PROPOSED SOLUTIONS TO ADDRESS THE CHALLENGES OF MEDICAL WASTE MANAGEMENT IN HEALTH FACILITIES IN KAMUKUNJI SUB-COUNTY, NAIROBI CITY COUNTY, KENYA

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DECLARATION AND APPROVAL

Declaration by the Student

This thesis is my original work and has not been presented for a degree in any other University for any other award**.**

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Approval by the Supervisors

We confirm that the work reported in this proposal was carried out by the candidate under our supervision

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LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
DMOH	District Medical Officer for Health
FHI	Family Health International
HAI	Hospital-Associated Infections
HCFs	Health Care Facilities
HCV	Hepatitis Care Virus
HCW	Health Care Waste
HCWM	Health Care Waste Management
HIV	Human Immunodeficiency Virus
ICRC	International Committee of the Red Cross
JICA	Japan International Cooperation Agency
KEPI	Kenya Expanded Program on Immunization
LLHFs	Low Level Health Facilities
SDGs	Sustainable Development Goals
MOH	Ministry of Health
MSF	Medicines San Frontiers
NEMA	National Environmental Management Authority
NGOs	Non-Governmental Organizations
SPSS	Statistical Packages for Social Sciences
UNEP	United Nation Environment Program
UNICEF	United Nations Children's Fund
WCM	Waste Chain Management
WHO	World Health Organization

ABSTRACT

Medical waste management in Kenya has been greatly affected by the country's elevated production levels. The majority of medical facilities do not have an extensive medical waste management system, or if they do, it does not handle waste thoroughly, and therefore is detrimental to humans and the environment. This research focuses on health facilities' management of medical waste in Kamukunji sub-county, assessing the specific problems of medical waste management in that area. This was a study focusing on healthcare workers that looks at their working conditions and habits. This study was an analytical cross-sectional study design that used Fischer formula for sample size determination. Multistage sampling methods for the selection of 10 health facilities and 141 study participants Before the actual data collection, the questionnaires were pre-tested in one of the public health facilities in Starehe Constituency (Casino Health centre) which was not sampled in the main study. Data was entered, cleansed of errors, and statistically analyzed using SPSS (Version 26.0). Majority of respondents (95.7%) use color to identify different types of medical waste with slightly less than half (49.6%) using labelling, 88.7% store medical waste receptacles inside a health facility, 90.8% had given a contractor to dispose some medical waste with 36.2% and 15.6% of wastes are incinerated and burning respectively. Most of health facilities (39.0%) had daily medical waste weighing less than 26kg with 34.8% and 12.1% weighing between 26-50 kg and 46-100 kg respectively, on observation, the quantity of health facility waste generated at most of selected health facilities was approximately 15 kilograms to approximately 80 Kg. Pumwani Maternity Hospital had the most quantity of medical waste (80Kg), with St Teresa's Parish Health Centre (50 Kg), Makkah Nursing Home (45 Kg) and the least from Bahati Health Center (15 Kg) during the study period. Majority of respondents (87.2%) did not associate medical wastes with various problems with 12.8% associated medical waste with accidents (55.6%), diseases (27.8%), and drainage blockages (27.8%). The R Square was 0.746, indicating that medical waste management was harmed by a lack of funding, insufficient logistics, a lack of disposal sites, and a lack of understanding. This demonstrated a 74.6 percent variance in healthcare waste management due to a lack of funding, insufficient logistical supply, a lack of disposal site, and a lack of awareness. The remaining 25.4% implies that there were additional issues affecting the healthcare waste management systems of the ten health facilities evaluated. By explicitly identifying a given color with a certain category and its accompanying hazard, segregation aids to safer waste processing. During the research period, Pumwani Maternity Hospital created the most medical waste (80Kg) and Bahati Health Center generated the least (15Kg). The study concludes that periodic updates in medical waste management are necessary, as is refresher training for healthcare professionals and waste handlers. A safe and hygienic system for the handling, segregation, collection, storage, transportation, treatment, and disposal of medical waste should also be in place at every healthcare institution. According to the report, Kenya's National Policy on Injection Safety and Medical Waste Management should be followed by all medical institutions. The strategy aims to emphasize the need of advocating for both the support and execution necessary to adequately manage healthcare waste. Future research might focus on various technologies involved in the treatment and disposal of this waste, or on increasing community knowledge about health care waste.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Medical waste is composed of waste from healthcare and medical procedures, like needles, sharp objects, tissues, bodily fluids, medications, and more (World Health Organization [WHO], 2017). Medical waste includes all waste produced by the following actions: diagnosing, producing or testing biologically, obtaining sufficient waste from households, and removing waste regulated under trauma waste management by practitioners in trauma waste management (International Committee for the Red cross [ICRC] 2019). It is challenging to deal with waste because of the impact it has on the environment and public health. While dealing with residential, commercial, municipal, agricultural, and construction and demolition waste is fine, there are no exceptions to dealing with solid and liquid waste, and in this regard, health waste needs to be treated with more severity (Abor & Bouwer, 2018).

Global health risks exist due to the potential hazard in the disposal of medical waste (WHO, 2017). Failure to safely dispose of contaminated needles and syringes can expose staff and the public to various severe health problems. In places where sanitation is difficult, people can gather equipment that has been contaminated and either make it usable again or sell it. Infections with diseases caused by contaminated needles such as Hepatitis B, C, and HIV spread rapidly: by 2000, the WHO found 21 million hepatitis B (32% of all new infections) virus infections; 2 million hepatitis C (40% of all new infections) virus infections; and 260,000 HIV infections (5% of all new infections) resulting from contaminated needles (WHO, 2017). In addition to the potential health risks and pollution of the surrounding environment, medical waste poses a risk to water quality, potentially infecting others with disease through water supply (Gao et al., 2015).

The average waste generation in hospitals, Kumarasamy and Jeevaratnam, (2017), was 0,934 kg/lb/Day; the percentage of non-hazardous waste produced in hospitals was 77.08%; and hazardous waste was 22,92%, which contributed to 32,1% of infections. An Irbid survey showed health-related waste generation rats in three hospitals at Princess Basma Hospital 6.904 kg/pat/day (4.315 kg/bed/day) 5.718 kg/pat/day (3.212 kg/bed/day) and 4.532 kg/pat/day (2,556 kg/bed/day) at Ibn Al-Nafis Hospital and, combined, contributed to 24.6 percent waste-management infections. A study carried out in Nigeria and South Africa has shown that Nigeria faces the problem of maladministration of hospital waste as the rest of the world. Recently, the management of hospital waste poses more problems with the introduction of disposables such as needles, syringes and similar items (Lakshmi, 2012). Studies in South Africa show that larger hospitals generate approximately 2kg per bed of waste where 0.5kgs are regarded as risky. This produces around 250,000 tons of hospital waste per year from all sorts of Nigeria and South Africa healthcare facilities, which has bad environmental effects and pollutes the land, air and water resources (Nagaraju, et al., 2013). In Tanzania, some public health establishments face a broad range of challenges in managing waste produced by them, covering financial, technical and administrative issues. Biomedical waste management financing at those facilities is extremely poor, leading to dubious treatment of medical waste generated in these facilities. Without making significant investments in low-level health facilities, like health centers and dispensaries, higher-level medical institutions have managed to become adept at managing medical waste. All these problems require an examination of the current situation in the LLHFs (Banu et al., 2015; Emilia et al., 2015).

Al-Emad (2016) asserts that the toxic nature of hospital waste poses grave concerns to environmental health. Due to Kenya's inadequate waste segregation methods, up to 50% of

garbage is discovered to be infectious in some medical institutions. Kenya's hospital waste management systems face huge hurdles. Patients face grave everyday threats as a result of indiscriminate trash disposal (Ministry of Health [MoH], 2015). Medical waste is becoming an increasing concern in Kenya. Historically, inappropriate medical waste disposal has been a non-issue for the general public, and the magnitude of this has had a detrimental effect on both poor and distracted members of society. The purpose of this research is to determine the factors affecting the health care waste management system at Nairobi County, Kenya.

Inadequate management of medical waste can pollute air, soil and water sources, causing serious health consequences for human, animal and other living beings. The infectious and hazardous nature of health waste requires care and tact for the management or handling of waste (Yawson, 2016). People working in the medical field and the general public can be affected by the effects of poor handling of medical waste. This includes medical staff, from nurses to doctors, along with their patients and waste scavengers. There are a number of parasites, which can be acquired by waste handlers, people living near trash dumps, and those who suffer from cholera, yellow fever, and salmonellosis. These people are found to be carrying gastrointestinal parasites (Kuchibanda & Mayo, 2015).

Despite having been created to ensure the health of its patients, the healthcare system in fact causes illness and disease by spreading infections and contamination. Medical facilities create a wide variety of infectious and/or hazardous medical waste that, if not handled in a meticulous and well-thought-out manner, can cause serious health problems for patients, health care workers, those collecting the waste, and the community. Given the foregoing, the study aims to identify the challenges to manage medical waste in healthcare facilities in the County of Nairobi.

1.2 Problem statement

Worldwide, governments are constantly on the lookout for solutions and alternatives that will help them improve their health standards. One strategy to raise standards is to create diverse public or private healthcare organizations. However, many health activities in these medical facilities result in enormous volumes of medical waste (Mwania, 2019). Healthcare institutions that offer patients preventative, curative, and rehabilitative treatment include hospitals (Hassan et al., 2018). One of the major environmental concerns is the management of hospital waste, which can significantly increase exposure to infectious pollutants. Especially hospital wastes have increased largely as medical activity has progressed rapidly and hospitals use relatively more disposable products (Makori, 2018).

The majority of health centers in Kenya, ranging from 18 percent to 64 percent, use ineffective waste treatment and disposal technologies, and excess water flowing from medical facilities sometimes gets into the public sewers unaltered before it gets treated, leading to a rash of disease outbreaks in the general population who drink this water. Among Kenya's most common challenges, the lack of awareness of, and education for health workers, the absence of storage and disposal facilities and other untreated devices are the unsuitable separation of infectious waste from general waste. Medical waste management poses health risks for communities in the Kamukunji sub-county. In this sub-county, health facilities face problems with poor funding, as they affect their waste management activities, which lead to public health problems. The test for 12 hospital waste management experts found relatively high rates of hepatitis B, pulmonary tuberculosis and enteric pathogens commonly associated with health care waste, multidrug-resistant bacterial organisms such as staphylococcus aureus (MRSA) resistant methicillin, and extensive-spectrum beta-lactamase organisms (ESBL) and Pseudomonas aeruginosa. Consequently, a research on the

difficulties in managing medical waste among health institutions in Kamukunji area is required.

1.3 Purpose of the Study

This study will analyze a list of solutions to deal with medical waste in Kamukunji sub-county in Nairobi City County.

1.4 Objectives of the Study

1.4.1 Broad Objective

To identify proposed solutions to address the challenges of medical waste management in health facilities in Kamukunji sub-county in Nairobi City County.

1.4.2 Specific Objectives

1. To determine the level of medical waste generation among health facilities in Kamukunji sub-county.
2. To identify medical waste management solutions to address the challenges in health facilities in Kamukunji sub-county in Nairobi City County.
3. To assess the perceptions of staffs towards solutions to address the challenges of medical waste management in health facilities in Kamukunji sub-county.
4. To determine the health risks of medical waste management in health facilities in Kamukunji sub-county in Nairobi City County.

1.5 Research Questions

1. What is the level of medical waste generation among health facilities in Kamukunji sub-county?
2. What are medical waste management solutions to address the challenges in health facilities in Kamukunji sub-county in Nairobi City County?

3. What are the perceptions of staffs towards solutions to address the challenges of medical waste management in health facilities in Kamukunji sub-county?
4. What are the health risks of medical waste management in health facilities in Kamukunji sub-county in Nairobi City County?

1.6 Null Hypothesis

1. Perceptions of staff at health facilities in Kamukunji sub-county have no influence towards medical waste management.
2. There are no health risks posed by medical wastes to humans and environment among health facilities in Kamukunji sub-county
3. Health facilities in Kamukunji sub-county have no significant influence medical waste management mechanisms

1.7 Justification

A great deal of effort is being put forth by governments around the world to develop strategies for reducing outbreaks of communicable diseases among the general public as well as for keeping the general public free and healthy from preventable outbreaks. NGOs and the health sector have taken up this initiative and therefore medical waste is expected to be managed properly to prevent disease outbreaks. Every health facility worldwide is expected to practice proper waste disposal around the world (Mugo, 2017). Despite severe bio-waste management regulations, many hospitals that are putting them into place regularly dispose of trash in inefficient, disorganized, and careless ways owing to neglect or ignorance. Due to ineffective separation procedures, hospital trash is commonly combined with general garbage, which causes a detrimental total waste flow. Because they are exposed to a range of health dangers and inadequate waste management training, trash disposal personnel are not safe. The current study clarifies the policies, procedures, and difficulties associated with managing biological waste.

Most medical waste can be recycled and recycled into new products instead of destroyed by combustion and incineration. Recycling prevents the combustion of these products, reduces air pollution and simultaneously saves natural resources. Hospitals can take further steps to reduce their production of trash. Reducing the amount of waste that hospitals produce will reduce the amount of waste that must be burned (Banu et al., 2015). Medical waste generators' poor attitudes, a lack of regular training, inadequate waste management equipment, and subpar central storage rooms were some of the issues that healthcare workers identified as difficulties. Other issues included a lack of understanding of medical waste management guidelines and a lack of compliance. The majority of the problems were found to be caused by the undertraining of healthcare personnel. Increased efforts should be made to offer the required tools and proper training for healthcare professionals in order to manage medical waste effectively.

1.8 Limitation

Only primary health care facilities in the Kamukunji sub-county will be included in the study's scope. Privately owned facilities as well as faith-based facilities will be excluded from the program. There is typically no indication of the nature of the link between the subject's exposure and the outcome, even if the study will be constrained by the cross-sectional research design that will be utilized, in which the subject's exposure and the outcome will be assessed concurrently. This will be addressed by the researcher by ensuring that the population sample size chosen will be sufficient to allow for generalization of the findings. The scope of the study will also be limited because it will be institutionalized and will only include primary health care facilities as a focus. As a result, only primary health care facilities will be considered in drawing conclusions from the findings, and no generalization will be possible to other hospitals.

1.9 Delimitation

A study on medical waste management was overdue because nobody had examined the problem in the Kamukunji sub-county of Nairobi City County (where the study was done). In order to make the planning and design of the county more comprehensive, this investigation will enable the county's stakeholders to clearly understand variables that they will need to pay attention to in order to give everyone access to the best possible health care.

1.10 Significance of the Study

The study's findings will assist county hospital administration teams and federal hospital administration teams in strengthening their capabilities in the field of medical waste management. Everyone in the hospital and the neighbourhood is responsible for managing medical waste, not only the hospital administration. It involves all departments and healthcare providers. To fill any gaps found, this information may be utilized to build improvement initiatives. Additionally, this study will benefit the National Environmental Management Authority (NEMA), which is responsible for the execution of the country's environmental regulations. Additionally, they are responsible for supervising and regulating environmental hazards.

This study is expected to inform a paradigm shift from conventional ineffective methods of medical waste management to effective modern and safe methods, and as a result, it will contribute to improving the health status of the people in Kamukunji sub-county as a whole. Expansions of diseases caused by improper handling and/or management of medical waste may be significantly reduced as a result of proper medical waste management, and a clean environment will be maintained at an affordable cost as the result.

The study's results could have implications for the construction of institutional guidelines for medical waste handling. This may result in decreased audit queries and increased costs from the inefficient handling of waste. For further investigation, the findings of the study will be made available to the Nairobi City County.

1.11 Assumptions

The study's premise was that respondents would provide accurate information based on their expertise.

1.12 Operational Definitional of Terms

Health care waste: All liquid or solid waste that is not treated, produced in the process of giving medical care, veterinary service or the during medical research that uses humans or animals.

Infectious waste: Materials used in medical procedures on people or animals that might potentially spread infectious diseases from one person to another. These include waste from infection isolation wards and other medical facilities, as well as materials or equipment that have been discarded from the diagnosis, treatment, and prevention of disease, as well as from the assessment of health status and identification purposes, and have come into contact with blood and its derivatives, tissues, tissue fluids, or excreta.

Pathological waste: it contains body parts, human fetuses, animal carcasses, fluids, and fluids and other body parts Among other types of waste, anatomical waste includes human or animal body parts. Though this category may contain healthy body parts, it must be classified as infectious waste.

Sharps: Refers to all items that have the ability to cut or puncture and hence carry the risk of injury or infection

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter examines literature from other studies conducted in connection to the study's unique aims. This section's reflection and gathering of the literature study aims to introduce a review of various historical researches that have been welcomed in conjunction with proposed solutions to meet the issues of medical waste management in health institutions. To match the characteristics of the issue under investigation, the literature utilized in this study was acquired from textbooks, libraries, the internet, and periodicals.

2.1 An Overview of Medical waste

Non-infectious medical waste is any kind of solid waste generated by medical diagnoses, treatments, or immunizations and includes medical waste generated by the production, research, or testing of biological specimens, including blood and blood products (Awodele et al., 2016). Medical waste like trash from hospitals' non-infectious cleanup activities are dumped in landfills while infectious medical waste goes to incinerators (Al-Khatib, 2014). Medical waste can be defined as any debris which contains infectious agents or viruses. That can include things like tissue and organ cultures, infectious virus stock, pathological waste, Human blood and blood products, which have been discarded, are no longer fit for consumption. Other discarded items include contaminated medical instruments, infected animal carcasses, and waste from medical, pathological, surgical, or pharmaceutical laboratories. Other medical waste includes things like these: (Guerrero et al., 2013; Hassan et al., 2018).

Because medical waste handling is a potentially hazardous activity, it requires specialized training that is tailored to the nature of hospital work, the hazards and risks to which employees may be exposed, and the responsibilities of individual employees (Njue et al., 2015). Although poor hazardous medical waste management is a problem in Kenya, it is a

problem throughout the world, not only in Africa, but also in developing countries everywhere (Mugo, 2017).

Nearly all injuries from sharps (such as needles and blades) result in a rise in infections in medical workers, hospital patients, and waste handlers and scavengers. Because of this, the need to treat medical waste at healthcare facilities has greatly increased (Hasan & Rahman 2018).

2.2 Waste management mechanisms employed by public health facilities

Most Kenyan hospitals are split on their categories of waste in regards to healthcare, as there are usually three major types (MoH, 2015). One of the most frequent waste management practices is using three bins to sort waste into the following categories: health conditions that are contagious or harmful general and puncture-proof containers filled with puncture-safe boxes to prevent waste spillage. According to WHO (2019), the purpose of any effective healthcare waste management system is to safeguard the environment and human health from the hazards presented by healthcare waste management. In light of this, effective management guarantees that infectious waste is managed in line with defined protocols from the point of creation through treatment and final disposal (Hasan & Rahman, 2018). Recent research indicate that Different countries have created unique waste management strategies for medical waste. However, any system for managing medical waste generally proceeds in the following order: medical waste segregation, storage, treatment, and final disposal of treated medical waste (Borowy, 2020; Odonkor & Mahami, 2020; United Nation environmental Programme [UNEP], 2020). The first step is to isolate medical waste; segregation helps to cut down on waste. Trash is divided into many groups throughout the generation steps at this stage (Muduli & Barve, 2015). Second-level storage is Temporal Storage. All waste is briefly kept at the source before being sent to either an on-site treatment facility or an off-site destination (Awodele et al., 2016). Typically, the waste is appropriately

stamped and only accessible to authorized personnel (Emilia et al., 2015). There is no established time period during which rubbish can or should accumulate before being treated and disposed of, according to research. However, it is normally recommended to use a shorter holding time for medical waste (McPherson, 2019; Mugo, 2017). The third stage is the treatment plan: Waste treatment's main goals are to make rubbish less dangerous for people to handle, recover recyclables, and protect the environment. Trash is treated to change its physical, biological, and chemical properties in accordance with the rules set forth by the regional environmental protection agency (EPA). As the most popular and widely used way of treating medical waste, incineration is an example of a treatment procedure (Makori, 2018; Odonkor & Mahami, 2020). The disposal of the cleaned up garbage is the last stage. Disposal is the process of placing cleaned garbage in a sanitary landfill or another location that complies with local regulations and environmental standards. Waste disposal is essential for wastes that must be incinerated, including sharps, radioactive garbage, and waste that cannot be burnt (Saat et al., 2015).

