

### SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Introduction

The chapter presents summary of findings, discussion, conclusions, recommendations and areas for further research.

#### 5.2 Summary of the findings

The study summary of findings is contained in Table 5.1.

**Table 5.1: Summary of Findings**

Objective	Main Findings
To examine how availability of finance influences implementation of centralized waste management system in private healthcare facilities in Nairobi County.	<ol style="list-style-type: none"><li>1. Capital cost of procuring healthcare waste treatment equipment - majority (64.9%) of sampled facilities did not have any form of waste treatment equipment and those who had (35.1%) had procured autoclave (61.5%), small scale incinerator (30.8%) and microwave (7.7%). Nairobi Women's Hospital Ngong' road branch had a commercial incinerator.</li><li>2. Operational cost of healthcare waste treatment equipment - majority (97.3%) of sampled private healthcare facilities allocate budget for healthcare waste management; the cost of operating waste treatment equipment per month was below Ksh100,000 for majority (92.3%) for those healthcare facilities that had equipment.</li><li>3. Financial liability of healthcare waste treatment - majority (81.1%) of the private healthcare facilities sampled did not insure their waste handlers. Of the waste handlers insured, majority were healthcare workers (71.4%), followed by cleaners, transporters and waste treatment equipment operators (the latter two sharing same emphasis). The annual insurance cost was mostly below Ksh50,000 as indicated by 57.1% of those facilities that insure their waste handlers.</li><li>4. The finance factors that affect implementation of centralized healthcare waste management system include: interest rates on</li></ol>

	<p>loans, high maintenance cost of equipment, availability of finance, poor management process, costly practice, high cost of incineration, high transportation cost, high cost of treating equipment, inadequate resources, high cost of disposal, low budget allocation, high cost of outsourcing waste handlers, lack of incentives from government and expensive equipment.</p>
<p>To establish how revenue stream affects implementation of centralized waste management system in private healthcare facilities in Nairobi County.</p>	<ol style="list-style-type: none"> <li>1. Client base of healthcare waste generators - 37 private healthcare facilities (including Nairobi Women's Hospital Hurlingham and Ongata Rongai branches) use the centralized waste treatment facility at the Nairobi Women's Hospital Ngong' road branch.</li> <li>2. Affordability of treatment and disposal of healthcare waste- healthcare facilities were being charged Ksh31 – 40 per kilogram of healthcare waste and client base was growing.</li> <li>3. Quality and type of healthcare waste- Nairobi Women's Hospital Ngong' road branch have quality control procedures in place including waste segregation, minimization and storage. The study also established that these quality control procedures were applied most of the times.</li> <li>4. Further, the study established that failure of contracted waste transporters to deliver full amount of waste collected from various health facilities and inability of waste companies to recycle waste materials were cited by Nairobi Women's Hospital as the main factors that affect revenue stream of centralized healthcare waste management system.</li> </ol>
<p>To determine how technical preparedness affects implementation of centralized waste management system in private healthcare facilities in Nairobi County.</p>	<ol style="list-style-type: none"> <li>1. Site selection - Nairobi Women's Hospital Ngong' road branch has only one final waste disposal (landfill) site in Nairobi County.</li> <li>2. Pre acceptance procedures - Nairobi Women's Hospital Ngong' road branch undertakes waste volume and weight verification upon arrival as well as verification of waste manifests from transporters.</li> <li>3. Waste collection - Nairobi Women's Hospital Ngong' road</li> </ol>

