ASSESSMENT OF EFFECTIVENESS OF HOSPITAL WASTE MANAGEMENT PRACTICES IN PUBLIC HEALTH FACILITIES IN GARISSA COUNTY - KENYA

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DECLARATION AND APPROVAL

Declaration by the Student

I the undersigned declare that this project is my original work and has never been submitted for a degree in the university or any other university.

Signature ….  ….. Date……17/06/2021..

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Approval by the Supervisors

We confirm that the work reported in this project was carried out by the candidate under our supervision as the university supervisors.

Signature …… Date……17/06/2021……..

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DR. ESTHER NDONGA

DEDICATION

I would like to dedicate this work to my loving wives, Fatuma and Halima and my children for the support they gave me throughout my project development.

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I am most grateful to my supervisors, Prof: Mbaruk Suleiman and Dr. Esther Ndonga who have guided and corrected me throughout my project development. Secondly, I acknowledge the contributions of the other university lecturers who guided me and librarians who immensely assisted me in accessing materials for this study. Lastly, I appreciate my classmates with whom we shared knowledge and experienced that enhanced my skills and ability towards completing this study.

ABSTRACT

Hospital waste management requires an organized systematic channeling of waste through practically appropriate recovery disposal routes, consistent with acceptable public health and environmental safeguards. Management of hospital wastes is identified as one of the most critical operations in hospital environment. This is because such wasted can cause serious health problems. The Ministry of Health estimates 47% of hospital waste generated cannot be accounted for, thus risking the health of individuals and the general environment. The study was aimed to identifying and assessing the determinants of effective waste management practices in public health facilities in Garissa County. The specific objectives of the study focused on effectiveness of waste management practices, exposure to hospital wastes and health risks associated with hospital wastes in public health facilities in Garissa County. The study adopted a cross sectional design. The target population of this study is 2240 management staffs in 32 public health facilities in Garissa County and 500 households around the damp sites. The study used stratified proportionate sampling to sample of 340 staff and random sampling to sample 328 members of the community potentially exposed to hospital wastes. Quantitative and qualitative research data was collected through questionnaires and observation respectively. Descriptive statistics such as frequencies and percentages were used to analyze categorical data while Chi-square test was used to determine the relationships between the variables. The analysis was aided by GraphPad Prism statistical software version 7.04. The data was presented in tables, bar graphs and charts. From the findings, it was concluded that on averagely, proper hospital waste segregation occurs in Garissa County health facilities. Most health facilities were established to have in place informed and dedicated who follow waste management guidelines. On the other hand, it was evident from the findings that most health facilities in Gerissa County lack suitable and adequate temporary waste holding and treatment areas. Similarly, there health facilities have inadequate transportation mechanisms hampering regular emptying of waste containers. In addition, available incineration facility was not in good condition. As a result of poor health waste management, people living around waste management areas are exposed to health risk including contaminated sharps, contaminated ground water, and food poisoning as well as skin infections. The study recommends that appropriate clinical waste management should be put into place to ensure protection of human health and the environment. Similarly, adequate and appropriate waste handling and management equipment be availed to health facilities for efficient waste management. Staff involved in waste handling and management should be trained to minimize injuries and to enhance hospital waste management efficiency and effectiveness. Lastly, waste management areas should be isolated and fenced and communities living around the areas sensitized on the potential health hazards and how such hazards can be avoided.

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LIST OF ABBREVIATIONS

AIDS	**:**	Acquired Immune Deficiency Syndrome
CI	**:**	Confidence Interval
EMA	**:**	Environmental Management Act
ESM	**:**	Environmentally Sound Management
HBV	**:**	Hepatitis B Virus
HCV	**:**	Hepatitis C Virus
HCWM	**:**	Healthcare Waste Management
HIV	**:**	Human Immunodeficiency Virus MoE Ministry of Environment
MOH	**:**	Ministry of Health
OECD	**:**	Economic Co-Operation and Development
OSHA	**:**	Occupational Safety and Health Administration
PATH	**:**	Program for Appropriate Technology in Health
UNEP	**:**	United Nations Environmental Programmme
UNESCO	**:**	United Nations Educational, Scientific and Cultural Organization
USSR	**:**	Union of Soviet Socialist Republics
WHO	**:**	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The term 'waste' includes both disposable and recyclable materials. Health officials around the world appear to be concerned with the safe disposal of these wastes. Thousands of tons of bio hospital waste from hospitals, nursing homes, and clinics, including contaminated cotton swabs and bandages, fluid containers, needles, catheters, human tissues, and body parts, are now discarded in open trash bins by the side of the road in most parts of the country. The amount of these hazardous wastes generated is projected to rise (Ali, Mahmood, Malik, & Aziz, 2015).

According to global statistics based on historical evidence from the Environmental Protection Agency of the United States and the Ministry of Health of Japan, hospitals generate 1 to 1.5 kg of waste per day per room, whereas waste generated in developing countries will reach 5.2 kg (United Nations (UN), 2012). However, the issue of hospital waste is more about consistency than quantities, for example. The gross volume of hospital waste in most developed countries is calculated to be just 1.5 percent of overall urban waste. Due to its nature, however, a particular requirement to deal with this waste in an appropriate and healthy manner is needed. Hospital wastes are also well accepted as significant issues that have negative consequences for the ecosystem and/or humans by direct or indirect interaction. Disease diagnosis or damage may occur as a consequence of contact with toxic healthcare waste (Zafar, Ali, Uddin, & Khan, 2009).

Diseases such as typhoid, cholera, acquired immunodeficiency syndrome (AIDS), and infectious hepatitis B may be spread due to poor hospital waste control (Mato & Kassenga, 1997). According to Prüss, Emmanuel, Stringer, and Pieper (2014), about 8 to 16 million new cases of Hepatitis B virus (HBV), 2.3 to 4.7 million cases of

Hepatitis C virus (HCV), and 80,000 to 160,000 cases of Human Immunodeficiency Virus (HIV) are diagnosed each year as a result of improper vaccinations and mainly attributable to very weak waste treatment programs. Foul odors, mosquitoes, cockroaches, rats, and vermin, as well as pollution of underground water from untreated hospital waste in landfills, may all cause environmental problems (Nemathaga, Maringa, & Chimuka, 2008).

The condition is much worse in Africa, according to studies from all over the continent indicating inadequate hospital waste management policies (MWM) (Leornard, 2003). MWM in Tanzania, according to Lyasenga and Manyele (2010), is poor; further, he claims that generators and handlers are largely unaware of issues relevant to hospital waste management. Despite the fact that Tanzania's hospital waste management systems are said to be weak, recent efforts to address the problems caused by poor management have resulted in the installation of 13 pilot SSI in different parts of the country. The government decided to expand the SSI to all referral regional and district hospitals in South Africa because of the program's success; for example, hospital waste is seen as a growing concern. There have been several news reports in recent months of patient waste being improperly disposed of. The vulnerable and oppressed people of community have suffered as a result of this condition (Tshitangano & Olanyi, 2018).

A national strategy was established in Kenya to include realistic technological solutions as well as a five-year blueprint for managing healthcare waste. The National Hospital Waste Management Plan of Action is a resource for health officials and program officers around the country (Njue, Cheboi, & Oiye, 2015). The aim of creating this initiative was to provide a method that will assist health administrators in preparing, executing, and tracking health care waste management practices in their hospitals. This proposal outlines the current state of hospital waste management based on a desk

analysis and a survey undertaken to document the current state of waste management in Kenya (Ministry of Health, Kenya, 2007).

In Garissa County, just like other counties in Kenya, hospital waste management is a matter of concern to the government. The County covers an area of 44,174.5 km2 with an estimated population of 623,604. The County has one referral level five hospital, seven level four hospitals, 19 level three facilities and 21 public health facilities served by only two dump sites namely Garissa Provincial General Hospital incinerator and the Quba dump site. It is evident that there is need for research on health waste management in the County (County Government of Garissa, 2020).

1.2 Problem Statement

Productions of hospital wastes continue to be on the rise as populations grow. For instance, Pakistan produces around 250,000 tons of hospital waste is annually (Ferreira & Teixeira, 2010). Botswana produces around 2,400 tons of healthcare waste annually (Government of Botswana, 2007). World Health Organization reports that only 15% of hospital wastes are infectious, toxic or radioactive (World Health Organization, 2018). Ministry of Health, Kenya reports that 39% of the waste was infectious, while 61% was non-infectious (Ministry of Health, Kenya, 2007). While medical reports indicate that hospital wastes are generally safe, mismanagement of health wastes poses health risks to people and the environment by contaminating the air, soil and water resources (Titto, Savino, & Townend, 2012). In Kenya, hospital waste management remains a challenge. Report by the Ministry of Health, Kenya (2015) indicates that hospital waste in Kenya still remains a challenge, characterized by inadequate waste handling facilities, poor staff training and poor disposal. The reports shows that waste management performance at 2015 were just 14.24 percent. In Garissa County, it is estimates that 47 percent of

hospital wastes are not accounted for. Most of the health facilities dispose of their waste by burying it in the dumpsite without any treatment. Waste from hospitals ends up mixing with animal carcasses and abattoir waste (Vidija, 2014).

Similarly, the disposal site has no lining, soil cover or gas control enhancing potential risk of ground water contamination. While initiatives have been put into place by the government to enhance hospital waste management capacity, no research evidence exist as to the weather there is enhanced effectiveness in hospital waste management. In fact, Ministry of Health aknowledged need for research on hospital waste management effectiveness, proving existence of a research gap. This sought to fill this knowledge gap by assessing the effectiveness of waste management practices in public health facilities Garissa County.

1.3 Justification of the Study

The results of this study would be relevant to local health policymakers, medical regulatory agencies, medication dealers, health professionals, donors, and all other stakeholders interested in the medical sector because they may offer useful knowledge for successfully planning, managing, and supervising healthy hospital waste disposal. The County Government of Garissa may also gain from the study in that it may learn about the factors that influence hospital waste management in health facilities and the challenges so as to deal with them in order to ensure that the environment is clean and health of its residents is assured.

1.4 Objective of the Study

In order to achieve the purpose of the study, the study was guided by the following research objectives.

1.4.1 Broad Objective

The main objective of the study was to assess the effectiveness of waste management practices and exposure to hospital wastes in public health facilities in Garissa County.