The focus of Mugo's (2017) research on the factors affecting waste management at public hospitals in Nakuru County, Kenya, was on the preexisting systems, the regulatory framework, the technology and training, and the people's awareness. According to the study, the performance of healthcare waste management in hospitals was positively impacted by the legal framework and technology. However, the study revealed that hospital waste management effectiveness was negatively impacted by the current system, waste management training, and public awareness. In addition, according to the study, waste segregation should be carried out in accordance with operational needs to enhance hospital healthcare waste management performance. The study recommended that healthcare staff members receive updated training on waste management. Additionally, it should be planned

for health professionals to receive regular training on healthcare waste and its management (Ernesto et al., 2015; Makori, 2018).

WHO (2019) states that in order for a hospital to have effective health care waste management, a committed waste management team, strategic planning, effective administration, a solid organization, adequate funding, supporting laws, and full employee participation are required. Health care workers are expected to practice environmental responsibility and promote policies that could reduce waste generation while upholding the standard of patient care and worker safety (Abor & Bouwer, 2018; UNEP, 2019; Yazie et al., 2019). The key elements of efficient healthcare waste management strategies are administration, organization, and the demand for adequate legislative and financial backing with skilled personnel actively participating (Khalaf, 2019). in keeping with the Strategic Plan for the management of medical waste (2015-2020) All arrangements and plans, as well as making sure the office complies with all legal requirements, must be developed and carried out by the healthcare waste management Committee. Whenever possible, the Committee should go above and beyond the legal minimum and strive to meet the best possible guidelines. In addition, the healthcare waste management board of trustees can create methods for recognizing and rewarding good behavior, as well as preventing unseemly or hazardous conduct (MoH, 2015). The Waste Chain Management (WCM) should include representatives from top management, research facilities, waste workers, procurement, accounting, maintenance, and support departments. (Yazie et al., 2019) To guarantee that the waste management objective is met, a single individual should be designated as the Trash Manager who communicates with all people involved with waste age and the board within and outside the office.

Yazie et al. (2019) claim that conducting a baseline assessment is necessary before implementing a new system in order to improve the availability of reference data on which to base the plan. Local health and environmental regulatory agencies may require some monitoring data, whereas other data can reveal system successes and failures in order to improve procedures. To do this, the annual operating plan for healthcare waste management should include a budget (MoH, 2015). To achieve ongoing improvement, the policy and goals for healthcare waste management should be revised each year (Yazie et al., 2019). Kenya can do this by modifying hospital committees' healthcare waste management policies to align with the current National Policy on Injection Safety and medical waste management. Similar to this, Kungu et al. (2016) evaluated the management of medical waste in a few Kenyan hospitals in Kiambu County. This study's objective was to assess hospitals' compliance with burn technology and waste management policies. A total of ten (ten) medical facilities were chosen. Regarding the placement of the incinerator, the study indicated that the majority of burners were positioned near populated regions, with 62.5% of all burners located near agricultural areas. At least 50 percent of all burners were constructed close to valleys and ridges, which increased the dispersion area and health danger, whereas few were constructed near forested areas (37.5 percent). The study discovered that 62.5% of the health centers under investigation had enclosures and overhead protection for their burner architecture. Additionally, the study showed that only 50% of health centers had pits built. The investigation also revealed that the majority of regularly occurring potentially dangerous substances that could be found close to the burners at the health center were released during combustion and that the ash residue contained a significant amount of metallic contaminants.

Hassan et al. (2018) analyzed 58 papers from 20 countries as part of their investigation of medical waste management procedures in Africa. 30% were determined to comply with

WHO's safe management of HCW recommendations. The survey found the lowest compliance with "appropriate use of colour codes," and the greatest with "daily removal of rubbish from service areas." The lack of notable progress in Africa's solid waste management has prompted the question of whether a global strategy should be implemented in favour of the current emphasis on individual countries' efforts (Hassan et al., 2018). Banu et al. (2015) examined the impact of healthcare characteristics on medical waste management in Serbian hospitals. Based on UN-WHO guidelines, a unique questionnaire was developed for the study to provide rapid evaluation of medical waste management at healthcare facilities. The number of hospital beds, the number of hospital days, the kind of medical services offered, and the amount of employees with medical waste management training have all been proven to significantly impact the way hazardous medical waste is handled.

Numerous hospitals on the West Bank sterilize positive bacterial cultures, blood samples, syringes, and any other waste from testing or treating AIDS-infected patients by autoclaving. In other hospitals, if available, garbage from isolation rooms is handled like regular waste (Kumarasamy & Jeevaratnam, 2017). The majority of waste (about 65 percent) is disposed of in open-air dumps, 15 percent is disposed of by open-air burning, and less than 10 percent is burned. The only cities with incinerators are Nablus and Jericho, where they were donated by Spain to the Ministry of Local Government. The incinerator in Jericho was inoperable, while the one in Nablus was operating at such a low level of efficiency that burnt rubbish could still be identified. The incinerator has a very short chimney, and studies conducted by the Chemical Engineering Department of Al-Najah University revealed that it pollutes the atmosphere and should not be used (Khalaf, 2019; UNEP, 2019). Always keep infectious garbage separate from all non-harmful trash. Long distance hand carrying of trash bags increases the risk of injury and waste spillage. Only authorized staff members are allowed

access to storage areas, which must be kept tidy. All medical personnel must put on protective clothing, including aprons, boots, pants, and gloves, when handling garbage. They must also follow infection control and good hand hygiene procedures at all times (WHO, 2019).

A comprehensive system of best practices and safety requirements, as well as a waste management strategy, must be put in place by all healthcare institutions that produce medical waste. A system for managing medical waste must have strong political and financial support, as well as enough human and financial resources (ICRC, 2019). It is also essential to be well-versed in the most recent environmental protection legislation in order to properly assess and implement hospital waste management and infection control strategies. Effective hospital waste management requires concerted efforts by medical staff, local governments, state and federal health and environmental agencies, and other key players (Eslami et al., 2014).

2.3 Challenges facing medical waste management among public health facilities

2.3.1 Knowledge of medical waste management

Medical waste is a danger to the public and the environment if it is not properly handled. It is vital for anyone who is involved in the administration of the substance to comprehend its importance when handled correctly. Although healthcare workers involved in management tend to have gaps in knowledge, attitude, and practice, and thus often risk the public's health and the environment through pollution (Makori, 2018). A lack of knowledge about medical waste management is an obvious mistake; this can affect the practice of safe waste disposal and should not be ignored (Odonkor & Mahami, 2020). Healthcare services, driven by the goals of eliminating risks, treating the sick, and dealing with health problems, all generate

waste, which could pose dangers to human health. When waste created by health care activities is concerned, its potential to cause infection and injury is higher than that of other types of waste. This makes healthcare waste the most dangerous. The mishandling of healthcare waste could have negative health impacts, with catastrophic consequences, and may also have severe effects on the environment (Saat et al., 2015). Interest in handling healthcare waste (HCW) sustainably has been growing due to public fears of the adverse health effects that could result from exposure to possibly hazardous waste that patients produce during medical treatment (Ali & Kuroiwa, 2018). There is a huge difference in how Sub-Saharan African countries handle healthcare waste management, and this difference is particularly significant (Emilia et al., 2015).

2.3.2 Inadequate resources

Along with environmental issues associated to healthcare waste management, such as the management of trash through waste separation and recycling, many nations throughout the world neglect to consider the volume and kind of healthcare waste that is created. Even though there might be serious health effects, it still occurs despite HCW being handled properly (Muduli & Barve, 2015). The Emilia (2015) team found that inadequate waste management systems result in 8 million to 16 million new cases of Hepatitis B virus (HBV), 2.3 million to 4.7 million new cases of Hepatitis C virus (HCV), and 80,000 to 160,000 new cases of HIV per year (HIV). No one should be surprised that in poor countries, where the various issues of healthcare compete for scarce resources, issues of waste management in healthcare have received less attention and don't get the prioritization they deserve. In healthcare management, the lack of good information on the critical aspect of healthcare

waste management, as well as limited and narrow research on the public health consequences of its failure, makes it difficult to make informed decisions (Gao et al., 2015).

2.3.3 Transportation of waste

It has been a challenge for many years in developing countries to manage healthcare waste management and keep track of the quantities and compositions of waste generated. Healthcare waste is thought to be dumped openly in dumps and the environment in the hundreds of tons. This is often done alongside regular trash and hazardous waste (Giacchetta & Marchetti, 2016). Others have noticed a complete lack of health care workers (HCW) infrastructure, which they say is contributing to avoidable patient deaths (Yawson, 2016). Methods of waste assessment and quantification have been numerous in different parts of the world. A multitude of methods are available, ranging from field observations, to administration of questionnaires, to quantification (Giacchetta & Marchetti, 2016). Other methods include the use of checklists, public and private records, and other relevant information (Mansab, 2015).

The information indicates that there's little variation in how various medical facilities manage their waste. (See the following figure) (Eslami et al., 2014). Waste minimization and reduction strategies were clearly absent at two different general hospitals, as described in the findings of a study by Awodele et al. (2016), who published their results regarding how the waste data and healthcare worker management practices of the two hospitals matched up (Borowy, 2020). If patients and the environment aren't protected from improper healthcare waste management, which compromises the air, water, and soil, people will be exposed to environmental risks. Health care facilities and hospitals have the obligation to provide citizens with good health. Even though healthcare wastes can present a greater risk than the

diseases that were originally present, proper management is critical to minimizing the risk (Khan et al., 2019). Before using any of these techniques, medical institutions must understand and study the issue and make a strategic plan, which takes into account local circumstances and is financially and logistically sustainable. It is essential to protect the health and environment from harmful waste such as medical waste by following all feasible procedures. It would be nice if we could get rid of all dangerous trash completely. Environmentally friendly waste management is defined by stricter control over waste storage, transportation, treatment, recycling, recovery, and disposal (ICRC, 2019).

2.3.4 Lack of rules or regulations

Even though the World Health Organization says that if medical waste is properly sorted and managed, it rarely becomes excessive (WHO,2017). The overwhelming majority of healthcare waste can be disposed of as regular municipal solid waste, excluding a few items like dangerous medical needles, pathological waste, and infectious waste (which need special handling), as well as a small percentage of potentially hazardous chemical, biological, and pharmaceutical waste that has to be stored in specially designed containers (ICRC, 2019).
Lack of rules or regulations concerning waste pick-up from hospital wards, treatment, handling, and disposal is a huge problem that must be addressed. These problems include inadequate training of personnel, who are inadequately equipped and lack waste management plans. This neglect of hospital waste causes it to be mixed with municipal trash, which only compounds the problem (Kumarasamy & Jeevaratnam, 2017).

It is hard to think of anywhere more serious than Africa with regard to medical waste management. You could name South Africa, Mozambique, Swaziland, Kenya, and Tanzania (Emilia et al., 2015; Kuchibanda & Mayo, 2015; Mugo, 2017). Poverty is identified as the

primary reason for the lack of success in most African countries' efforts to handle hazardous waste in a sustainable manner. Additionally, the low temperatures (under 200 degrees Celsius) used in the medical waste incinerators was resulting in the release of large amounts of dangerous byproducts such as HCl, CO, dioxins, and furans. The emissions from these incinerators are a hazard to the communities because these facilities (in hospitals) are located close to communities (Kuchibanda & Mayo, 2015). If not handled properly, treatment of the HCW (including burning) could result in a significant pollution threat to the environment and air, with the release of mercury, dioxins, and furans. The safe management of health-care workers is critical in protecting the health of both the patients and the doctors working in a hospital, as well as protecting the general public (MoH, 2015).

2.3.5 Waste segregation and disposal

Researchers working for the Japan International Cooperation Agency (JICA) and the Kenya Expanded Programme on Immunization (KEPI) discovered that in most medical facilities, health care waste management (HCWM) standards are not being met, which increases the risk of disease and injury for both patients and workers (MoH, 2015). The total number of survey responses that were examined was 233. The findings of the regression analysis show a strong positive relationship between perceived environmental performance and management commitment, feedback and evaluation, and empowerment. The relationship between incentives and perceived environmental performance, however, lacked statistical significance. Medical professionals' awareness of HCW transmission plays a key role in its evolution. Maintaining the proper level of preparedness is essential for assessing information gaps (Kumar et al., 2015; Njue et al., 2015).

Makori (2018) also conducted a research on Nairobi's hospital waste management. The wastes produced, how they were chosen and disposed of, and the effects they had on the environment were all carefully taken into account while analyzing these systems. According to the survey, poor waste management practices exist in healthcare facilities. This is done to make sure that hospital waste management, collection, and disposal are done properly and typically in a way that is safe for the environment.

Aside from increasing the danger of contracting infectious illnesses including AIDS, hepatitis, cholera, and TB, poor waste creation, packing, storage, transportation, treatment, and disposal practices can also contribute to environmental degradation (Al-Emad, 2016; Gao et al., 2015; Khan et al., 2019). According to the Bio-medical Waste Management and Handling Rules (2018), hazardous wastes must be carried in accordance with the Motor Vehicle Act, which regulates the carriage of such wastes. This stipulates that the vehicle transporting infectious biomedical wastes must be covered and properly marked. According to Kuchibanda and Mayo (2015), the majority of hospital garbage is transported using standard dump trucks, frequently with municipal solid waste. In 2012, an increasing number of private hospitals contracted the Integrated Waste Management Corporation, a private hazardous waste management organization (IWMI). This company provides clients with plastic containers and transports them to their incinerators (Eslami et al., 2014).

2.3.6 Lack of training

A WHO (2019) suggestion states that hospital staff members, especially senior clinical personnel and administrators, should have the choice to explain the advantages of healthcare waste management. The advantages to people's well-being, workplace security, the environment, and government efficiency must also be acknowledged. It is hoped that by

attaining this objective, interest and support from other workers in exercise preparation would be bolstered. Various classifications of the health workforce may be tailored to with distinct training exercises. These individuals are divided into two groups: clinic supervisors and authoritative staff who are responsible for implementing healthcare waste management guidelines, and waste handlers, (ICRC, 2019). Before executing any training plan, it is commonly agreed that doing a training needs assessment on skills and knowledge will improve the outcomes of informal and formal training activities. Training activities may be adapted to fit the needs of Ministry of Health employees, including individual health workers, by identifying the major job duties of hospital and administrative actors, expert competence analysis, and self-assessment of health workers (MoH, 2015).

As part of a statewide healthcare waste management training program, Kuchibanda and Mayo (2015) performed a survey in Tanzania between 2013 and 2014 to look at the current healthcare waste management systems in hospitals. In order to improve the prevention and control of infectious illnesses and reduce occupational health hazards, this was done to empower healthcare personnel to establish waste management systems in their healthcare facilities. The research recommended that all healthcare professionals in the nation have enough management and training about their level of knowledge and best practices for handling medical waste. Waste management education and training should be provided to healthcare professionals at all levels. Additionally, the general public has to be informed of the risks associated with treating medical waste improperly. Policymakers, health groups, the media, and the general public can all be the targets of advocacy campaigns that aim to make proper disposal of medical waste a shared responsibility. Occupational health nurses, nurse supervisors, and others should keep an eye on waste management and infection control practices inside healthcare facilities. To decrease risks and provide infection control

standards, ineffective hospital waste management practices must be recognized and changed (Ali & Kuroiwa, 2018).

The transmission of communicable diseases such as plague and rabies are facilitated by the presence of flies, insects, rats, cats, and dogs that are attracted to health care waste strewn throughout hospitals and their surrounding areas. Those who work in hospitals as trash collectors and sift rubbish run the danger of contracting tetanus and HIV. Incorrect recycling of single-use syringes, needles, intravenous sets, and other items like glass bottles may lead to the spread of infectious illnesses such as hepatitis, HIV, and other viral infections. Health administrators are responsible for safely managing hospital waste (Odonkor & Mahami, 2020). Hospital administration is looking into new approaches to managing waste that are scientific, safe, and economical in order to address the problem of how to dispose of medical waste in hospitals and other healthcare facilities. They are also keeping their staff up to date on new developments in this field. Strong hospital waste management systems are essential for ensuring hospital quality and are of the greatest significance (Awodele et al., 2016; Kumar et al., 2015).

According to a research from Nepal, the improper disposal of sharp waste was caused by both the lack of a waste management strategy and the carelessness of hospital personnel, patients, and visitors (Kumar et al., 2015). Hospital staff in underdeveloped nations lacks awareness regarding the spread of illnesses contracted in hospitals as a result of improper treatment of medical waste. Furthermore, poor attitudes of hospital personnel regarding hospital policy and standards on handling hospital trash, as well as insufficient hospital staff training on health care waste management, contribute to the incorrect disposal of sharp waste in developing nations' hospitals (Kumar et al., 2015). Studies have shown that the majority

of hospitals and independent doctors in Pakistan do not adhere to the regulations for the management of health care waste, placing patients, as well as other members of the staff and the physicians themselves, at risk for significant injuries and illnesses (Al-Khatib, 2014).

Due to their acquaintance with mishaps involving syringes and needles caused by sharps injury, hospital employees have a high level of information regarding sharps waste as components of medical waste. 75.0 % fewer hospital employees in Egypt were aware of their exposure to work hazards (Huda et al., 2022). More than 45% of the health care personnel surveyed in a Ugandan research reported suffering at least one needle stick injury in the preceding 12 months. The survey also discovered that sharps and other garbage were present in 38% of the healthcare facilities that were examined, posing a danger of needle stick injuries to the public. Even though the study did not define the number and kind of illnesses that may have been acquired, the likelihood of infections resulting from these injuries and exposures cannot be discounted (Wassie et al., 2021). The Soroti Regional Referral Hospital in Uganda conducted an assessment of injection safety and health care waste management, and it found that 92% of waste handlers had poor waste disposal standards, 3.4% had acceptable waste disposal methods, and 4.6% had good waste disposal practices. One of Soroti Regional Referral Hospital's biggest challenges in combating the rising amount and quality of rubbish created is hospital waste management (Babirye et al., 2020).

2.4 Health risks posed by medical wastes

Increasing the risk of child, adult, and animal contact with these wastes, resulting in serious health consequences, is the improper disposal of medical waste in healthcare establishments. This unsuccessful waste may also harm medical staff, which also pose a job hazard within the health care facility. Hospital-associated (HAI) infections affect about 5% of patients

receiving hospitals according to the World Health Organization (2017). Because of this, resources that would otherwise be allocated to other patients are diverted away from this critical task.

The improper disposal of medical waste in the environment has a variety of negative consequences as well as positive consequences (WHO, 2017). Chemical pollutants from medical waste (for example, heavy metals) cause inconvenience in the surrounding area, and their accumulation in soil may have an impact on the plants in the compound, resulting in a distorting of the hospital's landscape. The clinic would be forced to find a more expensive water source due to the water becoming more contaminated as a result of groundwater contamination (WHO, 2019). Unsanitary dumping of garbage is a major source of dangerous pollutants which pollute equipment and spread infection to humans and animals (Khalaf, 2019).

Open dump sites are unsightly and can scare patients away, which will damage the hospital's reputation. Rather than focusing on developing new ways to recycle and reuse waste, medical waste management should prioritize education on the proper disposal of waste to the relevant healthcare administrators (WHO, 2017). People in the healthcare field, including healthcare workers, waste handlers, haulers, and general public members, face possible occupational and public health risks if management of healthcare waste at institutions like hospitals, clinics, and other facilities is poor. Human lives could be threatened by pollution which affects air, water, and soil, in addition to wildlife (ICRC, 2019). The community members may be able to collect used medical equipment, which if not properly disposed of, can potentially spread disease. Healthcare waste issues have gotten more complicated, with increased incidence of HIV, SARS, and Hepatitis B. The risk of cross-contamination when handling and disposing of such waste has greatly increased (UNEP, 2020).

Infectious diseases can be spread when human blood, used for injections and blood testing, comes into contact with wounds caused by contaminated needles and syringes. After getting straight to the consequences for human health, focus should be on the environmental risks like pollution to water, air, and soil (UNEP, 2020). Upon reviewing the literature, it is clear that a significant amount of knowledge is lacking, and it is this gap that this study seeks to close. a) Background information As Hassan et al. (2018) have found in some studies that doctors, nurses, and laboratory technicians have better knowledge about medical waste management, they also acknowledge that there is still a gap in practice when it comes to medical waste management. Nurses and laboratory staff, as opposed to doctors, may have a better understanding of color coding and waste segregation at the source, as an example. All of the sanitary staff members are clueless when it comes to practices related to medical waste management. There is sometimes no correlation between the level of knowledge and the level of practice in medical waste disposal at the global, regional, and local levels. Therefore, on the basis of the findings from Kamukunji, this study seeks to fill in the gaps in knowledge regarding medical waste management challenges.