	<p>branch has contracted four waste transport companies to collect healthcare waste from 36 of the private healthcare facilities under study and to deliver the waste at the central treatment facility.</p> <ol style="list-style-type: none"> <li>4. Waste treatment - Nairobi Women's Hospital Ngong' road branch treats up to 16 tons of healthcare waste per month.</li> <li>5. Operations- Nairobi Women's Hospital Ngong' road branch has an operational manual for operating the healthcare waste management equipment. The study further revealed that they train their waste treatment equipment operators on safety procedures on healthcare waste handling, protective clothing for healthcare waste handling, post infection / injury procedures for healthcare waste handling, and safe transportation of healthcare waste.</li> </ol>
To examine how government policy and regulation affects implementation of centralized waste management system in private healthcare facilities in Nairobi County	<ol style="list-style-type: none"> <li>1. Permitting- Majority (73%) of the respondents stated that their health facilities have Biomedical Waste Management and Handling Permit, 27% had Environmental Impact Assessment License, 8% had Municipal Council Business License and 5.4% had Medical Practice and Dentists Board License.</li> <li>2. Policy and regulatory enforcement - Majority (94.6%) of the respondents were not aware of existence of policy and regulatory enforcement for waste management while only 5.4% pointed out that the Public Health Act, Biomedical Waste Management and Handling Regulations, Medical Practice and Dentists Act, Environmental Management and Coordination Act existed.</li> </ol>
To establish how management of healthcare facilities affects implementation of	<ol style="list-style-type: none"> <li>1. Planning- Most (88.9%) of the healthcare facilities sampled regularly plan for waste and had some sort of waste management plan.</li> <li>2. Organizing- All (100%) of respondents had an organized system</li> </ol>

centralized waste management system in private healthcare facilities in Nairobi County.	<p>for waste collection and disposal.</p> <ol style="list-style-type: none"> <li>3. Directing- Majority (92%) of the respondents indicated their respective healthcare facilities regularly ensured waste was properly treated and disposed of.</li> <li>4. Controlling- Most (67%) of respondents pointed out to existence of mechanism for final disposal of waste. In addition the study established that 97.2% of the respondents agreed to existence of policies and guidelines for safe disposal of waste from the healthcare facility to enhance control measures.</li> <li>5. Staffing and training - 100% of respondents agreed to existence of staff training on post infection / injury procedures for healthcare waste handling. Training on protective clothing for healthcare waste handling was second with 94.6%, while training of transporters on safe transportation of healthcare waste was indicated by 81.1%.</li> </ol>
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### 5.3 Discussion of the objectives

The aim of study was to establish factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County. The study objectives are discussed in the following sections.

#### 5.3.1 To examine how availability of finance influences implementation of centralized waste management system in private healthcare facilities in Nairobi County

The study found that majority of sampled facilities did not have any form of waste treatment equipment and those who had procured autoclave, small scale incinerator and microwave. This could have been due to lack of funds for capital costs even though majority of sampled private healthcare facilities were found to allocate budget for healthcare waste management. The study also showed that most healthcare facilities had nominal operational cost of less than Ksh100,000 per month. The

study further revealed that majority of the private healthcare facilities sampled do not insure their waste handlers. In addition the linear regression results show a strong positive relationship between availability of finance and implementation of centralized waste management and is in concurrence with Higgins (1999) who says that the three financial issues that must be addressed in implementing centralized waste management are capital cost, operational cost and liability.

Respondents quoted the following as financial factors that affect implementation of centralized waste management system, namely; high interest rates on loans, high maintenance cost of equipment, availability of finance, poor management process, costly practice, high cost of incineration, high transportation cost, high cost of treating equipment, inadequate resources, high cost of disposal, low budget allocation, high cost of outsourcing waste handlers, lack of incentives from government and expensive equipment were some of the factors that respondents stated affects implementation of healthcare waste management system.

### **5.3.2 To establish how revenue stream affects implementation of centralized waste management system in private healthcare facilities in Nairobi County**

The study established that failure of contracted waste transporters to deliver full amount of waste collected from various health facilities and inability of waste companies to recycle waste materials were cited by Nairobi Women's Hospital as the main factors that affect revenue stream of centralized healthcare waste management system. The study showed that charging a rate of ksh31-40 per kilogram of waste was affordable to all healthcare facilities sampled as they continued to pay for the service. The linear regression confirmed positive relationship between revenue and implementation of centralized waste management system. Thus revenue generated from providing waste treatment services enhances implementation of centralized waste management and this is in concurrence with Higgins (1999), and Prüss, Giroult and Rushbrook (1999) who have established that cash inflow has a direct impact on implementation of centralized waste management.

