

**OCCUPATIONAL SAFETY AND HEALTH ACCIDENTS AMONG BIOMEDICAL  
WASTE HANDLERS IN NAIROBI CITY COUNTY**

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TECHNOLOGY**

**NOVEMBER, 2017**

**DECLARATION**

This thesis is my original work and has not been submitted for the award of a degree or diploma in any other University.

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## **DEDICATION**

I dedicate this project to my wife Mary and my three kids Josephine, Henry and Ekra for their support.

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## **ABBREVIATIONS AND ACRONYMS**

<b>BMWM</b>	Biomedical Waste Management
<b>CBD</b>	Central Business District
<b>CBO</b>	Community Based organization
<b>CCN</b>	City Council of Nairobi
<b>CPCB</b>	Central Pollution Control Board
<b>DOSH</b>	Department of Safety and Health
<b>EMCA</b>	Environmental Management and Coordination Act
<b>HCWM</b>	Healthcare Waste Management
<b>JICA</b>	Japan International Co-operation
<b>KEMRI</b>	Kenya Medical Research Institute
<b>KNCPC</b>	Kenya National Clean Production Centre
<b>LAs</b>	Local Authority
<b>LOK</b>	Laws of Kenya
<b>MSE</b>	Medium Size Enterprises
<b>MSWM</b>	Municipal Solid Waste Management
<b>NEMA</b>	National Environmental Management Authority
<b>NCBDA</b>	Nairobi Central Business District Association
<b>NGO</b>	Non-Governmental Organization

<b>OSHA</b>	Occupational Safety and Health Act of 2007 laws of Kenya
<b>SWM</b>	Solid Waste management
<b>UNEP</b>	United Nation Environment Programme
<b>WHO</b>	World Health Organization

## ABSTRACT

Occupational accidents constitute significant problems that biomedical waste handlers face in Nairobi City County while in the line of duty. To address the problem, this study aimed to establish the underlying causes of accidents despite the level of awareness in the waste management and handling practices. The guiding objectives for exploring the subject were to assess the biomedical waste classification and management challenges among Nairobi City County waste handlers, determine the occupational accidents among biomedical waste handlers and establish the compliance status of the employers with the local legislation (Statutory and subsidiary laws) governing the field of occupational safety and health. A mixed research method defined by both qualitative and quantitative paradigms informed the study. The qualitative paradigm was informed by drawing upon primary and secondary sources including journals and articles. The quantitative paradigm relied upon primary sources that constituted data collection using questionnaires, observations and sample analysis. A sample size of one hundred and sixty eight (168) respondents was used in the survey with a target population of biomedical waste handlers in Nairobi City County. Descriptive statistics were used to analyze the quantitative data using Statistical Package for the Social Sciences (SPSS). The results showed significant challenges such as laxity in complying with the waste handling and segregation and management guidelines, practices and laws at different levels of waste management. High failure rates on the use of biomedical protective equipment and improper maintenance of personal hygiene were among other contributing factors to the prevalence of occupational hazards. . How employee attitudes and compliance problems contribute to the problem of accidents among the waste handlers was also investigated. It has been observed that, despite the implementation of biomedical waste handling regulations, policies, laws and standards at different levels of healthcare facilities and waste handling employees, occupational accidents are still rampant. Empirical evidence has been adduced which suggests that continued increase in the number of occupational accidents need to be investigated to establish appropriate measures to protect biomedical waste handlers. Data collected from respondents revealed that 34.3 % of the respondents wore gloves while 65.6% % do not while on duty, which infers that a large number of employees are at risk of injuries from pricks in the hands and fingers and potential contaminations. 71.3% of those involved in the study wear masks while 28.8% do not wear mouth masks . The risk of communicable diseases is therefore relatively high among the biomedical waste handlers due the high. Failure by employers to comply with the statutory laws, regulatory requirements and the lack of reliable accident management best practices to safeguard bio-medical waste handlers were additional contributing factors. The study recommends the County government of Nairobi to design awareness programs on best practices in waste management.



## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Background of the Study**

Offering medical services at various healthcare institutions generates biomedical waste that is a global problem with significant implications on the occupational health of those who handle the waste. Biomedical waste refers to any waste, generated during the diagnosis, treatment or immunization of human beings from a healthcare facility. Waste from healthcare settings ranges from general waste such as paper and food remains, to infectious waste such as syringes and needles to highly infectious waste such as anatomical body parts to special waste such as mercury from broken thermometers and body imaging films. The term health-care waste includes all the waste generated within health-care facilities, research centres and laboratories related to medical procedures (WHO, 2004). In addition, waste includes the some types of waste originating from minor and scattered sources, including waste produced in the course of health care undertaken at homes such as home dialysis, self-administration of insulin and recuperative care. Detailed classification has been provided by World Health Organization (2004) as described below: Health care services generate wastes and approximately 20% of this waste is considered hazardous across the globe. The average amount of hazardous waste generated in health care facilities in high income and low income countries is 0.5 and 0.2 kg per bed 2 per day respectively (WHO, 2011). Infectious and anatomic wastes represent 15% of the total waste in the world. It is estimated that 16 000 million syringes are used annually, however not all syringes and needles are disposed of properly (WHO, 2011). Of the 20 % waste that is not well disposed, chemicals and pharmaceuticals represent 3%, genotoxic, radioactive and heavy metals 1% while sharps account for 1 % of the total waste (WHO, 2004). Sharps represent a major source of disease transmission



and spread if disposed irregularly. According Practice Green health, (2013) United States, hazardous waste problem results from increased use of disposable items. The amount of waste produced by hospitals is over 5.9 million tons annually. In developing countries proper disposal of hazardous wastes is still poses a significant challenge (Harhay *et al.*, 2009). Hazardous waste is not often classified separately and this makes hazardous waste are generated in large quantities. In Africa, the high cost of safety boxes for sharps' disposal affects the use of these boxes (UNDP, 2009). Affordability of advanced technologies for treatment and disposal of hazardous waste is considerably low in most sub-Saharan Africa countries. Most of the medical waste is mostly dumped with general waste (Kumar *et al.*, 2007).

In Kenya, the most common practice of HWM is segregation of sharps while all other solid wastes are mixed together shows that the amount of hazardous waste generated per day per patient is approximately 0.915 kilograms in health facilities in Kenya (Mazrui, 2010) .A situational analysis in Kenya revealed that an estimated 20% of biomedical wastes generated in Nairobi City County pose significant challenges of high potential infections and injuries among biomedical waste handlers (Othigo, 2014). Biomedical waste is defined as “waste generated by health care activities that includes a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials” (Othigo, 2014). The potential results of poor waste management includes exposing waste handlers to infection, toxic and injuries and risks polluting the environment if waste is not appropriately segregated and disposed. The study views emerging issues on poor classification and management of biomedical wastes, inadequate and inappropriate knowledge on the procedures of handling healthcare wastes and deficiencies in complying with statutory laws underpin some of the areas of focus of investigation. Besides, Muniafu and Otiato

(2010) noting that weak compliance with the laws of the government of Kenya and the World Health Organization's (WHO) guidelines on healthcare waste storage, transportation and disposal present significant problems to address. Managing waste in Kenya is vested on local authorities through the County Government Act of 2012 Laws of Kenya and the Public Health Act Cap 242 Laws of Kenya (Othigo, 2014). Subsequent county laws have been enacted by local authorities to support in the management of solid waste and sewerage services. The Environmental Management and Coordination Act (EMCA) Cap 387 Laws of Kenya obligates industries and businesses to take the responsibility of managing waste resulting from their activities. Furthermore, Henry *et.al* (2006) demonstrated the importance of complying with the Environmental Management and Coordination (Waste Management) regulations of 2006 on managing hazardous and non-hazardous wastes. The requirements as detailed in law define the various regulations and standards to qualify for the waste management permits. As provided for in the regulations, adhering to the color coding classification of various biomedical wastes present an additional challenge for biomedical waste handlers' protection from occupational health hazards such as sharp inoculation injuries.

According to Henry *et.al* (2006), the principles of handling biomedical waste define appropriate implementation of hazard management plans, policies and continuous monitoring of the health and safety of waste handlers. Training, appropriate use of personal protection equipment, implementation of appropriate healthcare programs and immunization of biomedical waste handlers define the principles underlying Muniafu and Otiato's (2010) discourse of health and safety practices.

The disposal of wastes originating from public and private health-care establishments cause adverse effects on human health and the environment (air, water, soil, animals, plants, landscape)

that are detrimental to the public security and order (Muniafu and Otiato, 2010). Henry *et.al* (2006) note that ineffective management of waste from health-care establishments pose similar health risks as municipal and industrial wastes. There is need to treat and handle healthcare wastes in consistence with the requirements of the disposal of healthcare wastes in Kenya and the World Health Organization.

A synopsis of the Kenyan situation shows lack of accurate national statistical figures on waste generation levels. However, Nairobi City County generates a per capita municipal waste of about 2400 tons per day (National Environment Management Authority, (2005). Nairobi generates approximately 748.8 Kg/day healthcare wastes per day that comprises 75% infectious wastes (Othigo, 2014). Statistical data from National Environment Management Authority (NEMA) on waste management in Kenya, 2009 shows that only 10 registered biomedical waste disposal incinerators are available in Nairobi (Allison and Von Blottnitz., 2010). The incineration facilities are either run by hospitals or function autonomously in the management of the healthcare wastes. This leads to the question on how to effectively manage healthcare wastes and address occupational safety and health problems associated with inadequate handling of the wastes in Nairobi County. To address the problem, the study's target population consisted of biomedical wastes handlers within Nairobi City County.

## **1.2 Statement of the Problem**

The problem of occupational health accidents among waste handlers is global. Despite the well-defined statutory laws, policies and guidelines for the classification, management and disposal of biomedical waste from healthcare facilities in Kenya, a 20% increase in the prevalence rate of occupational health accidents between 2013 and 2014 was reported in Nairobi County (Othigo, 2014). This was against the background of large quantities of Biomedical Waste (BMW) gener-

ated by healthcare facilities in Nairobi City County with a rapidly increasing population estimated at 3,138,369 (Egondi *etal.* 2015).

The rationale is that occupational safety and health risks due to the classification, management problems and the disposal of biomedical waste continues to be a major source of accidents among biomedical waste handlers (Olima, 2001). Examples of the wastes that pose significant health risks include used syringes, needles, bandages, blood, contaminated protective equipment, contaminated food materials and occasionally human body parts. It is imperative to enumerate the potential threats and pre-disposing factors that biomedical waste handlers in Nairobi City County are faced with. Moreover, it is critical to identify the highest threats, their frequencies and the mitigation strategy in biomedical waste management. That leads to the question on if poor waste management practices underpins reasons for the high frequency occupational health accidents among biomedical waste handlers in Nairobi City County.