1.4.2 Specific Objectives

i. To assess the waste management practices used in public health facilities in Garissa County.
ii. To determine the relationship between knowledge and awareness on hospital waste and effectiveness of hospital waste management in public health facilities in Garissa County
iii. To assess the level of health risks attributed to hospital wastes in public health facilities in Garissa County
iv. To assess how exposure to medical wastes influence effectiveness of hospital waste management in public health facilities in Garissa County

1.5 Research Questions

i. Which are the waste management practices used in public health facilities in Garissa County?
ii. What is the relationship between the level of awareness and knowledge on hospital effectiveness of hospital waste management in public health facilities in Garissa County?

iii. What are the health risks associated with hospital wastes in public health facilities management in Garissa County?

iv. How does exposure to medical wastes influence effectiveness of hospital waste management in public health facilities in Garissa County?

1.6 Scope of the Study

The study aimed at identifying and assessing the effectiveness of hospital waste management effectiveness in public health facilities Garissa County. The study targeted health workers in public health facilities in Garissa County and the community lining around dumpsites. In addition, the study assessed the health risks associated with community exposure to health wastes.

1.7 Limitations of the Study

The study experienced respondents laxity in giving the research data fearing that the information sought was sensitive and would be used to intimidate them or print a negative image about them or the health facility. The study was in some instances affected by respondents' hostility, with some respondents turning down the request to fill questionnaires. Lastly, the study experienced unavailability of reliable field data regarding the amount and types of wastes generated from health-care facilities, including the hazardous component and transportation of same along the waste chain is another limitation of the study.

1.8 Delimitations of the Study

To overcome the challenge of respondents' hostility, the researcher assured the respondents that the data collected was purely for academic purpose. The researcher presented an authorization permit from the University along with an introduction letter to confirm that the data requested would be for academic purposes only. The researcher addressed the limitation of unavailability of reliable field data on the amount and types of wastes by obtaining as much information as possible from the local public health authorities and in-charges of the respective institutions.

1.9 Operational Definition of Key Terms

Health facilities (HF): Hospitals, medical and dental laboratories, fitness centers, and pharmacies are among the healthcare delivery establishments registered and recognized by the Ministry of Health and Social Welfare (MOHSW).

Hospital Waste: Wastes; Medical facilities produce dangerous or non-hazardous waste during medical operations, clinical experiments, testing, prevention, curative, and/or diagnostic procedures.

Hospital Waste Management: Both practices leading to the proper and secure disposal of waste produced by health care facilities.

Improper Disposal: Disposing of pharmaceuticals in the trash, indiscriminate disposal to illegal dumpsites in cities, or even flushing pharmaceuticals down the toilet, where they join the sewer system, are both examples.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents the literature review of the study. The chapter presents theoretical review and empirical literature on hospital waste management practices, hospital waste awareness and knowledge, hospital waste exposure and hospital waste management effectives. In addition, the chapter presents conceptual framework and summary of reviewed literature.

2.1 Theoretical Literature

This study is underpinned on the Theory of Waste Management, the Health Belief Model and The Behavioral Change Model. The theories are discussed in this section.

2.1.1 Theory of Waste Management

Theory of waste management is founded on founded on premise that waste management is a process aimed at reducing harm to human, animals and environment in general. The theory tries to develop a robust waste management system (Pongrácz, Phillips, & Keiski, 2006). The theory provides conceptual analysis of wastes, activities of waste management and the objectives of waste management (Klaus, 1997). The idea is to build sustainability in the waste management system (Pongrácz, 2004). According to the theory of waste management, wastes can be reduced through strict avoidance and prevention and source, adoption of more efficient technology, improvement of waste quality, reuse and recycling of wastes (Mweu, Odero, Kirui, & Kinuthia, 2015).

The theory of waste management is based on industrial ecology paradigm. Based on this paradigm, hazardous and harmful effects and impacts of wastes can be eliminated

or minimized through effective waste management (Hostovsky, 2000). In this study, the researcher intends to adopt the theory of waste management to explain how effective hospital waste management can be adopted to minimize pollution and harmful effects such as injuries and infections to community attributed to poor management and disposal of hospital wastes.

2.1.2 Health Belief Model

Health belief model (HBM) was developed in 1950s to help in understanding why people fail to adopt disease prevention initiatives or early detection strategies (LaMorte, 2019). The theory provides a theoretical model to guide in prevention of diseases and predict health behaviors among individuals. The model argues that individual's heath is predicted by perceived susceptibility, perceived severity, perceived benefits, cues to action and self-efficacy (Rural Health Information Hub, 2002). The model motivates individuals to adopt positive health behaviors to avoid negative health consequences (Amanullah & Uddin, 2008).

While the health belief model has been widely adopted in health, a number of limitations associated with the model have been identified by scholars. The weaknesses include the model ignores individuals' attitude and acceptance of a health behavior, social acceptance and environmental and economic factors. The theory also assumes that information access is equal and that individuals make health decisions objectively (Norman & Conner, 2017). In this study, the researcher adopted health belief model to explain the possible behaviors of individuals concerning health concerns resulting from exposure to hospital wastes. The model explains the possible laxity among health professionals and individuals concerning exposure to hospital wastes.

2.1.3 The Behavioral Change Model

Behavioral change model is emerging as a very useful theory in understanding of changes in health related behaviors. The theory is applicable in implementation of public health interventions where the public in required to exhibit some behavioral changes (Campbell, Hildon, & Hobbs, 2014). Behavioral change model links environmental management with change goals. The theory explains why people change their behaviors and how change in behaviors can be initiated (Shaw, 2015). The key elements of behavioral change are; threat, fear, response efficacy, self-efficacy, barriers, benefits, attitudes, intentions, causes of action and reactance (Bandura, 2019).

In a study by Tucker and Speirs (2003), the behavioral change model was established to be appropriate in understanding human behaviors with respect to waste management. The study revealed that initial experience with waste leads to development of long term attitudes that affect response to waste management. Similarly, subsequent risks associated with wastes influence attitude towards wastes and waste management. The study revealed that the changes in attitude are very crucial in sustainable waste management. According to Grose et al. (2012), organization or government needs to understand the influence of policies and culture influence behaviors. Changes in behaviour initiatives must then be developed in cognizant of such factors.

In this study, the researcher applies the behavioral change model to understand the bahavioural patterns exhibited by medical practitioners and officers in health facilities where hospital wastes are generated as well as the members of the community living around the waste management areas. This theory informs on the social and cultural factors that are important in waste management decisions and practices.

2.2 Literature on Research Variables

This section presents literature compiled from the past studies on the research variables, indicators as well as relationship between the research variables.

2.2.1 Hospital Wastes

In order to ensure compliance with WHO standards of waste from hospitals encompasses the above wide range of implements and patient paraphernalia, including tubes, medical tools, dressings, waste syringes, chemical waste, patient belongings, blood, and drugs, and toxic items, components, World Health connects them all institutions involved in the procedure to the cleanup process.

Hospital waste is divided between common waste and exclusive waste by the WHO. Private or insignificant waste is all weak. Red bag waste may include items, for example, bagging products from wet laundries, office supply crates, and powders that pose no threat to human or environmental health (World Health Organization, 1999).

Hospital wastes can be classified as therapeutic waste. Hospital waste Tracking Act (1988) identified therapeutic waste as any strong or fluid waste that is delivered in the, treatment, conclusion or inoculation of people or creatures, or in the generation and testing of natural living being. A wide range of squanders which are delivered by, specialist's centers or workplaces, healing centers, research and restorative units are viewed as therapeutic wastes (Srishti, 1998).

The second type of waste generated by hospitals is contagious, as well. There are infectious wastes, such as pathogenic microbes, viruses, parasites, and fungi present in adequate amounts or too great a concentration to induce illness in hosts that are vulnerable to infection. Unrefrigerated squander which includes society and utilizes post-mortems from work and correspondence, treatment dialysis that's tainted by wild

animals, seclusion with contaminated specimens, and so on (World Health Organization, 2011).

Pathological wastes are the next in the waste hierarchy of hospital generated waste. This class of biohazardous wastes includes skin, bones, fetuses, animal carcasses, human bodily fluids, and body pieces, and the majority of bodily fluids. that includes things like human and animal body parts that are part of the anatomy are often called anatomical waste The above is classified as contagious waste, even though the fact is that anatomical waste often includes good tissue (World Health Organization, 1999).

Other waste generated by the hospital includes needles and pharmaceuticals. Shatterproof bags, scalpels, scissors, shattered glass, pricked fingers, shard sheared cut fingers, and torn fingernails are all things that can cut you. Infected products are often called healthcare waste, which can cause harm or harm to the container they are contained in while they are present (Srishti, 1998) as well as unused pharmaceuticals that have to remain medication, sterile clothing used in the medical wards, as well as prescription vials, packets, needles, and gas canisters with or oxygen tanks which may be used for subsequent patient needs (World Health Organization, 2011).

Genotoxic and cytotoxic wastes were described by the World Health Organization (2005). Carcinogenic, teratogenic, and of course the various wastes produce, mutagenic as well. Most dangerous waste streams (militarily speaking) contain materials which present real health problems for people on the way in as well as the way out of a facility, and those which need to be addressed when they're sent away. Contaminants genotoxiques, contiendront des méens d' ure (a des produits cytostatiques), des méiques, des délayés avec des résidus-sintrants chimiques, et des matière-res radioactives pour lesqui produisent des chimiothérapies. of course, a lot of cytotoxic wastes would be required to treat the patient; certain substances which can either

execute or interrupt the formation of particular types of cells and tissue in certain cases are utilized in the chemotherapy process They are some kind of pollution that medical facilities have to deal with. Each dangerous chemical used in healthcare has at least one material that is poisonous, has a PH less than 2, which can cause chemical burns, and one that is higher than 12 that is corrosive, and another that can potentially cause or increase the risk of chemical burns, and some that are flammable, cytostatic, and genotoxic. Hazardous wastes include strong, for example, sugars, toluene and the phosphapluret compounds, while nonhazardous chemical residues include amino acid- and salt chemical substances such as sulfonium monoxides and some organic and inorganic salts, such as thiosulfate phosphates (Leornard, 2003).

2.2.2 Hospital Waste Management Practices

The goal of hospital waste management is to keep institutions and healthcare staff and patients well while remaining secure (Wafula, Musiime, & Oporia, 2017). It is explained in the article by Beldi (2014) there are many hospital waste management procedures. In this researcher evaluated the manner in which hospital waste is disposed, how the waste is treated, the most, as well as its packaging, its delivery, and how the waste is incinerated.