### **5.3.3 To determine how technical preparedness affects implementation of centralized waste management system in private healthcare facilities in Nairobi County**

The study found that Nairobi Women's Hospital Ngong' Road branch has final waste disposal (landfill) site and they undertake waste volume and weight verification upon arrival as well as

verification of waste manifests from transporters. The study established that Nairobi Women's Hospital Ngong' road branch has contracted four waste transport companies to collect healthcare waste from 36 of the private healthcare facilities under study and to deliver the waste at the central treatment facility and that they have an operational manual for operating the healthcare waste management equipment. The study further showed that they train their waste treatment equipment operators on safety procedures on healthcare waste handling, protective clothing for healthcare waste handling, post infection / injury procedures for healthcare waste handling, and safe transportation of healthcare waste. These steps taken by the Nairobi Women's Hospital are in line with what the WHO (1997), Higgins (1999), and Prüss, Giroult and Rushbrook (1999) advocate, namely the necessity to have in place site selection, pre acceptance procedures, collection, treatment, and operation mechanism for a successful centralized waste management system.

#### **5.3.4 To examine how government policy and regulation affects implementation of centralized waste management system in private healthcare facilities in Nairobi County**

With respect to permitting, the study findings indicated that majority of the respondents stated that their health facilities have Biomedical Waste Management and Handling Permit, few had Environmental Impact Assessment License, Municipal Council Business License and Medical Practitioners and Dentists Board License. On the issue of policy and regulatory enforcement, the study established that most of the respondents were not aware of existence of policy and regulatory enforcement for waste management while very few pointed out that they were aware Public Health Act, Biomedical Waste Management and Handling Regulations, Medical Practice and Dentists Act, Environmental Management and Coordination Act existed. According to UNEP (1997), all waste handlers and stakeholders should be aware of the national legislation on healthcare waste management including policy and technical guidelines for implementation of the law.

#### **5.3.5 To establish how management of healthcare facilities affects implementation of centralized waste management system in private healthcare facilities in Nairobi County**

The study found out that management of healthcare facility was the most significant factor affecting implementation of centralized waste management system. This is in agreement with Kela, Nazareth, Goel and Agarwal (1999) who emphasize that medical waste is a management issue and not a technological one. On planning, the study established that most of the healthcare facilities sampled regularly plan for waste and had some sort of waste management plan. With respect to organizing,



the study indicated that all of respondents were unanimous that their healthcare facilities had an organized system for waste collection and disposal. On directing, according to the study findings, majority of the respondents indicated their respective healthcare facilities regularly ensured waste was properly treated and disposed of. As concerns controlling, the study showed majority of respondents pointed out to existence of mechanism for final disposal of waste. In addition the study established that majority of the respondents agreed to existence of policies and guidelines for safe disposal of waste from the healthcare facility. Regarding staffing and training, all respondents agreed to existence of trained staff on post infection / injury procedures for healthcare waste handling, on protective clothing for healthcare waste handling was second with majority, and training of transporters on safe transportation of healthcare waste.

#### **5.4 Conclusions**

This section presents conclusion of the study objectives. The study sought to find out factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County. The study found out that there was positive correlation among factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County and that management of healthcare facility was the most significant followed by (in order of significance) availability of finance, technical preparedness, revenue stream, and government policy and regulation. This is tandem with Kela, Nazareth, Goel and Agarwal (1999) who emphasize that medical waste is a management issue and not a technological one. In addition the independent variables under study explained 84% of the variation of the dependent variable.

The study showed that majority of the private healthcare facilities sampled did not insure their waste handlers and that majority of the respondents were not aware of existence of policy and regulatory enforcement for waste management. It also emerged that failure of contracted waste transporters to deliver full amount of waste collected from various health facilities and inability of waste companies to recycle waste materials were cited by Nairobi Women's Hospital as the main factors that affect revenue stream of centralized healthcare waste management system. It also revealed finance factors that affect implementation of centralized healthcare waste management system include high interest rates on loans, high maintenance cost of equipment, unavailability of finance, high cost of incineration, high transportation cost, high cost of treatment equipment, inadequate resources, high cost of disposal, low budget allocation, high cost of outsourcing waste handlers, and lack of incentives from government.