### **1.3 Justification**

The recurrence and increase of workplace health related accidents among biomedical waste handlers in Nairobi City County despite the use of biomedical waste management practices being in place compelled the need to address the persistent problem of occupational accidents. Empirical evidence suggests that the enactment of diverse waste handling procedures, laws and policies governing the workplace environment among biomedical waste handlers has not ameliorated workplace accidents and diseases. Besides, the national laws of Kenya such as the Occupational Safety and Health Act of 2007, the Ministry of Health through the Department of Public Health based on the National Plan of Action on Healthcare Waste Management as well as sectorial laws on the management of biomedical wastes have failed to provide frameworks on how to effectively address the problem of persistent workplace accidents (Egondi *etal* 2015).

It is imperative to note that the Public Health Act Cap 242, part IX deals with sanitation and housing. The Act imposes responsibility on local authorities to take measures and maintain their areas in clean and sanitary condition. It also prevents the occurrence of nuisances and aspires to remedy nuisances or other conditions liable to be injurious or dangerous to health. Section 118 defines nuisances and includes any accumulation or deposit of refuse which is offensive or which is injurious or dangerous to health. The Environmental Management and Coordination (Waste Management) regulations of 2006 provides for segregation, packaging, transportation, storage and disposal of biomedical waste (Othigo, 2014). This is basically meant to prevent environmental pollution that could otherwise affect the general public and natural resources.

#### **1.4 Scope**

This is an in-depth discourse of the occupational safety and health accidents biomedical waste handlers get exposed to in Nairobi City County and recommendations of appropriate protective measures to protect them from occupational accidents. The goal could be achieved through the resulting recommendations on how to classify waste and associated risk factors to comply with statutory and subsidiary laws governing the occupational health and safety of biomedical workers.

This was achieved by administration of questionnaires to the respondents; data was collected from the respondents in month (four weeks). This study also aimed at investigating the occupational hazards inherent at the work places but which workers were ignorant of. This was achieved through collection of samples from treated and untreated waste

This study was designed to formulate an appropriate framework for the effective regulation, monitoring and protection of biomedical waste handlers and the general public from workplace health and safety related accidents.

## **1.5 Objectives**

### **1.5.1 General Objective**

To determine the causes of occupational health accidents among biomedical waste handlers in Nairobi County.

### **1.5.2 Specific Objectives**

1. To enumerate the potential risks and pre-disposing factors among biomedical waste handlers in Nairobi City County.
2. To evaluate the skills and knowledge of biomedical waste handlers in Nairobi County on best practices in biomedical waste management.
3. To establish the compliance status of waste handling companies with the local legislation (Statutory and subsidiary laws) governing biomedical waste handling.in Nairobi County.

## **1.6 Research Questions**

1. What are the potential risks and pre-disposing factors that biomedical waste handlers in Nairobi City County face?
2. How does the level of skills and knowledge of biomedical waste handlers in Nairobi County contribute to occupational accidents?
3. What is the compliance status of the waste handling companies with the laid down local legislation (Statutory and subsidiary laws) governing the field of occupational safety and health?.

### **1.7. Hypotheses.**

1. There are no potential risks and pre-disposing factors among biomedical waste handlers in Nairobi City.
2. Biomedical waste handlers in Nairobi County do not have skills and knowledge of on best practices in biomedical waste management.
3. There is no compliance status of waste handling companies with the local legislation (Statutory and subsidiary laws) governing biomedical waste handling in Nairobi County.

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Introduction

The theoretical and empirical review of related literature on occupational safety and health hazards justify the use of the human factors theory and the Petersen's Accident/Incident theory. The theories explain the persistent problem of occupational or workplace accidents that biomedical waste handlers experience in Nairobi County. The framework provides an explanation of the risks and hazards affecting personnel directly involved in handling waste based on the research objectives. The review shows emerging issues that have implications on the occupational health of biomedical waste handlers in Nairobi County. A critique of reviewed literature relevant to the study revealed existing research gaps.

##### 2.1.1 Theoretical Review

Reinach and Viale's (2006) discourse of occupational accidents that biomedical waste handlers experience are explained in the context of Petersen's Accident/Incident and the human factors theories. Muniafu and Otiato (2010) build on this precise exposition of the reasons for the persistent problems of workplace hazards typical of Nairobi County waste handling embodied in the key elements defined in the theories. Despite some significant variations in the perspectives on the application of the theories, Wickens, *et.al* (2013) view the human factors theory as providing accurate explanation of the sources of problems in biomedical waste handling on the basis of overload, inappropriate responses and inappropriate execution of waste collection, transportation and disposal activities. The human factors theory's overload elements include environmental factors that cause personal problems defined by workplace related stress and situational factors such as unclear instructions and lack of understanding of risk factors leading to poor classification of



waste. Inappropriate responses include situations where generators of waste and biomedical waste handlers detect but fail to appropriately segregate waste. Failure to comply with health and safety rules and removing safety marks such as careless use of color codes to mark waste collection containers constitute the problem. The theory shows that inappropriate activities in waste handling procedures inclusive of inadequate biomedical waste handling skills and poor judgment of waste handling risks formed the foundation of the study.

According to Reinach and Viale (2006), Petersen's Accident/Incident theory provides an accurate representation of the sources of occupational safety and health hazards among biomedical waste handlers including overload in the context of worries at the workplace, use of alcohol and other drug abuse substances, lack of motivation, fatigue and working under pressure to deliver. Besides, ergonomic traps include incompatible expectations, workstation issues, force, reach, feel and a small number of workers (Othigo, 2014). Petersen's Accident/Incident theory shows that erroneous decisions occur through misjudgement because of poor classification of waste, poor logical decisions and unconscious desire to err (Reinach and Viale, 2006). The factors are summed up in system failures that are defined by poor policies, laws and rules implementations, responsibility, inspection, training, corrections, inspection and lack of standards. Human errors constitute direct causes of workplace accident and injuries or damage. The rationale for applying both theories in the study is to provide the guidelines and explanation of the factors that can cause or prevent exposure to occupational health hazards for biomedical waste handlers in Nairobi County (Othigo, 2014). The predisposition characteristics inclusive of environmental factors are perceptions and susceptibility of the waste handlers and environmental factors. Besides, situational factors include peer pressure, supervision priorities, attitude and individual risk assessment capabilities of the waste exposures.

In practice, the operating term, biomedical waste refers to waste generated at different stages such as: medical diagnosis, treatment, or immunization of human beings/animals and in the production or biological testing and alike in the Healthcare Institutions (Baverja *et al.*, 2000). The Healthcare Wastes (HCW) is categorized as infectious and non-infectious but not all HCW have the potential to transmit infection. It is estimated that 80-85% is non-infectious waste, 10% is infectious and 5% is hazardous waste according to Central Pollution Control Board (CPCB, 2000).

Healthcare services aim to reduce health problems and to prevent potential health risks. In doing so, however, waste is often generated that is potentially harmful to the handlers, public health and the environment. Waste generated from healthcare practices or produced by healthcare workers in the execution of their duties should be considered infectious unless otherwise assessed by a healthcare practitioner. With rapid urbanization and an ever increasing population growth and subsequent increase in need for healthcare services there has been a substantial increase in the generation of biomedical waste and contamination of air, water and land resources. The process of disposal of these wastes during services for collection, transportation, treatment and disposal of bio medical wastes exposes the personnel dealing with these wastes to various health hazards and occupational safety concerns. These wastes from different healthcare units when not managed properly create problems for human health and the environment. Some of the biomedical wastes have been proved to be extremely toxic and infectious (WHO, 2004). The uncontrolled dumping of such wastes has not only brought about increasing number of incidents of health hazards but also causing contamination of surface and ground water and thus posing serious environmental threat to human beings.

Most of the healthcare units in different localities in Kenya do not have proper biomedical wastes management system. Mixing of general and infectious waste, to more or less extent has been a common feature for most healthcare units. Since segregation of different categories of waste at source is most important in healthcare waste management, the problem deserves utmost attention.

Producers of biomedical wastes should ensure that robust segregation of materials is practiced. This will enable materials to be properly labeled, stored, transported and treated. Segregation of biomedical waste of different categories at source is an integral part of an efficient waste management. Healthcare workers, patients, waste handlers, waste pickers and the general public are exposed to health risks from infectious waste (particularly sharps), chemicals and other special biomedical wastes. Improper disposal of Biomedical waste (BMW), including open dumping and uncontrolled burning, increases the risk of spreading infections and of exposure to toxic emissions from incomplete combustion. For these reasons, occupational health and safety should be a component of biomedical waste management plans. It is important to ensure all hospitals and other medical facilities can dispose of their medical wastes in properly equipped incinerator or autoclave/shredding system which can handle such waste in an environmentally sound manner.

### 2.1.2 Conceptual framework

## 2.2 Empirical Reviews

### 2.2.1 Casues of occupational biomedical waste accidents

To be consistent with the duty of care requirements, correct classification of biomedical waste forms a solid foundation for ensuring effective protection of waste handlers under strict compliance with the waste management laws. Muniafu and Otiato (2010) argue that the problems on ineffective segregation of waste still persist leading to accidents and other adverse effects on waste handlers within Nairobi County. Henry *et al.* (2006) provide an excellent discourse of the challenges associated with the problem of classifying and managing biomedical waste citing it to be a significant source of waste handling related accidents.

Inadequate management, indiscriminate disposal from the sources of waste, poor establishment of waste handling policies, weak waste segregation practises, lack of enforcement and awareness of robust waste management policies and lack of interest and commitment from the senior staff constitute some of the critical factors that expose waste handers to accidents. Empirical evidence by Henry et al. (2006) show that combining a small amount of hazardous waste with non-hazardous waste makes the resulting waste 100% hazardous, which poses a lot of risk for the worker. The challenges is to ensure commitment and compliance with waste segregation and management practises such as practises and laws have shown places employees are at a greater risk of contracting diseases by handling inappropriately segregated waste.

In addition, inappropriate containment of waste to its level of risk such as waste that requires UN approved packaging and poorly implemented decontamination procedures to prevent and minimise exposure to pathogens and contagious fluids add to the waste segregation challenges.

A similar study on the composition of waste by Muniafu and Otiato (2010) provided evidence showing that 15% to 25% of waste generated from hospitals is hazardous while the remaining 75% is non-hazardous. Wrong combination of non-hazardous with hazardous wastes makes the entire waste 100% hazardous (Ferri, *et.al*, 2015).

A study by Muniafu and Otiato (2010) based on a quantitative analysis of data showed that lack of proper segregation techniques exposes waste handlers significant health risks besides widening the scope of those vulnerable to the health risks such as doctors, nurses, patients, hospital management staff, the general public and the environment. Inappropriate waste segregation, failure to adhere to municipal laws and systems laws besides the failure to follow the WHO guidelines on waste management leads to the wrong disposal of waste from hospitals. Muniafu and Otiato (2010) have noted this to be the direct result of unawareness problems, laxity in law enforcement, lack of process ownership and gaps in constant monitoring of waste management methods. Despite the serious gaps and methodological flaws of Muniafu and Otiato's (2010) study on biomedical waste classification and management challenges, the discourse accurately represents actionable issues to protect biomedical waste handlers. Ferri *et al.* (2015) proposed the use of a comprehensive Workplace Safety and Health Management framework consisting of a policy, management commitment, effective planning, reliable implementation and operations, performance measurements and an audit review program.