2.2.2.1 Waste Segregation

Segregation of waste separation encompasses: (Cheng , Sung, Yang , & Lo, 2008). Waste segregation, according to Blenkharn (2011), is the method of separating garbage and waste items in order to reuse and recycle materials. It is the first and most critical method of clinical waste management in healthcare facilities. According to reports, only ten percent of healthcare pollution is deemed highly contagious. With adequate

segregation at the origin, the proportion may be lowered to 1-5 percent (United Nations Environmental Programme (UNEP), 2002).

Medical waste must be distinguished from general waste at the point of generation, such as in all patient care activity areas, diagnostic service areas, procedure theaters, labor rooms, and treatment rooms, for healthy healthcare waste management. Waste is segregated at the point of generation so that it can be routed via the proper disposal pathway (Abor & Bouwer, 2008). Segregation is beneficial in the proper handling of hazardous waste. Non-risk waste, which accounts for 20% of hospital waste, is distinguished from risk waste (Evangeline, 2015).

The generator of bio hospital waste, such as physicians, nurses, and technicians, should be responsible for segregation. Waste segregation is stressed as a way of separating and storing healthcare vulnerability waste and healthcare general waste in suitable bins. Which allows those that administer the containers outside of the hospital wards to properly locate and manage them (Pruss , Giroult , & Rushbrook, 1999). Segregation often means that different types of healthcare vulnerability waste are stored in the right bins and handled appropriately. Segregation at the root reduces the risk of contamination, damage to those handling waste, and the volume of waste that may be incinerated, and is essential for the safe disposal of healthcare waste (Mato & Kassenga, 1999).

It is important to separate various waste types in order to ensure proper disposal. Hospitals are required to dispose of general waste alongside infectious waste if source isolation is not implemented, resulting in unnecessary disposal costs (Roslan & Habidin, 2014). Segregation not only helps to minimize the costs of managing patient waste, but it also assures that the proper pathways for collection, distribution, and final disposition of hospital waste are in place. Furthermore, hospital waste is separated from

one another so all types of medical waste must be stored, stored, and disposed of in various ways. Sharps/syringes, needles, cartridges, broken glass, and all other infected sharp tool or object disposal, for example, must be done differently. Marayana (2009) recommends that hospital employees be supplied with color-coded and numbered waste receptacles and sack holders in order for segregation to function effectively. These receptacles should be put as near to the point of output as practicable, and they should be replaced until they are three quarters complete, tightly bound, and numbered accordingly.

2.2.2.2 Hospital Waste Handling

Once the waste has been separated and stored in plastic bags or rigid containers, the handling protocols for clinical waste begin. Handling of patient waste occurs at all stages, according to Rappe and Nyregen (2009), and it is by handling that various individuals come into close interaction with hospital waste. Hospital waste operatives, as well as everyone else interested with waste handling, must manage it properly and with care, keeping in mind the potential dangers. Porters and other operatives must carry overalls, heavy duty or industrial gloves, and durable shoes, as well as goggles and a mask for incineration, to avoid injury from sharps. When treating, storing, or incinerating patient waste, these safety garments must be worn (Mato & Kassenga, A study on problems of management of medical solid waste in Dar es Salaam and their remedial measures, 1997).

Both bruises, abrasions, and other injuries suffered during handling should be identified to the Infection Control Officer, according to Beldeh (2014). (ICO). Hepatitis B vaccine is needed for healthcare staff, operatives, and any other personnel engaged in the management of clinical waste in order to prevent them from viral hepatitis B

infection. Personnel in charge of health and safety must guarantee that all individuals, even contractors who handle waste, are adequately covered (Pruss et al. , 1999).

2.2.2.3 Hospital Waste Storage

Waste must be collected between storage and final removal, and does not accumulate in public areas such as corridors, wards, or other public areas. There are several containers available for storing various forms of waste (World Health Organization, 1999). Plastic bags and rigid containers in various types are among them. On a 24-hour schedule, the waste is collected from the collection points until the containers are filled to the required size. Waste can not be held any more than 48 hours (Beldeh, 2014).

Temporary waste storage, according to Pruss et al. (2014), is the location where patient waste is stored before being shipped to final disposal sites. The amount and form of clinical waste collected, as well as the frequency of collections, determine the location and scale of any waste storage. Bulk storage facilities should be maintained safe from wild and domestic livestock, rats, pests, and insects by a closed wire mesh enclosure. Entry to these areas should be restricted to staff responsible for the handling, delivery, incineration, and final disposal of the waste. Both storage containers, both internal and external, must be held clean and disinfected, and they must be quickly emptied. In the event of a leak, disinfectants can be put next to the waste.

2.2.2.4 Hospital Waste Transportation

Hospital waste must be transported from the point of generation to the facilities where it can be stored and/or disposed of, according to Insa, Zamorano, and López (2010). Hospital waste must be collected and transported by qualified staff from approved waste disposal firms. The transportation of hospital waste is determined by the type of

waste. According to Amanullah and Uddin (2008), the transportation of hospital waste should always be regulated by a document that indicates the volume and form of waste, the origin of the waste, the waste collection date, and the destination. Singh (2001) developed that when waste is shipped inside the plant, all containers should be covered and labelled as biohazardous according to WHO guidelines. According to the Government of Botswana (2007), bags and rigid containers must be labelled "clinical waste," the place of manufacture must be stated, and clinical waste must be transported using red wheelie bins, trolleys, and carts designed specifically for transporting clinical waste. The containers can be quickly washed and emptied, allowing waste to be treated with ease.

According to Kumari, Jurel, Srivastava, and Singh (2013), transportation routes inside a hospital should be clearly marked to prevent passing across patient care areas. To reduce the chances of bio-hospital waste combining with general waste, separate periods should be set aside for its transportation. There must be a liaison between waste sources and those responsible for collection and storage as waste is delivered from healthcare facilities to disposal locations by respective municipal authorities or contractors. Only specially built vehicles can be used to move this kind of waste.

2.2.3 Hospital Waste Treatment and Disposal

For the management of clinical waste, a number of key technologies are usable. Waste treatment reduces the length, weight, infectivity risk, and organic compounds in the waste stream (Pruss et al., 2014). Incineration, autoclaves and retorts, microwaves, and disinfection processes are examples of treatment procedures (Sawalem, Selic, & Herbell, 2008). According to the literature, dumpsites, managed landfills, sanitary

landfills, and pits are the most popular disposal methods for solid clinical waste, especially in developed countries (El-Salam , 2010).

Different waste types must be handled accordingly, according to Ananth, Prashanthini, and Visvanathan (2009). Burn and non-burn technologies are often used to classify healthcare waste management technologies, particularly for infectious waste, and each has its own set of benefits, drawbacks, and deployment requirements. Incineration is the most often promoted disposal technology for hospital waste. Incineration remains the gold standard disposal method, but it is increasingly being used only for the most complex waste fractions (Blenkharn, 2011). Incineration is described by Mato and Kassenga (1997) as a regulated combustion method for converting solid, liquid, or gaseous waste to carbon dioxide, other gases, and relatively noncombustible residue or ash. The World Health Organization (2010) recommended incineration as a feasible intermediate solution, especially for developed countries with restricted waste management options such as autoclaves, shredders, or microwaves.

A correctly built and installed incinerator can totally destroy garbage, leaving just ashes as residuals, and it should be fitted with a scrubber to capture harmful air contaminants released (Nemathaga et al., 2008). Incineration, according to environmentalists, merely changes the type of pollution while maintaining the hazards (Mmereki, 2018). Incinerators combust waste, leaving behind radioactive ash and noxious chemicals that can pollute the environment. Workers' wellbeing, public health, and the atmosphere are all said to be harmed by these pollutants. Incinerators for medical waste are a major cause of dioxins and mercury in the atmosphere. Non-burn systems tend to produce less contaminants, are more cost-effective, lightweight, and dependable, and do not produce secondary pollutants (Adil & Kafeel, 2020).

2.3.4 Awareness and Knowledge on Hospital Waste Management

Daily training programs are needed for every clinical waste management scheme to operate smoothly. To raise awareness of health, safety, and environmental concerns among hospital workers, proper training is needed (Sasu & Kümmerer, 2011). Staff employees who handle waste should receive instruction in waste handling, segregation, recycling, and treatment procedures. Since successfully completing required preparation, this category of citizens should be supplied with safety equipment and obtain certificates of proficiency (Pruss et al., 2014).

According to Abdulla et al. (2008), 29 percent of hospitals in Northern Jordan had not offered instruction on hospital waste management to physicians and other professionals, and 57 percent of the hospitals surveyed had given only minimal training to support workers. According to a survey conducted by Yong, Xiao, and Wang (2008) in Nanjing city hospitals in China, the following training issues were discovered: there was a shortage of adequate training and education services for all hospital personnel. Doctors and nurses were given special training and instruction in some clinics, while cleaning staff and technicians were not. Training and education systems have not been established in any of the hospitals. They also discovered that there is a shortage of adequate coordination, monitoring, and assessment of the results of hospital waste management training and education programs.

According to Coker et al. (2009), 59 percent of health staff in Ibadan, Nigeria, were not educated in hospital waste management. The programs in Ibadan tertiary hospitals, where any form of instruction is provided, are not up to date.

2.2.5 Exposure to Hospital Wastes

The importance of health hazards is shown by a recent International Labour Organization (ILO) report that at least 2 million accidents each year are caused by industrial diseases and accidents among the world's 2.7 billion employees (ILO, 2003). Since evidence for calculating nonfatal disease and disability is not valid for much of the world, the ILO figures for deaths are just the tip of the iceberg. Employees' underreporting of sharps accidents is well known in the literature, with figures varying from 22% to 99%, and has been shown to differ by profession and hospital (Efaq, Rahman, Nagao, & Kadir , 2017).

According to the ILO, work-related illnesses and accidents cost the economy around 4% of GDP (ILO, 2003). The total direct costs, which include laboratory costs for both source patients and exposed workers, labor costs associated with research and counseling, and post-exposure prophylaxis costs, are reported to be $3,042, with costs varying from $1,663 to $4,838 (Center for Disease Control (CDC), 2009).

Sharps accidents should be avoided, although the ultimate target should be to eliminate them. As a first move in that direction, the US Public Health Service has set a national health goal for 2010 to reduce sharps accidents among health-care employees by 30%. (CDC, 2009). Furthermore, government laws mandate health care providers to develop concrete policies to mitigate these accidents. Government officials, employers, and service suppliers, as well as health care professionals themselves, must work together to prevent sharps accidents.