## 5.5 Recommendations

This section outlines recommendations on the study objective as noted by the researcher.

The researcher makes the following recommendations:

1. The healthcare facilities should ensure their healthcare workers and waste handlers are properly insured against injury arising from handling healthcare waste.
2. A concerted effort should be taken by all stakeholders including healthcare managers, the Government, the National Environment Management Authority (NEMA) and other regulatory authorities, to ensure awareness and compliance with waste management policies and regulations in private healthcare facilities in Nairobi County.
3. There is need for financial institutions to address the finance factors affecting implementation of centralized waste management system including improving accessibility to affordable finance
4. The government should provide tax rebates on waste management equipment and consumables to enhance procurement and widespread use of waste management equipment.
5. Waste transporters and waste treatment facilities should endeavor to develop a waste treatment and transportation protocol and guideline to ensure proper waste verification and recycling where possible.

## 5.6 Areas of further study

This section provides suggestions by the researcher on areas of further research. The researcher suggests the following areas of further study, namely:

1. An investigation of other factors (not explained by the independent variables under this study) that affect implementation of centralized waste management in private healthcare facilities in Nairobi County
2. A study of factors affecting implementation of centralized waste management system in private healthcare facilities in other Counties in Kenya other than Nairobi County.
3. A research on factors affecting healthcare waste transportation in Kenya.
4. A study on the financial viability of centralized waste management projects in Kenya.
5. A study on the challenges of implementing policy and regulations for waste management in Kenya.

6. A research on the effect of private sector incentives on implementation of centralized healthcare waste management system.

## 5.7 Summary

This chapter provided the summary of findings, discussion, conclusions and recommendations of the study. It also provided areas suggested by the researcher for further study.

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## APPENDIX I

### TRANSMITAL LETTER

**Kenneth O. Osano**  
**Department of Extra Mural Studies**  
**School of Distance and Continuing education**  
**University of Nairobi**  
**P.O Box 30197-00100, G.P.O, Nairobi**  
**Tel: 202738339 | Cell: 0722 805099 | Email: Ken\_Osano@europa.bd.com**

**SUBJECT: MASTER OF ARTS IN PROJECT PLANNING AND MANAGEMENT**  
**RESEARCH PROJECT**

**STUDY TOPIC:** Centralized Healthcare Waste Management

**STUDY TITLE:** Factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County

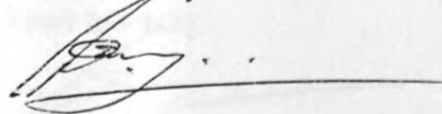
Dear Sir/Madam,

I am a final year MA Student carrying out an academic research for the purpose of examination leading to the award of a degree of Master of Arts in Project Planning and Management.

The purpose of this letter is to request you to provide the required information as per the questionnaires and interview guides provided. Kindly be as honest and as thorough as possible. The information you provide will be considered as confidential and will only be used for the purpose of my examination only.

Thanking you in advance for your cooperation.

Yours faithfully



**Kenneth O. Osano**  
**L50/63671/2010**

## APPENDIX II

### REQUEST FOR STUDY RESEARCH

**Kenneth O. Osano**  
**Department of Extra Mural Studies**  
**School of Distance and Continuing education**  
**University of Nairobi**  
**P.O Box 30197-00100, G.P.O, Nairobi**  
**Tel: 202738339 | Cell: 0722 805099 | Email: Ken\_Osano@europa.bd.com**

**SUBJECT: REQUEST TO CONDUCT A STUDY RESEARCH AT THE NAIROBI WOMEN'S HOSPITAL**

**STUDY TOPIC:** Centralized Healthcare Waste Management

**STUDY TITLE:** Factors affecting implementation of centralized waste management system in private healthcare facilities in Nairobi County

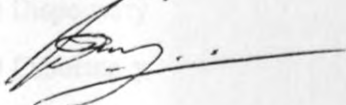
Dear Sir/Madam,

I am a final year MA Student carrying out an academic research for the purpose of examination leading to the award of a degree of Master of Arts in Project Planning and Management.