Gizalew et al. (2021) give empirical evidence that mixing a little bit of hazardous garbage with nonhazardous waste results in 100% hazardous waste, posing a major risk to the worker. Odonkor and Mahami (2020) carried out an analogous study on the composition of rubbish and discovered that 15 to 25% of hospital waste is hazardous while the remaining 75% is nonhazardous. When hazardous and nonhazardous wastes are mixed improperly, the resultant waste is entirely hazardous (Babirye et al., 2020). Based on a quantitative analysis of data, Mitiku et al. (2020) discovered that improper segregation techniques expose waste handlers to serious health risks. They also discovered that the scope of those at risk for health risks has been expanded. Hospital waste is improperly disposed of because to improper waste

segregation, failure to adhere to local regulations and system laws, and failing to meet WHO waste management guidelines. This is the direct result of difficulties with illiteracy, lax law enforcement, a lack of process ownership, and holes in the routine monitoring of waste management practices, claim Kurian et al. (2016). The debate properly highlights practical concerns to safeguard biomedical waste handlers notwithstanding the study by Gizalew et al. (2021) on the categorization and management challenges of biomedical waste's severe gaps and methodological flaws.

Poor handling of medical waste poses a serious hazard to public health in most undeveloped countries, including Zanzibar, by infecting and injuring employees, waste handlers, the environment, and nearby residents (WHO, 2019). Air, water, and soil pollution are exacerbated by improper treatment of medical waste, resulting in major environmental hazards. Pollutants can be divided into biological, chemical, and radioactive categories. The mere production of medical waste as well as its collection, treatment, and disposal can contribute to environmental problems (Manyele & Lyasenga, 2018). The improper disposal of hospital waste and exposure to such material pose a significant threat to the environment and human health, necessitating specialized treatment and management prior to final disposal (Njue et al., 2015).

Hospital waste generated during patient treatment has a variety of negative and detrimental consequences on the environment and on humans. Hospital trash poses a potential health risk to healthcare personnel, the general public, and the local flora and animals. Garbage disposal at hospitals and other healthcare facilities is an increasing challenge worldwide, especially in poor countries (Singh et al., 2022). Hospital trash, especially sharps waste made up of syringes, needles, cannulas, guide wires, shattered glass, scalpels, and blades, is the most likely source of disease transmission. Over 20% of people who handle sharp items have stick

injuries, and over 85% of incidents involving them happen between the time of usage and disposal. Safe handling should come before the many options for treatment and disposal. Any member of the medical staff who works with garbage should be provided with full personal protection gear, including goggles, masks, gloves, and boots. In addition, it is recommended that they obtain immunizations against tetanus and hepatitis B, as well as a subsequent health assessment and documentation of their health condition (Hassan et al., 2018). Medical care is essential for human life and health, but the waste generated by medical treatment poses a significant threat to nature and the human community. The environment, workers, and patients' health are all directly impacted by improper waste management at healthcare institutions. In hospitals and medical facilities across the world, a lot of potentially infectious waste is produced (McPherson, 2019). Typhoid, cholera, hepatitis, and AIDS are spread through injuries brought on by syringes and needles contaminated with human body parts. Poor health care waste management results in environmental pollution, an unpleasant odor, and the growth and multiplication of insects, rodents, and worms (Babirye et al., 2020; Gizalew et al., 2021; Mitiku et al., 2022).

Hospital trash is dangerous to the environment and public health in addition to the patients and staff who handle it. The handling, segregation, mutilation, disinfection, storage, transportation, and disposal of biological waste at any institution are crucial procedures. Waste segregation (separate) and identification are essential for biological waste reduction and efficient management. The most effective way to distinguish between the various garbage categories is to sort biomedical waste into colored plastic bags or containers (Mwania, 2019).

In recent years, injections using infected needles and syringes have drastically declined in low- and middle-income countries, in part because of campaigns to stop injection devices

from being reused. Despite these advancements, improper injections were responsible for 33,800 new HIV infections, 1.7 million hepatitis B infections, and 315,000 hepatitis C infections in 2010 (UNEP, 2019; WHO/UNICEF, 2017). A person has a 30%, 1.8%, and 0.3% chance of getting HBV, HCV, and HIV via a single needle-stick injury from a syringe used on an infected source patient, respectively. Risks can arise from human sorting of hazardous trash from healthcare institutions and scavenging at waste disposal sites. These behaviors are widespread throughout the world, although they are especially common in low- and middle-income countries. The risk of needle sticks and exposure to toxic or infectious materials for the garbage workers is acute. According to a WHO/UNICEF research from 2017, slightly more than half (58%) of the institutions examined from 24 countries had appropriate procedures in place for the secure disposal of medical waste.

Individuals who scavenge on trash disposal sites are also at risk, although these risks are less well-documented. Other hospital staff and waste-management operators outside of health care organizations are also at risk (Singh et al., 2022). This sort of illness poses a significantly lesser risk to patients and the general population. However, certain illnesses propagated by different media or caused by more resilient agents may represent a major risk to the general population and hospitalized patients. For example, unregulated sewage discharges from field hospitals treating cholera patients have been closely linked to cholera epidemics in some Latin American nations (Guerrero et al., 2018; Khalaf, 2019; Khan et al., 2019). Individual instances of accidents and infections caused by medical waste are extensively documented. However, the general condition remains difficult to gauge, particularly in developing nations. It is believed that exposure to badly handled healthcare wastes in poorer nations has contributed to a large number of cases of infection with a wide variety of pathogens (Khan et al., 2019).

The hazards presented by inadequately managed medical waste may also be exacerbated by the existence of germs that are immune to antibiotics and chemical disinfectants in healthcare facilities. For instance, it has been proven that natural bacteria were exposed to plasmids from laboratory strains found in hospital waste through the waste disposal system. Additionally, it has been shown that antibiotic-resistant Escherichia coli may live in an activated sludge plant, however under normal wastewater disposal and treatment conditions, there does not seem to be a significant transfer of this bacterium (Guerrero et al., 2018). Sharps that have been contaminated, particularly contaminated hypodermic needles, and concentrated cultures of pathogens are probably the waste items that offer the biggest health dangers. Sharp objects that are germ-infected not only cause cuts and punctures but also spread infection to the wounds they leave behind. Sharps are categorized as an exceptionally hazardous waste type due to the dual danger of disease and harm transfer (Borowy, 2020). The most significant challenge is to diseases, such as viral blood infections, which might be transmitted by the subcutaneous administration of the causal agent. Needles used for hypodermic injection are substantial contributors to the sharps waste category. These needles are especially hazardous due to the fact that they are often tainted with blood (Saat et al., 2017).

The medications and chemicals that are used in hospitals and other medical facilities are often hazardous. The quantities of these compounds that are detected in medical waste are often rather low; nevertheless, when undesired chemicals and medications are thrown away together with their expiration dates, greater concentrations may be discovered. Burns, acute or chronic poisoning, and other forms of bodily injury might result from their usage (Al-Emad, 2016; Gao et al., 2015). Ingestion, inhalation, or absorption of a chemical or drug via the skin or mucous membranes may all lead to intoxication. Intoxication can occur in a

variety of ways. Inflammable, caustic, or reactive chemicals may cause harm to the mucous membranes of the skin, eyes, and airways if they come into touch with these substances. Burns are the most often seen kind of injury, since they are typically caustic and employed in large quantities, disinfectants are a particularly significant component of this category. Furthermore, it is important to keep in mind that reactive chemicals can create very harmful secondary compounds (Eslami et al., 2014; Huda et al., 2022; Wassie et al., 2021). Everyone who comes into touch with pesticides stored in leaky drums or broken bags might be adversely affected, either directly or indirectly. When it rains heavily, pesticides can soak into the ground and poison the water supply. Direct product contact, inhaling fumes, consuming tainted water or food, or inhaling vapors can all result in poisoning. As a result of incorrect disposal techniques, such as burning or burying, there is also the risk of fire and contamination (Ali & Kuroiwa, 2018).

Chemical residues dumped into the sewer system may harm receiving waterways' natural ecosystems or hinder the operation of biological sewage treatment plants (Huda et al., 2022). Similar problems may be caused by pharmaceutical residues from antibiotics and other drugs, heavy metals like mercury, phenols, and derivatives, as well as disinfectants and antiseptics. When some medications or chemicals are manufactured or administered in the medical field, genotoxic substances may also be exposed. The main modes of exposure include inhalation of dust or aerosols, absorption via the skin, consumption of food accidentally contaminated with cytotoxic drugs, chemicals, or waste, and ingestion as a result of negligence, such as mouth pipetting (Hassan et al., 2018; Kurian et al., 2016). Exposure can also happen if you come into touch with chemotherapy patients' body fluids and secretions. The sort of disease caused by radioactive waste depends on the type and extent of exposure. From minor issues like headaches, dizziness, and nausea to far more serious

ones. Radioactive waste has the ability to change genetic material since it is genotoxic, just as certain pharmaceutical waste. Handling extremely active sources, such as some sealed sources from diagnostic instruments, can cause far more serious harm (such as tissue destruction needing amputation of bodily parts), hence it should be done with the utmost care. Low-activity waste can be dangerous if its exterior surfaces are contaminated or if it is stored improperly or for an extended period of time. Workers in health care, waste management, or cleaning who are exposed to this radiation are at danger (Babirye et al., 2020; Singh et al., 2022).

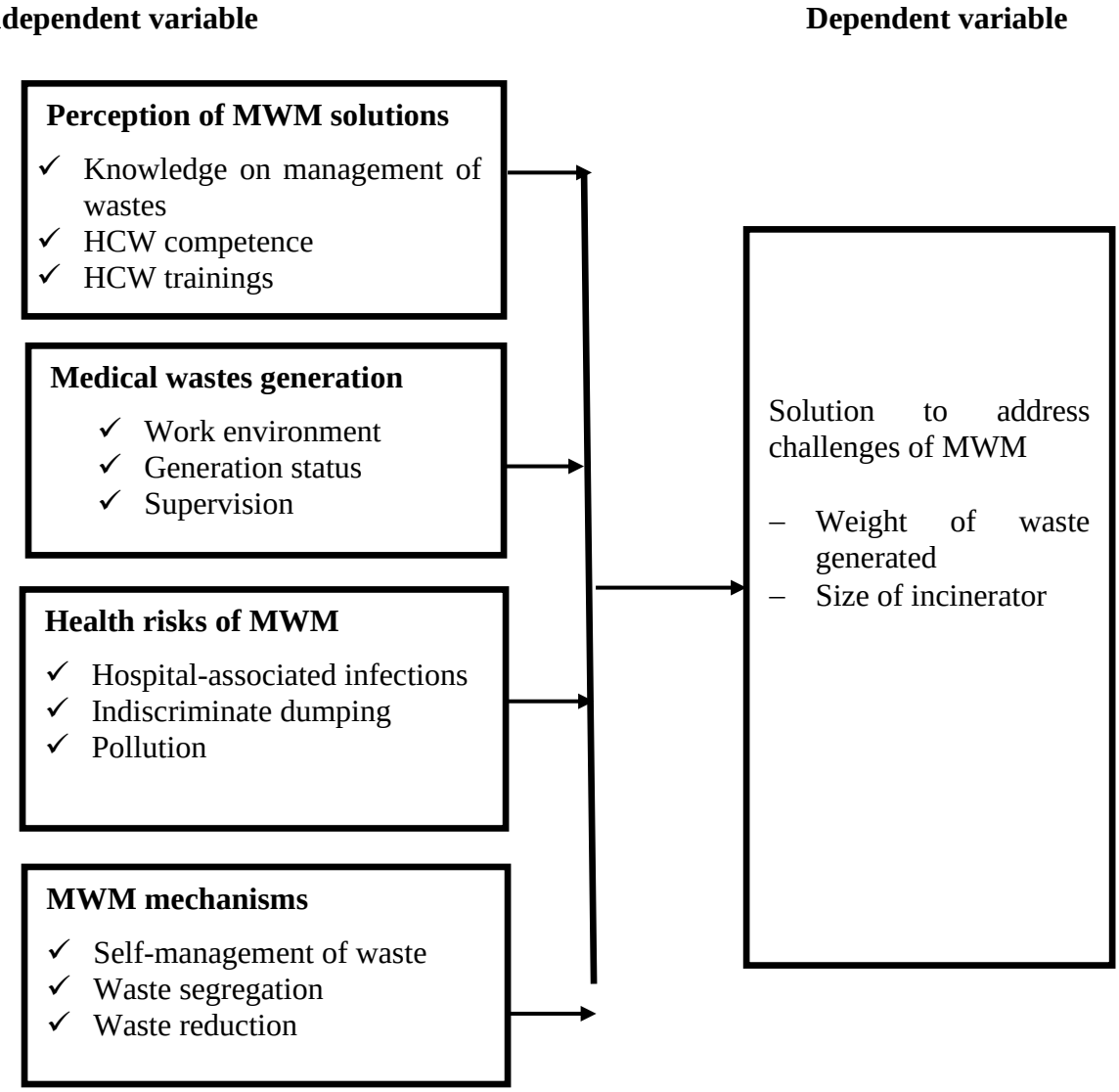
2.5 Conceptual Framework

The handling and disposal of medical waste generated by public health facilities is expected to be as safe as possible for the health of individuals and animals, as well as the environment. As a result, every medical facility is expected to handle and dispose of its medical waste as safely as possible in order to avoid severe consequences. When it comes to medical waste management, health facilities in Kamukunji sub-county face a number of difficulties. These difficulties include a lack of sufficient funds, a scarcity of qualified personnel, inconvenient locations, a lack of knowledge about waste handling and management, a scarcity of appropriate disposal sites, and a variety of other issues.

Every one of these challenges creates a significant problem for these facilities because they inevitably result in improper waste management by the facilities, putting their own and patients' health in jeopardy, the possibility of harming the general public's health due to improper waste disposal, legal sanctions, and environmental degradation. According to the following conceptual framework, the relationship between these variables is depicted graphically.

Figure 2. 1:

Conceptual Framework



Adopted from Yazie et al., (2019) and modified

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter describes how to collect and analyze data for this study. It begins with a detailed description of the study's research design and then moves on to a description of the study area. The variables that are used are identified and described (independent and dependent variables). It then describes the inclusion and exclusion criteria, as well as the study population. Following that, sample size determination, sampling procedure, and research instruments are provided. Finally, data management from the study and ethical issues related to the study are discussed.

3.1 Research Design

The study is used both quantitative and qualitative design approaches and analytical cross-sectional study design. For this study, it was a cross-sectional survey design because it helped us make sure we minimize bias and maximize evidence reliability. To find out where their country stands demographically, Mugenda and Mugenda's country wants to complete a population survey, and as they describe, a cross-sectional study does the trick (2013). One or more variables are related. This design defines the site conditions and enables information from a large population sample to be obtained. The cross-sectional study design can also provide information about attitudes that would otherwise be difficult to measure with observational methods. It is widely used because of its low cost and availability of information

3.2 Study Area

Nairobi County's Kamukunji sub county hosted the research, which was conducted at local health facilities. Nairobi County is one of the 47 counties that make up the country of Kenya. It is the smallest county in the state, but it has the highest population of any of the counties.

The County is located at 1°09′S 36°39′E and 1°27′S 37°06′E and covers 696 square kilometers (270 square miles) with a population density of 6,247 people per square kilometer. Located in Kenya's capital city, Nairobi, it is one of the most populous counties in the country. The city has a resident population of approximately 4,397,073 million people (female: 2,204,376; male: 2,192,452; intersex: 245) as of the most recent population count in 2019, making it the country's most populous city in terms of population (Statistics, 2019). The Köppen climate classification system says that Nairobi has a subtropical highland climate. Evenings in the Andes Mountains, at 1,795 meters (5,889 feet) above sea level, can be quite cold, with June and July being especially chilly, with temperatures dropping to 9 degrees Celsius (48 degrees Fahrenheit). In terms of weather, December to March are the sunniest and warmest months of the year. The daytime temperatures average around 25 degrees. In the previous period, the daily maximum temperature averaged 24 degrees Celsius (75 degrees Fahrenheit). Even though it gets rainier during the two rainy seasons, the amount of rain is pretty mild. The first rainy season typically begins in September and brings rainy, overcast conditions until October, which is the cloudiest period of the year. Nairobi is located very close to the equator, which means the city's seasons aren't very different. There are two categories of seasons: wet and dry. Because of this, the time when the sun rises and sets each day stays fairly consistent. Kenya's capital, Nairobi, is divided into 17 sub-counties, a total of three county referral hospitals (Mama Lucy Kibaki Hospital (level 4), Mbagathi Hospital (level 3), and Pumwani Maternity Hospital (Level 3) serve the population of the county. The county government also has approximately 45 health centers that are classified as level 3 or lower.

3.3 Study Population

The study focused on healthcare workers who either generate or handle such as clinicians, cleaners and support staff waste working at health facilities in Kamukunji sub-county. There

are approximately 202 healthcare workers. The target population comprised of all the clinicians, cleaners and support staff involved in waste management. A sample has been defined as a set of selected elements from the study population which is studied and thereafter the results generalized to the target population. Orodho (2012) argues that these elements must share unique characteristics.

3.3.1 Inclusion Criteria

- All healthcare workers working at health facilities in Kamukunji sub-county.
- All healthcare workers working who have been at the health facility for more than 6 months
- All healthcare workers working who consented to take part in the study voluntarily as well.

3.3.2 Exclusion criteria

- Healthcare workers working who was on leave i.e., sick leave, annual leave, maternity/paternity leave etc.
- All healthcare workers working who did not consent to take part in the study voluntarily.

3.5 Sampling Procedure

Multistage sampling is used in this study and randomly selected sampling is used among the Kenyan counties to choose one county, Nairobi County to select one sub county, stratified samples are a probability sampling technology that divides the entire population into strata and subgroups and then proportionally selects the final subgroups from the v county Random cluster sampling of health facilities was performed, where 10 health centers in the sub-country are selected. Systematic sampling methods are then used to obtain the minimum sample size needed using duty Rota as a sampling framework.

Proportionate sampling was used to select respondents in each public health facility and each cadre per health facility

Table 3. 1*:*

Proportionate Sampling

Health facility	**Health worker population**	**Percentage distribution**	**Sample Size**
Bahati Health Center	25	12.4%	18
Rapha Medical Clinic	15	7.4%	11
Pumwani Maternity Hospital	56	27.7%	41
Majengo Dispensary	18	8.9%	13
Shauri Moyo Clinic	10	5.0%	7
Kamukunji Health Management Office	25	12.4%	18
Makkah Nursing Home	20	9.9%	15
Biafra Lions Medical Clinic	10	5.0%	7
St Teresa's Parish Health Centre	15	7.4%	11
Diani Dispensary	8	4.0%	6
Total	**202**		**147**

3.6 Sample Size Determination

A sample calculation is a method of determining the number of participants in a study. The study used Fischer et al (1997) to determine sample size

The Fischer formula is:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where:

n is the sample size [where the population is greater than 10,000].

Z = Normal standard deviation of the mean. In this case, the 95 percent confidence interval was used, resulting in a Z value of 1.96.

P denotes the proportion of the population that possesses the desired trait.

1- p = The proportion of the population that does not have the desired characteristic (or characteristics).

In the 95 percent confidence interval,

D^2 equals the degree of precision, which is 0.5.

Therefore n = $\frac{1.96^2\ (0.5)\ (1\text{-}0.5)}{(0.05)\ (0.05)}$ =384

Since the target population at the hospital has less than 10,000, the alternative formula was applied using the following formula.

$$nf = \frac{n}{1 + {}^{n}/_{N}}$$

Where:

nf = the desired sample size for population <10,000

N = total study population which is 202

n= the calculated sample size.

$$nf = \frac{384}{1 + {}^{384}/_{202}}$$

$$nf = 133$$

The targeted sample size was therefore be 133

A 10% of 133 was added to account for lost questionnaires, incomplete questionnaires, and non-responses, as well as questionnaires that were not completed for unknown reasons. Therefore, a minimum of 147 sample size was used

3.7 Instrumentation

3.7.1 Questionnaire

A structured questionnaire that was administered by the participants was used as a research tool (Appendix iv). These were utilized to gather the data necessary to address the study topics. Pre-coded questions were used to ensure that they addressed the study's research goals. The filling of questionnaire was done electronically. Additionally, they supplied thorough information on the respondents and the criteria that the committee is scrutinizing. It also includes an observational check list (Appendix v) for qualitative data collection.