Muniafu and Otiato (2010) established other key challenges to include management of biomedical waste, lack of adequate attention in waste segregation from the direct sources of waste, inadequate knowledge on waste segregation methods, lack of efficient training on waste classification techniques for nurses and other sources of biomedical waste. Allison and Von Blottnitz (2010) and Ferri *et al.* (2015) note that waste disposal and segregation sites lack clear notices

and posters in English and other understandable languages on disposal of specific types of waste. This facilitates indiscriminate disposal of waste.

Guerrero *et al.* (2013) show that hospitals within Nairobi County form a significant source of classification and waste management problems because they lack the requisite infrastructure to tackle the biomedical waste classification problems. Serious flaws in classifying waste into the requisite categories of waste sharps, human anatomical waste, animal waste, microbiology and biotechnology waste, chemical waste, incinerator waste, different types of solid waste and discarded medicines and cytotoxic drugs have been noted.

Egondi *et al.* (2015) note that lack of monitoring and controls mechanism, absence of personnel protective gear during the segregation and transportation of biomedical waste, inadequate training given to the protection of waste handlers, careless dumping of clinical waste within the non-infectious waste exposing workers to the risk of waste hazards. Allison and Von Blottnitz (2010) from the management perspective noted that waste segregation not only reduces risks to the handlers but also reduces the cost of disposal and that some of the segregated non-hazardous wastes can be re-used or recycled thus cutting expenditure.

According to Ahmed *et.al.* (2015), 90% of Nairobi County biomedical waste handlers have poorly worked audit reports with records of work related accidents, which is a statutory requirement for organizations to comply with in waste management. Ahmed *et al.* (2015) assessed compliance in record keeping of 30 organizations targeting a population of 100 organizations that generate biomedical waste and established that 73% failed to keep records to evade responsibility for employees vulnerable to the risk of accidents and other workplace hazards. The study noted physical injuries from sharp objects like needles and blades constituted the leading causes of infection from diseases such as hepatitis B and HIV, liquid wastes, plastics and incinerator ash.

Parizeau (2015) noted several emerging accident related issues and work related accidents to include deficiency in knowledge on how to apply preventive measures to human health and contamination with untreated anatomical wastes.

Ahmed *et al.* (2015) conducted a study of Hospital Staff Exposure Risks and Awareness on Poor Medical Waste Management – A Case study of the Tabuk Regional Healthcare System- Saudi Arabia. It was established that the strongest exposure risk factors were sharp and needle stick injuries for Healthcare personnel (Patan and Mathur (2015)). The risk and the likelihood of nosocomial infections resulting from poor waste management and control, ingestion of repackaged drugs that have been disposed of, inhalation of air and dust particles from biomedical waste are direct causes of health risk and workplace accidents.

A study conducted by Siddharudha and Sowmyashree (2015) on Occupational Exposure to Infection on Healthcare Waste Handlers of a Tertiary Care Hospital in South India, established that 41.8% of healthcare waste handlers had exposure to healthcare waste and ‘needle stick injuries. Siddharudha and Sowmyashree (2015) identified pharmaceutical wastes, heavy metal wastes, pressurized containers and chemical wastes inclusive of laboratory reagents, expired disinfectants and organic chemical wastes as the main sources of accidents biomedical waste handlers incurred.

Ahmed *et al.* (2015) established that the most significant problems noted among biomedical facilities were poor maintenance of incinerators that are often in bad working conditions. Incinerators in good working conditions are a precondition for the reduction or prevention of work related hazards including toxic chemicals such as heavy metals and dioxin. Siddharudha and Sowmyashree (2015) recommended that compliance with special equipment handling guidelines including emergency provisions in case of accidents were mandatory especially when handling

biomedical waste and during waste related handling emergencies (Garg and Sarkar, 2013). The study recommended organizations to develop programs to train and create awareness among biomedical waste handlers and facilities that generate healthcare waste. Competent organizations to undertake such awareness creation exercises include the Kenya National Bio-safety Authority, NEMA and Department of Occupational Safety Health (DOSHS).

Mucocutaneous injury, which is the result of blood splashing into the mouth, open skin and nose were prevalent accidents that occurred when handling waste (Patan and Mathur, 2015). Further they concluded that unsafe collection and disposal of different types of biomedical waste strongly facilitated workplace accidents.

### **2.2.2 Knowledge and attitude of biomedical waste handlers on occupational safety and health.**

According to Othigo (2014), the defining elements of effective accident management include the knowledge and attitude of waste handlers that determines the extent and compliance levels in the bio-medical waste collection, transportation and disposal regulations and standards. Such requirements are consistent with the Ministry of Health, Kenya National Guidelines on Safe Disposal of Pharmaceutical Waste, 2001, which embeds hazard protection elements that include rarely used equipment such as face masks, obligatory overalls, leg protection, disposable gloves, obligatory industrial aprons and eye protectors. Siddharudha and Sowmyashree (2015) assessed the common causes of occupational waste handling accidents and concluded in a recommendation that designing methods to overcome problems such as failing to provide adequate warning signals in the workplace, failure to immunize workers, poor management practices, lack of proper waste packaging and poor waste transportation practices constituted effective methods of managing accidents. Moving of dangerous equipment must be penalized so as to control the level



of accidents. Based on the guidelines, organization that fails give to adequate warning signals to machine operators or those working in unsafe environments with dangerous equipment must be penalized to control the frequency of accidents. Othigo (2014) established that failing to develop and implement programs to curb work related stress among employees was among the leading causes of work related accidents. The study showed no evidence of hazard communication addressing occupational challenges faced by biomedical waste handlers.

Othigo (2014) argues that communication could provide workers with the appropriate instructions on how to handle biomedical wastes besides providing information on collective protective measures and awareness of overall hazard prevention policies.

Pietra *et al.* (2005) conducted a study on the effect of system approach and a blame –free environment on organizational performance. It was established that a system approach and a blame-free environment, aimed at better organizational performances as well as leading to much better results than focusing on individuals. Furthermore, it was also found that the use of technology, information accessibility, communication, patient collaboration and multi-professional teamwork are successful strategies to reach the goal of patient safety within healthcare organizations.

Parizeau (2015) recommends the use of appropriate methods which include immediate first aid measures such as keeping eyes and wounds washed clean, developing organizational culture and structures to accommodate waste handlers, retention of accident causing items with appropriate documentation of sources and use of medial surveillance.

A research by Singh and Gupta (2009) concluded a study with suggestions on accident management methods that include safe use of cytotoxic drugs among pharmacists in healthcare facilities, use of safe product handling procedures, implementation of emergency response procedures,

clarification using product data sheets that show detailed hazards handling procedures and educating cytotoxic drug handlers.

### **2.2.3 Investigation of Employer Compliance Status to Regulations**

Complying with the standards and regulations governing biomedical waste handling is a prerequisite for effective accident management among biomedical waste handlers. Othigo (2014) has suggested the element of safety for the protection of waste handlers to be a standard requirement for complying with standards, rules and regulations issued under the occupational safety and health policy guidelines for the health sector in Kenya.

A study by Othigo (2014) assessed biomedical waste compliance status at the Mater Hospital in Nairobi County using the policy framework for regulating biomedical waste management of the Hospital as a standard. The results showed that Mater Hospital has a program in place that directs waste handlers on waste management legislations and policies to ensure effective accident management. Inclusive of the legislations and policies were the Public Health Act Cap 242, Radiation Protection Act Cap 243, management of Hazardous Waste, Poisonous Substances Act 247, Food Drug and Substances Act 254, Medical Practitioners and Dentist Act 253, Environmental Management and Coordination Act Cap 387 Laws of Kenya, Water Act 2002, Land Control Act Cap 406 and Environmental Management and Regulations (Waste Management Regulations 2006 ensuring that there is safe biomedical wastes handling at the institution. Despite the policy and legislation framework in place being driven by an effective waste management program, compliance with the laws was at the minimum besides lack of records to show the level of compliance within the biomedical waste handlers.

### **2.2.3.1 Use of Personal Protective Equipment**

One of the requirements suggested by Wilkins (2016) for avoiding the prevalence of workplace accidents is the use of protective equipment to avoid direct contamination because of equipment failure. Singh and Gupta (2009) view legislations as a tool that provides guidelines and rules for the protection of workers, which are often not followed. This is consistent with the Petersen's Accident/Incident theory which suggests that every worker deserves protection from hazardous waste to live a healthy life. However, the study suggested that Kenya National Bio-safety Authority should develop, implement and enforce health and safety policy on use of personal protective equipment among bio-medical solid waste facilities. Bio-medical health facility must provide or purchase personal protective equipment on top of educating their employees on the importance of use of personal protective gear while working at facility.

Wilkins (2016) conducted a study on personal protective Equipment in the humanitarian governance of Ebola: between individual patient care and global bio-security in Ghana found that the importance of personal protective Equipment in mediating between individual patient care and bio-security helps in saving individual lives and protecting populations. From the findings, it was recommended that the government must monitor and carryout consistent annual health and safety check up within the bio-medical waste facility to ensure all employed staff health standards are followed.

Singh and Gupta (2009) argue in a detailed assessment of workplace hazards and protection among biomedical waste handlers and concluded that the application of use personal protection as protective measures against the risk of exposure to hazardous chemicals including pesticides.

### **2.2.2 Personal Hygiene**

According to Boss *et.al.* (2014), the World health organization policy framework provides that every employees working in any given organization is entitled to safe and good personal hygiene. Towards those goal, the study recommends that the Bio-safety Authorities must ensure that the implementation of Hospital Waste Management Rules is followed at all levels so as to maintain employee personal.

Boss *et.al.* (2014) conducted a study on personal hygiene among bio-medical waste handlers. From the study, it was established that maintaining personal hygiene is crucial in reducing care-less disposal of wastes by Healthcare facilities which is a concern for medical staff, patients, general community and largely the environment. The results of the study recommend that the Kenya National Bio-safety Authority must also punish organization that fails to avail personal protective device. It must also ensure that all the safety standards on personal hygiene are used and this is achieved through monitoring of training program that are offered by bio-medical solid waste facilities on personal hygiene.

According to Sharma (2010), awareness on Bio-Medical Waste Management among Healthcare Personnel of Some Important Medical Centers in Agra, it was found that inappropriate practice of BMW handling and management exposes handlers and general public to health and environment hazard once they do not keep their personal hygiene.

### **2.3 Critique of the Existing Literature Relevant to the Study**

According to Reinach and Viale's (2006) discourse of Petersen's Accident/Incident and the human factors theories accurately relate occupational safety and health hazards among biomedical waste handlers to the theories' defining elements with minor inconsistencies. Othigo (2014) build on Reinach and Viale (2006) exposition that failed to link theory with empirical evidence

of waste management and workplace related hazards. Despite the logical fallacies in Othigo's (2014) investigations, the theories were conceptualised in a framework that relied on un-stated facts exclusive of valid assumptions to the research problem. However, Othigo (2014) provided valid results using a suitable research design, valid sample size and current data despite excessively narrowing the study of focus to workplace hazards and challenges. In one instance on classification of waste, the author relied on personal opinion rather than empirical evidence to show how failing to comply contributed to the challenges related to classification and management of waste.