The purpose of this letter is to kindly request you to allow me to conduct a study research at your hospital. The study title is as indicated above. The information you provide will be considered as confidential and will only be used for the purpose of my examination only. I will undertake to sign an oath of secrecy as per your research policy.

Thanking you in advance for your cooperation and understanding.

Yours faithfully

  
**Kenneth O. Osano**  
L50/63671/2010

# APPENDIX III

## INTERVIEW GUIDE

Form Serial Number.....

### Instructions

#### Schedule A- General Information

Name of healthcare facility: \_\_\_\_\_

Physical location of healthcare facility: \_\_\_\_\_

Please place **X** where appropriate.

1. How far is your healthcare facility from the Nairobi Women's Hospital?

- a) Below 5km ☐
- b) 6-10km ☐
- c) 11-15km ☐
- d) 16 - 20km ☐
- e) Above 21km ☐

2. What type of healthcare is your facility?

- a) Hospital with in patient service ☐
- b) Clinic ☐
- c) Dispensary ☐
- d) Laboratory ☐
- e) Other (specify) \_\_\_\_\_

3. If hospital with in patient department, how many beds does your healthcare facility have?

- a) Below 30 ☐
- b) 31-60 ☐

- c) 61-90 ☐
- d) 91- 120 ☐
- e) Above 121 ☐

**Schedule B- Availability of Finance**

1. Does your facility have healthcare waste treatment equipment?

- a) Yes ☐
- b) No ☐

2. If yes, what type of healthcare waste treatment equipment does your facility have?

- a) Incinerator ☐
- b) Autoclave ☐
- c) Microwave ☐
- d) Other (Specify) \_\_\_\_\_

3. How much did the healthcare waste treatment equipment cost?

- a) Below Ksh 500,000 ☐
- b) Ksh500,001 – 1,000,000 ☐
- c) Ksh1,000,001- 1,500,000 ☐
- d) Ksh1,500,001 – 2,000,000 ☐
- e) Ksh 2,000,001 – 2,500,000 ☐
- e) Above 2,500,001 ☐

4. Does your healthcare facility allocate budget for healthcare waste management?

- a) Yes ☐
- b) No ☐

5. If yes, what is your estimated annual budget for healthcare waste management?

- a) Below Ksh 200,000 ☐
- b) Ksh 200,001 – 400,000 ☐
- c) Ksh400,001 – 600,000 ☐
- d) Ksh600,001 – 800,000 ☐
- e) Above Ksh 800,001 ☐

6. Please indicate the estimated cost of operating the waste treatment equipment per month?

- a) Below Ksh 100,000 ☐
- b) Ksh 100,001 – 200,000 ☐
- c) Ksh200,001 – 300,000 ☐
- d) Ksh300,001 – 400,000 ☐
- e) Above Ksh 400,001 ☐

7. Are the waste handlers insured against any potential injury arising from handling healthcare waste?

- a) Yes ☐
- b) No ☐

8 If yes, please specify which waste handlers are insured (mark appropriately)

- a) Healthcare workers ☐
- b) Cleaners ☐
- c) Transporters ☐
- d) Waste treatment equipment operators ☐

9. What is the estimated annual insurance cost?

- a) Below Ksh50,000 ☐
- b) Ksh50,001-100,000 ☐
- c) Ksh100,001- Ksh200,000 ☐
- d) Over Ksh200,001 ☐

10. In your view what are the top three finance factors that affect implementation of centralized healthcare waste management system?

- a) \_\_\_\_\_
- b) \_\_\_\_\_
- c) \_\_\_\_\_

### Schedule C: Revenue Stream

1. Please indicate how many healthcare facilities use your centralized healthcare waste management equipment to treat their waste?