The availability of safer needle systems and sharps bags will be appropriate steps to reduce the likelihood of patient sharps accidents. The bulk of needle and sharps accidents can be avoided by a mixture of preparation, better operating procedures, and the usage of medical instruments and sharps safety systems (Davis, 2004).

The population in the vicinity of the damp sites is at a high risk of being exposed to health risks, especially when the damp sites are accessible. In developed nations, open pit dumping is the most popular form of hospital waste disposal (Al-Khatib, 2013). This is more likely due to the fact that it is less costly and there are no other viable alternatives. Despite the fact that it is the cheapest alternative, open dumping has long been recognised as a public health and environmental contamination threat (Al-Khatib & Sato, 2009). Since the waste is open to scavengers and wildlife, it is an unregulated and insufficient recycling choice for clinical waste (Coker et al., 2009).

As a result, hospital waste can never be dumped on or around open dumps. This is due to the fact that untreated hospital waste spreads contagious pathogenic microorganisms through the atmosphere, either directly by wounds, inhalation, or absorption, or indirectly through the food chain or a pathogenic host animal (Pruss et al., 1999). Furthermore, breeze quickly sweeps over the dumped garbage, dispersing atmospheric contaminants into the surrounding areas (Nemathaga et al., 2008; Coker et al., 2009).

2.3 Empirical Literature

Several studies have been conducted on hospital waste management by researchers in various parts of the world. Kumar, Somrongthong and Shaikh (2015) evaluated effectiveness of healthcare waste management training model among health professionals. The study adopted quasi-experimental design and was based in Pakistan. The study established that healthcare workers are very crucial in hospital waste management. The study also revealed that training among hospital waste handlers significantly influence effectiveness of hospital waste management. In addition, the study identified knowledge, attitude and practices as other key determinants of medical waste management practices.

Almuneef and Memish (2003) conducted a study to assess effectiveness of hospital waste management with focus on the incineration facility. In the study, it was reported that while incineration is a recommended hospital waste management practices, incineration can lead to emission of that are hazardous to human health. The study recommended that hospital waste management officers must be trained on safe hospital waste handling practices. Min addition, the waste management practices and processes must be audited to make sure that the waste management plan is implemented as planned. Lastly, there is need for written down policies and procedures on hospital waste management.

These wastes need to dispose in a safe and responsible manner. There is need for national waste management plan in development of national plans of action for hospital waste management. In addition, there is need to designate special locations where hospital wastes can be disposed off, dumped or treated.

A study by Irianti, Prasetyoputra and Herat (2013) assessed the determinants of hospital waste management in Indonesia. The study focused on segregation at source and color-coded collection system. The study reported that hospital wastes are not only harmful to the public, but also to the patients and health care providers. It was observed that while waste segregation is among the popularly applied waste management practice, budget, central policy, management policy, and availability of standard operating procedures play key role in successful management of hospital wastes. The study recommends that there is need to out into place effective systems, procedures and regulations in handling hospital wastes.

In a separate study on healthcare waste management paradigms and sustainable waste treatment alternative in Khulna city conducted by Hasan and Rahman (2018), it was observed that various approaches are being adopted as alternatives to contemporary

waste management strategies. Some of these strategies are heavily built on modern technology. Modern technology is increasingly being adopted in incineration with the intention of improving the process and reducing the risks associated with the process. The method adopted in waste handling, treatment and disposals must be technically and financially sound. Similarly, the method must be safe and responsible.

In the health care waste management strategic plan 2015-2020 published by Ministry of Health, Kenya, hospital waste management is identified a very crucial. This is particularly because of the nature of the hospital wastes and the potential risks the wastes present in the environment. The strategic plan outlines the way forward for waste management officials in Kenya, especially in public hospitals. The plan outlines the key inputs in hospital waste management such as waste management training, waste management resource allocation and legal framework for hospital waste management (Ministry of Health, Kenya, 2015).

In Uganda, Kwikiriza et al. (2019) assessed hospital waste management in rural Uganda. In this study, it was evident that responsible hospital waste management does not only protect hospital staff but also the general public and local environment. However, the study established that most hospitals do not conform to required guidelines on waste segregation, waste transportation, waste storage and waste disposal. While the hospitals did not appear to implement effective hospital waste management, the production of hospital wastes is still on the rise. The study recommends that hospital wastes must be properly segregated, transported in appropriate conditions and disposed on in safe way.

2.4 Conceptual Framework

In this study, the researcher was interested assessing the effectiveness of hospital waste management in public hospitals in Garissa County. The study considered Health Waste Handling, Health Waste Storage, Health Waste Transportation and Health Waste Incineration. In addition, the study considered the role of knowledge and awareness on hospital waste management effectiveness. The relationship between the research variables is presented in figure 1.

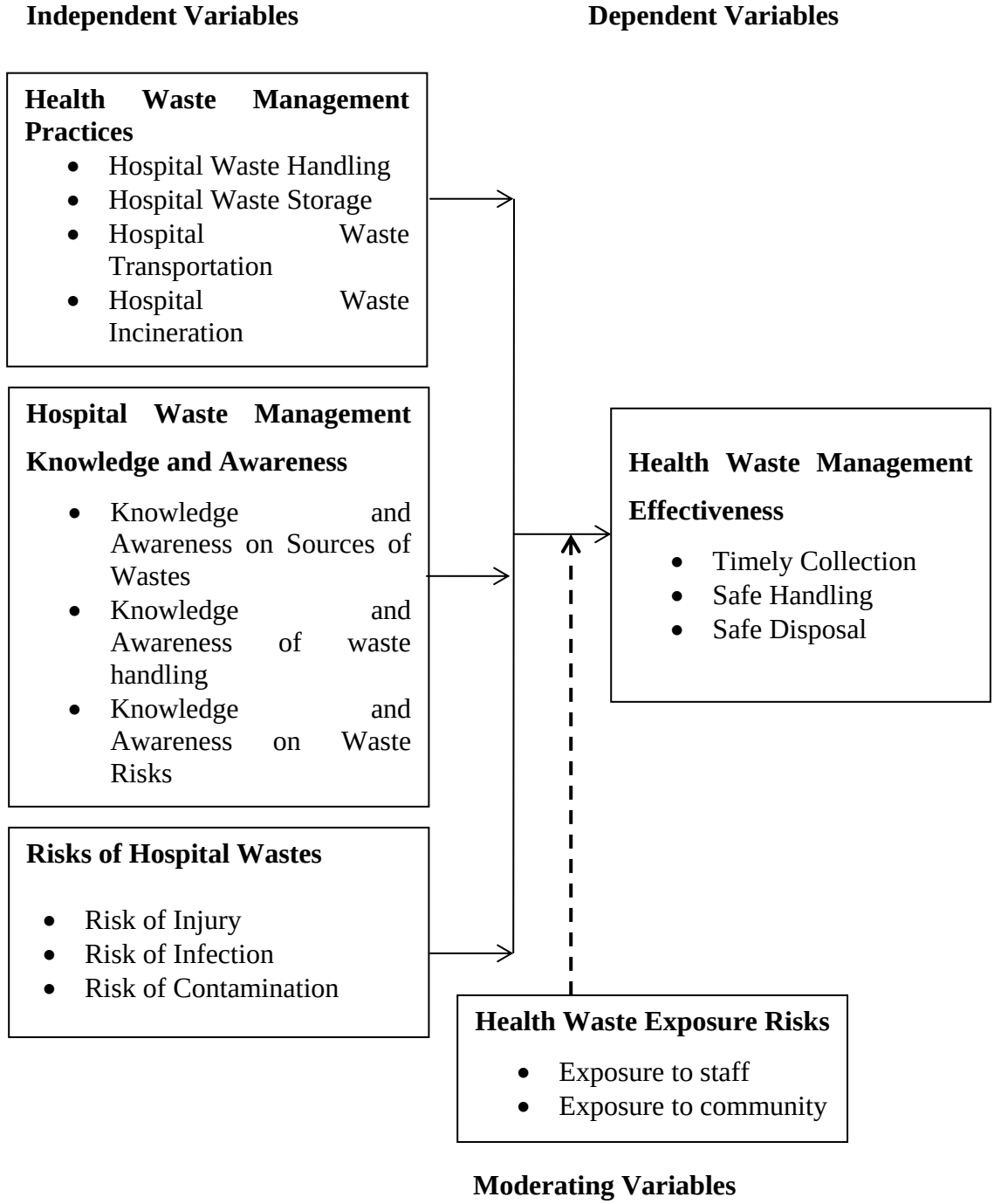

Figure 1: Conceptual Framework

2.5 Critique of Literature

The study reviewed literature on hospital waste management practices. Literature indicates that studies have been conducted on hospital waste management in various parts if the world (Adil & Kafeel, 2020; Sasu & Kümmerer, 2011). Literature indicates that hospital waste management effectiveness is critical as it does not only ensure clean environment Coker et al. (2009) but also reduces hazards and risks associated with poor hospitals waste management (Efaq et al., 2017). Studies reveal that there is need to enhance awareness among health care officials and members of the public, especially those living around the waste disposal areas (Al-Khatib, 2013; Davis, 2004). Findings from empirical studies indicate mixed findings on the research variables discussed in this study (Nemathaga et al., 2008; Amanullah &Uddin, 2008, Pruss et al., 2014; Beldeh, 2014; Leornard, 2003). From these findings, it is clear that there is a research gap that needs to be filled through a study. This study is informed by the existing research gap.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents methods and methodology to be applied in the study. It outlines the research design, research population, sampling techniques and procedures, data collection tools and procedure, data analysis and results presentation.

3.1 Research Design

The study adopted descriptive and a cross sectional design. Cross sectional study collects and analyses data within a fixed time period (Mugenda & Mugenda, 2003). Descriptive design was used because it relates research variable and provides a snapshot of the frequency or prevalence and the characteristics of the status of study population at a particular point in time (Kothari, 2004).

3.2 Location of the Study

The study was carried out in Garissa County which is located in north eastern region of Kenya it covers an area of 44,174.5km2 with an estimated population of 623,604 (Kenya National Bureau of Statistics, 2019). Garissa County is made up the following sub-counties; dadaab, balambala, lagdera, fafi, ijara and hulugho sub County. The damp sites are the Garrisa PGH incinerator and the quba dumpsite (County Government of Garissa, 2020).