A lot of primary research exists that provide scientific facts on waste handling occupational accidents. A research by Muniafu and Otiato (2010) on occupational accidents uses key words such as prick injuries, contamination, sharps, pathological and chemical contacts to describe occupational accidents. The author depicts the source of exposure to workplace accidents on the failure of biomedical waste handlers to inappropriately apply workplace regulation such as wearing of protective clothing. Muniafu and Otiato (2010) do not identify such accidents to be related to the problem of wrongful classification such as categorizing sharps with the pathological waste. Communication problems do not arise in the study. Henry *et al.* (2006) accurately depicts the type of accidents to include mucocutaneous injury and pricks despite being narrow in scope. The elements captured define occupational safety and health hazards among biomedical waste handlers based on study findings by Wilkins (2016) on the use personal protective equipment. In addition, its scope was not identified. Thus, there is need for the current study to examine how the use of personal protective equipment's determines the occupational safety and hazard among bio-medical waste handlers in Nairobi County.

Boss *et.al.* (2014) researched on personal hygiene among biomedical waste handlers by narrowing the scope to the individual waste handlers without factoring external issues such as organizational responsibility. The study established that maintaining personal hygiene was crucial in reducing careless disposal of wastes by Healthcare facilities which was a concern for medical staff, patients, general community and largely the environment.

Based on the study by Ahmed *et al.* (2015) which analyzed a Hospital Staff Exposure Risks and Awareness about Poor Medical Waste Management- A Case study of the Tabuk Regional Healthcare System- Saudi Arabia, its findings can highly be acknowledged in the current because it tried to establish how work-related accidents may be a major factor influencing occupational safety and hazard among bio-medical waste handlers. However, its findings cannot be generalized into the current study because of the difference in their scope.

A study conducted in Tertiary Care Hospital in South India by Siddharudha and Sowmyashree (2015) on Occupational Exposure to Infection on Healthcare Waste Handlers established various issues on occupational exposure to infection on healthcare waste handlers among hospitals. Major findings could be replicated in Nairobi County that was inclusive of risks associated with waste classification and management issues.

A study by Pietra *et al.* (2005) on the effect of system approach and blame –free environment on organizational performance provide findings that cannot be generalized because of limited application of the approach to a hazard free environment. It failed to critically analyze whether the use of personal protective equipment's determines the occupational safety and hazard among biomedical waste handlers.

Othigo (2014) conducted a study to evaluate the biomedical waste management approaches used by the Mater Hospital in Nairobi County. The study focused on policies and regulations that guide the management of biomedical waste in the Mater Hospital. The results showed that there is need for a study to examine the same issues among other hospitals in the County (Patan and Mathur (2015).

The outcome of the literature review on occupational safety and health accidents among biomedical waste handlers in Nairobi County was influenced by different factors. Those factors include intentional and unintentional combination of hazardous with non-hazardous healthcare waste, making the entire waste hazardous. It was established that lack of commitment in the side of the senior staff to develop a training and development program on occupational hazards for waste handlers, the failure to adhere to World Health Organization waste segregation and management policies and standards and lack of adequate attention in waste segregation practices were identified to be among the waste segregation and management challenges. Besides, serious flaws in waste classification such as indiscriminate waste disposal methods were influenced by several factors inclusive of waste occupational hazards including infections, workplace injuries, waste classification and management approaches such as lack of commitment from the designate organizations. Compliance gaps were established to include inappropriate use of failure to use personal protective equipment in the governance of healthcare among waste handlers.

Although much has been done in the same field, still there is limited information on how the use of protective equipment's determines the occupational safety and hazard among bio-medical waste handlers. Thus, there is need for the current study to examine how the use of personal protective equipment's determines the occupational safety and hazard among bio-medical waste handlers in Nairobi County.

It is imperative to note that different authors had little discourse on the challenges biomedical waste handlers experience at the place of work despite providing detailed and accurate exposition of the use of policies, procedures and categorisation of waste. Besides, the waste management policy, planning, implementation, performance measurements and audit reviews had serious gaps in the literature review. Different occupational hazards were identified with little countermeasures to address them when they happen in the workplace despite generalisations on managing workplace accidents. Another area with glaring gaps was how to ensure compliance with Nairobi County laws and by laws and other statutory requirements on biomedical waste handling and management at the place of work.

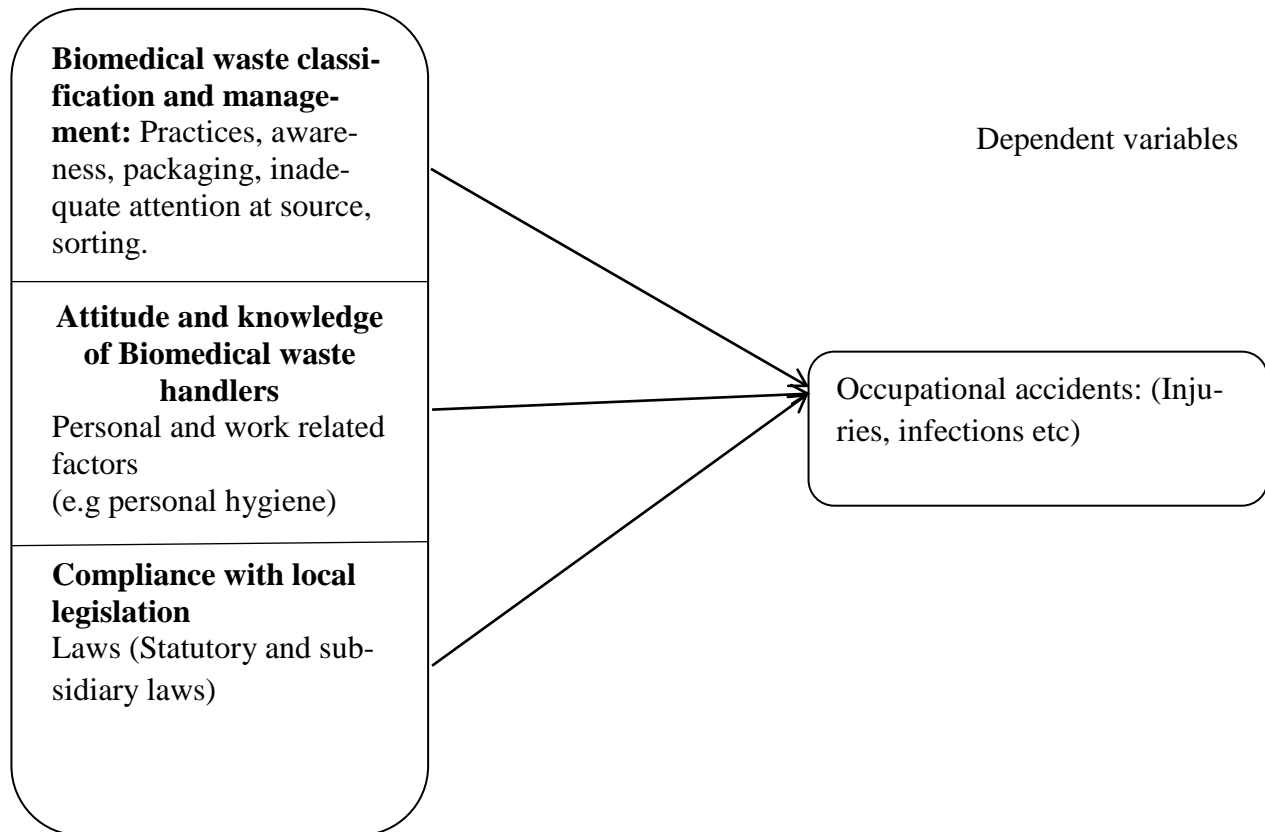
The studies differ on methodologies used in the investigations and the scope of investigation. The result was a compelling need to conduct current research on how to address the issue of occupational safety and health accidents among bio-medical waste handlers in Nairobi County.

#### 2.1.2 Conceptual framework

The conceptual framework defines the relationship between presumed causes (independent variables) of the occupational health accidents and the presumed effects (dependent variable) as illustrated in Figure 2. Independent variables include biomedical classification and management issues that have direct effects on safety of biomedical waste handlers within Nairobi County. Empirical evidence shows that despite segregation of waste being the key to successful biomedical waste management program, it is also viewed as a significant source of problems in the waste management practice. Occupational accidents that follow the various classification and management issues have direct effects on the health of the workers. Examples include infection diseases leading to gastro-enteric and respiratory infections among others. Compliance with local legislative laws (Statutory and subsidiary laws) is mandatory for protecting employees from health risks.



## Independent variables



**Figure 2.1 Conceptual framework**

### **2.5 Limitations.**

The researcher could not collect data from all employees handling biomedical waste working in Nairobi City County, however, the sampling strategy enabled the researcher to generalize the findings across other biomedical waste handlers. In addition, employees were skeptical of getting involved in the research. However, I explained to the participants the purpose of the study and encouraged them to answer the research questions.

## CHAPTER THREE

### 3.0 MATERIALS AND METHODS

#### 3.1 Study Sites

The study involved five different facilities handling biomedical waste within Nairobi metropolitan area. The sites under study included, three public hospitals namely Mathari Referral Hospital, Mbagathi District Hospital and Kenyatta National Hospital. The facilities are as shown in Figure 3.1 below. One medical research / learning institutions; Kenya Medical Research Institute and one NEMA registered private BMW disposal sites within Nairobi County; Envirosafe Limited.



**Figure. 3.1 Location of the study in Nairobi City County**

**Source. [www.googlemaps.com](http://www.googlemaps.com)**

### **3.2 Study Design**

A mixed research method using a descriptive research design approach constituting both the quantitative and qualitative paradigms was used to investigate the occupational safety and accidents among biomedical waste handlers in Nairobi County. The descriptive approach was used to develop numerical data for statistical analysis that was used to make conclusions on the subject of investigation. The mean, mode and percentage summaries on the study variables besides the analyzing the behavior of multiple variables on the dependent variable formed the basis for establishing their effects on the dependent variable. The rationale for using a descriptive research design includes providing a better understanding of the current situation on biomedical waste handlers in Nairobi County, provide the rationale for the incident prevalence of occupational health hazards despite the existence of policies, guidelines and laws governing the segregation, collection, transportation and disposal of healthcare waste.

### **3.3 Target Population**

The target population for this project included workers in every stage of the biomedical waste handling cycle with specialized focus on those who handle biomedical waste. Inclusive were biomedical waste at the waste generation stages, the segregation stage, waste loading transportation unloading and unloading stage.