- a) Below 10 ☐
- b) 11-20 ☐
- c) 21-30 ☐
- d) 31-40 ☐
- e) Above 41 ☐

2. What rate do you charge per kilo of healthcare waste?

- a) Below Ksh20 ☐
- b) Ksh21 - 30 ☐
- c) Ksh31 - 40 ☐
- d) Ksh41- 50 ☐
- e) Above 51 ☐

3. Do you have any quality control procedures in place?

- a) Yes ☐
- b) No ☐

4. If yes, please specify the quality control procedure

- a) Waste segregation ☐
- b) Waste minimization ☐
- c) Waste recycling ☐
- d) Waste storage ☐
- e) Other (specify) \_\_\_\_\_

5. How often do you apply quality control procedures?

- a) None of the times ☐
- b) Sometimes ☐
- c) Most of the times ☐
- d) All the time ☐

6. In your view what are the top three factors that affect revenue stream of centralized healthcare waste management system?

- a) \_\_\_\_\_
- b) \_\_\_\_\_
- c) \_\_\_\_\_

**Schedule D – Technical Preparedness**

1. Which of the following permits did you have to obtain to operate the centralized healthcare waste management equipment (tick where appropriate)?

- a) Environmental Impact Assessment ☐
- b) Municipal Council Business License ☐
- c) Medical Practitioners and Dentists Board License ☐
- d) Biomedical Waste Management and Handling Permit ☐
- e) Other (specify) \_\_\_\_\_

2. How many final waste disposal sites are available to you in Nairobi County? (Tick where appropriate)

- a) None ☐
- b) 1 ☐
- c) 2 ☐
- d) 3 and above ☐

3. Which of the following pre acceptance procedures do you have in place?

- a) Ascertaining of quantity and composition of waste at source ☐
- b) Pre-scheduling of waste collection ☐
- c) Waste volume and weight verification upon arrival ☐
- d) Visual inspection of waste physical characteristics ☐
- e) Verification of waste manifests from transporters ☐

f) Other (specify) \_\_\_\_\_

4. Do you have transport system for healthcare waste collection?

a) Yes ☐ b) No ☐

5. If yes, how many transporters are contracted by the hospital to collect healthcare waste?

a) Less than 5 ☐

b) 6-10 ☐

c) 11-15 ☐

d) 16 - 20 ☐

e) Above 21 ☐

6. How much healthcare waste is treated per month by the centralized healthcare waste management facility?

a) Up to 500kgs ☐

b) 501 – 1000kgs ☐

c) 1001 – 1500kgs ☐

d) 1501 – 2000kgs ☐

e) Above 2001kgs ☐

7. Do you have any operational manual for operating the healthcare waste management equipment?

a) Yes ☐ b) No ☐

8. Are the healthcare workers / waste handlers trained on safe handling of healthcare waste?

a) Yes ☐ b) No ☐

9. If yes, please indicate which of the following applies (mark appropriately)

a) Are trained on safety procedures on healthcare waste handling ☐

b) Are trained on protective clothing for healthcare waste handling ☐

c) Are trained on post infection / injury procedures for healthcare waste handling ☐

d) Transporters are trained on safe transportation of healthcare waste ☐

e) Other (specify) \_\_\_\_\_



10. Are the waste treatment equipment operators trained on safe handling of healthcare waste?

- a) Yes ☐ b) No ☐

11. If yes, please indicate which of the following applies (mark appropriately)

- a) Are trained on safety procedures on healthcare waste handling ☐  
b) Are trained on protective clothing for healthcare waste handling ☐  
c) Are trained on post infection / injury procedures for healthcare waste handling ☐  
d) Are trained on proper handling of waste treatment equipment ☐  
e) Other (specify) \_\_\_\_\_

### Schedule E – Government policy and regulation

1. What type of permits or license for handling waste does your healthcare facility have?

- a) Environmental Impact Assessment ☐  
b) Municipal Council Business License ☐  
c) Medical Practitioners and Dentists Board License ☐  
d) Biomedical Waste Management and Handling Permit ☐  
e) Other (specify) \_\_\_\_\_