3.7.2 Validity

The validity of an exploration instrument is the degree to which it estimates what it expects to gauge and performs as it is intended to do so. The validity criterion was used to ensure that the deliberate factors are indeed what is expected to be estimated and that no other variable has been introduced. As a result, my boss, who is an expert in the field, examined the validity of the instrument to determine whether it meets the objectives of the investigation and whether the inquiry reflects the optimal response. Prior to appropriation for the actual

collection of information, the legitimacy of the information was enhanced. In addition, a pre-testing and study was conducted in order to modify the poll as necessary. Furthermore, the investigation was done in this manner utilizing Cronbach's Alpha, with the Alpha coefficient ranging from 1-5 in increasing order of value in relation to the request. The findings of the pre-testing study were used to determine how the poll was changed in accordance with Cronbach's 0.7 hypothesis. Even though the hypothesis states that, on average, higher scores indicate more trustworthiness in the produced scale, the coefficient of 0.7 has been demonstrated to be a worthy coefficient.

3.7.3 Reliability

A half-split test method was used to test the reliability of the instrument. The test items were split into dual halves of content matched objects and scores of the two halves was scored separately. If the test is accurate, scores on both sides would have a high correlation (Cohen et al., 2007).

$$\textit{Reliability of the overall test} = \frac{2\ x\ reliability\ for\ ½\ tests}{1 + reliability\ for\ ½\ tests}$$

Product Moment of Pearson Correlation to evaluate reliability, co-efficient shall be used. To assess the reliability of the instruments, the correlation coefficient of 0,75 would be sufficient. Mugenda and Mugenda (2003) have stated that there has been a strong correlation coefficient of 0.8 and above between measures. Problems related to the study objectives was examined carefully during the design of the questionnaire.

The Cronbach Alpha Reliability Coefficient test revealed that reliability results for the questionnaire as an instrument for perceptions of staffs towards solutions to address the challenges was 0.894; for level of medical waste generation among health facilities was 0.807; for health risks of medical waste management in health facilities it was 0.786; and for medical waste management solutions to address the challenges was 0.779.

Table 3. 2*:*

Cronbach Alpha Reliability Coefficient

Variables	CAC	Comments
Perceptions of staffs towards solutions	0.894	Acceptable
Level of medical waste generation	0.807	Acceptable
Health risks of medical waste management	0.786	Acceptable
Medical waste management solutions	0.779	Acceptable

3.8 Methods of Data Collection

3.8.1 Pre-Testing of Research Instrument

Before the actual data collection, the questionnaires were pre-tested in one of the public health facilities in Starehe Constituency (Casino Health centre) which were not sampled in the main study. This was done in order to ensure that subjects from the pre-test study were not used in the actual research. In this way, the researcher was able to make significant modifications to the research instruments. When used in this study, pre-testing increases the reliability and validity of the research instruments by ensuring that they are a consistent measure of the concept that is intended to be measured.

3.8.2 Data Collection Procedure

The structured questionnaires comprising both open-ended and closed-ended questions addressing each aim were completed electronically by health professionals in Kamukunji

sub-county. The questionnaires were filled by research assistance electronically for every respondent at their respective duty stations. Among those working in the health-care facilities were medical professionals such as doctors, nurses, clinical officers, public health officers, and hospital waste handlers. Prior to the filling of the tools, the health workers were given a thorough introduction to the equipment. In order to ensure that no respondent was interviewed twice, data was collected from each of the sampled facilities until the desired sample size is reached. The questionnaire was completed by the research assistant. A sufficient amount of time was provided for the respondents to freely and confidentially respond to the questions. It is anticipated that this took 2 weeks.

3.9 Methods of Data Analysis

It collects and then edits all the information to ensure consistency between individuals and to identify where any omissions are to be found. It is summarized, coded and entered for further processing after it has been collected and edited. It was necessary to conduct the data analysis for this project with the help of the statistical software SPSS. During the initial stages of the analysis process, exploratory data techniques was employed in order to uncover the structure of the data and to identify outliers, or values that have been entered in an unusual manner and which are not expected. For the purposes of this study, quantitative data was coded and processed using the SPSS version 26.0 statistical package. To summarize, organize, and simplify the information gathered during this research project, definitional statistics, such as frequencies, standard deviations, and means, was used. The relationship between dependent and independent variables in this situation was determined with the help of correlation analysis. A significance level of less than 0.05 was used in this study to determine importance. By using the bivariate analysis, you can determine the statistically significant relationship between independently defined variables and the dependent variable. To estimate the strength of the connection between separate variables and dependent

variable, the combination of odds ratio (OR) and 95% confidence interval (CI) is used. The statistical significance of the less than 0.05 level for each study is determined and the results are reported as a two-sided p value with 95 percent trust intervals (CI) for each study. A multivariate analysis is carried out after a bivariate analysis has been completed, and all independent variables that were found to be significantly associated during the bivariate analysis was taken into account together in the multivariate analysis. This was accomplished through the application of Binary logistic theory and practice. When estimating the strength of association between a retained independent variable and a dependent variable under consideration, the adjusted odds ratios (AORs) and their respective 95 percent confidence intervals (CIs) was used.

According to the research objectives, qualitative data collected from participants using an observational checklist was cleaned and coded manually based on themes developed from their responses (thematic analysis), and the results was reported in narrative form, with quantitative data being used to supplement and reinforce the findings. Various representations of the findings were presented including tables, bar charts, graphs, and pie charts.

3.10 Logistical and Ethical Consideration

The Kenya Methodist University Graduate School granted approvals for this study, and the National Committee on Science, Technology, and Innovation gave the permission. The Kenya Methodist University Ethical Committee (KeMU-ERC) also gave ethical approval, which was forwarded to the appropriate authorities in Nairobi County for implementation. An ethical committee from the relevant health facility also gave their approval for the research. Respondents was asked for their informed consent prior to participating. Participant's choices about whether or not to participate in the study was respected at all times throughout the duration of the study. Those who participate in the study was informed

that they have the option to participate or not, and that they have the right to withdraw from the study at any time during the study's duration. In the meantime, they continued to receive the care that they would have received otherwise. As an incentive or reward for participating in the study, there was no financial or other benefits provided to participants. At all times, the participants' confidentiality and anonymity was protected by the research team. Neither personally identifiable information nor financial information is intended to be collected, and all information provided was used solely for scientific research purposes. All of the information collected was stored, analyzed, and reported in a way that does not allow for the identification of any particular participant or team. The fact that participants did not undergo any invasive procedures means that there were no physical risks associated with taking part in this activity. According to the study's objectives, the findings was communicated to the Kenya Methodist University, as well as public health facilities throughout the county of Nairobi. In addition, every effort was made to have the findings published in a variety of reputable journals and publications after they are completed.

CHAPTER FOUR: RESEARCH FINDINGS, INTERPRETATION AND DISCUSSION

4.1 Introduction

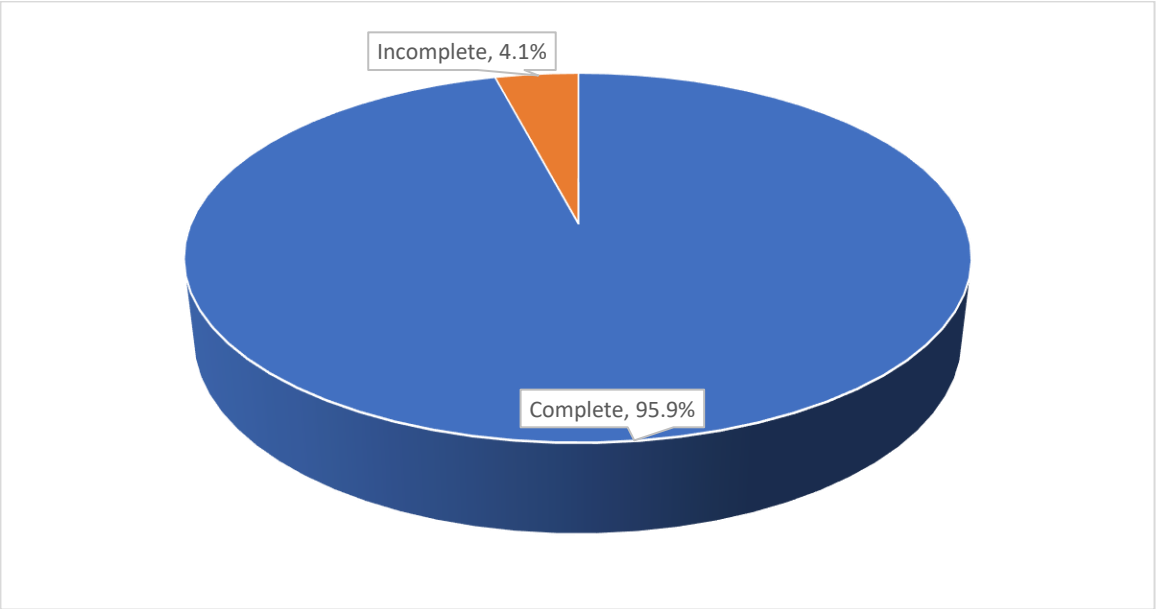
The chapter assessed the unprocessed information obtained in the field. Tables and figures were also provided in the chapter to demonstrate the findings from various tools. Finally, each goal was examined and debated in line with the conceptual framework's hierarchy of importance.

4.2 Response Rate

The distribution of 147 questionnaires yielded a response rate of 95.9%, as shown in Figure 4.1, with 141 of those surveys being successfully returned by respondents. Response rates were categorized by Mugenda (2008) as follows: over 85% implies great performance, 70–85% shows very good performance, 60–70% suggests acceptable performance, and less than 50% indicates unsatisfactory performance. This response rate thus gave an excellent representation of both the sample and the entire population.

Figure 4. 1:

Response Rate



4.3 Healthcare Waste Generation

4.3.1 Availability of Waste Storage Receptacle

All the health facility had medical waste storage receptacle with most of facilities (90.1%) had safety boxes and 73.8% use standard dust bins to store the medical waste you generate

Table 4. 1:

Availability of Waste Storage Receptacle

Characteristics	Frequency	Percent
Safety boxes	127	90.1%
Pedal bins	60	42.6%
Standard dust bins	104	73.8%
Improvised receptacle	15	10.6%
Bucket	23	16.3%

As illustrated in Table 4.1, on observation it was found that most (60%) of health facility had filled up safety boxes and standard dustbins, sixty percent of respondents reported that

their health institution had distinct containers (bins) for different types of garbage. Similarly, 70% of respondents said that hazardous waste generated by health care was segregated prior to treatment and disposal in their healthcare facilities. Furthermore, 50.0 percent of respondents said that healthcare waste was handled in their institution before being disposed away. It was also discovered that 60% of respondents said their facility clearly displays the waste management process, from segregation to final disposal. The findings revealed that among the other elements affecting the healthcare waste management system at the ten chosen health facilities in Kamukunji sub county, special containers (Bins) for various forms of trash received the highest mean score. The results support Kuchibanda and Mayo's (2015) assertion that healthcare waste should be segregated from the start and disposed of in line with relevant laws and classifications.

4.3.2 Quantity of Daily Waste Production

Most of health facilities (39.0%) had daily medical waste weighing less than 26kg with 34.8% and 12.1% weighing between 26-50 kg and 46-100 kg respectively.

Table 4. 2:

Quantity of Daily Waste Production

Quantity	Frequency	Percent
0-25kg	55	39.0%
26-50kg	49	34.8%
51-75kg	20	14.2%
76-100kg	17	12.1%

On observation, the quantity of health facility waste generated at the various hospitals ranged from approximately 15 Kg to approximately 80 Kg. Pumwani Maternity Hospital generated the highest quantity of medical waste (80Kg), followed St Teresa’s Parish Health Centre (50 Kg), Makkah Nursing Home (45 Kg) and the least from Bahati Health Center (15 Kg) during

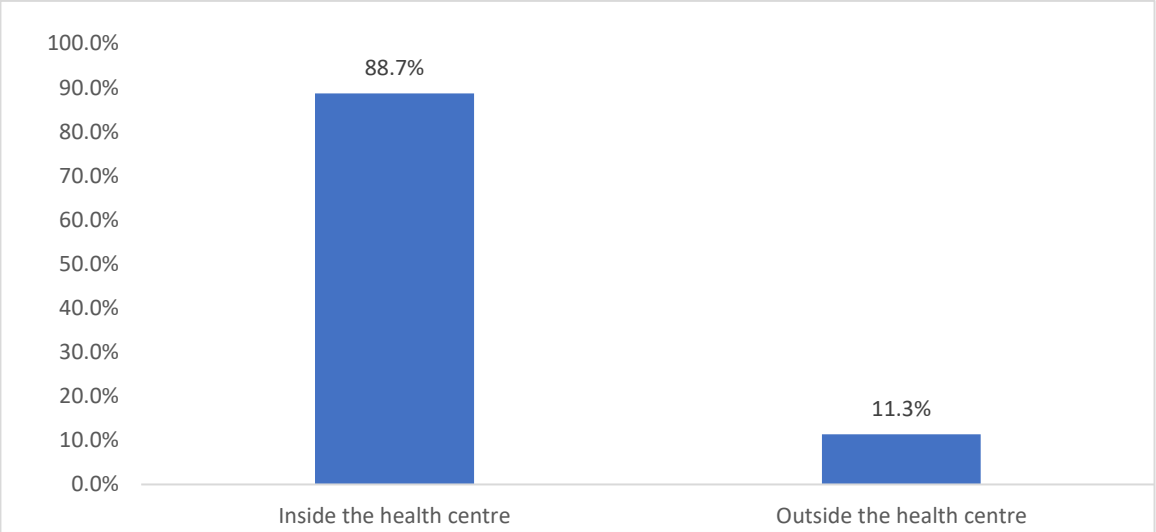
the study period. Others, Rapha Medical Clinic (18 kg), Majengo Dispensary (35 kg), Shauri Moyo Clinic (30 kg), Kamukunji Health Management Office (70kg), Makkah Nursing Home (35 kg), Biafra Lions Medical Clinic (41 kg), and Diani Dispensary (28 kg).

4.3.3 Storage of Receptacle for Medical Waste

Majority of health facilities (88.7%) store medical waste receptacles inside a health facility.

Figure 4. 2:

Storage of Receptacle for Medical Waste



On observation, over half of the health institutions said that there are frequently inadequate trash containers to handle the volume of healthcare waste generated. Only about a quarter of health institutions surveyed have some form of medical waste separation at the site of creation, and there are no designated carts or routes for trash transportation. The majority of health institutions lack waste storage areas. Over 80% of establishments in the Kamukunji sub county lack secure storage for medical waste. The garbage bags are heaped in the restrooms and even in the kitchens, which is unsightly and poses a significant hygiene hazard. Additionally, the data indicated that garbage, with the exception of sharps, is not segregated. Two-thirds of health care institutions have safe sharps containers (sometimes

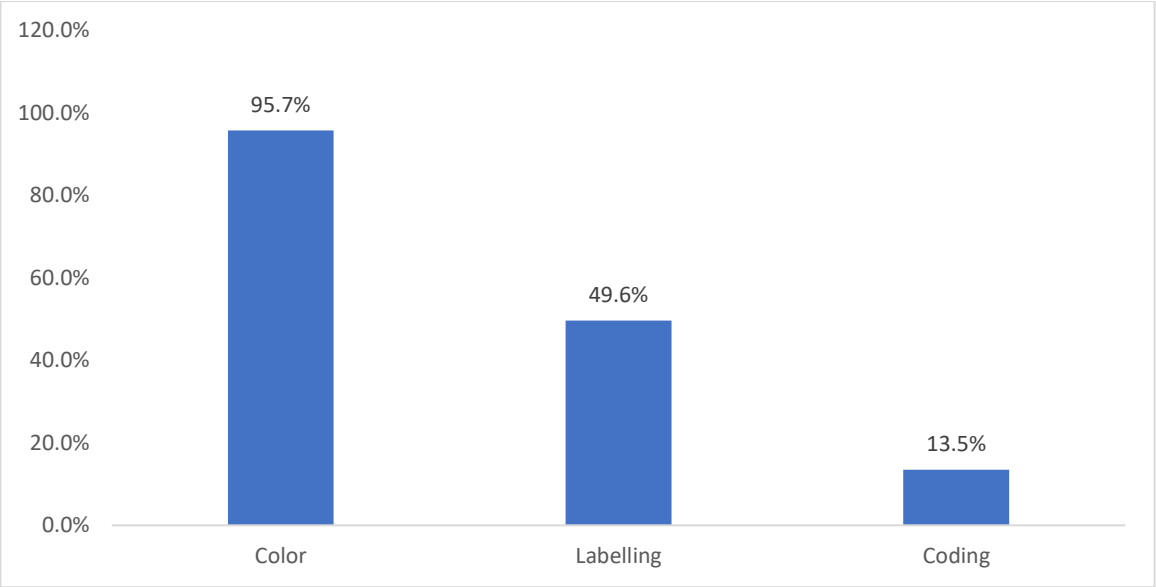
plastic bottles). Only about half separate other categories of garbage, such as waste generated in operating rooms and laboratories, which includes infectious and pathological waste.

4.3.4 Identification Method for Different Types of Medical Waste

Majority of respondents (95.7%) use color to identify different types of medical waste with slightly less than half (49.6%) using labelling (Figure 4.3).

Figure 4. 3:

Identification Method for Different Types of Medical Waste



The researcher wanted to know which categories of healthcare waste respondents thought were separated in their healthcare institution. Respondents stated that they divided their garbage into ordinary waste, infectious waste, and severely infectious waste when it came to placing it in receptacles. In a study carried out in Ghana, Emilia et al. (2015) found that both public and private hospitals separated non-infectious or general garbage from infected waste before dividing it into different groups.

The purpose of the study was to identify responders using information from garbage containers used in healthcare institutions. According to the respondents, their healthcare facility mostly uses safety boxes, sharps containers, adapted local containers, and color-coded bins. These findings are corroborated by Kumarasamy and Jeevaratnam (2017), who stated that the use of color coding and marking enables easy segregation and identification of various waste categories. Thus, segregation leads to safer waste management by explicitly identifying a certain color with a particular category and its related danger.

On observation, only 40% of facilities utilize color coding (for infectious waste, they used yellow or red bags). One-third of hospitals lack enough on-site storage containers. All healthcare trash is frequently mixed with ordinary rubbish in open buckets lined with extremely thin plastic bags. The bags are insufficiently sturdy and, in many cases, readily perforated, allowing for leakage and spilling. Containers are not labeled, and there is no way to distinguish between garbage generated in kitchens and waste generated in labs.

4.3.5 Disposal of Healthcare Waste

Most of health facilities (90.8%) had given a contractor to dispose some medical waste with 36.2% and 15.6% of wastes are incinerated and burning respectively (Table 4.3).

Table 4. 3:

Disposal of Healthcare Waste

Disposal of healthcare waste	Frequency	Percent
Incineration	51	36.2%
Crude burning	22	15.6%
Given to a contractor to dispose	128	90.8%

The researcher wanted to ascertain respondents' methods of waste treatment technology utilized by healthcare facilities. According to the respondents, their healthcare facility mostly employed incineration, composite pits, placenta pits, open burning, and burning chambers. The results are analogous to those of Njue et al. (2015), who found evidence of trench digging at health centers.

Participants were asked about the challenges they've had when trying to use medical waste equipment in a hospital setting. Most of the respondents said they were at risk of infection because their healthcare facility did not provide them with adequate bin liners or ongoing medical education on how to properly handle healthcare waste equipment. They also said that some of the waste equipment was not weatherproof, making it difficult to work in bad weather conditions. WHO (2017) confirmed the findings, noting that the most frequently encountered problems with healthcare waste include a lack of awareness of the health hazards associated with HCW materials, a lack of education on proper waste management techniques, a lack of waste disposal systems, a lack of human and financial resources, and finally, a lack of priority given to the topic of healthcare waste.