### **3.4 Sampling Method**

The study sites were arrived at due to the nature of biomedical waste generated and handling procedures employed at different points during collection, transport and disposal. The selected waste type is considered the most hazardous due to its infectious nature and therefore required urgent address. The facilities were selected from a list of the fifteen NEMA licensed biomedical waste disposal site/facilities in Nairobi. For the hospitals the three selected sites were the only

licensed public hospitals. While one private incinerator in Nairobi was selected from a list of five (5) NEMA licensed biomedical waste disposal sites. The respondents were selected based on their areas of duties among those involved in the collection of the biomedical waste, the transportation and those at the disposal points (incinerator operators). The employers were represented by the facilities managers, for hospitals I interviewed hospital administrators while for the private incinerator the respondent was the Company Director, for the research institute the employer representative was the Administration Manager.

### **3.4.1 Sample Size Determination**

Survey sampling strategy was used because of the descriptive nature of the study to collect the required data for statistical analysis. The level of precision required in providing estimates of the rates, proportions and means justified the sampling methodology.

In theory, the confidence interval was based on the form:

(Point estimate)  $\pm$  (Margin of error)

- a) The point estimate was a value computed from the sample based on the sample proportion.
- b) The margin of error (or “plus or minus number”) was computed from a variety of components – the level of confidence (e.g. 95%), the variability in the outcome variable and the sample size.

The facilities used for the study have a target population of 1,000 biomedical waste handlers who work at different stages. The sample size was calculated using the formula recommended by Mugenda and Mugenda, (2003).

To determine the sample size for use in this study, the following formula recommended by Mugenda and Mugenda, (2003) was used:

$$n = \frac{(Z_{\alpha/2})^2 P (1-P)}{d^2}$$

Where; n = the desired sample where population < 10 000

Z = standard normal deviation (1.96) corresponding to 95% confidence limit.

d = degree of precision usually set at 0.05.

P = Proportion of the target population expected to have the (0.5) P taken as 50%.

$$n = \frac{(1.96)^2 (0.5)(0.5)}{0.0025} = 384.16$$

The sample was adjusted for finite population as follows, Fishers' *et al.* (1998)

$$n_f = n/1 + (n/N)$$

Where; n<sub>f</sub> = the sample for size < 10 000

n = desired sample size for population > 10 000.

N = estimate of the population size (300)

$$n_f = 384/1 + (384/300) = 168$$

The sample size of 168 takes into account all the target facilities and was distributed among workers in the various sections of BMW disposal chain. In theory, an ANOVA with repeated measures is used to compare three or more group means where the participants are the same in each group. This usually occurs in two situations: (1) when participants are measured multiple

times to see changes to an intervention; or (2) when participants are subjected to more than one condition/trial and the response to each of these conditions wants to be compared.

### **3.5 Research Instruments**

The questionnaires included the demographic characteristics and the personal information, duration of work such as the age of waste collector, marital status and place of residence, terms of employment, monthly salary, position and type of work of waste collector. It also included whether the waste collector have been stuck with hard object or vehicle, fallen down while pulling or pushing the waste trolley, hit by any hard or sharp objects, lifted more than his capacity, pricked by hypodermic needles, or had been in contact with harmful chemicals. The fourth scale captured accident management practices at the workplace while the fifth scale was on employer compliance with laid down legislation and standards (*appendix 3*).

### **3.6 Data Collection Procedure**

The data was collected using questionnaire from the selected biomedical facilities. The target groups were given the questionnaires personally. Most of the BMW waste collectors were given the tools at their respective point of operation in the BMW disposal chain. Authority was also sought where necessary with the relevant authorities or officials. They were explained on the purpose of the study, the consent form which was attached to the questionnaire was read to participants. Each questionnaire was completed within a range of 15 to 20 minutes. Willing participants were left with the questionnaire if they so requested and an agreement was made on expected day and time of collection.

### **3.7 Data Analysis**

Quantitative data was collected from the respondents and coded for descriptive statistical analysis to produce frequencies and percentages. Statistical Package for Social Science (SPSS) was used to obtain various tables with different statistical values.

## **CHAPTER FOUR**

### **4.0 RESULTS**

#### **4.1 Introduction**

This chapter presents the results and discussion on descriptive statistical analysis of the findings on Occupational accidents among biomedical waste handlers in Nairobi County.

#### **4.2 Results**

To enumerate the potential risks and pre-disposing factors among biomedical waste handlers in Nairobi City County.

##### **4.2.1 Statistics of the Sample Size**

The data was obtained by issuing questionnaires to 168 Bio-medical Waste Handlers in five biomedical waste health facilities in Nairobi County as shown in Table 4.1.

Table 4.1 shows the sample size chosen from the target population using a random selection procedure to create the desired sample size for data analysis. Questionnaires were issued to 168 biomedical waste handlers in five facilities who filled and returned them to the researcher. The sample of 168 people has a standard deviation of 1.03239, which shows a population size that is highly variable because of its composition in age, education, work experience and knowledge of biomedical waste handling requirements. However, the Std. Error of Mean is .07965, showing a low value, which shows a high degree of accuracy the data collection and statistical analysis of the variables of interest.



Table 4.1: Summary statistics of the sample size

**Statistics**

N	Valid	168
	Missing	0
Mean		3.2560
the		.07965
Std. Deviation		1.03239

N	168
Validly missing	0
Mean	3.2560
Error	.07965
Standard deviation	1.03239

**4.2.2 Percentage of returned Questionnaires**

The percentage of returned questionnaires constitutes 95.2% with 4.8%, which were not returned. It is important to note that one hundred and sixty (160) questionnaires were answered and returned, translating into 95.2 %, which was a reliable figure for informing the study as shown in table 4.2.

Table 4.2: Percentage of returned Questionnaires

	<b>Frequency</b>	<b>Percentage (%)</b>	<b>Cumulative Percent</b>
Returned Questionnaires	160	95.2	95.2
Not Returned	8	4.8	100.0
Total	168	100.0	

The results in table 4.3 shows that 160 questionnaires, which were returned had a Standard error of Kurtosis of 0.381, a number which shows that the Skewness and Kurtosis statistics could tell the properties of the dispersion of the dataset used in the investigation had the desired properties of education, knowledge of waste management and employment characteristics. Here, by deducing from the results in Table 4.3, the Std. Error of Kurtosis of .0381 demonstrates a high degree of consistency of the variables of interest in the reference population of 1000 employees that was used in the study for statistical analysis. On the other hand, the Std. Error of Skewness of 0.192 shows that the Standard Error of Skewness has a small deviation existing between the values of the sample that was taken randomly from the same target population distribution for statistical analysis. This makes the sample characteristics to show an asymmetrical distribution. This justifies the use of the 160 returned questionnaires for the study.

Table 4.3: Statistical analysis for returned questionnaires

N	Valid	160
	Missing	0
Mean		1.0000
Std. Deviation		.00000
Std. Error of Skewness		.192
Std. Error of Kurtosis		.381

N	160
Std. Deviation	1.0000
	.192
Std. Error of Kurtosis	.381

#### 4.2.4 Educational Status of the respondents

Respondents were composed of 3.1% university level qualifications, 18.8% Diploma graduates, 48.8% secondary level qualifications, 15.0% primary level qualifications, those with Certificate constituted 12.5% and those without formal education constituted 1.9% (Table 4.4). The educational levels of the respondents were considered in order to inform the nature of the responses. The categories included no education at all, primary secondary and college and university education.

Table 4.4: Summarized data showing educational status of respondents.

	Frequency	Cumulative Percent
University	5	3.1
Diploma	30	21.9
Secondary	78	70.6
Primary	24	85.6
Certificate	20	98.1
None	3	100.0
Total	160	

#### **4.2.5 Years of work experience among respondents.**

There was significant percentage of 11.2% employees with less than one year experience in handling biomedical waste (Table 4.6). On the other hand, those with 1 to 5 years' experience constituted 43.6% and those in the category of 6 and more years of experience consisted of 11.6%. A statistical analysis of the years of working experience in theory was justified because knowledge and working experience have effects on the working practices of the employees.

Table 4.5: Working Experience

Work experience	Frequency	Cumulative Percent
Under one year	27	16.9
1-3 Years	57	52.5
4-5 Years	48	82.5
Above 6 years	28	100.0
Total	160	

#### **4.2.6 Terms of Employment**

The respondents were asked to state the terms of reference offered by employing institutions that handle Bio-waste. The terms of employments were categorized into the following: permanent, casual, contract and attachment.

Permanent employees constituted 33.8%, casual workers 18.8%, those on contract 39.4% and those on attachment constituted 8.1%. The results depicted a situation of some gaps in employees' terms of employment in the bio-medical handling facilities.

Table 4.6: Distributions of Respondents by Employment Terms

Terms of Employment	Frequency	Cumulative Percent
Permanent	54	33.8
Casual	30	52.5
Contract	63	91.9
Attachment	13	100.0
Total	160	

#### 4.2.7 Causes of accidents among biomedical waste handlers in Nairobi County.

Types of accidents that occur during waste handling range from being pricked leading infections due infectious biological agents. Other accidents lead to muscle tearing, fractures, falls, physical scratches and abrasions. The statistics of Skewness of educational status was 0.477 while that for inadequate attention to directions was 0.881 (Table 4.8), which is less symmetrical. However, the Skewness for improper waste classification knowledge (1.053), inadequate training and awareness (1.727), Lack of enforcement of waste handling standards (1.090), poor enforcement of waste handling policies (1.514) and inadequate waste classification knowledge (1.245) have positive values that are greater than 1.0 showing that the distribution is far from symmetrical. The results show highly positive values of the Skewness, which is very pointed and statistically undesirable. The statistics points out that the variables noted have significant implications on the increase in the number of accidents noted among biomedical waste handlers in Nairobi County. The statistics shows the variables that were tested to determine the extent of their contributions for the prevalence of accidents among biomedical waste handlers in Nairobi County.

Table 4.7: Causes of occupational accidents among Biomedical waste handlers

Statistical analysis	Educational Status	Improper waste classification at source	Inadequate attention to directions	Inadequate training and awareness	Lack of enforcement of waste handling standards	Poor enforcement of waste handling policies	Inadequate waste classification and handling knowledge
N	160	160	160	160	160	160	160
Mean	3.2063	1.2688	1.3000	1.1750	1.2625	1.2000	1.2375
Std. Deviation	1.04669	.44470	.45970	.38116	.44137	.40126	.42689
Std. Error of Skewness	.193	.172	.193	.177	.099	.111	.182

#### 4.2.8 Responses to the causes of accidents among biomedical waste handlers.

The question that was answered was: what the respondent deemed and thought contributed to occupational accidents while at their day to day activities of handling biomedical waste. The results showed that 20 % of the respondents believed accidents to be due to poor waste management practices, 15.6% due to poor waste classification at source, 10.6% due to poor enforcement of waste handling policies and 11.9% due to lack of enforcement of waste handling standards (Table 4.8). Besides, 12.5% of the respondents regarded inadequate training and awareness

as the factors that contributed to workplace accidents, 23.1% poor waste classification knowledge and 6.3% was due to inadequate attention to direction.