3.3 Target Population

The target population is the list of all members or items that the research is interested in. It is the universe that the researcher is interested in (Kothari, 2004). The target population of this study was 2240 management staffs in 32 public health facilities in Garissa County and community living along the dumpsites. These staffs are in-charges of pharmacy, orthopedic, surgical, nursing, laboratory, nutrition and kitchen, records, public health, outpatient departments, x-ray, physiotherapy and occupational, mortuary, stores and procurement, maintenance, laundry and comprehensive care centre in each of the 32 public health hospital facilities in the County (County Health Office, 2016). The study as well targeted the community around the damp sites who are the first hit by the environmental nuisance which arise due to foul odour, flies, cockroaches, rodents, and vermin as well as contamination of underground water by untreated hospital waste in the damp sites. These were the 500 households around the damp sites.

3.4 Sampling Size Determination

The study used simple random sampling technique to sample the households to be involved in the study. Simple random sampling is considered unbiased as it ensures all members of the population have equal chances of being selected into the sample (Kothari, 2004). The method is not affected by external factors that lead to discrimination when selecting a research sample (Mugenda & Mugenda, 2003). The formula by Fisher, Laing and Stoeckel (1983) discussed by Mohamed (2017) was applied.

Where;

n= the required sample size

P = proportion of population with the required characteristics of the study (0.5)

Q = proportion of population without the required characteristics of the study (1-P)

N= Total population

e = accuracy level required. Standard error = 5%

Z= Z value at the level of confidence of 95% = 1.96

$$n = 1.96^2 0.5.0.5 \frac{500}{0.05^2(500-1) + 1.96^2 0.5.0.5}$$

n=217.

The sample size of the community households study was determined using above and as sample of 217 was obtained.

The health workers were stratified into the following strata as presented in table 1 below.

Table 1: Sample Frame for the Health Workers

Job Cadre	**Number**
Clinical Officer	550
Lab Tech	437
Nurses	835
Doctors	30
Dentist	12
Student Doctors	10
Cleaners	202
Mortuary Staff	7
Total	**N=2083**

Source: Researcher (2018)

The sample sizes for the strata were determined using the proportionate stratification formula presented below

$$n_h = (N_h / N) * n$$

Where n_h is the sample size for stratum h,

N_h is the population size for stratum h,

N is total population size, and n is total sample size

The sample sizes for the strata were obtained as presented in table 2.

Table 2: Strata Samples for Health Workers

Job Cadre	**Strata Size**	**Sample Size**
Clinical Officer	550	58
Lab Tech	437	48
Nurses	835	174
Doctors	30	7
Dentist	12	3
Student Doctors	10	3
Cleaners	202	45
Mortuary Staff	7	2
Total	**N=2083**	**n=340**

Source: Researcher (2018)

3.5 Sampling Procedure

A sample is proportion of the target population that the researcher intends to involve in data collection (Kothari, 2004). Garissa County Health workers have different job cadres that were considered as different strata. The respondents were selected by randomly picking personal numbers from employers list at the County head office for each job cadre using a computer generated random table the respondent per job cadre were selected proportionate to the study population to attain the required sample size as shown below.

3.6 Data Collection Tools

Data collection tools are key in determining the quality of research findings (Mugenda & Mugenda, 2003). Data was collected by the use of questionnaires and observations. The questionnaires comprised of both close ended-structured, and open-ended, unstructured questionnaires in order to encourage in-depth responses. A checklist as an observational guide was constructed following recommended standards for management of hospital waste. The observational guide was used to assess observe practices of handling hospital waste in different section of hospitals.

3.7 Data Collection Procedures

Data collection procedure outlines how the respondents were accessed and how the data collection instrument was administered (Kothari, 2004). Quantitative data was collected using structured questionnaires. The Researcher administered questionnaires individually to all respondents and waited for them to fill where possible. Where respondents did not have time to fill questionnaires instantly, the respondents were given adequate time to fill questionnaires. The researcher sought respondents contacts and followed up to collect duly filled questionnaires The researcher exercised care and control to ensure all questionnaires issued to respondent were received and to achieve this, the register of questionnaire was maintained. On the other hand, qualitative data was collected through observation. Observation guide was used to ensure the researcher only focuses on areas of interest.

3.8 Validity and Reliability of the Instruments

Validity and reliability analysis ensures the research instruments measure the intended variables, collect intended data and yield reliable results from analysis.

3.8.1 Pilot Testing

Pilot test helps in identifying and proactively managing potential challenges likely to be encountered duking research (Mugenda & Mugenda, 2003). In order to ensure data quality, the questionnaire were pretested on a selected sample of 15 respondents which were selected randomly. The respondents were given the same questions after two weeks keeping the initial conditions constant. Comments that were made during pretesting were analyzed and considered so as to improve the quality and reliability of the questionnaire and hence ready for final interviews.

3.8.2 Validity Analysis

Content and construct validity is used to determine validity. The degree to which data obtained using a particular instrument reflects a specific area or substance of a particular definition is known as content validity (Mugenda & Mugenda, 2003). The content validity of the instrument was developed through a lengthy phase of item selection and refining throughout its production. The material validity was pre-tested with experts in the industry, as well as hospital executives.

3.8.3 Reliability Analysis

Reliability analysis assesses the ability of research instruments to produce the same findings when similar analysis is repeated. To assess reliability, research questionnaires were administered to a group of 10 respondents. From the data collected, the researcher

computed cronbach alpha. Cronbach alpha enables the researcher to find out whether a respondent provided the same score on a variable if that variable administered repeatedly to the same respondent (Kothari, 2004). Mugenda and Mugenda, (2003) contends that Cronbach's alpha value that is at least 0.70 suffices for a reliable research instrument. The study thus used an alpha value that is at least 0.70 to test the reliability.

3.9 Data Analysis and Presentation

The records from observations were equally checked for completeness and consistency. Data analysis entailed quantitative and qualitative approaches. Quantitative data from the questionnaire was corded and entered into the computer for computation of descriptive statistics. The GraphPad prism version 7.04 scientific statistical software was used to analyze the collected data. The qualitative data generated from observations were categorized in themes in accordance with research objectives and presented in prose form. This was done on all the specific objectives of the study.

Inferential analysis by use of Chi-square was used to determine the statistical significance of relationship between independent variables. The relationship between waste management practices, community exposure and knowledge and awareness was established. The results were presented in tables and accompanied by explanations.

3.10 Ethical Consideration

Mount Kenya University's Ethical Research Committee was consulted for approval (MKU ERC). In order to perform study in Garissa County, a research permit was obtained from NACOSTI. Permission was requested from the local county authorities as well as the chief of the study district. Respondents were informed that the knowledge they provided would only be used for analysis. The researcher clarified to the

participants that the project is voluntary, and that they will not be paid or rewarded if they join, and that the analysis will not harm them, so they can feel free to do so. Before signing the consent document, participants were granted the opportunity to pose questions. They were informed that they had the freedom to withdraw from the analysis at any point and that doing so would have no negative consequences. The target group would not be required to include any details that would disclose their identity, so privacy was maintained in the analysis.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

The chapter presents the data analysis, and presentation of the study findings based on the study objectives. The study sought to assess the waste management practices used in public health facilities in Garissa County, to assess the health risk due to exposure of the hospital waste to the community around the dumpsites in Garissa County and to determine knowledge and awareness on hospital waste management among care personnel in public health facilities in Garissa County.

4.2 Response Rate

A total of 340 health professionals and 217 community members were surveyed. They also completed and returned the questionnaires, resulting in a 100% answer score. A response rate of 50 percent is sufficient for research and reporting, according to Mugenda and Mugenda (2003); a rate of 60 percent is fine, and a rate of 70 percent or more is outstanding. The answer rate was deemed outstanding based on the assertion. This was possible mainly because the researcher performed a drop and wait system of data gathering, where the researcher together with the research assistants would hand deliver the questionnaire and wait as the respondents answered the questionnaire.

4.3 Respondents' Demographic Information

The study sought to assess the demographic information of the respondents. This was intended to establish their capabilities in answering the research questions. The findings are presented in this section.

4.3.1 Garissa County Health Workers' Demographic Information

The study sought to find out the respondents' demographic characteristics based on Profession, Gender, Level of education, Number of years worked and the Type of Hospital served. Table 3 below shows the demographic information of Health workers of Garrisa County.

Table 3: Health Workers' Demographic Information

			Doctor	Nurse	Clinical Officer	Lab Tech	Dentist	Student Doctor	Cleaner	Mortuary Attendant	Total
Profession		N	(N7(2)	174(51)	58(17)	48(14)	3(1)	3(1)	45(13)	2(1)	340(100)
Gender	Male	N	(N5(2)	67(32)	38(18)	32(15)	3(1)	2(1)	15(7)	2(1)	164(48)
	Female	N	(N2(1)	107(61)	20(11)	16(9)	0(0)	1(1)	30(17)	0(0)	176(52)
Level of education											
Primary	Male	N	(N0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	15(100)	0(0)	15(4)
	Female	N	(N0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	30(100)	0(0)	30(9)
Secondary	Male	N	(N0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	2(100)	2(1)
	Female	N	(N0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Tertiary	Male	N	(N0(0)	65(53)	33(27)	25(20)	0(0)	0(0)	0(0)	0(0)	123(36)
	Female	N	(N0(0)	104(78)	20(15)	10(7)	0(0)	0(0)	0(0)	0(0)	134(39)
University	Male	N	(N0(0)	2(11)	4(22)	7(39)	3(16)	2(11)	0(0)	0(0)	18(5)
	Female	N	(N0(0)	3(27)	1(9)	6(55)	0(0)	1(9)	0(0)	0(0)	11(3)
NO of Years worked											
0-5yrs	Male	N	(N3(5)	25(39)	15(23)	12(19)	2(3)	2(3)	5(8)	0(0)	64(19)
	Female	N	(N2(3)	30(45)	10(15)	8(10)	0(0)	1(2)	15(23)	0(0)	66(19)
6-10yrs	Male	N	(N2(4)	22(40)	13(24)	10(18)	1(2)	0(0)	7(13)	0(0)	53(15)
	Female	N	(N0(0)	45(71)	5(8)	5(8)	1(2)	0(0)	7(11)	0(0)	63(19)
11-15yrs	Male	N	(N0(0)	20(44)	10(22)	10(22)	0(0)	0(0)	3(7)	2(4)	45(13)
	Female	N	(N0(0)	32(67)	5(10)	3(6)	0(0)	0(0)	8(17)	0(0)	48(14)
>16yrs	Male	N	(N0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
	Female	N	(N0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Type of Hospital											
Referral	Male	N	(N4(7)	15(26)	15(26)	10(17)	3(5)	2(3)	6(16)	0(0)	58(17)
	Female	N	(N1(2)	25(48)	10(19)	8(15)	0(0)	1(2)	7(13)	0(0)	52(15)
Sub-County	Male	N	(N1(3)	10(32)	10(32)	5(16)	0(0)	0(0)	3(10)	2(16)	31(9)
	Female	N	(N1(3)	15(43)	10(29)	4(11)	0(0)	0(0)	5(14)	0(0)	35(10)
Health Centre	Male	N	(N0(0)	20(43)	13(28)	10(22)	0(0)	0(0)	3(7)	0(0)	46(14)
	Female	N	(N0(0)	40(68)	5(8)	4(7)	0(0)	0(0)	10(17)	0(0)	59(17)
Dispensary	Male	N	(N0(0)	22(76)	0(0)	7(24)	0(0)	0(0)	0(0)	0(0)	29(9)
	Female	N	(N0(0)	27(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	27(8)

Source: Field Data (2020)

From the study findings in table 3, 52% of the respondents were female while 48% of the respondents were male. This implies that both genders were involved in the study indicating that the study did not suffer from gender biasness. Majority of the respondents (75 %) had Tertiary Level level of education, 8% indicated they attained university education, 1% indicated secondary level, while 13% of the respondents indicated primary level. This implies that most of the respondents were educated and in a position to understand the question and answer questions on hospital waste management in their public health facilities. Majority had worked for 5 years and less comprising of 38% while none had worked for over 16 years (0%). Furthermore, majority (32%) worked at the County referral hospital while only 17% were working at local dispensaries.