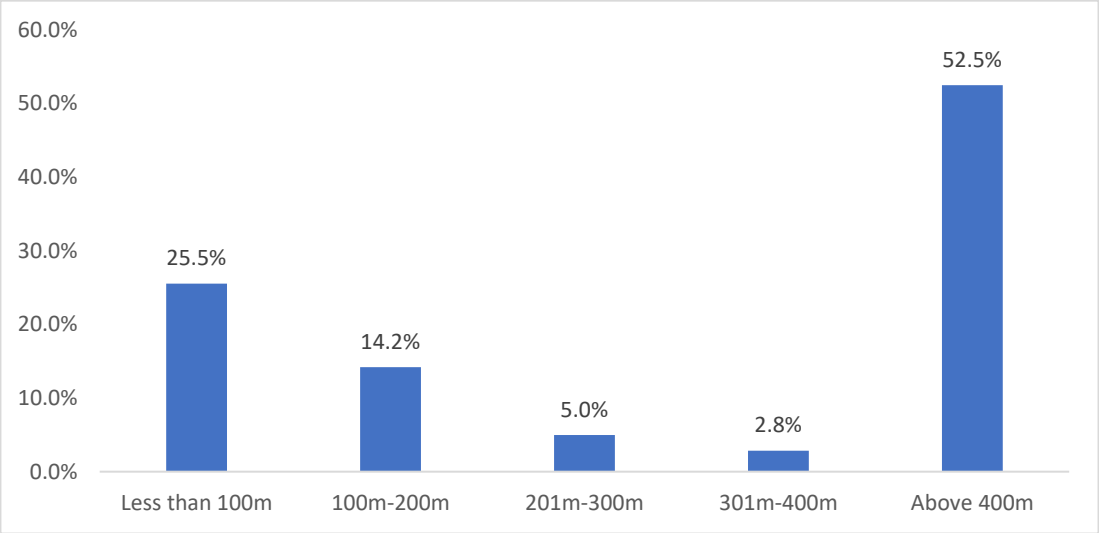
Researchers also wanted to know how respondents felt about the ultimate waste disposal techniques used by health care facilities. Respondents stated that the majority of their healthcare facilities used deep pit burials and open-burning as their preferred methods of burial. Medical waste in Kenyan hospitals is being burned in the open without any safeguards, according to Njue et al. (2015), who claim that the release of dioxins, furans and heavy metals that cause cancer in humans and kill ecosystem life has had a negative impact on the health of local residents who live near healthcare facilities.

4.3.6 Distance to Disposal Site from the Health Centre

More than half of health facilities (52.5%) had disposal site above 400 metres from the facility.

Figure 4. 4:

Distance to Disposal Site from the Health Centre

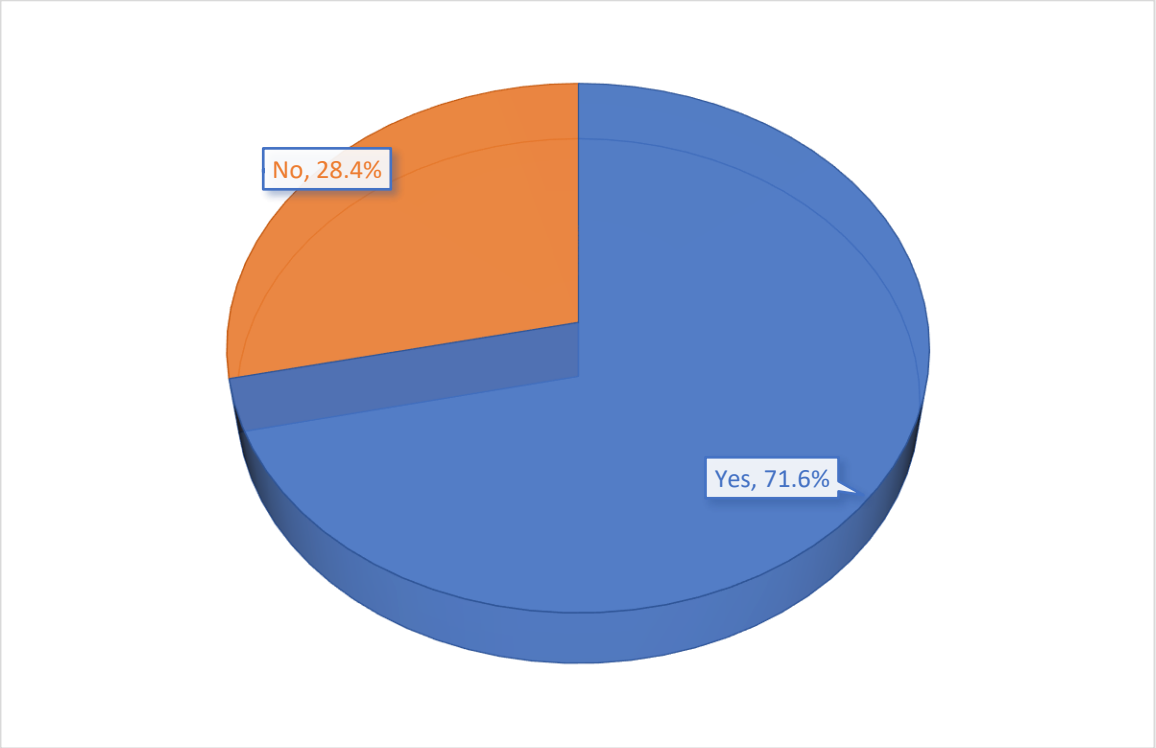


4.3.7 Availability of Manual/Guidelines on Healthcare Waste Management

Slightly less than three quarter (71.6%) of respondents had manual/guidelines on health care waste management in the facility.

Figure 4. 5:

Availability of Manual/Guidelines on Healthcare Waste Management



4.4 Factors Affecting Waste Management

4.4.1 Various Factors Affecting Waste Management

Lack of funds (76.4%), and lack of disposal site (73.6%) were common factors affecting waste management (Table 4.4).

Table 4. 4:

Various Factors Affecting Waste Management

Factors	Frequency	Percent
Lack of funds	107	76.4%
Poor logistics supply	70	50.0%
Lack of disposal site	103	73.6%
Lack of knowledge	77	55.0%

4.4.2 Correlational Analysis

The coefficient of association is now equal to 0 when there is no correlation between the qualities at all. As was already said, the definition of statistical significance is a probability (p) of less than 0.01 (p0.01). Statistically, the association is not significant if the probability is greater than or equal to 0.01 (p>0.01). The correlation between the study's key variables was ascertained using the Pearson correlation coefficient (r) analysis. Correlation The coefficient establishes, with a 95% confidence interval, the association between the predictor variable and the response variable (healthcare waste management system), as well as the degree of interdependence between the four predictor variables. The results of Table 4.5 demonstrate the significance of the association between a lack of cash, a deficient logistical supply, a lack of disposal space, and a lack of expertise among health institutions in Kamukunji sub county.

The findings indicated that while there is no statistically significant association between inadequate logistical supply and a lack of finance, there is a weaker positive relationship (r = 0.134, p =0.089). However, there was a statistically significant and stronger positive relationship between a lack of disposal site and a lack of funding (r = 0.562, p=0.003), as well as a statistically significant and stronger positive relationship between a lack of disposal site and a lack of logistic supply (r = 0.329, p = 0.011). Additionally, a statistically significant and stronger positive link was discovered between lack of knowledge and a lack of funds (r = 317, p=0.024), a lack of disposal sites (r = 0.384, p = 0.008), and a lack of logistic supply (r = 0.377, p = 0.019). All predictor factors demonstrated a positive connection with the response variable, suggesting that they may all be used to describe the healthcare waste management system in Kamukunji sub county.

Table 4. 5:

Correlational Analysis

		Lack of funds	Poor logistics supply	Lack of disposal site	Lack of knowledge
Lack of funds	r	1			
	Sig. (2-tailed)				
Poor logistics supply	r	0.134	1		
	Sig. (2-tailed)	0.089			
Lack of disposal site	r	0.562*	0.329*	1	
	Sig. (2-tailed)	**0.003**	**0.011**		
Lack of knowledge	r	0.317*	0.377*	0.384*	1
	Sig. (2-tailed)	**0.024**	**0.019**	**0.008**	

4.4.3 Multiple Regression Analysis

The R Square value for the regression summary findings in Table 4.6, which shows that medical waste management was negatively impacted by a lack of financing, a poor logistical supply, a shortage of disposal space, and a lack of awareness, is 0.746. This demonstrated a 74.6 percent variance in healthcare waste management due to a lack of funding, insufficient logistical supply, a lack of disposal site, and a lack of awareness. The remaining 25.4 percent suggests that there were additional elements affecting the healthcare waste management systems of the ten health institutions in Kamukunji Sub County that were not examined in this study.

Table 4. 6:

Multiple Regression Analysis

Model	R	R square	Adjusted R square	Std. Error of the estimate
1	0.864a	0.746	0.662	0.163

a. Predictor: (Constant), lack of funds, poor logistics supply, lack of disposal site, and lack of knowledge

4.5 Health Risks of Medical Waste Management

4.5.1 Problems of Medical Waste at the Community

Majority of respondents (87.2%) did not associate medical wastes with various problems with 12.8% associated medical waste with accidents (55.6%), diseases (27.8%), and drainage blockages (27.8%) as presented in table 4.7.

Table 4. 7:

Problems of Medical Waste at the Community

Characteristics		**Frequency**	**Percent**
Medical waste problems	Yes	18	12.8%
	No	123	87.2%
Problems	Diseases	5	27.8%
	Accidents	10	55.6%
	Land pollution	7	38.9%
	Drainage blockages	5	27.8%

4.5.2 Health Risks Associated to Medical Waste at the Facility

Almost 11% of respondents associated health risks to medical waste at the facility such as diseases (80.0%), sharps-inflicted injuries (80.0%), and pollution (53.3%) as presented in table 4.8.

Table 4. 8:

Health Risks Associated to Medical Waste at the Facility

Characteristics		Frequency	Percent
Health risks associated to medical waste	Yes	15	10.6%
	No	126	89.4%
Specific health risks	Diseases	12	80.0%
	Pollution	8	53.3%
	Sharps-inflicted injuries	12	80.0%

Observations at the healthcare facilities in Kamukunji Sub County raised concerns about the hazards connected to the management of healthcare waste and interventions, particularly the possibility of staff members being pricked or injured by needles. However, the usage of personal protective equipment reduced the risk (PPE). Most medical staff members at Pumwani Maternity Hospital used the proper personal protective equipment. However, during the research period, less than 30% of workers at the Diani dispensary, Majengo dispensary, and Rapha Medical Clinic wore enough PPE, placing them at risk for nosocomial infections and needlestick wounds/pricks.

4.5.3 Individual Health Risks Associated to Medical Waste

At least 6% had been affected by medical waste with 62.5% and 50.0% affected on physical injury and environmental pollution respectively.

Table 4. 9:

Individual Health Risks Associated to Medical Waste

Characteristics		Frequency	Percent
Affected by the medical wastes	Yes	8	5.7%
	No	133	94.3%
Individual health risks	Physical injury	5	62.5%
	My attitude was affected	1	12.5%
	The environment was polluted	4	50.0%

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter, the researcher has reviewed the major findings of the study, which have been arranged in accordance with the mentioned objectives of the research. The researcher has also discussed the major elements of the study, which consists of the research objectives, the purpose of the study, and methodology applied. The study population, sample size, research procedure and data collection method have also been discussed in this chapter. The major findings have been arranged in accordance with the mentioned objectives of the research. The researcher has also stated the conclusions obtained from the findings of the research, which have been outlined based on the four main objectives of the research, and in addition, makes recommendations for purposes of improvement.

5.2 Discussion

5.2.1 Perceptions of Staffs Towards Medical Waste Management

According to the survey, the majority of respondents utilized color to differentiate between different categories of medical waste. When separating healthcare trash in health institutions, it was classified as general garbage, infectious waste, and highly infectious waste. Healthcare institutions used safety boxes, sharps containers, color-coded bin liners, and locally-made containers for medical waste. This is in line with the findings of Hassan et al. (2018), who found that while doctors, nurses, and laboratory technicians have shown an improvement in understanding of medical waste management in certain studies, they also acknowledge that there is still a gap in practice. For instance, nurses and laboratory personnel could be more knowledgeable about color coding and waste segregation at the source than physicians. Medical waste management practices are absolutely unknown to every member of the sanitation team. There is typically minimal connection between medical waste disposal knowledge and practice at the global, regional, and local levels. In a study conducted in

Ghana, Emilia et al. (2015) found that both public and private hospitals separated non-infectious or general trash from infected waste before classifying the waste into specific groups. Color coding and marking provide for simple waste category sorting and identification, claim Kumarasamy and Jeevaratnam (2017). As a result, segregation promotes safer waste management by directly associating a certain hue with a specific category and the associated risk.

Proper waste segregation must be performed at the time of generation. Health care workers who generate waste should be educated and trained on how to properly segregate and store it, and material safety data sheets should be made available to identify its composition. Color-coded labels and containment systems should be implemented, as should easy-to-use methods for separating medical waste from non-hazardous waste (Tesfahun, 2015). A study conducted in Istanbul's hospitals found that medical waste disposal training programs had a significant impact on the understanding of health care personnel in Istanbul. Lack of proper training and supervision is the fundamental problem with medical waste disposal (Ozder et al., 2013). Concerns about utilizing medical waste equipment in hospitals include infection risk, a lack of medical instruction on how to properly handle medical waste equipment, and the absence of suitable bin liners given by the hospital. These are the most common problems patients have reported. Deep pit burial and open burning were often adopted by healthcare establishments for the final disposal of the wastes generated.

5.2.2 Level of Medical Waste Generation Among Health Facilities

The study found that most of health facilities (39.0%) had daily medical waste weighing less than 26kg with 34.8% and 12.1% weighing between 26-50 kg and 46-100 kg respectively. On observation, the amount of garbage created by health facilities varied between about 15

and 80 kg. During the research period, Pumwani Maternity Hospital created the most medical waste (80Kg), followed by St Teresa's Parish Health Centre (50Kg), Makkah Nursing Home (45Kg), and Bahati Health Center (15Kg). Infectious and non-infectious waste made up the majority of hospital trash. When infected and non-infectious wastes are combined, the combined waste becomes infectious. This is consistent with Dinesh et al. (2010)'s conclusion that India generates around 3000 million tons of trash yearly, of which 10% to 25% are infectious or harmful to humans or animals and are detrimental to the ecosystem. According to the WHO (2017), if these two basic categories of waste (infectious and non-infectious) are not properly segregated (separated), the entire volume of health care waste must be considered infectious under the precautionary principle, highlighting the critical nature of establishing a safe and integrated waste management system.

To manage trash properly, it is vital to separate contagious and non- pathogenic garbage. This corroborates Yashpal and Poonam's (2018) argument that infectious garbage must be kept segregated from non-infectious waste. This is because if infectious garbage, which accounts for just 10-15 percent of total waste, is combined with non-infectious waste (80-85 percent), the entire waste becomes infectious. Once the volume of hospital waste has expanded (raised), the environmental effect may be severe. According to research done in Bangladesh by Prism, (2019) of the 6.4 tons of hospital trash generated daily, 5.2 tons were determined to be non-infectious, accounting for 80.77 percent of the total garbage. According to the study, the performance of healthcare waste management in hospitals was positively impacted by the legal framework and technology. However, the study revealed that hospital waste management effectiveness was negatively impacted by the current system, waste management training, and public awareness. The study also recommended waste segregation in order to enhance hospital healthcare waste management performance

in accordance with operational needs. The research recommended that hospital staff members receive updated training on waste management. Additionally, it should be planned for health personnel to get frequent training on healthcare waste and its management (Ernesto et al., 2015; Makori, 2018). Top management, research facilities, garbage employees, procurement, accounting, maintenance, and support departments should all have members on the WCM. (Yazie et al. 2019) To make sure the waste management objective is attained, one person should be assigned the role of trash manager, who interacts with all board members and others involved in waste management both within and outside the office.

5.2.3 Health Risks of Medical Waste Management in Health Facilities

The study indicated that majority of respondents (87.2%) did not associate medical wastes with various problems in the community with 12.8% associated medical waste with accidents (55.6%), diseases (27.8%), and drainage blockages (27.8%). Almost 11% of respondents associated health risks to medical waste at the facility such as diseases (80.0%), sharps-inflicted injuries (80.0%), and pollution (53.3%). Additionally, at least 6% had been affected by medical waste with 62.5% and 50.0% affected on physical injury and environmental pollution respectively. It was discovered that healthcare professionals were employing protective equipment supplied for the proper disposal of healthcare waste and were aware of the vaccine required to guard against the hazards associated with healthcare waste management. It was also demonstrated that healthcare workers knew how to deal with needle stick wounds and pricks at their facilities. Similar to this, the WHO (2017) estimates that infected needles contributed to 260,000 HIV infections, 2 million Hepatitis C virus infections, and 21 million Hepatitis B virus infections in 2015. (5 percent of all new infections). Accidents happen when sharps like needles or other objects are not collected in sturdy, puncture-proof containers during garbage disposal. The danger of needle stick

injuries to healthcare workers rises due to improper design or overflow of current sharp containers (WHO, 2017). In addition to the risks brought on by direct touch, medical waste can harm people's health by poisoning water supplies during waste treatment and polluting the air through the release of very dangerous gases during burning. The bodies of water may get contaminated when medical waste is dumped in an open pit or too close to them. Dioxins, furans, and other dangerous air pollutants may be emitted during the public burning of medical waste or during incineration in an incinerator without emission controls, making persons who breathe this air very sick (Nadeem, 2014). One study found that 45% of the medical waste produced in the KwaZulu-Natal region of South Africa could not be accounted for, suggesting that it was forcibly dumped, buried, or burnt, endangering both human and environmental health (Ramokate, 2014). According to study on solid medical waste management done in Zimbabwe by Kudoma (2018), sharps are disposed of in plastic bags, putting workers' health at risk by exposing them to pricks and cuts. Placentas and fetuses have been found scattered around dumpsters, demonstrating the lack of security around waste storage. The reputation of the hospital would suffer as a result of open trash sites, which are ugly and may frighten off patients. Medical waste management should place more emphasis on educating the necessary healthcare administrators on safe waste disposal than on finding novel ways to recycle and reuse trash (WHO, 2017). If healthcare waste management at institutions like hospitals, clinics, and other facilities is subpar, everyone in the healthcare industry—including healthcare professionals, trash handlers, haulers, and members of the general public—may be at risk for occupational and public health problems. Pollution that harms animals, as well as the air, water, and soil, might endanger human lives (ICRC, 2019). The community members may be able to collect used medical equipment, which if not properly disposed of, can potentially spread disease. Healthcare waste issues have gotten more complicated, with increased incidence of HIV, SARS, and Hepatitis B.

The risk of cross-contamination when handling and disposing of such waste has greatly increased (UNEP, 2020). Infectious diseases can be spread when human blood, used for injections and blood testing, comes into contact with wounds caused by contaminated needles and syringes. After getting straight to the consequences for human health, focus should be on the environmental risks like pollution to water, air, and soil (UNEP, 2020). Upon reviewing the literature, it is clear that a significant amount of knowledge is lacking, and it is this gap that this study seeks to close. a) Information on the setting Doctors, nurses, and laboratory technicians have greater awareness of medical waste management, according to several research by Hassan et al. (2018). However, they also accept that there is still a gap in practice. Doctors might not comprehend color coding or source-based waste segregation as well as nurses and laboratory personnel could. When it comes to procedures for managing medical waste, the whole sanitation team is ignorant.