Table 4.8: Statistics on responses to causes of accidents among biomedical waste handlers.

	Frequency	Cumulative Percent
a.Poor waste management practices	32	20.0
b.Poor waste classification at source	25	35.6
c.Poor enforcement of waste handling policies	17	46.3
lack of enforcement of waste handling standards	19	58.1
d.Inadequate training and awareness	20	70.6
e.Poor waste classification knowledge	37	93.8
f.Inadequate attention to directions	10	100.0
Total	160	



#### 4.2.9 Types and nature of occupational accidents

An investigation on occupational accidents revealed 9.4% noted that they have suffered contamination which includes hazardous and non-hazardous chemicals, 13.1% had muscle tearing and 10.6% noted that they had suffered scratches. The results show that 3.1% have suffered falls, while 15% have lifted heavy objects and 16.9% have worked in high temperature and low temperature environments. However, 5.6% recorded having been struck by falling objects.

Table 4.9: Occupational waste handling accidents

	Frequency	Cumulative Percent
Pricks	47	29.4
Contaminations	24	44.4
Muscle Tearing	21	57.5
Scratch	6	61.3
Falls	13	69.4
Lifting heavy objects	21	82.5
Struck by falling object	28	100.0
Total	160	

#### 4.2.10 Statistical analysis of waste handling accidents

A statistical analysis of the question on the types of occupational accidents that biomedical waste handlers are exposed to is shown in Table 4.10. A Skewness of 0.891 shows the distribution of effects of struck by falling materials, lifting heavy objects, pricks, contaminations, muscle tearing, scratch and falls among the biomedical waste handlers in Nairobi County. It was noted that

those respondents who have been struck by falling materials while on duty are very few.. The data shows that pricks, contaminations, scratches are most common among biomedical waste handlers.

Table 4.10: Statistical analysis of waste handling accidents

Statistical analysis	Struck by falling materials	Lifting heavy objects	Pricks	Contaminations	Muscle Tearing	Scratch	Falls
N	160	160	160	160	160	160	160
Mean	1.7000	1.3000	1.4000	1.3313	1.3563	1.2375	1.3125
Std. Deviation	.45970	.45970	.49144	.47214	.48039	.42689	.46497
Skewness	-.891	.881	.412	.724	.606	1.245	.817
Std. Error of Skewness	.192	.192	.192	.192	.192	.192	.192

#### **4.2.11 To evaluate the skills and knowledge of biomedical waste handlers in Nairobi County on best practices in biomedical waste management.**

##### **Knowledge on safe waste handling methods**

A statistical test was conducted to determine the effects of awareness status of the biomedical waste handlers on their effectiveness and knowledge on safe waste handling methods.

The results of the statistical test in answering the question if lack of knowledge on safe waste handling methods contributed to the workplace related accidents are shown on Table 4.12. The results show that 31.9% of the respondents strongly agreed that lacking appropriate knowledge

on waste handling methods was a significant cause of occupational accidents. Of the respondents, 31.9% agreed that lacking appropriate knowledge was a direct cause of accidents while 21.9% neither agreed nor disagreed that knowledge on safe waste handling methods was an intervening variable that underpinned the cause of occupational accidents. However, 11.3% disagreed on the Knowledge on safe waste handling methods as a reason for the prevalence of accidents and 3.1% strongly disagreed.

Table 4.3: Knowledge on safe waste handling methods

	Frequency	Cumulative Percent
Strongly agree	51	31.9
Agree	51	63.7
Neither agree nor disagree	35	85.6
Disagree	18	96.9
Strongly disagree	5	100.0
Total	160	

#### 4.2.12 Effects of education on biomedical accidents prevention

Table 4.4: Effects of education on biomedical waste handling accidents

Opinions of respondents to effect of education	Frequency	Cumulative Percent
Strongly agree	67	41.9
Agree	46	70.6
Neither agree nor disagree	24	85.6
Disagree	14	94.4
Strongly disagree	9	100.0
Total	160	

To test the implications of awareness on accident prevention, a Kendall's tau coefficient statistic test statistical test was conducted as shown in table 13.

Table 4.14: Correlations of education with safe waste handling methods

Correlations

		Knowledge on safe waste handling methods	Effects of education on biomedical waste handling accidents
Kendall's tau_b	Knowledge on safe waste handling methods	Correlation Coefficient	.834
		Sig. (1-tailed)	.305
		N	160
	Effects of education on biomedical waste handling accidents	Correlation Coefficient	1.000
		Sig. (1-tailed)	.
		N	160

Table 4.13 reports the results of a Kendall's Tau coefficient statistical test that was conducted to measure the ordinal association between knowledge on safe waste handling methods and effects of education on biomedical waste handling accidents. Kendall's tau coefficient was used as an alternative to Pearson's product-moment correlation and the Spearman rank-order correlation coefficient because the sample size was small compared with the size of the target population. The test statistic provides information about the movement of the relationship among the two variables (Knowledge on safe waste handling methods and effects of education on biomedical waste handling accidents) used in the study. On a 1-tailed significance test the results were significant at  $t$  ( $\tau_b = .834$ ,  $p = .305$ ) a coefficient of  $-.034$ , indicating a weak negative correlation between the two variables. This can be interpreted to mean additional factors such as failure to adhere to regulations, lack of management support and commitment and other noise factors, which contribute to the noise variables that adversely affect the implications education on waste handling accidents.

### **4.3 To establish the compliance status of waste handling companies with the local legislation (Statutory and subsidiary laws) governing biomedical waste handling.**

#### **Compliance status with standards and regulations**

This investigation was conducted to establish the compliance status of employees and employers of biomedical waste handlers to the local legislation (Statutory and subsidiary laws) governing occupational safety and health in Nairobi County.

#### **4.3.1 Uses of Personal Protective Equipment**

The exposure of employees to a large number of accidents makes them vulnerable to that pose danger to their eyes, faces, nose, hands and even legs.

#### 4.3.1.1 Wearing gloves

The respondents were asked whether employees frequently wear gloves at the place of work from 160 participants. The results showed that 34.3 % of the respondents wear gloves while 65.6% % do not, which shows that a significant number of employees are vulnerable to injuries that prick the hands and fingers besides getting contaminated (Table 4.14)

Table 4.15: Wearing gloves

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	55	34.4	34.4	34.4
No	105	65.6	65.6	100.0
Total	160	100.0	100.0	

#### 4.3.1.2 Wearing masks

The results reported in table 4.15 show that 71.3% of those involved in the study wear masks while 28.8% do not. The risk of getting inhalable diseases is very high among the biomedical waste handlers because of the high relative percentage of working without masks.

Table 4.16: Wearing masks

	Frequency	Cumulative Percent
Yes	114	71.3
No	46	100.0
Total	160	

#### **4.3.1.3 Wearing Overall**

The use of personal protective body cover among bio-medical handlers when handling biomedical waste is as shown in Table 4.16. The results showed that 30.6% wear overalls while 69.4% do not. The implications are that a significant number of employees do not wear overalls, which leaves a large number vulnerable to the risk of contracting diseases besides getting injured and exposed to work related hazards.



Table 4.17: Wearing overall

	Frequency	Cumulative Percent
Yes	49	30.6
No	111	100.0
Total	160	

#### 4.3.1.4 Supervisor ensures protective gear is worn

Results in Table 4.17 show that 71.3% of biomedical waste handlers use protective equipment while 28.8% do not at the place of work.

Table 4.18: Supervisor ensures protective gear is worn

	Frequency	Cumulative Percent
yes	114	71.3
No	46	100.0
Total	160	

#### 4.3.2 Personal Hygiene

This study also sought to investigate on personal hygiene in the bio-medical waste handling facilities Kenya. In order to investigate on personal hygiene, the respondents were asked a number of questions. These related to personal hygiene in the bio-medical waste handling facilities.

#### 4.3.2.1 Washing hands with antiseptic

We investigated the status of employees in keeping their personal hygiene. The result shows that 73.8% wash hands with antiseptic while 26.3% do not (Table 4.18). The 26.3% remain highly vulnerable to work related hazards, which is a significant percentage of biomedical waste handlers. The risk of injuries and contaminations remain high among the group of employees.

Table 4.5: Washing hands with antiseptic

	Frequency	Cumulative Percent
Valid Yes	118	73.8
Valid No	42	100.0
Total	160	

#### 4.3.2.2 Washing work clothes

Washing work clothes is one method of dealing with health risks that happen due to dirty clothing. According to Table 4.19, 76.9% of the respondents agreed that they wash work clothes while 23.1% do not wash their clothes after work and failing to wash clothes makes it a significant problem among waste handlers.

Table 4.20: Washing work clothes

		Frequency	Cumulative Percent
Valid	Yes	123	76.9
	No	37	100.0
	Total	160	

#### 4.3.2.3 Eating at the place of work

Eating at the place of work if not properly regulated makes the worker vulnerable to the risk of contaminating diseases. Our results shows that 63.1% positive while 36.9% do not eat at the place of work(Table 4.20)

Table 4.21: Eating at the place of work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	101	63.1	63.1	63.1
	No	59	36.9	36.9	100.0
	Total	160	100.0	100.0	

#### 4.3.2.4 Taking shower after work

On the question whether employees take a shower after work the results indicated that 80% do bath while 20% do not take a shower.

Table 4.22: Taking shower after work

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	128	80.0	80.0	80.0
No	32	20.0	20.0	100.0
Total	160	100.0	100.0	

#### 4.3.2.5 Sharing protective clothing with colleagues

Our results shows that 82.5% share clothes with their fellow workers while 17.5% do not (Table 4.22). These results show how vulnerable employees could be in keeping clean

Table 4.23: Share protective clothing with colleagues

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	132	82.5	82.5	82.5
No	28	17.5	17.5	100.0
Total	160	100.0	100.0	

#### 4.3.3 Accident Management

The respondents were asked to indicate the extent to which they agreed on various statements related to accident management. Some of the issues included access to first-aid services, compensation and sick leave among others. It was found that 63.1% of the accidents were reported while 36.9% of the accidents were not (Table 4.23).

Table 4.6: Accident Reporting

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	101	63.1	63.1	63.1
No	59	36.9	36.9	100.0
Total	160	100.0	100.0	

#### 4.3.4 Compliance with legislation

We also sought to assess employee and employers compliance to waste handling legislation and sub laws. Among the researched elements were knowledge of compliance laws and other requirements, acquisition of certificate of registration for the biomedical waste handling institutions and availability of regular safety and health audits.

##### 4.3.4.1 Compliance with Laws

**The results showed that 78.8% of the respondents agree that they did comply with laws and regulations governing handling of biomedical waste while 21.3% did not comply** Table 4.24. Failure to comply with laws and regulations had serious implications on the occupational health of biomedical waste handlers.

Table 4.7: Compliance with legislation

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	126	78.8	78.8	78.8
No	34	21.3	21.3	100.0
Total	160	100.0	100.0	

#### 4.3.4.2 Work Place Registration

We sought to answer the questions whether biomedical waste handlers worked with companies that were registered with the appropriate authorities. The certificate of registration is important because it provides the waste handling facilities the legitimacy to handle waste as per the regulations outlined in the waste disposal act of the Nairobi County Government. Typically, the results show that 54.4% have the license while 45.6% are not registered (Table 4.25).