4.3.2 Community Respondents

From the findings, 60% of the community respondents were male while 40% were female. This is an implication that the study involved more male than female respondents from community around the damp sites. From the results 36% of the respondents from the community indicated they had attained primary school education, 23% indicated they had no formal education, 18 % indicated they had secondary education, 13% indicated they had Tertiary Level education while 8% indicated they had university education. This implies that majority of the respondents had basic education.

On the age, 40% of the community respondents indicated they were 26-35 years, 28% indicated 36-45 years,23% indicated they were under 25, 8% indicated they were 46-55 years while 4% indicated they were 56 years and above. This implies that most of

the community respondents around the damp sited was 26-35 years old. Table 4 shows the demographic information of the community respondents.

4.3.3 Community Respondents' Demographic Information

The study assessed the community respondent's demographic characteristics. The findings were as presented in table 4.

Table 4: Community Respondents' Demographic Information

Cadre	**Category**	**N**	**N (%)**
Gender	Male	130	60
	Female	87	40
Level of Education	No formal education	50	23
	Primary	80	37
	Secondary	40	18
	Tertiary	29	13
	university	18	8
Age	Under 25	50	23
	26-35	80	37
	36-45	60	28
	46-55	18	8
	56 and Above	9	4
Total		217	100

Source: Field Data (2020)

4.3 Types of Hospital Wastes

The study requested the health workers to indicate the type of wastes in the health facilities. The responses were as presented in table 5.

Table 5: Types of Hospital Waste

Type of waste		Doctor	Nurse	Clinical	Lab technolog	Dentist	Student	Cleaner
Infectious	N	7	174	58	48	3	3	45
	N	5	120	47	40	2	1	32
	n%	71	69	81	83	67	33	71
Pathological and	N	3	139	24	31	2	0	29
Anatomical	N	1	57	5	18	1	0	12
	n%	33	41	21	58	50	0	41
Chemical	N	4	153	39	45	1	0	0
	N	2	126	20	32	1	0	0
	n%	50	82	51	71	100	0	0
Pharmaceutical	N	6	169	54	34	3	2	37
	N	4	149	50	11	3	1	14
	n%	67	88	93	32	100	50	38
General	N	5	171	56	42	3	2	43
stuff)	N	4	159	47	38	2	1	39
	n%	80	93	84	90	67	50	91
Radioactive/Genot	N	6	127	41	36	3	2	0
	N	1	15	19	23	1	1	0
	n%	17	12	46	64	33	50	0
Proper waste Segregation	%Mean	53	64	63	66	70	31	40

Source: Field Data (2020)

According to the findings in table 5, majority of the respondents (90 %) indicated that the most frequent comprised of general wastes with genotoxic waste being the least frequent (28 %). It was shown that 36 % comprised of anatomical wastes like tissues, organs, body parts, human fetuses, blood and body. Infectious wastes including cultures and stocks of infectious agents from laboratories waste from survey and autopsy and dialysis from infected patients constituted about 73 %. Chemical and pharmaceutical wastes comprised of 75 % and 76% respectively. The study sought to determine whether there the wastes were properly segregated. From the findings, 70 % of the dentists indicated hospital wastes were properly segregated, followed by laboratory technologists (66 %). It was noted that student doctors and mortuary staff slightly

agreed that hospital wastes were properly segregated with percentage mean scores of 31 % and 17 % respectively.

4.4 Hospital Waste Management

Hospital waste management was assessed in terms of hospital waste handling, hospital waste handling and incrimination. The findings were as presented in this section.

4.4.1 Hospital Waste Handling

The current study assessed the availability and the conditions of hospital waste handling and management facilities in Garissa County hospitals. The findings were as presented in table 6.

Table 6: Hospital Waste Handling

Availability of management facility	Waste	Doctor & Dentist	Nurse	Clinical officer	Lab technologist	Student doctor	Other Support staff
Study Population	N	10	174	58	48	3	47
	N%	100	100	100	100	100	100
Is there a hand washing facility?	N (Yes)	9	169	57	48	3	26
	N%	90	97	98	100	100	57
Is there a temporary waste storage facility?	N (Yes)	8	170	55	48	2	44
	N%	80	98	95	100	67	94
Is there a special equipment for hospital waste	N (Yes)	3	83	9	21	1	12
	N%	30	48	16	43	33	25
handling?							
Is there a specific area for hospital waste disposal?	N (Yes)	2	109	26	17	1	19
	N%	20	63	45	35	33	40

Source: Field Data (2020)

It was found that most of the health workers agreed that there were hand-washing facilities with a frequency of 90-100 % except for the support staff who showed a frequency of 57 %. As to whether the hospitals had temporary waste storage facilities, all the laboratory technologists indicated yes as opposed to only 67 % of the student doctors. Generally, 96 % of the responds indicated that there were temporary storage facilities for the hospital wastes generated. In regard to the presence of special equipment/facility for hospital waste management, it was generally indicated that only 38 % of the respondents agreed. The study sought to determine the presence of specific areas for waste disposal. It was indicated by 51 % of respondents that the hospitals had a specific area where wastes were dumped/held awaiting further transportation to other regions or incinerator.

4.4.2 Hospital Waste Incineration

As to whether there were incineration facilities, there analysis gave the findings presented in table 7.

Table 7: Hospital Waste Incineration

Availability/condition of waste management facility			Nurse officer	Clinical	Lab technologist	Student doctor	Other Support staff	
Are incineration facilities available?	N(Only One with 200-400Kg capacity)		8	148	46	32	1	23
	N%		80	85	79	67	33	49
	N(Don't Know)		2	26	12	16	2	24
	N%		20	15	21	33	67	51
What is the condition of available incinerator?	Good	N	0	0	0	0	0	0
		N%	0	0	0	0	0	0
	Fair	N	6	78	17	16	0	18
		N%	60	45	29	33	0	38
	Don't Know	N	4	96	41	32	3	29
		N%	40	53 55	71	67	100	62

Source: Field Data (2020)

From the analysis, it was found that only one incinerator was present in the whole County. It was also shown that 76 % of the respondents were aware of its presence while 24 % did not know if it exists. The study also went further to determine the condition of the available incinerator. From the study findings, 60 % of the respondents did not know the condition of the available incinerator while 40% indicated that it was in fair condition. Surprisingly, all the respondents indicated that it was not in good condition.

4.3.3 Hospital Waste Storage and Transportation

The study sought to establish the hospital wastes storage and transportation practices. The findings were as presented in table 8 and figure 2 and 3.

Table 8: Hospital Waste Handling and Storage Practices

Waste management practice Doctors		Nurses	Clinical Dentists	Laboratory technologis	Student	Support
Study Population	N 10	17	58	48	3	47
	N% 10	10	10	100	100	100
Is hospital waste handled before treatment and disposal?	N (Yes) 9	15	49	36	2	39
	90	91	84	75	67	83
Is there a temporary facility?	N (Yes 6	12	37	29	1	19
	N% 60	74	64	60	33	40
Is hospital waste stored before further action	N (Yes) 8	15	47	41	2	43
	80	91	81	85	67	91
Does a waste handler records of the waste	N (Yes 2	63	22	15	0	11
	N% 20	36	38	31	0	23
Are plastic waste disposal?	N 10	17	56	46	3	44
	N% 10	99	97	90	100	94
Is there a routine waste collection?	N 0	50	19	20	0	22
	N% 0	29	33	42	0	47
Is hospital waste health facility?	N 7	15	43	14	2	27
	N% 70	89	74	29	67	57
Is Hospital waste disposal area?	N 5	95	38	12	1	18
	N% 50	56	66	25	33	38
Does incineration of place daily?	N 4	76	21	8	0	21
	N% 40	44	36	17	0	45

Source: Field Data (2020)

According to the study population, 90 %, 91 %, 84 %, 75 %, 67 % and 83 % of doctors and dentists, nurses, clinical officers, laboratory technologist, student doctors and support staff respectively indicated that the generated waste was temporarily handled before undergoing treatment and disposal. Furthermore, 60 %, 74 %, 64 %, 60 %, 33 % and 40 % of doctors and dentists, nurses, clinical officers, laboratory technologist, student doctors and support staff respectively indicated that temporary waste storage facilities are present. Out of 340 health workers, 80 %, 91 %, 81 %, 85 %, 67 % and 91 % of doctors and dentists, nurses, clinical officers, laboratory technologist, student doctors and support staff respectively showed that the wastes are

stored for at least one day before they are either treated, disposed or transported for further action.

It was noted that 20 %, 36 %, 38 %, 31 %, 0 % and 23 % of doctors and dentists, nurses, clinical officers, laboratory technologist, student doctors and support staff respectively indicated that weighing of the generated wastes by waste handlers took place and that there is a routine schedule for hospital waste collection. On the other hand, 100 %, 99 %, 97 %, 90 %, 100 % and 94 % of doctors and dentists, nurses, clinical officers, laboratory technologist, student doctors and support staff respectively showed that plastic bags and containers were being used hospital waste packaging and transportation.