5.2.4 Medical Waste Management Solutions

The study discovered a 74.6 percent variance in healthcare waste management due to a lack of funding, insufficient logistical supply, a lack of disposal location, and a lack of awareness. The remaining 25.4% suggests that there may have been other factors influencing the healthcare waste management systems of the ten chosen healthcare facilities in Kamukunji Sub County that were not investigated in this study. Given that there are typically three fundamental types of healthcare waste, the majority of Kenyan hospitals are categorized into these categories (MoH, 2015). One of the most often used waste management strategies is to separate garbage into three bins: infectious or dangerous health conditions, ordinary waste, and puncture-proof containers packed with puncture-safe boxes to avoid waste spilling. At terms of management responsibilities for healthcare waste management in healthcare

institutions, management was in charge of planning, budgeting, assisting with training, and delivering supplies. The most often used waste treatment technologies were open burning, burning chambers, and unlawful incineration, according to a qualitative analysis of the waste treatment procedures used by healthcare facilities. Because medical waste handling is a potentially hazardous activity, it requires specialized training that is tailored to the nature of hospital work, the hazards and risks to which employees may be exposed, and the responsibilities of individual employees (Njue et al., 2015). Although poor hazardous medical waste management is a problem in Kenya, it is a problem throughout the world, not only in Africa, but also in developing countries everywhere (Mugo, 2017). Nearly all injuries from sharps (such as needles and blades) result in a rise in infections in medical workers, hospital patients, and waste handlers and scavengers. Because of this, the need to treat medical waste at healthcare facilities has greatly increased (Hasan & Rahman 2018). The challenges include guaranteeing dedication and compliance with waste management methods, such as norms and regulations that indicate workers are more likely to contract infections if trash isn't properly segregated. Based on a quantitative analysis of data, Mitiku et al. (2020) discovered that improper segregation techniques expose waste handlers to serious health risks. They also discovered that the scope of those at risk for health risks has been expanded. Hospital waste is incorrectly disposed of due to poor waste segregation, noncompliance with regional legislation and system requirements, and noncompliance with WHO waste management recommendations. This is the direct result of difficulties with illiteracy, lax law enforcement, a lack of process ownership, and holes in the routine monitoring of waste management practices, claim Kurian et al. (2016). The debate properly highlights practical concerns to safeguard biomedical waste handlers notwithstanding the study by Gizalew et al. (2021) on the categorization and management challenges of biomedical waste's severe gaps and methodological flaws.

5.3 Conclusion

The study revealed that respondents mostly used colour-coded bin, sharp container, improvised local container, and safety box. According to our observations, one-third of health institutions do not have enough onsite storage containers. By explicitly identifying a given color with a certain category and its accompanying hazard, segregation aids to safer waste processing. In buckets coated with very thin plastic bags, healthcare waste is mixed with ordinary rubbish. The bags are insufficiently tough and readily perforated, allowing for leakage and spilling. Containers are not labeled, and there is no way to distinguish between garbage generated in kitchens and waste generated in labs.

In this study, most of health facilities had daily medical waste weighing less than 26kg with 34.8% and 12.1% weighing between 26-50 kg and 46-100 kg respectively. On observation, During the research period, Pumwani Maternity Hospital created the most medical waste (80Kg) and Bahati Health Center generated the least (15Kg).

The study revealed that most of respondents did not associate medical wastes with various problems in the community and also associated health risks to medical waste at the facility. Only few of HCW had been affected by medical waste with mostly on physical injury and environmental pollution.

The analysis discovered a statistically significant and greater positive association between a lack of disposal sites and a lack of funding; similarly, a statistically significant and larger positive relationship was discovered between a lack of disposal sites and a lack of logistic supply. Additionally, it was shown that a statistically significant and greater positive

association existed between a lack of knowledge and a lack of funds, a lack of disposal sites, and a lack of logistical supplies.

5.4 Recommendations

It's also recommended in the study that all healthcare facilities in Kamukunji Sub County and all across the country receive proper management training on all elements of health workers' knowledge and practice. Health workers and waste handlers can be protected from exposure and accidents by identifying and filling in knowledge gaps among different types of healthcare employees. Refresher training for waste handlers and health care workers should also be provided following a critical review of existing waste management practices, including the stages of segregation; storage; collection; transportation; treatment; and disposal; as well as the development/adoption of guidelines and standard operating procedures.

There should be a requirement for every health care facility (HCF) to maintain an efficient, safe, and hygienic medical waste management system that is as low-risk for workers, the public's health, and our environment as possible. This can be done by coordinating with the relevant ministries and agencies within each HCF.

Because healthcare workers lack knowledge of HCW management principles and current policies at healthcare facilities in Kamukunji sub county, the study suggests that medical waste management policies be updated on a regular basis and that waste handlers and healthcare workers receive refresher training on medical waste management policies in health facilities in Kamukunji sub county and throughout Kenya. The 2007 National Policy on Injection Safety and Medical Waste Management, which emphasizes the need to advocate

for both the support and execution of healthcare waste management in Kenya, is another suggestion that all Kenyan health facilities follow.

The following ideas have an impact on how the 2007 policy is implemented: Safer injection devices as well as sharp waste disposal procedures are used to reduce the danger to health care personnel, patients and communities as a whole, and to reinforce the essential human resources for the strategy to be effective.

5.5 Areas for Further Research

In the Kamukunji subcounty of Nairobi County, 10 public health institutions were the subject of this study. To compare the results from different health institutions in Kenya, comparable research may be conducted at other hospitals. Future study may concentrate on various technologies used in the handling and disposal of medical waste, or on educating the public about medical waste, as they are emerging issues that call for literature to address the growing concerns.

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APPENDICES

Appendix i: Consent Form

Title: PROPOSED SOLUTIONS TO ADDRESS THE CHALLENGES OF MEDICAL WASTE MANAGEMENT IN HEALTH FACILITIES IN KAMUKUNJI SUB-COUNTY, NAIROBI CITY COUNTY, KENYA

Introduction:

My name is **Caxton Mbuvi** I am an MPH student from Kenya Methodist University. I am conducting a study titled: **PROPOSED SOLUTIONS TO ADDRESS THE CHALLENGES OF MEDICAL WASTE MANAGEMENT IN HEALTH FACILITIES IN KAMUKUNJI SUB-COUNTY, NAIROBI CITY COUNTY, KENYA** the findings will be utilized to influence the development of institutional guidelines for handling medical waste which may lead to reduction in audit queries and costs which may be aggravated by improper waste management.

Procedure to be followed

Participation in this study will require that I ask you some questions and also access all the hospital's department to address the six pillars of the health system. I will record the information from you in a questionnaire check list. You have the right to refuse participation in this study. You will not be penalized nor victimized for not joining the study and your decision will not be used against you nor affect you at your place of employment.

Please remember that participation in the study is voluntary. You may ask questions related to the study at any time. You may refuse to respond to any questions, and you may stop an interview at any time. You may also stop being in the study at any time without any consequences to the services you are rendering.

Discomforts and risks.

Some of the questions you will be asked are on intimate subject and may be embarrassing or make you uncomfortable. If this happens; you may refuse to answer if you choose. You may also stop the interview at any time. The interview may take about 40 minutes to complete.

Benefits

There are no direct benefits or reward, but the results obtained will help in identifying the gaps so that measures to reduce the unmet needs can be undertaken. If you participate in this study, you will help to generate new knowledge in this area that will inform decision-makers to make decisions that are research-based.

Rewards

There is no reward for anyone who chooses to participate in the study.

Confidentiality

The interviews will be conducted in a private setting within the hospital. Your name will not be recorded on the questionnaire and the questionnaires will be kept in a safe place at the University.

Contact Information

In case you wish to contact the researcher for any inquiries about the study, feel free to do so through the following contacts;

Researcher; **Caxton Mbuvi**; Email address: caxtonmbuvi@yahoo.com

Supervisor; Dr. Kimani Makobu Email address: makobukimani@gmail.com

Supervisor; Ms. Teresia Kyulu Email address:kyuluteresia@gmail.com

Participant's Statement

The above statement regarding my participation in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time. I understand that I will not be victimized at my place of work whether I decide to leave the study or not and my decision will not affect the way I am treated at my workplace.

Name of Participant……Date……Signature…….

Investigator's Statement

I, the undersigned, have explained to the volunteer in a language s/he understands the procedures to be followed in the study and the risks and the benefits involved.

Name of Interviewer……Date…….

Interviewer Signature……

Appendix ii: Questionnaire

Title: PROPOSED SOLUTIONS TO ADDRESS THE CHALLENGES OF MEDICAL WASTE MANAGEMENT IN HEALTH FACILITIES IN KAMUKUNJI SUB-COUNTY, NAIROBI CITY COUNTY, KENYA

Study ID: …… **Date**: ……/……/……

Instructions: ***Do not write your name or any other personal data on the questionnaire.***

Please follow the instructions while answering questions in each area.

The information given here will remain confidential.

1. Approximately how much medical waste do you produce daily?
    a. 0-25kg [ ]
    b. 26-50kg [ ]
    c. 51-75kg [ ]
    d. 76-100kg [ ]
    e. Above 100kg [ ]
    f. Don't know
2. Do you have medical waste storage receptacle?
    a. Yes [ ]
    b. No [ ] *If No to No.2, Skip to No.4*
3. If yes to no.2 above, which receptacle do you use to store the medical waste you generate?
    a. Safety boxes [ ]
    b. Standard dust bins [ ]
    c. Pedal bins [ ]
    d. Improvised receptacle [ ]
    e. Others (specify)…….
4. Where do you keep your receptacle for medical waste?
    a. Inside the health centre [ ]
    b. Outside the health centre [ ]
    c. Other (specify)……....
5. Is there any identification method for different types of medical waste in the facility?
    a. Yes [ ]
    b. No [ ]

6. If yes to no.5 above, which one?
    a. Color [ ]
    b. Labeling [ ]
    c. Coding [ ]
    d. Other (specify)……..
7. How far is the disposal site from the health Centre?
    a. Less than 100m
    b. 200m
    c. 300m
    d. 400m
    e. Above 500m
8. Are there any manual/guidelines on health care waste management in the facility?
    a. Yes [ ]
    b. No [ ]
9. How do you dispose of healthcare waste at this facility?
    a. Incineration [ ]
    b. Burying [ ]
    c. Crude burning [ ]
    d. Crude dumping [ ]
    e. Given to a contractor to dispose [ ]
    f. Other (specify)……..
10. In your opinion, which factors would you say affect waste management in this facility?
    a. Lack of funds [ ]
    b. Poor logistics supply [ ]
    c. Lack of disposal site [ ]
    d. Lack of knowledge [ ]
    e. Others (specify)……..
11. Do you associate medical wastes with any problems?
    a. Yes [ ]
    b. No [ ]
12. If yes in the no.11 above, which problems?
    a. Diseases [ ]
    b. Accidents [ ]

c. Land pollution [ ]

d. Drainage blockages [ ]

e. Other (specify)…….

13. In your opinion, do you think there are any health risks associated to medical waste in this health facility?

a. Yes

b. No

14. If yes above, what are some of the risks you are aware of? ……
……
…….

15. Have you been affected by the medical wastes?

a. Yes

b. No

16. If yes above pick one that applies

a. Physical injury

b. My attitude was affected

c. The environment was polluted

d. Others (Specify)……

Thank you for your cooperation

Appendix iii: Observation Checklist

Title: PROPOSED SOLUTIONS TO ADDRESS THE CHALLENGES OF MEDICAL WASTE MANAGEMENT IN HEALTH FACILITIES IN KAMUKUNJI SUB-COUNTY, NAIROBI CITY COUNTY, KENYA

Identification

1) **Date ……**
2) **Health facility number…….. Type of health facility……**

1. Are appropriate waste storage receptacles provided?

   Yes [ ] No [ ]

2. Are there signs of waste spillage?

   Yes [ ] No [ ]

3. Is the waste being segregated at the point of generation?

   Yes [ ] No [ ]

4. Are all types of waste disposed of together?

   Yes [ ] No [ ]

5. Are the HCW using personal protective equipment

   Yes [ ] No [ ]

6. Number of solid wastes generated on a daily basis

Amount of solid medical wastes generated daily				
0-25kg	**26-50kg**	**51-75kg**	**76-100kg**	**Above 100kg**

Appendix iv: KEMU Scientific Ethics and Review Committee

KENYA METHODIST UNIVERSITY
P. O. BOX 267 MERU - 60200, KENYA
TEL: 254-064-30301/31229/30367/31171
FAX: 254-64-30162
EMAIL: serc@kemu.ac.ke

November 1, 2021

KeMU/SERC/PHT /54/2021

Caxton Mbuvi
Kenya Methodist University

Dear Caxton,

SUBJECT: PROPOSED SOLUTIONS TO ADDRESS THE CHALLENGES OF MEDICAL WASTE MANAGEMENT IN HEALTH FACILITIES IN KAMUKUNJI SUB-COUNTY, NAIROBI CITY COUNTY, KENYA.

This is to inform you that Kenya Methodist University Scientific Ethics and Review Committee has reviewed and approved your above research proposal. Your application approval number is KeMU/SERC/PHT/54/2021. The approval period is 1st November 2021 – 1st November 2022

This approval is subject to compliance with the following requirements

I. Only approved documents including (informed consents, study instruments, MTA) will be used.

II. All changes including (amendments, deviations, and violations) are submitted for review and approval by Kenya Methodist University Scientific Ethics and Review committee.

III. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KeMU SERC within 72 hours of notification.

IV. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KeMU SERC within 72 hours.

V. Clearance for export of biological specimens must be obtained from relevant institutions.

VI. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal

VII. Submission of an executive summary report within 90 days upon completion of the study to KeMU SERC.

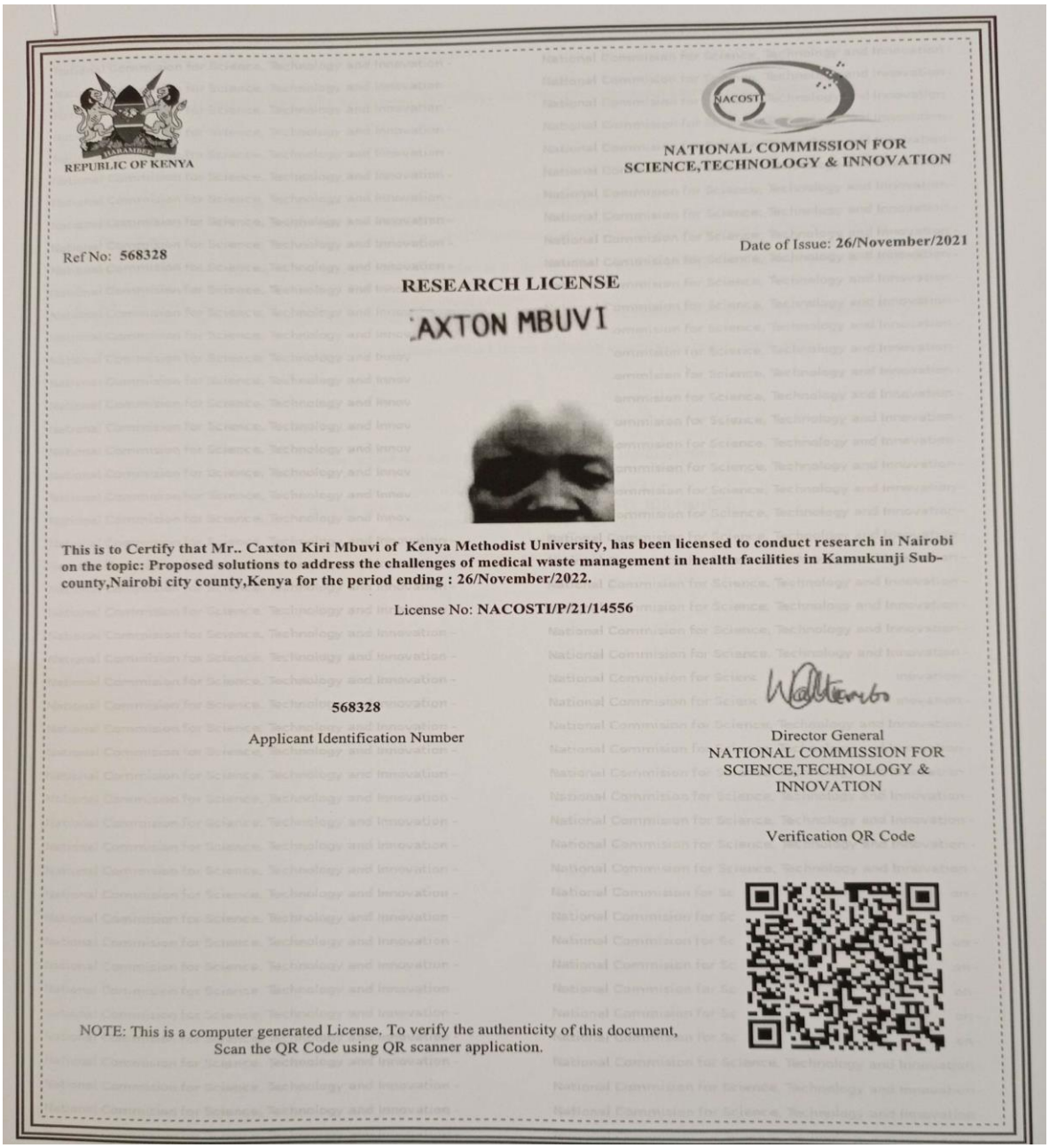
Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

KENYA METHODIST UNIVERSITY P.O. Box 267-60200, MERU

Dr. A. WAMACHI
Chair, SERC

Appendix v: NACOSTI Permit



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **568328**

Date of Issue: **26/November/2021**

RESEARCH LICENSE

CAXTON MBUVI

This is to Certify that Mr.. Caxton Kiri Mbuvi of Kenya Methodist University, has been licensed to conduct research in Nairobi on the topic: Proposed solutions to address the challenges of medical waste management in health facilities in Kamukunji Sub-county,Nairobi city county,Kenya for the period ending : 26/November/2022.

License No: **NACOSTI/P/21/14556**

568328

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

CONDITIONS

1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearence from relevant Government Agencies
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Appendix vi: Nairobi Metropolitan Services Research Authorization

REPUBLIC OF KENYA

EXECUTIVE OFFICE OF THE PRESIDENT
NAIROBI METROPOLITAN SERVICES

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Telephone +3313002/4
When replying please quote

Kenyatta International Convention Centre
P. O. Box 49130-00100
NAIROBI

REF: EOP/NMS/HS/073

DATE: 8th December 2021

CAXTON K. MBUVI
KENYA METHODIST UNIVERSITY
Nairobi

Dear Mr. Caxton,

RE: RESEARCH AUTHORIZATION

This is to inform you that the Nairobi Metropolitan Services - Health Directorate's Research Technical Working Group (RTWG) reviewed the documents on the study titled "Proposed Solutions to Address the Challenges of Medical Waste Management in Health Facilities in Kamukunji Sub-County, Nairobi City County, Kenya".

I am pleased to inform you that you have been authorized to undertake the study at Kamukunji Sub County in Nairobi County. The researcher will be required to adhere to the ethical code of conduct for health research in accordance to the Science Technology and Innovation Act, 2013 and the approval procedure and protocol for research for Nairobi.

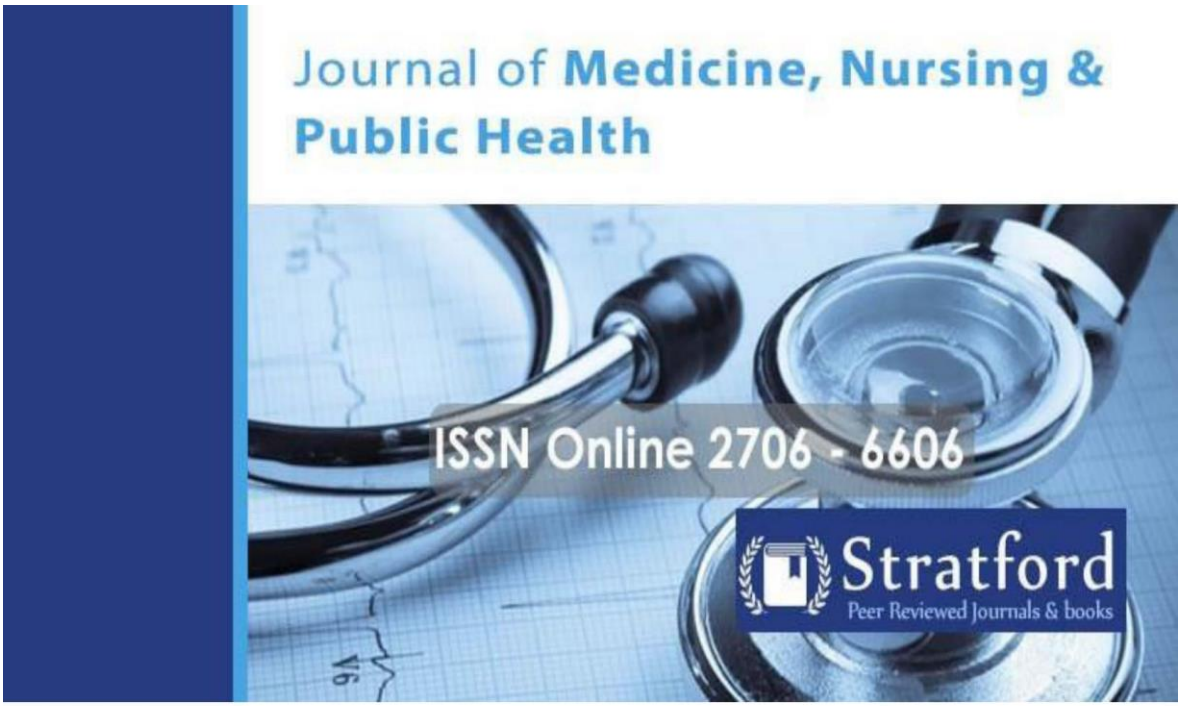
On completion of the study, you will submit one hard copy and one copy in PDF of the research findings to the RTWG. In addition, you will disseminate recommendations of the research at a virtual meeting organized by the RTWG. By copy of this letter, the Sub County Medical Officer of Health - Kamukunji is to accord you the necessary assistance to carry out this research study.