Table 4.8: Certificate of registration

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	87	54.4	54.4	54.4
No	73	45.6	45.6	100.0
Total	160	100.0	100.0	

#### 4.3.4.3 Safety and Health Audits

On safety and health audits we found that 53.8% of the companies that the waste handlers worked for regularly conducted safety and health audits while 46.3% did not (Table 4.26). It is

imperative to note that such audits fall short of the required number of audits and fail to show the regularity of the audits in compliance with the regulations and laws on biomedical waste handling.

Table 4.9: Safety and Health Audits

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	86	53.8	53.8	53.8
Valid No	74	46.3	46.3	100.0
Total	160	100.0	100.0	

#### 4.3.4.4 Specialized Medication

On whether the employees received specialized medication, the results show that 41.9% do receive specialized treatment while 58.1% do not (Table 4.27).

Table 4.10: Specialized treatment after work

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	67	41.9	41.9	41.9
Valid No	93	58.1	58.1	100.0
Total	160	100.0	100.0	

#### 4.3.4.5 Training on safety and health

Asked whether they received any training on safety and healthy, 45% of the respondents confirmed that they are trained on safety and health. However, 55% indicated that they were recruited without going through such training on safety and health training and have never been trained (Table 4.28).

Table 4.11: Training on safety and health

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	72	45.0	45.0	45.0
	No	88	55.0	55.0	100.0
	Total	160	100.0	100.0	

#### 4.3.4.6 Regular assessment of risk

On the question of whether the work places are subjected to regular risk assessment, 69.4% of the respondents agree that regular risk assessment are conducted on the status of the working environment and in compliance with standard and regulations while 30.6% do not (Table 4.29).

Table 4.30: Regular assessment of risk

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	111	69.4	69.4	69.4
	No	49	30.6	30.6	100.0
	Total	160	100.0	100.0	



## CHAPTER FIVE

### DISCUSSION

#### **5.1 Enumeration of the potential risks and pre-disposing factors among biomedical waste handlers in Nairobi City County.**

##### **5.1.1. Causes of accidents among biomedical waste handlers in Nairobi County**

In compliance with the Duty of Care requirements, one of the major causes that was identified as the major cause of the persistent occurrence of accidents among biomedical waste handlers in Nairobi County include waste classification and management challenges. In practice and theory, poor waste segregation practices were shown to be the leading causes of infections and other health hazards such as injuries and breathing problems. It is worth noting that over 79% of biomedical wastes are non-hazardous, but the rest of the waste constituting 21% is hazardous, which is both harmful to the people and deleterious to the environment. Often, waste the waste generated from healthcare institutions not only includes biomedical substances, but a wide variety of domestic and household wastes because of poor packaging and handling of other waste materials. Such wastes if not properly classified and segregated at source are potential sources of accidents such as pricking and direct contaminations. Besides, pathological wastes also constitute the waste that could cause contaminations among waste handlers. Pathological waste includes human waste, tissues and other organs. Chemical wastes, sharps, pharmaceutical waste, infectious waste and radioactive waste also constitute the sources of accidents Baveja *et.al* (2000). It is imperative for healthcare workers to identify sharps such as needles, saws, glass, nails, scalpels and needles and segregate them appropriately to avoid the effects of pricking and causing injuries to biomedical waste handlers who work on the assumptions that healthcare workers who are well aware of the effects of poorly segregated waste on the health of the biomedical waste handler could segregate and pack the waste for safe handling. A similar trend should be established for

other categories of waste with stringent measures to create a protective working environment for biomedical waste handlers. This should be consistent with the underlying biomedical waste classification principles. Often, such principles are not deeply embedded in the minds of the employees and sometimes ignorance plays a significant role combined with limited knowledge to add to the problem of the frequency of accidents. In principle, classifying waste according to sharps, general waste, infectious waste, pathological waste, pharmaceutical waste and radioactive waste signifies competence in waste classification and management in the whole waste management cycle. The results show that laxity in enforcing standards is not only an individual problem at the employee level but spans the management hierarchy of different healthcare facilities generating biomedical waste. Laxity includes lack of observation of the waste segregation and management policies and standards, storage and containment, transportation and handling of devices such as wheelbarrows and chutes constitutes the critical challenges faced by biomedical waste handlers. Other areas identified include lack of immunization, waste management implementation methods and lack of performance measurements and audits. Other situations include mixing hazard and non-hazardous materials without due regard to the resulting effects that makes the entire material hazardous to handle and dispose in the waste management cycle. Besides, poor segregation practices enhanced the risk of potentially hazardous materials getting disposed of carelessly leading to contamination. Addressing the challenges could lead to a reduction in treatment costs, the number of employees exposed to occupational hazards, low impact on ecological environment and potential epidemics prevention.

## **5.12 Nature of Occupational Accidents**

It is imperative to note that a significant number and type of accidents that have significant implication on the safety and health of biomedical waste handlers in Nairobi County include pricks, contamination, muscle tearing, falls and scratches. Occupational accidents that are caused by direct contact with the biohazardous wastes have the potential to cause infectious diseases that are often communicable leading to illnesses propagated by infectious agents. Often, it is important for the waste handlers to be educated on the type and nature of accidents that could be caused due to the biomedical wastes to help them protect themselves from the potential effects of the accidents. A study on Healthcare Waste Handlers of a Tertiary Care Hospital in South India established that 41.8% of healthcare waste handlers had exposure to healthcare waste and 'needle stick injury. Another study was carried out by Ahmed *et.al* (2015) on Analysis of Hospital Staff Exposure Risks and Awareness about Poor Medical Waste Management- A Case study of the Tabuk Regional Healthcare System- Saudi Arabia it found that the strongest exposure risk factor to sharp and needle stick injuries exists for healthcare personnel. Thus, there is high likelihood that, work related accidents may be a major factor influencing occupational safety and health among bio-medical waste handlers.

### **5.2.3 Accident Management**

The results on the study on safety and risk management in hospitals is consistent with the findings by Michel *et al* (2009), which shows that the prevalence, severity and causes of a large variety of different types of adverse events in hospitals, as well as the effectiveness of various approaches enhance the safety required for appropriate interventional methods to protect the waste handler. It is evident that the types of interventions and outcomes can be classified into three categories the first category is detection, secondly, mitigating factors and thirdly actions to reduce

risk of accidents. This is consistent with the study by Pietra *et al.* (2005), which showed that a system approach and a blame-free environment, aimed at better organizational performances, leads to much better results than focusing on individuals. Waste handlers should use proactive measures that consistently address each specific class of waste. For instance, Discarded Medicines and Cytotoxic drugs should be handled in secured containers and waste sharps shredded before being handled for disposal. Furthermore, use of technology, information accessibility, communication, patient collaboration and multi-professional team-work are successful strategies to reach the goal of patient safety within healthcare organizations. Additionally, Hassan and Misra (2011) on their study noted that doctors, nurses and laboratory technicians have better knowledge than sanitary staff regarding biomedical waste management. Hence, are aware on what to do in case an accident occurs.

#### **5.20. Evaluation of skills and knowledge of biomedical waste handlers in Nairobi County on best practices in biomedical waste management.**

Data collected from 160 respondents revealed that 34.3 % of the respondents wore gloves while 65.6% % do not while on duty, which implies that a significant number of employees are at risk of injuries that arise from pricks on the hands and fingers besides getting contaminated. A study in Ghana suggested that a key recipe for avoiding the prevalence of workplace accidents is the use of protective clothing to avoid direct contamination in cases of equipment failure. From the findings, it was recommended that the government must monitor and carryout consistent annual health and safety check up within the bio-medical waste facility to ensure all employed staff health standards are followed ( Wilkins., 2006).

The results further showed that about 71.3% of those involved in the study wear masks while 28.8% do not. The risk of getting inhalable and communicable diseases is therefore relatively

high among the biomedical waste handlers due the high relative percentage of working without mouth masks. Some of the challenges that impede health care workers from adhering to safety practices include inconvenience, availability and access to protective equipment (NIOSH., 2004)

### **5.3. Compliance status of waste handling companies with the local legislation (Statutory and subsidiary laws) governing biomedical waste handling.**

#### **Employer Compliance**

The finding of the study carried out by Othigo (2014) on evaluation of biomedical waste management and was carried out at the Mater Hospital in Nairobi County; the study was to examine the policies and regulations regarding biomedical waste management of the Mater Hospital. The researcher established that there are numerous biomedical waste management legislations and policies in place; Public Health Act Cap 242, Radiation Protection Act Cap 243, management of Hazardous Waste, Poisonous Substances Act 247, Food Drug and Substances Act 254, Medical Practitioners and Dentist Act 253, Environmental Management and Coordination Act Cap 387 Laws of Kenya, Water Act 2002, Land Control Act Cap 406 and Environmental Management and Regulations (Waste Management Regulations 2006 ensuring that there is safe biomedical wastes handling at the institution. With these numerous legal frameworks in place, the result of the study shows that the hospital failed to provide information on the quantity of waste the hospital generated hence employer might not be complying with the set regulations and policies.

#### **5.3.1 Personal Hygiene**

The majority of the respondents were positive that personal hygiene determines the occupational safety and hazard among bio-medical waste handlers. This is consistent with the findings by Singh and Gupta (2009) on his study awareness on Bio-Medical Waste Management among Healthcare Personnel of Some Important Medical Centers in Agra found that inappropriate prac-

tice of BMW handling and management exposes handlers and general public to health and environment hazard once they do not keep their personal hygiene.

There are a number of researchers who have also been able to review on personal hygiene among bio-medical waste handlers. For instance, Boss et.al. (2014) observes that maintaining personal hygiene is crucial in reducing careless disposal of wastes by Healthcare facilities which is a concern for medical staff, patients, general community and largely the environment. This concurs with the finding of this study which established that personal hygiene is important in determining the occupational safety and hazard among bio-medical waste handlers.

### **5.3.2 Personal protective equipment**

From the findings of the study, it is evident that the use of personal protective equipment's is essential for maintaining health and safety of staff. The findings obtained in this study corroborate with findings from previous body of knowledge. For instance, Sargent and Gallo (2003) reported that the management of hazards in biomedical research facilities requires the application of the traditional industrial hygiene responsibilities of anticipation and personal protective equipment when exposures cannot be eliminated.

Another study Singh and Gupta (2009) explained that the application of use personal protection as measures is important in protection from risk of exposure to hazardous chemical like pesticide. Further, Wilkins (2016) on in his study on personal protective Equipment in the humanitarian governance of Ebola: between individual patient care and global bio-security established that the importance of personal protective Equipment in mediating between individual patient care and bio-security helps in saving individual lives and protecting populations. This is in line with the findings of this study which show that use of personal protective equipment determine the occupational safety and hazard among bio-medical waste handlers.