As to whether hospital waste is collected daily from the health facility, 0 %, 29 %, 33 %, 42 %, 0 % and 47 % of doctors and dentists, nurses, clinical officers, laboratory technologist, student doctors and support staff respectively indicated the presence of routine schedule for waste collection from the hospital to the storage/disposal area. As to whether hospital waste is collected daily from the hospital, 70 %, 89 %, 74 %, 29 %, 67 % and 57 % of doctors and dentists, nurses, clinical officers, laboratory technologist, student doctors and support staff respectively stated that waste is collected on a daily basis from the health facility.

The study assessed the frequency of waste transportation to the disposal area. From the results, 50 %, 56 %, 66 %, 25 %, 33 % and 38 % of doctors and dentists, nurses, clinical officers, laboratory technologist, student doctors and support staff respectively said the hospital waste was transported daily to disposal areas.

Concerning the frequency of incineration of hospital wastes, 40 %, 44 %, 36 %, 17 %, 0 % and 45 % of doctors and dentists, nurses, clinical officers, laboratory technologist, student doctors and support staff respectively indicated that hospital waste was

incinerated on a daily basis. The study also sought to determine the mode of transport used in ferrying hospital wastes to the dumpsites. It was found that; wheelbarrows were the most employed followed by wheeled trolleys with vehicles being the least used. Figure 2 below shows the mode of waste transportation and frequency of use according to the study population

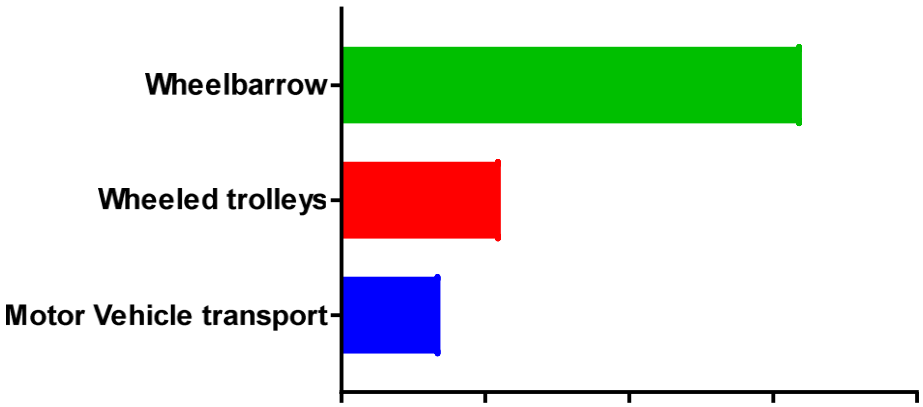

Figure 2: Hospital Waste Transportation Methods in Garissa County Hospitals

The current study also investigated the methods for waste disposal. The findings showed that burning was the most frequent methods with autoclaving being the less frequent. Figure 3 below demonstrates the results.

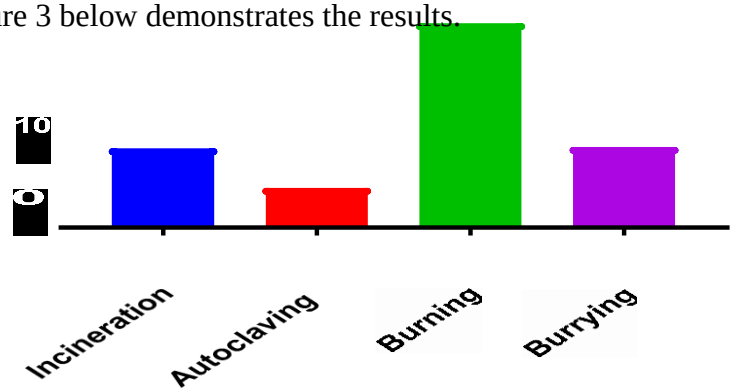

Figure 3: Waste Disposal Methods

4.4 Health Risk due to Exposure

The study assessed health risks due to exposure. This section presents research findings from the analysis.

4.4.1 Assessment of Hospital Waste-Related Skin Infections Risk Exposure

The study sought to determine if the persons living around waste dumpsites were exposed to skin infections caused by improper disposal of hospital waste. In this study, 70 % of the young females were exposed to hospital waste-associated skin infections as opposed to 36 % of adult counterparts. These results were statistically significant at $p<0.05$ with Odds ratio of 4.181 with a 95 % CI at 1.388 to 12.61; $p=0.0098$.

The results similarly indicated that 60 % of younger male individuals were exposed to skin infections emanating from improper disposal of hospital waste as opposed to 27 % of adult males. This results showed a 95 CI at 1.77 to 9.068 with an Odds Ratio of 4.056 with $p=0.0018$.

In terms of age, it was shown that 76 % of respondents aged below 25 years were exposed to skin infections as compared with only 16 % of those aged between 25 and 30 years old. This showed a stronger statistical significance at 6.607 to 40.27 with an Odds ratio of 16.32. A greater chasm was shown by $p<0.0001$.

There was no significant difference between those aged 36 to 45 years and those older than 45 years (Odds Ratio0.5938 (0.2265 to 1.778); $p=0.3234$. These show that those respondents who are younger in age residing around the dumpsites have a higher propensity of being exposed to hospital waste-related skin infections as opposed to older respondents. Table 9 below shows the relationship between age and gender and the risk of exposure to skin infections due to improper hospital waste dumping.

Table 9: Assessment of Hospital Waste-Related Skin Infections Risk Exposure According to Community Respondents

Cadre	Sub-cadre		Exposed to skin infections risk	Not exposed to skin infections risk	Odds Ratio (95% CI)	*p* Value
Femal	Young	N	14	6	4.181	0.0098
		N%	70	30	(1.388 to 12.61)	
	Adult	N	24	43		
		N%	36	64		
Male	Young	N	18	12	4.056	0.0018
		N%	60	40	(1.77 to 9.068)	
	Adult	N	27	73		
		N%	27	73		
Age	Below25	N	38	12	16.32	<0.000
	yrs	N%	76	24	(6.607 to 40.27)	
	and 25-35	N	13	67		
		N%	16	84		
	36-45 l	N	12	48	0.5938	0.3234
	46≥55	N%	20	80	(0.2265 to 1.778)	
		N	8	19		
		N%	30	70		

Source: Field Data (2020)

4.4.2 Assessment of Medical Sharps Injury Risk Exposure

The current study assessed the risk of medical sharps injury exposure to the communities living around dumpsites. It was strikingly determined that all persons dwelling or accessing hospital waste disposal sites were at a high risk of getting injured by contaminated medical sharps disposed in those areas. The results exhibited a greater statistical significance at 95 CI with p values less than 0.05. Table 10 below presents the results.

Table 10: Assessment of Medical Sharps Injury Risk Exposure According to Community Respondents

			Exposed to sharps injury risk	Not exposed to sharps injury risk	Odds Ratio (95% CI)	*p* Value
Female	Young	N	12	8	4.214	0.0070
		N%	60	40	(1.453 to 12.28)	
	Adult	N	21	59		
		N%	26	74		
Male	Young	N	22	8	16.89	<0.0001
		N%	73	27	(6.09 to 47.41)	
	Adult	N	14	86		
		N%	14	86		
Age	Below 25 yrs and 25-35	N	40	8	39.44	<0.0001
		N%	83	17	(13.72 to 99.05)	
		N	9	71		
		N%	11	89		
	36-45 and 46≥55	N	7	53	0.1226	<0.0001
		N%	12	88	(0.04361 to	
		N	14	13		
		N%	52	48		

Source: Field Data (2020)

4.4.3 Water and Food Poisoning Risk Exposure

The present study assessed the risk of exposure of persons residing around waste dumpsites to contaminated drinking water and food. It was shown that although 60 % of young females and

26 % adult females were exposed to risks of water and food poisoning, the results were not statistically significant at $p<0.05$ as depicted by $p>0.9999$; Odds Ratio (0.9344) with a 95 % CI at 0.3269 to 2.584. Similarly, there were no significant differences in risk exposure between respondents aged 36-45 and 46≥55 years as shown by $p=0.2442$; Odds ratio 0.5333 with a 95

% CI at 0.2127 to 1.271.

It was however noted that persons aged below 25 years were at a higher risk of contaminated medical sharps injuries as compared with those aged between 25 and 35 years. The results were statistically significant with Odds Ratio of 12.47 with a 95 % CI at 5.218 to 29.49. This depicted a greater chasm with p<0.0001. It was also shown that 73% of young males were exposed to

sharps injuries as compared with 14 % of adult counterparts. These findings were statistically significant at p<0.05 with Odds ratio of 0.3688 and a 95 % CI at 0.1535 to 0.9223; p=0.0332. the results are presented in table 11 below.

Table 11: Assessment of Water and Food Poisoning Risk Exposure According to Community Respondents

			Exposed to water and risk	Not exposed to water and poisoning	Odds Ratio (95% CI)	*p* Value
Female	Young	N	15	5	0.9344	>0.9999
		N%	60	40	(0.3269 to 2.584)	
	Adult	N	6	1		
		N%	26	7		
Male	Young	N	1	1	0.3688	0.0332
		N%	73	27	(0.1535 to 0.9223)	
	Adult	N	78	2		
		N%	14	86		
Age	Below 25 yrs and 25-35	N	37	1	12.47	<0.0001
		N%	83	17	(5.218 to	
		N	17	63		
		N%	11	89		
	36-45	N	24	3	0.5333	0.2442
	46≥55	N%	12	88	(0.2127 to 1.271)	
		N	15	1		
		N%	52	48		

Source: Field Data (2020)

4.5 Knowledge and Awareness and Hospital Waste Management Effectiveness

The current study assessed the significance of profession, level of education, training on hospital waste management and number of years worked/experience on proper hospital waste management awareness.

4.5.1 Significance of Profession on Proper Hospital Waste Management

The current study sought to find out the relationship between profession and proper waste management awareness levels. The findings showed that 70 %, 69 %, 60 %, 33 %, 33 % and 33 % of doctors and dentists, nurses, clinical officers, laboratory technologists, student doctors and support staff respectively indicated that sharps w a s t e s are incinerated when the sharps containers are ¾ full. Following analysis, this data was significant at $\chi 2$= 33.98; df=5; N=194; p<0.0001. This was statistically significant at p<0.05) since the p value was less than 0.05.

Concerning waste container emptying when ¾ full, 20 %, 38 % and 26 %, 60 %, 50 % and 17 % of doctors and dentists, nurses, clinical officers, laboratory technologists, student doctors and support staff respectively indicated that waste containers are emptied when ¾ full. This data was significant at $\chi 2$= 24.21; Df=5; N=118; p=0.0002. This data was statistically significant at p<0.05) since the p value was less than 0.05.