Yours sincerely,

DR. OUMA OLUGA - OGW
DIRECTOR HEALTH SERVICES

Cc: Sub County Medical Officer of Health - Kamukunji

Appendix vii: Publication



Proposed Solutions to Address the Challenges of Medical Waste Management in Health Facilities in Kamukunji Sub-County, Nairobi City County, Kenya

Caxton K. Mbuvi, Teresia Kyulu & Dr. Kimani Makobu

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Proposed Solutions to Address the Challenges of Medical Waste Management in Health Facilities in Kamukunji Sub-County, Nairobi City County, Kenya

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Abstract

Medical waste management in Kenya has been greatly affected by the country's elevated production levels. The majority of medical facilities do not have an extensive medical waste management system, or if they do, they do not handle waste thoroughly, and therefore is detrimental to humans and the environment. This research focuses on health facilities' management of medical waste in Kamukunji sub-county, assessing the specific problems of medical waste management in that area. This was a study focusing on healthcare workers, their working conditions and habits. This study was an analytical cross-sectional study design. Multistage sampling methods for the selection of 10 health facilities and 141 study participants. The R square was 0.746, indicating that medical waste management was harmed by a lack of funding, insufficient logistics, a lack of disposal sites, and a lack of understanding. This demonstrated a 74.6 percent variance in healthcare waste management due to a lack of funding, insufficient logistical supply, a lack of disposal site, and a lack of awareness. The remaining 25.4% implies that there were additional issues affecting the healthcare waste management systems of the ten health facilities evaluated. By explicitly identifying a given color with a certain category and its accompanying hazard, segregation aids to make waste processing safer. During the research period, Pumwani Maternity Hospital generated the most medical waste (80Kg) and Bahati Health Center generated the least (15Kg). The study concludes that periodic updates in medical waste management are necessary, as is refresher training for healthcare professionals and waste handlers. Additionally, it is advised that each health care facility have a safe and hygienic system in place for the handling, segregation, c collection, storage, transportation, treatment, and disposal of medical waste. All health facilities in Kenya, the study states, should adhere to the National Policy on Injection Safety and Medical Waste Management (2007). The 2007 strategy aims to emphasize the need of advocating for both the support and execution necessary to adequately manage healthcare waste.

Keywords: *Medical waste generation, health risks, medical waste management solutions, challenges of medical waste management, health facilities*

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1.0 Introduction

Medical waste is composed of waste from healthcare and medical procedures, like needles, sharp objects, tissues, bodily fluids, medications, and more (WHO, 2017). Medical waste includes all waste produced by the following actions: diagnosing, producing or testing biologically, obtaining sufficient waste from households, and removing waste regulated under trauma waste management by practitioners in trauma waste management (ICRC, 2019). It is challenging to deal with waste because of the impact it has on the environment and public health. While dealing with residential, commercial, municipal, agricultural, and construction and demolition waste is fine, there are no exceptions to dealing with solid and liquid waste, and in this regard, health waste needs to be treated with more severity (Abor & Bouwer, 2018).

Global health risks exist due to the potential hazard in the disposal of medical waste (WHO, 2017). Failure to safely dispose contaminated needles and syringes can expose staff and the public to various severe health problems. In places where sanitation is difficult, people can gather equipment that has been contaminated and either make it usable again or sell it. Infections with diseases caused by contaminated needles such as Hepatitis B, C, and HIV spread rapidly: by 2000, the WHO found 21 million hepatitis B (32% of all new infections) virus infections; 2 million hepatitis C (40% of all new infections) virus infections; and 260,000 HIV infections (5% of all new infections) resulting from contaminated needles (WHO, 2017). In addition to the potential health risks and pollution of the surrounding environment, medical waste poses a risk to water quality, potentially infecting others with disease through water supply (Gao et al., 2015).

The average waste generation in hospitals, Kumarasamy & Jeevaratnam, (2017), was 0,934 kg/lb/Day; the percentage of non-hazardous waste produced in hospitals was 77.08%; and hazardous waste was 22,92%, which contributed to 32,1% of infections. An Irbid survey showed health-related waste generation rats in three hospitals at Princess Basma Hospital 6.904 kg/pat/day (4.315 kg/bed/day) 5.718 kg/pat/day (3.212 kg/bed/day) and 4.532 kg/pat/day (2,556 kg/bed/day) at Ibn Al-Nafis Hospital and, combined, contributed to 24.6 percent waste-management infections. A study carried out in Nigeria and South Africa has shown that Nigeria faces the problem of maladministration of hospital waste as the rest of the world. Recently, the management of hospital waste poses more problems with the introduction of disposables such as needles, syringes and similar items (Lakshmi, 2012). Studies in South Africa show that larger hospitals generate approximately 2kg per bed of waste where 0.5kgs are regarded as risky. This produces around 250,000 tons of hospital waste per year from all sorts of Nigeria and South Africa healthcare facilities, which has bad environmental effects and pollutes the land, air and water resources (Nagaraju, et al., 2013).

In Tanzania, some public health establishments face a broad range of challenges in managing waste produced by them, covering financial, technical and administrative issues. Biomedical waste management financing at those facilities is extremely poor, leading to dubious treatment of medical waste generated in these facilities. Without making significant investments in low-level health facilities, like health centers and dispensaries, higher-level medical institutions have managed to become adept at managing medical waste. All these problems require an examination of the current situation in the LLHFs (Banu et al., 2015; Emilia et al., 2015).

Al-Emad (2016) asserts that the toxic nature of hospital waste poses grave concerns to environmental health. Due to Kenya's inadequate waste segregation methods, up to 50% of garbage is discovered to be infectious in some medical institutions. Kenya's hospital waste

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management systems face huge hurdles. Patients face grave everyday threats as a result of indiscriminate trash disposal (MoH, 2015). Medical waste is becoming an increasing concern in Kenya. Historically, inappropriate medical waste disposal has been a non-issue for the general public, and the magnitude of this has had a detrimental effect on both poor and distracted members of society. The purpose of this research is to determine the factors affecting the health care waste management system at Nairobi County, Kenya.

Inadequate management of medical waste can pollute air, soil and water sources, causing serious health consequences for human, animal and other living beings. The infectious and hazardous nature of health waste requires care and tact for the management or handling of waste (Yawson, 2016). People working in the medical field and the general public can be affected by the effects of poor handling of medical waste. This includes medical staff, from nurses to doctors, along with their patients and waste scavengers. There are a number of parasites, which can be acquired by waste handlers, people living near trash dumps, and those who suffer from cholera, yellow fever, and salmonellosis. These people are found to be carrying gastrointestinal parasites (Kuchibanda & Mayo, 2015).

Despite having been created to ensure the health of its patients, the healthcare system in fact causes illness and disease by spreading infections and contamination. Medical facilities create a wide variety of infectious and/or hazardous medical waste that, if not handled in a meticulous and well-thought-out manner, can cause serious health problems for patients, health care workers, those collecting the waste, and the community. Given the foregoing, the study aims to identify the challenges to manage medical waste in healthcare facilities in the County of Nairobi.

1.1 Problem Statement

Worldwide, governments are constantly on the lookout for solutions and alternatives that will help them improve their health standards. By establishing various public or private healthcare institutions, a way of improving standards can be achieved. However, in these health institutions, different health activities lead to huge amounts of health care waste (Mwania, 2019). Hospitals are health facilities that provide patients with preventive, curative and rehabilitative care (Hassan et al., 2018). One of the major environmental concerns is the management of hospital waste, which can significantly increase exposure to infectious pollutants. Hospital wastes have increased largely as medical activity has progressed rapidly and hospitals use relatively more disposable products (Makori, 2018).

The majority of health centers in Kenya, ranging from 18 percent to 64 percent, use ineffective waste treatment and disposal technologies, and excess water flowing from medical facilities sometimes gets into the public sewers unaltered before it gets treated, leading to a rash of disease outbreaks in the general population who drink this water. Among Kenya's most common challenges, the lack of awareness of, and education for health workers, the absence of storage and disposal facilities and other untreated devices are the unsuitable separation of infectious waste from general waste. Medical waste management poses health risks for communities in the Kamukunji sub-county. In this sub-county, health facilities face problems with poor funding, as they affect their waste management activities, which lead to public health problems. The test for 12 hospital waste management experts found relatively high rates of hepatitis B, pulmonary tuberculosis and enteric pathogens commonly associated with health care waste, multidrug-resistant bacterial organisms such as staphylococcus aureus (MRSA) resistant methicillin, and extensive-spectrum beta-lactamase organisms (ESBL) and Pseudomonas aeruginosa. Therefore,

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a study on the challenges of medical waste management among health facilities in Kamukunji district was needed.

1.2 Research Objectives

i. To assess the perceptions of staffs towards solutions to address the challenges of medical waste management in health facilities in Kamukunji sub-county.

ii. To determine the level of medical waste generation among health facilities in Kamukunji sub-county.

iii. To determine the health risks of medical waste management in health facilities in Kamukunji sub-county in Nairobi City County.

iv. To identify medical waste management solutions to address the challenges in health facilities in Kamukunji sub-county in Nairobi City County.

2.0 Empirical Review

2.1 An Overview of Medical waste

Non-infectious medical waste is any kind of solid waste generated by medical diagnoses, treatments, or immunizations and includes medical waste generated by the production, research, or testing of biological specimens, including blood and blood products (Awodele et al., 2016). Medical waste like trash from hospitals' non-infectious cleanup activities are dumped in landfills while infectious medical waste goes to incinerators (Al-Khatib, 2014).

Medical waste can be defined as any debris which contains infectious agents or viruses. That can include things like tissue and organ cultures, infectious virus stock, pathological waste, human blood and blood products, which have been discarded, are no longer fit for consumption. Other discarded items include contaminated medical instruments, infected animal carcasses, and waste from medical, pathological, surgical, or pharmaceutical laboratories. Other medical waste includes things like these: (Guerrero et al., 2013; Hassan et al., 2018).

Because medical waste handling is a potentially hazardous activity, it requires specialized training that is tailored to the nature of hospital work, the hazards and risks to which employees may be exposed, and the responsibilities of individual employees (Njue et al., 2015). Although poor hazardous medical waste management is a problem in Kenya, it is a problem throughout the world, not only in Africa, but also in developing countries everywhere (Mugo, 2017). Nearly all injuries from sharps (such as needles and blades) result in a rise in infections in medical workers, hospital patients, and waste handlers and scavengers. Because of this, the need to treat medical waste at healthcare facilities has greatly increased (Hasan and Rahman 2018).

2.2 Waste management mechanisms employed by public health facilities

Most Kenyan hospitals are split on their categories of waste in regards to healthcare, as there are usually three major types (MoH, 2015). One of the most frequent waste management practices is using three bins to sort waste into the following categories: health conditions that are contagious or harmful general and puncture-proof containers filled with puncture-safe boxes to prevent waste spillage.

2.3 Challenges facing medical waste management among public health facilities

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Medical waste is a danger to the public and the environment if it is not properly handled. It is vital for anyone who is involved in the administration of the substance to comprehend its importance when handled correctly. Although healthcare workers involved in management tend to have gaps in knowledge, attitude, and practice, and thus often risk the public's health and the environment through pollution (Makori, 2018). A lack of knowledge about medical waste management is an obvious mistake; this can affect the practice of safe waste disposal and should not be ignored (Odonkor & Mahami, 2020).

Healthcare services, driven by the goals of eliminating risks, treating the sick, and dealing with health problems, all generate waste, which could pose dangers to human health. When waste created by health care activities is concerned, its potential to cause infection and injury is higher than that of other types of waste. This makes healthcare waste the most dangerous. The mishandling of healthcare waste could have negative health impacts, with catastrophic consequences, and may also have severe effects on the environment (Saat et al., 2015). Interest in handling healthcare waste (HCW) sustainably has been growing due to public fears of the adverse health effects that could result from exposure to possibly hazardous waste that patients produce during medical treatment (Ali & Kuroiwa, 2018). There is a huge difference in how Sub-Saharan African countries handle healthcare waste management, and this difference is particularly significant (Emilia et al., 2015).

Many countries around the world fail to think about the amount and type of healthcare waste that is generated in addition to environmental concerns related to healthcare waste management such as the management of waste through waste separation and recycling. Even though it may cause severe health consequences, it happens despite proper handling of HCW (Muduli & Barve, 2015). The Emilia (2015) team discovered that each year, approximately 8 million to 16 million new cases of Hepatitis B virus (HBV), 2.3 million to 4.7 million new cases of Hepatitis C virus (HCV), and 80,000 to 160,000 new cases of human immunodeficiency virus (HIV) are reported due to insufficient waste management systems (HIV).

No one should be surprised that in poor countries, where the various issues of healthcare compete for scarce resources, issues of waste management in healthcare have received less attention and don't get the prioritization they deserve. In healthcare management, the lack of good information on the critical aspect of healthcare waste management, as well as limited and narrow research on the public health consequences of its failure, makes it difficult to make informed decisions (Gao et al., 2015).

It has been a challenge for many years in developing countries to manage healthcare waste management and keep track of the quantities and compositions of waste generated. Healthcare waste is thought to be dumped openly in dumps and the environment in the hundreds of tons. This is often done alongside regular trash and hazardous waste (Giacchetta & Marchetti, 2016). Others have noticed a complete lack of health care workers (HCW) infrastructure, which they say is contributing to avoidable patient deaths (Yawson, 2016). Methods of waste assessment and quantification have been numerous in different parts of the world. A multitude of methods are available, ranging from field observations, to administration of questionnaires, to quantification (Giacchetta & Marchetti, 2016). Other methods include the use of checklists, public and private records, and other relevant information (Mansab, 2015).

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The information indicates that there's little variation in how various medical facilities manage their waste. (See the following figure) (Eslami et al., 2014). Waste minimization and reduction strategies were clearly absent at two different general hospitals, as described in the findings of a study by Awodele et al. (2016), who published their results regarding how the waste data and healthcare worker management practices of the two hospitals matched up (Borowy, 2020). If patients and the environment aren't protected from improper healthcare waste management, which compromises the air, water, and soil, people will be exposed to environmental risks. Health care facilities and hospitals have the obligation to provide citizens with good health. Even though healthcare wastes can present a greater risk than the diseases that were originally present, proper management is critical to minimizing the risk (Khan et al., 2019).

Before using any of these techniques, medical institutions must understand and study the issue and make a strategic plan, which takes into account local circumstances and is financially and logistically sustainable. It is essential to protect the health and environment from harmful waste such as medical waste by following all feasible procedures. It would be nice if we could get rid of all dangerous trash completely. Environmentally friendly waste management is defined by stricter control over waste storage, transportation, treatment, recycling, recovery, and disposal (ICRC, 2019).

Even though the World Health Organization says that if medical waste is properly sorted and managed, it rarely becomes excessive (2017). The overwhelming majority of healthcare waste can be disposed of as regular municipal solid waste, excluding a few items like dangerous medical needles, pathological waste, and infectious waste (which need special handling), as well as a small percentage of potentially hazardous chemical, biological, and pharmaceutical waste that has to be stored in specially designed containers (ICRC, 2019). The lack of rules or regulations concerning waste pick-up from hospital wards, treatment, handling, and disposal is a huge problem that must be addressed. These problems include inadequate training of personnel, who are inadequately equipped and lack waste management plans. This neglect of hospital waste causes it to be mixed with municipal trash, which only compounds the problem (Kumarasamy & Jeevaratnam, 2017).

It is hard to think of anywhere more serious than Africa with regard to medical waste management. You could name South Africa, Mozambique, Swaziland, Kenya, and Tanzania (Emilia et al., 2015; Kuchibanda & Mayo, 2015; Mugo, 2017). Poverty is identified as the primary reason for the lack of success in most African countries' efforts to handle hazardous waste in a sustainable manner. Additionally, the low temperatures (under 200 degrees Celsius) used in the medical waste incinerators results in the release of large amounts of dangerous byproducts such as HCl, CO, dioxins, and furans. The emissions from these incinerators are a hazard to the communities because these facilities (in hospitals) are located close to communities (Kuchibanda & Mayo, 2015).

If not handled properly, treatment of the HCW (including burning) could result in a significant pollution threat to the environment and air, with the release of mercury, dioxins, and furans. The safe management of health-care workers is critical in protecting the health of both the patients and the doctors working in a hospital, as well as protecting the general public (MoH, 2015).

Researchers working for the Japan International Cooperation Agency (JICA) and the Kenya

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Expanded Programme on Immunization (KEPI) discovered that in most medical facilities, health care waste management (HCWM) standards are not being met, which increases the risk of disease and injury for both patients and workers (MoH, 2015).

2.4 Health risks posed by medical wastes

The improper disposal of medical waste in healthcare establishments increases the risk of child, adult, and animal contact with these wastes, resulting in serious health consequences. This unsuccessful waste may also harm medical staff, which also pose a job hazard within the health care facility. Hospital-associated (HAI) infections affect about 5% of patients receiving hospitals according to the World Health Organization (2017). Because of this, resources that would otherwise be allocated to other patients are diverted away from this critical task.

The improper disposal of medical waste in the environment has a variety of negative consequences as well as positive consequences (WHO, 2017). Chemical pollutants from medical waste (for example, heavy metals) cause inconvenience in the surrounding area, and their accumulation in soil may have an impact on the plants in the compound, resulting in a distorting of the hospital's landscape. The clinic would be forced to find a more expensive water source due to the water becoming more contaminated as a result of groundwater contamination (WHO, 2019). Unsanitary dumping of garbage is a major source of dangerous pollutants which pollute equipment and spread infection to humans and animals (Khalaf, 2019).

Open dump sites are unsightly and can scare patients away, which will damage the hospital's reputation. Rather than focusing on developing new ways to recycle and reuse waste, medical waste management should prioritize education on the proper disposal of waste to the relevant healthcare administrators (WHO, 2017). People in the healthcare field, including healthcare workers, waste handlers, haulers, and general public members, face possible occupational and public health risks if management of healthcare waste at institutions like hospitals, clinics, and other facilities is poor. Human lives could be threatened by pollution which affects air, water, and soil, in addition to wildlife (ICRC, 2019). The community members may be able to collect used medical equipment, which if not properly disposed of, can potentially spread disease. Healthcare waste issues have gotten more complicated, with increased incidence of HIV, SARS, and Hepatitis B. The risk of cross-contamination when handling and disposing of such waste has greatly increased (UNEP, 2020).

Infectious diseases can be spread when human blood, used for injections and blood testing, comes into contact with wounds caused by contaminated needles and syringes. After getting straight to the consequences for human health, focus should be on the environmental risks like pollution to water, air, and soil (UNEP, 2020).

Upon reviewing the literature, it is clear that a significant amount of knowledge is lacking, and it is this gap that this study seeks to close. a) Background information As Hassan et al. (2018) have found in some studies that doctors, nurses, and laboratory technicians have better knowledge about medical waste management, they also acknowledge that there is still a gap in practice when it comes to medical waste management. Nurses and laboratory staff, as opposed to doctors, may have a better understanding of color coding and waste segregation at the source, as an example. All of the sanitary staff members are clueless when it comes to practices related to medical waste management. There is sometimes no correlation between the level of knowledge and the level of practice in medical waste disposal at the global, regional, and local levels. Therefore, on the basis of the findings from Kamukunji, this study seeks to fill in the gaps in

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knowledge regarding medical waste management challenges.