## CHAPTER SIX

### 6.0 CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 Introduction

This chapter presents the summary, conclusion and recommendations of this study on occupational safety and health accidents among biomedical waste handlers in Nairobi County.

#### 6.2 Summary

The purpose of this study was to examine occupational safety and health accidents among biomedical among biomedical wastes handlers. The following were the specific objectives that guided: To determine the causes of occupational accidents among biomedical waste handlers in Nairobi County, to evaluate the attitude and knowledge of biomedical waste handlers in Nairobi County affect the biomedical waste handlers and to establish the compliance status of the employers with the local legislation (Statutory and subsidiary laws) governing occupational safety and health in Nairobi County. A true experimental descriptive research design was used in this study. The sample size of this study consisted of one hundred and sixty eight people working in biomedical wastes handling. The key data collection instrument that was used in the study was a questionnaire. Data was collected and analyzed with the help of Statistical Package for Social Science (SPSS). Descriptive statistics was used in data analysis. From the analysis, the following key findings were made. Noting that over 79% of biomedical wastes are non-hazardous, but the rest of the waste constituting 21% is hazardous, which is both harmful to the people and to the environment. Data collected in this study from 160 respondents revealed that 34.3 % of the respondents wore gloves while 65.6% % did not while on duty, which implies that a big number of employees are at risk of injuries that arise from pricks on the hands and fingers besides getting contaminated.

### **6.3 Conclusion**

This current study concludes the following.

1. There were the potential challenges with significant impact on the occupational health and safety of biomedical waste handlers in Nairobi County for healthcare facilities to address; awareness on waste classification and management challenges, ineffective segregation of waste at source, inappropriate waste management practises, use of indiscriminate waste disposal, ineffective enforcement of waste handling policies, lack of interest by the management, lack of commitment by the management, inappropriate waste packing at source and ineffective training on best practices in waste management.

2. Various occupational accidents were reported to have occurred within the health facilities under study. It was noted that most of this accidents could be reduced and eliminated. The accidents included; physical injuries e.g. pricks, cuts and scratches, effects of lifting heavy objects, effects of working in high temperatures, contamination, ineffective accident management program, inhaling poisonous gases, effects of lack of sick leave falls and muscle tearing. Channels for accident reporting were not established and in some cases no registration data on occupational accidents.

3. It was established that all the facilities were registered with the Occupation Safety department as Workplace thus complying with the statutory and regulatory requirements.

### **6.4 Recommendations.**

This study recommends the following.

1. Recommendations arising from this study were based on the key findings of the causes of accidents, attitude of biomedical waste handlers and compliance with the standards and



regulations that govern the management and handling of biomedical wastes in Nairobi County. To address the causes of accidents, it is imperative for the county waste management authority to take proactive measures and put in place appropriate mechanisms for educating the employees on biomedical waste management handling and management best practices to reduce and ameliorate the adverse effects of accidents, address the negative attitudes and low opinions towards safe waste handling methods and ensure compliance with the laws is enforced among the workers to protect them.

2. Results obtained in this study attribute work related accidents to the level of education as a leading cause with a mean of 3.206. It has further been demonstrated that 20 % of the respondents believed accidents to be due to poor waste management practices, 15.6% due to poor waste classification at source, 10.6% due to poor enforcement of waste handling policies and 11.9% due to lack of enforcement of waste handling standards. Besides, 12.5% of the respondents regarded inadequate training and awareness as the factors that contributed to workplace accidents, 23.1% poor waste classification knowledge and 6.3% was due to inadequate attention to direction. These causes require to be addressed with utmost attention by the waste handling companies and employ strict regulation code to the employees.
3. Every worker deserves to be protected from hazardous waste so as to live a healthy life. In that context, Kenya National Bio-safety Authority should develop, implement and enforce health and safety policy on use of personal protective equipment among biomedical solid waste facilities. Bio-medical health facility must provide or purchase personal protective equipment on top of educating their employees on the importance of use of personal protective gear while working at facility. The government must monitor and

carryout consistent annual health and safety check up within the bio-medical waste facility to ensure all employed staff health standards are followed. Kenya National Bio-safety Authority should also cancel licenses in case the bio-medical waste facility are not following the health and safety rules.

4. According to World health organization policy framework, every employees working in any given organization is entitled to safe and good personal hygiene. Kenya National Bio-safety Authority must ensure that the implementation of HWM Rules 2005 is followed at all levels so as to maintain employee personal. This could be consistent with the Kenya National Bio-safety Authority must also punish organization that fails to avail personal protective device. It must also ensure that all the safety standards on personal hygiene are used and this is achieved through monitoring of training program that are offered by bio-medical solid waste facilities on personal hygiene
5. Bio-medical handling facilities should provide a workplace free from serious recognized hazards and comply with standards, rules and regulations issued under the occupational safety and health policy guidelines for the health sector among other statutory laws and requirements in Kenya

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## APPENDICES

### Appendix 1: University Introduction Letter to Conduct Research



**JOMO KENYATTA UNIVERSITY  
OF  
AGRICULTURE AND TECHNOLOGY**

**INSTITUTE OF ENERGY AND ENVIRONMENTAL TECHNOLOGY**

*P.O. BOX 62000, NAIROBI, KENYA. Tel: (067) 52251/52711/52181-4. fax: (067) 52164. Thttp. Email:director@iест.kuat.ac.ke*

17<sup>th</sup> February, 2016

**TO WHOM IT MAY CONCERN**

**RE: MBURU MOSES NGUTHU – EET32-0527/2010**

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The above named person is a Master of Science in Occupational Health and Safety (OSH) student in this Institute. He is currently involved in his research project on "*Occupational Safety and Health Hazards among Biomedical Waste Handlers in Nairobi County*"

This is therefore to request you to offer him any assistance that he may require in data collection.

Thank you.

**PROF. ROBERT KINYUA,  
DIRECTOR, INSTITUTE OF ENERGY & ENVIRONMENTAL TECHNOLOGY**

## Appendix 2: Participant Letter of Consent

### PARTICIPANT LETTER OF CONSENT

**Research student Name:** Moses N. Mburu  
**Institution:** Jomo Kenyatta University of Science & Technology  
**Study topic:** Occupational Safety and Health Hazards among Biomedical Waste handlers  
**Contact:** Tel. 0722 – 939652 Email. [wamose2000@yahoo.com](mailto:wamose2000@yahoo.com)

Dear Sir / Madam

You are invited to participate in a research study on Occupational Safety and Health hazards among biomedical waste handlers. In particular, I am interested in understanding your personal experiences in handling of biomedical waste. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information.

#### **PROCEDURE**

The researcher will ask you questions based on a self-administered questionnaire.

#### **CONFIDENTIALITY**

For the purposes of this research study, your comments will be held in confidence and will not be used to expose your identity. Every effort will be made by the researcher to preserve your confidentiality. You have a right to be or not to be anonymous or assigned a code whichever is your preference.

#### **VOLUNTARY PARTICIPATION**

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason.

#### **BENEFITS**

The results of this study can be shared with you on your request and the recommendations from this study will be of mutual benefit to you and your organization. The results will also be published in journals

#### **RISK**

There are no anticipated adverse risks in this study. However the researcher will explain any of your concerns.

#### **CONSENT**

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature \_\_\_\_\_ Date \_\_\_\_\_

Research Student; Moses Mburu

Signature:



Appendix 3: Questionnaire for Biomedical Waste Handlers

1. Gender

a) Male [ ]

b) Female [ ]

2. Marital Status

a) Married [ ]

b) Single [ ]

3. Age bracket

a) Below 30 yrs	[ ]	c) 41-50 years	[ ]
b) 31-40 years	[ ]	d) 51 years and above	[ ]

4. Education Level

a) University	[ ]	c) Secondary	[ ]
b) College	[ ]	d) Primary	[ ]

5. Work Station \_\_\_\_\_

6. Work Designation

a) Loader	[ ]	c) Clerk	[ ]
b) Driver	[ ]	Others _____	

7. Years of Service

a) Under 1 year	[ ]	c) 3-5 years	[ ]
b) 1-2 years	[ ]	d) above 6 years	[ ]

8. Terms of Employment

a) Permanent	[ ]	c) Contract	[ ]
b) Casual	[ ]	d) Other _____	

9. Healthcare insurance \_\_\_\_\_

10. If insured type of insurance \_\_\_\_\_

**11. Use of Personal Protective Equipment**

	<b>Question</b>	<b>Al- ways</b>	<b>Fre- quently</b>	<b>Some- times</b>	<b>Rarely</b>	<b>Never</b>
a)	Do you wear gloves while on duty?					
b)	Do you wear safety shoes or appropriate foot cover?					
c)	Do you wear facemask?					
d)	Do you wear overall?					
e)	Does your supervisor ensure that you are in the right protective gear while at work?					

## 12. Personal Hygiene

	<b>Question</b>	<b>Al- ways</b>	<b>Fre- quently</b>	<b>Some- times</b>	<b>Rarely</b>	<b>Never</b>
a)	Do you wash your hands with antiseptics?					
b)	Do you wash your working cloths at home?					
c)	Do you use antiseptic to wash your cloths					
d)	Do you eat at workplace?					
e)	Do you shake hands with members of public while at work?					
f)	Do you shower after work?					
g)	Do you share protective clothing with col-leagues?					
h)	Do you use mobile phone while at work?					
i)	Do you bath after work?					

### 13. Work related accidents

	Question	Al-ways	Fre-quently	Some-times	Rarely	Never
a)	Have you ever had a muscle tear while lifting?					
b)	Have you ever been scratched by waste material?					
c)	Have you ever suffered from any fall?					
d)	Have you ever lifted more than your capacity					
e)	Have you been working in conditions of very low or very high temperatures					
f)	Have you ever been pricked by sharps or hypodermic needles?					
g)	Have you been in contact with harmful chemicals?					
h)	Have you ever been struck by falling materials?					
i)	Do you report any accidents to your employer?					
j)	Does your employer investigate the accidents?					

#### 14. Accident Management

	<b>Question</b>	<b>Al- ways</b>	<b>Fre- quently</b>	<b>Some- times</b>	<b>Rarely</b>	<b>Never</b>
a)	Do you have access to First-Aid services?					
b)	Did you receive specialized treatment after the accident					
c)	Was the accident ever reported to Department of Occupational safety and health services?					
d)	Were you given sick leave?					
e)	Were you compensated?					

## 15. Employer compliance

	<b>Question</b>	<b>Yes</b>	<b>No</b>	<b>Not sure</b>
a)	Does the work place have a certificate of registration?			
b)	Is there an operational Safety and Health Committee?			
c)	Are there annual safety and health audits?			
d)	Is there a competent first-aider?			
e)	Have you ever been given a copy of your certificate of fitness?			
f)	Are there regular Risk Assessment			
g)	Are the employees trained on Safety and Health?			
h)	Does the facility maintain register of workplace injuries?			
i)	Are work place accidents reported to DOSH?			
j)	Are there pre-employment medical test and post-employment tests?			

**Thank you for your cooperation**