2. Do you have in place any policies / regulations for healthcare waste management?

- a) Yes ☐ b) No ☐

3. If yes, indicate which of the following policies / guidelines is / are currently being applied by your institution

- a) The Public Health Act ☐  
b) Environmental Management and Coordination Act ☐  
c) Medical Practitioners and Dentists Act ☐  
d) Biomedical Waste Management and Handling Regulations ☐  
e) Other (specify) \_\_\_\_\_

### Schedule F: Management of healthcare facility

1. Does your healthcare facility regularly plan for waste management?

a) Yes ☐ b) No ☐

2. Does your healthcare facility have a system for collecting healthcare waste?

a) Yes ☐ b) No ☐

3. Does your healthcare facility regularly ensure waste is properly treated and disposed of?

a) Yes ☐ b) No ☐

4. Does your healthcare facility have a mechanism for final disposal of waste?

a) Yes ☐ b) No ☐

5. Does your healthcare facility have policies and guidelines for safe waste disposal?

a) Yes ☐ b) No ☐

6. Please tick appropriately the type of training your healthcare workers / waste handlers have taken.

a) Are trained on safety procedures on healthcare waste handling ☐

b) Are trained on protective clothing for healthcare waste handling ☐

c) Are trained on post infection / injury procedures for healthcare waste handling ☐

d) Transporters are trained on safe transportation of healthcare waste ☐

e) Other (specify) \_\_\_\_\_

#### **Schedule G- Implementation of centralized healthcare waste management system**

1. Does your healthcare facility have a waste management plan?

a) Yes ☐ b) No ☐

2. To what extent do you apply waste storage and transportation procedures?

a) None of the times ☐

b) Sometimes ☐

c) Most of the time ☐

d) All the time ☐

3. How do you manage your healthcare waste?

a) On site ☐

b) Off site ☐

c) Both on site and off site ☐

d) Other (specify) \_\_\_\_\_

4. If offsite, how many times in a week do you deliver your healthcare waste to the centralized healthcare waste management facility?

- a) Once a week ☐
- b) Twice a week ☐
- c) Thrice a week ☐
- d) Four times a week ☐
- e) More than four times a week ☐

5. Do you have an existing procedure for centralized healthcare waste management?

- a) Yes ☐
- b) No ☐

6. To what extent do you think institutional policy on healthcare waste management affects implementation of centralized waste management system?

- a) Very significantly ☐
- b) Significantly ☐
- c) Not significantly ☐
- d) Not at all ☐

7. Please explain

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8. To what extent do you think the level of awareness of healthcare waste management among healthcare workers affects implementation of centralized waste management system?

- a) Very significantly ☐
- b) Significantly ☐
- c) Not significantly ☐
- d) Not at all ☐

9. Please explain

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10. To what extent do you think private sector incentives for healthcare waste management affects implementation of centralized waste management system?

- a) Very significantly ☐
- b) Significantly ☐
- c) Not significantly ☐
- d) Not at all ☐

11. Please explain

## APPENDIX IV

### SAMPLE SIZE FOR A GIVEN POPULATION SIZE

#### Sample size for a given population size

N	S	N	S	N	S	N	S	N	S
10	10	80	6086	200	132	380	191	900	269
15	14	85	70	210	136	400	196	950	274
20	19	90	73	220	140	420	201	1000	278
25	24	95	76	230	144	440	205	1100	285
30	28	100	80	240	148	460	210	1200	291
35	32	110	86	250	152	480	214	1300	297
40	36	120	92	260	155	500	217	1400	302
45	40	130	97	270	159	550	226	1500	306
50	44	140	103	280	162	600	234	1600	310
55	48	150	108	290	165	650	242	1700	313
60	52	160	113	300	169	700	248	1800	317
65	56	170	118	320	175	750	254	1900	320
70	59	180	123	340	181	800	260	2000	322
75	63	190	127	360	186	850	265	2200	327

Source: Krejcie and Morgan (1970)