3.0 Research Methodology

This study was an analytical cross-sectional study design that used Fischer et al., (1997) formula for sample size determination. Multistage sampling methods for the selection of 10 health facilities and 141 study participants. Before the actual data collection, the questionnaires were pre-tested in one of the public health facilities in Starehe Constituency (Casino Health Centre) which was not sampled in the main study. The relationship between dependent and independent variables in this situation was determined with the help of correlation analysis. To estimate the strength of the connection between separate variables and dependent variable, the combination of odds ratio (OR) and 95% confidence interval (CI) was used. The statistical significance of the 0.05 level for each study was determined and the results were reported as a two-sided p value with 95 percent trust intervals (CI) for each study.

A multivariate analysis was carried out after a bivariate analysis has been completed, and all independent variables that were found to be significantly associated during the bivariate analysis were taken into account together in the multivariate analysis. This was accomplished through the application of binary logistic theory and practice. When estimating the strength of association between a retained independent variable and a dependent variable under consideration, the adjusted odds ratios (AORs) and their respective 95 percent confidence intervals (CIs) was used. Qualitative data collected from participants using an observational checklist was cleaned and coded manually based on themes developed from their responses (thematic analysis), and the results were reported in narrative form, with quantitative data being used to supplement and reinforce the findings. Various representations of the findings were presented including tables, bar charts, graphs, and pie charts.

4.0 Results and Discussion

4.1 Healthcare Waste Generation

4.1.1 Availability of Waste Storage Receptacle

All the health facility had medical waste storage receptacle with most of facilities (90.1%) had safety boxes and 73.8% use pedal bins to store the medical waste you generate

Table 1: Availability of Waste Storage Receptacle

Characteristics	Frequency	Percent
Safety boxes	127	90.1%
Pedal bins	60	42.6%
Standard dust bins	104	73.8%
Improvised receptacle	15	10.6%
Bucket	23	16.3%

As illustrated in Table 1, on observation it was found that most (60%) of health facility had filled

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up safety boxes and standard dustbins, sixty percent of respondents reported that their health institution had distinct containers (bins) for different types of garbage. Similarly, 70% of respondents said that hazardous waste generated by health care was segregated prior to treatment and disposal in their healthcare facilities. Additionally, 50.0 percent of respondents reported that healthcare waste was processed prior to being disposed of in their facility. Additionally, it was determined that 60% of respondents reported that their facility clearly indicates the path for waste management from segregation to final disposal. The findings indicated that among the other elements influencing the healthcare waste management system at the ten selected health institutions in Kamukunji Sub County, distinct containers (Bins) for various types of garbage received the highest mean score. The findings corroborate Kuchibanda and Mayo's (2015) claim that segregation of healthcare waste should begin at the point of creation and should be disposed of in accordance with applicable legislation and classifications.

4.1.2 Quantity of Daily Waste Production

Most of health facilities (39.0%) had daily medical waste weighing less than 26kg with 34.8% and 12.1% weighing between 26-50 kg and 46-100 kg respectively.

Table 2: Quantity of Daily Waste Production

Quantity	Frequency	Percent
0-25kg	55	39.0%
26-50kg	49	34.8%
51-75kg	20	14.2%
76-100kg	17	12.1%

On observation, the quantity of health facility waste generated at the various hospitals ranged from approximately 15 Kg to approximately 80 Kg. Pumwani Maternity Hospital generated the highest quantity of medical waste (80Kg), followed St Teresa's Parish Health Centre (50 Kg), Makkah Nursing Home (45 Kg) and the least from Bahati Health Center (15 Kg) during the study period.

4.1.3 Storage of Receptacle for Medical Waste

Majority of health facilities (88.7%) store medical waste receptacles inside a health facility.

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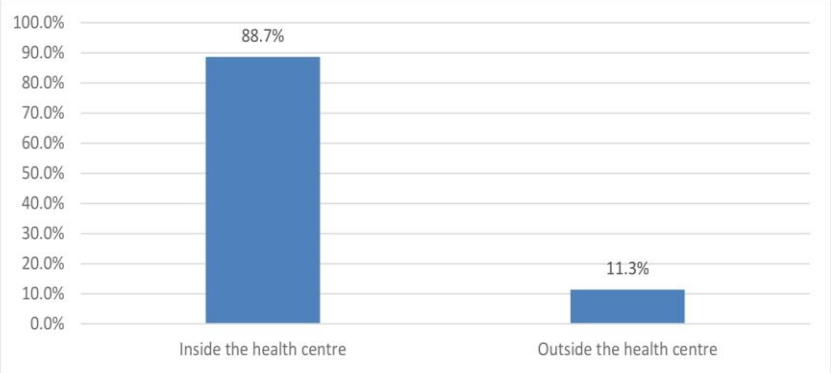

Figure 1: Storage of Receptacle for Medical Waste

On observation, over half of the health institutions said that there are frequently inadequate trash containers to handle the volume of healthcare waste generated. Only about a quarter of health institutions surveyed have some form of medical waste separation at the site of creation, and there are no designated carts or routes for trash transportation. The majority of health institutions lack waste storage areas. Over 80% of establishments in the Kamukunji sub county lack secure storage for medical waste. The garbage bags are heaped in the restrooms and even in the kitchens, which is unsightly and poses a significant hygiene hazard. Additionally, the data indicated that garbage, with the exception of sharps, is not segregated. Two-thirds of health care institutions have safe sharps containers (sometimes plastic bottles). Only about half separate other categories of garbage, such as waste generated in operating rooms and laboratories, which includes infectious and pathological waste.

4.1.4 Identification Method for Different Types of Medical Waste

Majority of respondents (95.7%) use color to identify different types of medical waste with slightly less than half (49.6%) using labelling (Figure 2).

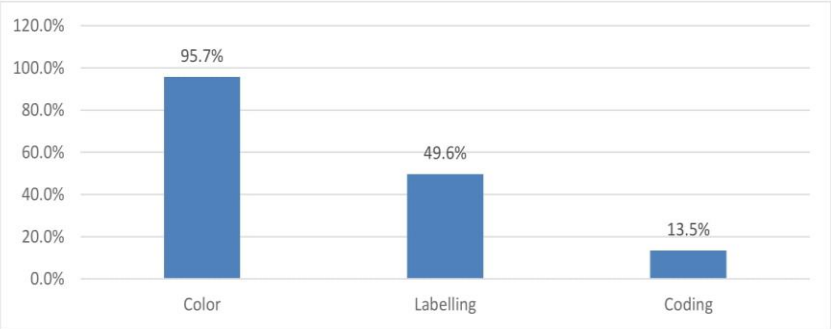

Figure 2: Identification Method for Different Types of Medical Waste

The researcher sought to ascertain respondents' perceptions on the various types of healthcare waste separated in their health facility. When it came to separating their rubbish into receptacles, respondents said that they separated their waste into general waste, infectious waste, and extremely infectious waste. Emilia et al. (2015) conducted a study in Ghana and observed that

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both public and private hospitals divided their trash into various groups by first determining the kind of waste and then separating non-infectious or general waste from infected waste.

The researcher wanted to ascertain respondents' perceptions on healthcare waste containers used in healthcare facilities. The respondents responded that their health institution mostly used color-coded bins, sharps containers, improvised local containers, and safety boxes. These findings are corroborated by Kumarasamy and Jeevaratnam (2017), who stated that the use of color coding and marking enables easy segregation and identification of various waste categories. Thus, segregation leads to safer waste management by explicitly identifying a certain color with a particular category and its related danger.

Only 40% of facilities utilize color coding (for infectious waste, they used yellow or red bags). One-third of hospitals lack enough on-site storage containers. All healthcare trash is frequently mixed with ordinary rubbish in open buckets lined with extremely thin plastic bags. The bags are insufficiently sturdy and, in many cases, readily perforated, allowing for leakage and spilling. Containers are not labeled, and there is no way to distinguish between garbage generated in kitchens and waste generated in labs.

4.1.5 Disposal of Healthcare Waste

Most of health facilities (90.8%) had given a contractor to dispose some medical waste with 36.2% and 15.6% of wastes are incinerated and burning respectively (Table 3).

Table 3: Disposal of Healthcare Waste

Disposal of healthcare waste	Frequency	Percent
Incineration	51	36.2%
Crude burning	22	15.6%
Given to a contractor to dispose	128	90.8%

The researcher wanted to ascertain respondents' perceptions on waste treatment technology utilized by healthcare facilities. The respondents responded that their Healthcare Facility mostly used open burning, burning chambers, composite pits, placenta pits, and incineration. The findings are comparable to those of Njue et al., (2015), who discovered that health centers had dug trenches. Additionally, the study discovered that the majority of potentially toxic compounds identified in the vicinity of health center burners were emitted during combustion, and the leftover ash included a high concentration of metallic contaminants.

Participants were asked about the challenges they've had when trying to use medical waste equipment in a hospital setting. Most of the respondents said they were at risk of infection because their healthcare facility did not provide them with adequate bin liners or ongoing medical education on how to properly handle healthcare waste equipment. They also said that some of the waste equipment was not weatherproof, making it difficult to work in bad weather conditions. WHO (2017) confirmed the findings, noting that the most frequently encountered problems with healthcare waste include a lack of awareness of the health hazards associated with HCW materials, a lack of education on proper waste management techniques, a lack of waste disposal systems, a lack of human and financial resources, and finally, a lack of priority given to the topic of healthcare waste.

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Researchers also wanted to know how respondents felt about the ultimate waste disposal techniques used by health care facilities. Respondents stated that the majority of their healthcare facilities used deep pit burials and open-burning as their preferred methods of burial. Medical waste in Kenyan hospitals is being burned in the open without any safeguards, according to Njue et al., (2015), who claim that the release of dioxins, furans and heavy metals that cause cancer in humans and kill ecosystem life has had a negative impact on the health of local residents who live near healthcare facilities.

4.1.6 Distance to Disposal Site from the Health Centre

More than half of health facilities (52.5%) had disposal site above 400 metres from the facility.

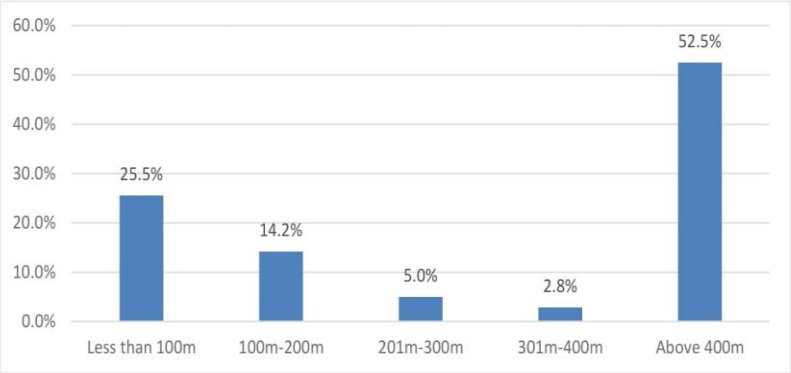

Figure 3: Distance to Disposal Site from the Health Centre

4.1.7 Availability of Manual/Guidelines on Healthcare Waste Management

Slightly less than three quarter (71.6%) of respondents had manual/guidelines on health care waste management in the facility.

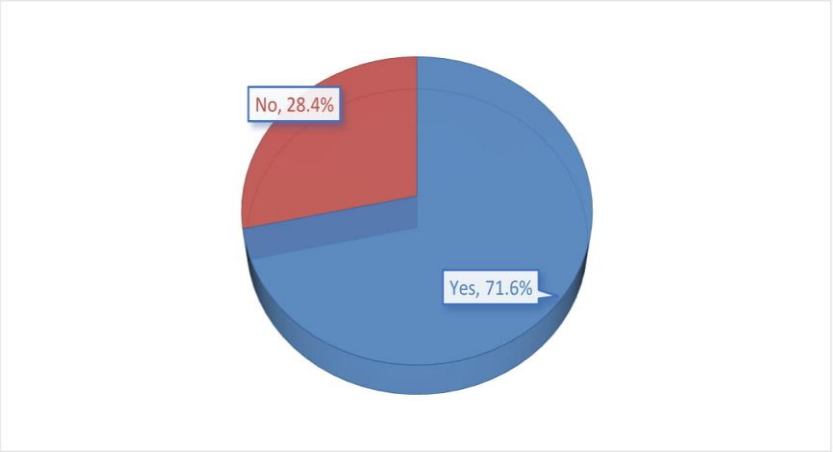

Figure 4: Availability of Manual/Guidelines on Healthcare Waste Management

4.2 Factors Affecting Waste Management

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4.2.1 Various Factors Affecting Waste Management

Lack of funds (76.4%), and lack of disposal site (73.6%) were common factors affecting waste management (Table 4).

Table 4: Various Factors Affecting Waste Management

Factors	Frequency	Percent
Lack of funds	107	76.4%
Poor logistics supply	70	50.0%
Lack of disposal site	103	73.6%
Lack of knowledge	77	55.0%

4.2.2 Correlational Analysis

When the traits are completely unrelated to one another, the coefficient of association is now equal to zero. As previously stated, statistical significance is defined as a probability (p) less than 0.01 ($p<0.01$). When the probability is more than 0.01 ($p>0.01$), the link is considered non-significant statistically. Pearson correlation coefficient (r) analysis was used to determine the correlation between the variables of interest in this study. Correlation The coefficient determines the degree of interdependence between the four predictor variables and the relationship between the predictor variable and the response variable (healthcare waste management system) at a 95% confidence range. The results of Table 5 demonstrate the significance of the association between a lack of cash, a deficient logistical supply, a lack of disposal space, and a lack of expertise among health institutions in Kamukunji Sub County. The findings indicated that while there is no statistically significant association between inadequate logistical supply and a lack of finance, there is a weaker positive relationship ($r = 0.134$, $p = 0.089$). However, there was a statistically significant and stronger positive relationship between a lack of disposal site and a lack of funding ($r = 0.562$, $p=0.003$), as well as a statistically significant and stronger positive relationship between a lack of disposal site and a lack of logistic supply ($r = 0.329$, $p = 0.011$). Additionally, a statistically significant and stronger positive link was discovered between lack of knowledge and a lack of funds ($r = 317$, $p=0.024$), a lack of disposal sites ($r = 0.384$, $p = 0.008$), and a lack of logistic supply ($r = 0.377$, $p = 0.019$). All predictor factors demonstrated a positive connection with the response variable, suggesting that they may all be used to describe the healthcare waste management system in Kamukunji Sub County.

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Table 3: Correlational Analysis

		Lack of funds	Poor logistics supply	Lack of disposal site	Lack of knowledge
Lack of funds	r	1			
	Sig. (2-tailed)				
Poor logistics supply	r	0.134	1		
	Sig. (2-tailed)	0.089			
Lack of disposal site	r	0.562*	0.329*	1	
	Sig. (2-tailed)	**0.003**	**0.011**		
Lack of knowledge	r	0.317*	0.377*	0.384*	1
	Sig. (2-tailed)	**0.024**	**0.019**	**0.008**	

4.2.3 Multiple Regression Analysis

According to the regression summary results in Table 6, the R Square value is 0.746, indicating that medical waste management was harmed by a lack of funding, a deficient logistical supply, a lack of disposal space, and a lack of understanding. This demonstrated a 74.6 percent variance in healthcare waste management due to a lack of funding, insufficient logistical supply, a lack of disposal site, and a lack of awareness. The remaining 25.4 percent suggests that there were additional elements affecting the healthcare waste management systems of the ten health institutions in Kamukunji Sub County that were not examined in this study.

Table 4: Multiple Regression Analysis

Model	R	R square	Adjusted R square	Std. Error of the estimate
1	0.864a	0.746	0.662	0.163

a. Predictor: (Constant), lack of funds, poor logistics supply, lack of disposal site, and lack of knowledge

4.3 Health Risks of Medical Waste Management

4.3.1 Problems of Medical Waste at the Community

Majority of respondents (87.2%) did not associate medical wastes with various problems with 12.8% associated medical waste with accidents (55.6%), diseases (27.8%), and drainage blockages (27.8%) as presented in table 7.

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Table 5: Problems of Medical Waste at the Community

Characteristics		Frequency	Percent
Medical waste problems	Yes	18	12.8%
	No	123	87.2%
Problems	Diseases	5	27.8%
	Accidents	10	55.6%
	Land pollution	7	38.9%
	Drainage blockages	5	27.8%

4.3.2 Health Risks Associated to Medical Waste at the Facility

Almost 11% of respondents associated health risks to medical waste at the facility such as diseases (80.0%), sharps-inflicted injuries (80.0%), and pollution (53.3%) as presented in table 8.

Table 6: Health Risks Associated to Medical Waste at the Facility

Characteristics		Frequency	Percent
Health risks associated to medical waste	Yes	15	10.6%
	No	126	89.4%
Specific health risks	Diseases	12	80.0%
	Pollution	8	53.3%
	Sharps-inflicted injuries	12	80.0%

Concerning the risks associated with the management of healthcare waste and interventions, observations at Kamukunji sub county health facilities suggested that personnel were at risk of needle-stick injuries/pricks. However, danger was mitigated with the use of personal protective equipment (PPE). At Pumwani Maternity Hospital, the majority of healthcare professionals used suitable personal protective equipment. However, less than 30% of employees at Diani dispensary, Majengo dispensary, and Rapha Medical Clinic wore sufficient PPE during the research period, putting them at risk of nosocomial infections and needle-stick injuries/pricks.

4.3.3 Individual Health Risks Associated to Medical Waste

At least 6% had been affected by medical waste with 62.5% and 50.0% affected on physical injury and environmental pollution respectively.

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Table 7: Individual Health Risks Associated to Medical Waste

Characteristics		Frequency	Percent
Affected by the medical wastes	Yes	8	5.7%
	No	133	94.3%
Individual health risks	Physical injury	5	62.5%
	My attitude was affected	1	12.5%
	The environment was polluted	4	50.0%

5.0 Conclusion

The study revealed that respondents mostly used color-coded bins, sharps containers, improvised local containers, and safety boxes. According to our observations, one-third of health institutions do not have enough onsite storage containers. By explicitly identifying a given color with a certain category and its accompanying hazard, segregation aids to safer waste processing. In buckets coated with very thin plastic bags, healthcare waste is mixed with ordinary rubbish. The bags are insufficiently tough and readily perforated, allowing for leakage and spilling. Containers are not labeled, and there is no way to distinguish between garbage generated in kitchens and waste generated in labs.

In this study, most of health facilities had daily medical waste weighing less than 26kg with 34.8% and 12.1% weighing between 26-50 kg and 46-100 kg respectively. On observation, during the research period, Pumwani Maternity Hospital created the most medical waste (80Kg) and Bahati Health Center generated the least (15Kg).

The study revealed that 87.2% of respondents did not associate medical wastes with various problems in the community. Almost 11% associated health risks to medical waste at the facility. At least 6% had been affected by medical waste with 62.5% and 50.0% on physical injury and environmental pollution.

The analysis discovered a statistically significant and greater positive association between a lack of disposal sites and a lack of funding; similarly, a statistically significant and larger positive relationship was discovered between a lack of disposal sites and a lack of logistic supply. Additionally, it was shown that a statistically significant and greater positive association existed between a lack of knowledge and a lack of funds, a lack of disposal sites, and a lack of logistical supplies.

6.0 Recommendations

It's also recommended in the study that all healthcare facilities in Kamukunji Sub County and all across the country receive proper management training on all elements of health workers' knowledge and practice. Health workers and waste handlers can be protected from exposure and accidents by identifying and filling in knowledge gaps among different types of healthcare employees. Refresher training for waste handlers and health care workers should also be provided following a critical review of existing waste management practices, including the stages of segregation; storage; collection; transportation; treatment; and disposal; as well as the development/adoption of guidelines and standard operating procedures.

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There should be a requirement for every health care facility (HCF) to maintain an efficient, safe, and hygienic medical waste management system that is as low-risk for workers, the public's health, and our environment as possible. This can be done by coordinating with the relevant ministries and agencies within each HCF.

The study recommends that medical waste management policies be updated on a regular basis and that healthcare workers and waste handlers receive refresher training on medical waste management policies in health facilities in Kamukunji sub county and throughout Kenya because healthcare workers lack knowledge about HCW management principles and existing policies at healthcare facilities in Kamukunji sub county. A further recommendation is that all Kenyan health institutions adhere to the 2007 National Policy on Injection Safety and Medical Waste Management, which stresses the need of pushing for both the support and implementation of healthcare waste management in Kenya.

The following ideas have an impact on how the 2007 policy is implemented: Safer injection devices as well as sharp waste disposal procedures are used to reduce the danger to health care personnel, patients and communities as a whole, and to reinforce the essential human resources for the strategy to be effective.

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