On whether the healthcare personnel recap used needles by their hands, 0 %, 19 %, 9 %, 17 %, 0 % and 7 % of doctors and dentists, nurses, clinical officers, laboratory technologists, student doctors and support staff respectively indicated that they always recapped used needles by hand.

Similarly, 10 %, 25 %, 40 %, 30 %, 50 % and 80 % of doctors and dentists, nurses, clinical officers, laboratory technologists, student doctors and support staff respectively said that they sometimes recap used needles by hand. On the other hand,

90 %, 56 %, 5 2 % , 5 3 % , 5 0 % and 13 % of doctors and dentists, nurses, clinical officers, laboratory technologists, student doctors and support staff respectively stated they never use hands to recap used needles. This was statistically significant at, $\chi 2 = 59.99$; Df=10; N=337; $p < 0.0001$. This data was statistically significant at $p<0.05$) since the p value was less than 0.05.

The study sought to find out whether the healthcare workers were aware and adhered to the universal precaution rule. The findings showed that 60 %, 83 %, 81 %, 68 %, 67 % and 26 % of doctors and dentists, nurses, clinical officers, laboratory technologists, student doctors and support staff respectively indicated that they were are and adhered to the universal precaution rule on hospital waste handling and management. This data was statistically significant $\chi 2 = 62.28$; Df=5; N=240; $p < 0.0001$. This data was statistically significant at $p<0.05$) since the p value was less than 0.05.

The study also sought to determine if the healthcare personnel were aware on the government plan on hospital waste management. It was shown that 78 %, 67 %, 64 %, 62 %, 50 % and 4 % of doctors and dentists, nurses, clinical officers, laboratory technologists, student doctors and support staff respectively were aware of the government plan concerning medical waste management. This data was statistically significant $\chi 2 = 61.56$; Df=5; N=192; $p < 0.0001$. This data was statistically significant at $p<0.05$) since the p value was less than 0.05. Table 4.10 below presents the results.

Table 12: Knowledge and Awareness and Hospital Waste Management according to Profession

Waste management practice		Doctors & Dentists	Nurses	Clinical officers	Lab technologists	Student doctors	Other Support staff	χ2 (Df)	p Value
At what level are sharps wastes incinerated?	N (¾ Full)	7	120	35	16	1	15	33.98(5)	<0.0001
	N%	70	69	60	33	33	33		
	N(Not Full)	3	54	23	32	2	31		
	N%	30	31	40	67	67	67		
At what level are waste containers emptied?	N (¾ Full)	2	64	15	28	1	8	24.21(5)	0.0002
	N%	20	38	26	62	50	17		
	N (Not full)	8	106	42	17	1	38		
	N%	80	62	74	38	50	83		
How often do you use your hands to recap used needles	N(always)	0	34	5	8	0	3	59.99(10)	<0.0001
	N%	0	19	9	17	0	7		
	N (sometimes)	1	43	23	14	1	37		
	N%	10	25	40	30	50	80		
	N(never)	9	97	30	25	1	6		
	N%	90	56	52	53	50	13		
Are you aware of /do you adhere to the universal/ conventional precaution rule?	N (yes)	6	142	46	32	2	12	62.28(5)	<0.0001
	N%	60	83	81	68	67	26		
	N(no)	4	30	11	15	1	35		
	N%	40	17	19	32	33	74		
Are you aware of the Government plan on bio hospital waste management	N (yes)	7	117	37	28	1	2	61.56(5)	<0.0001
	N%	78	67	64	62	50	4		
	N(no)	2	57	21	17	1	43		
	N%	22	33	36	38	50	96		

Source: Field Data (2020)

4.5.2 Significance of the Education Level on Hospital Waste Management Effectiveness

This study sought assess the influence of the level of education of healthcare workers on correct hospital waste management. The health workers at different levels of education were requested to indicate the level at which sharps wastes were incinerated. From the obtained results, 22 %, 0 %, 49 % and 62 % of primary, secondary, Tertiary Level (comprising of certificate, diploma and higher diploma) and university (undergraduate and post-graduate) indicated that sharps waste was incinerated at ¾ full. Following analysis, the results were significant $\chi 2= 0.0012$; Df=3; N=154; $p < 0.0001$. This data was statistically significant at $p<0.05$) since the p value was less than 0.05.

In terms of whether the waste containers were emptied at ¾ full, 36 %, 50 %, 57 % and 45 % of primary, secondary, Tertiary Level (comprising of certificate, diploma and higher diploma) and university (undergraduate and post-graduate) showed that the containers were emptied when they were ¾ full. After analysis, it was found that the results were significant $\chi 2= 8.101$; Df=3; N=177; $p =0.0440$. This data was statistically significant at $p<0.05$) since the p value was less than 0.05.

As to whether the health care workers used their hands to recap used needles, 5 %, 0 %, 18 % and 0 % of primary, secondary, Tertiary Level (comprising of certificate, diploma and higher diploma) and university (undergraduate and post-graduate) indicated they always recapped used needles by hand. In addition, 62 %, 100 %, 60 % and 45 % of primary, secondary, Tertiary Level (comprising of certificate, diploma and higher diploma) and university (undergraduate and post-graduate) said they sometimes recap by hand used needles. On the other hand, 27 %, 0 %, 33 % and 55

% of primary, secondary, Tertiary Level (comprising of certificate, diploma and higher diploma) and university (undergraduate and post-graduate) stated they never recapped

used needles with their hands. After analysis, results were significant $\chi 2= 10.14$; Df=6; N=331; p =0.1187. However, this data was not statistically significant at $p<0.05$) as the p value was greater than 0.05.

This study also assessed whether the education level influenced the health workers' awareness and adherence to the universal precaution rule. It was found that, 38 %, 50 %, 63 % and 69 % of primary, secondary, Tertiary Level (comprising of certificate, diploma and higher diploma) and university (undergraduate and post-graduate) were aware of the conventional precaution rule. These results were significant $\chi 2= 11.31$; Df=3; N=200; p =0.0102. This data was statistically significant at $p<0.05$) as the p value was lower than 0.05.

Additionally, this study sought to assess if the health care personnel were aware of the government's plan on biohospital waste handling and management. The results depicted that 4%, 0 %, 33 % and 66 % of primary, secondary, Tertiary Level (comprising of certificate, diploma and higher diploma) and university (undergraduate and post-graduate) were aware of the government's plan. The findings showed a $\chi 2= 31.80$; Df=3; N=107; $p <0.0001$. This data was statistically significant at $p<0.05$) as the p value was lower than 0.05. Table 13 below shows the results.

Table 13: Knowledge and Awareness of Proper Hospital Waste Management According to the Level of Education

Waste management practice		Primary	Secondary	Tertiary	University	$\chi 2$ (Df)	Degrees of Freedom	*P* value
At what level are sharps wastes incinerated?	N (¾ Full)	10	0	126	18	15.89	3	0.0012
	N%	22	0	49	62			
	N(Not Full)	35	2	131	11			
	N%	78	100	51	38			
At what level are waste containers emptied?	N (¾ Full)	16	1	147	13	8.101	3	0.0440
	N%	36	50	57	45			
	N (Not full)	29	1	110	16			
	N%	64	50	43	55			
How often do you use your hands to recap used needles?	N(always)	5	0	18	0	10.14	6	0.1187
	N%	11	0	7	0			
	N (sometimes)	28	2	153	13			
	N%	62	100	60	45			
	N(never)	12	0	86	16			
	N%	27	0	33	55			
Are you aware of/do you adhere to the universal/conventional precaution rule?	N (yes)	17	1	162	20	11.31	3	0.0102
	N%	38	50	63	69			
	N(no)	28	1	95	9			
	N%	62	50	37	31			
Are you aware of the Government's plan on bio hospital waste management?	N (yes)	2	0	86	19	31.80	3	<0.0001
	N%	4	0	33	66			
	N (no)	43	2	171	10			
	N%	96	100	67	34			

Source: Field Data (2020)

4.5.3 Relationship between Experience and Hospital waste Management Effectiveness

The current study assessed the relationship between the number of years worked by healthcare personnel and proper hospital waste management. The study findings showed that 48 % of those that had worked for at-most 5 years, 48 % of those had worked for between 6 and 10 years and

52 % of those that had worked for more than 11 years stated that sharps waste was incinerated when ¾ full. This gave a $\chi 2$ value of 0.2497 (2df); N=168 with p=0.8826. However, this was not statistically significant because the determined p value was greater than 0.05.

As to whether the waste containers were emptied at ¾ full, 57 % of those that had worked for at-most 5 years, 78 % of those had worked for between 6 and 10 years and 85 % of those that had worked for more than 11 years stated that sharps waste was incinerated when ¾ full. This gave a $\chi 2$ value of 24.19 (2df); N=244 with $p<0.0001$. This had a statistical significance at $p<0.05$.

Regarding the use of hands to recap used needles, 9 % of those that had worked for at-most 5 years, 5 % of those had worked for between 6 and 10 years and 2 % of those that had worked for more than 11 years indicated they always recapped used needles by hand. On the other hand,

42 % of those that had worked for at-most 5 years, 39 % of those had worked for between 6 and 10 years and 35 % of those that had worked for more than 11 years said they sometimes recap used needles by hand while 38 % of those that had worked for at-most 5 years, 56 % of those had worked for between 6 and 10 years and 62 % of those that had worked for more than 11 years never recapped used needles by hand.

Following analysis, this gave a $\chi 2$ value of 27.64 (4 df); N=244 with $p<0.0001$. This had a statistical significance at $p<0.05$.

The study also assessed if the healthcare personnel were aware of and adhered to the universal precaution rule when handling hospital waste. 43 % of those that had worked for less than 5 years, 73 % of those had worked for between 6, 10 years, and 77 % of those that had worked for more than 11 years indicated they were aware and were mindful of the universal/conventional precaution rule. This data gave a $\chi 2$ value of 30.89 (2df); N=213 with $p<0.0001$. This had a statistical significance at $p<0.05$.

The study also assessed if the healthcare workers were aware of the government's plan on bio- hospital waste handling and management. It was found that 28 % of those that had worked for at-most 5 years, 79 % of those had worked for between 6 and 10 years and 89 % of those that had worked for more than 11 years were aware of the government’s plan. These results had a $\chi 2$ value of 108.1 (2df); N=211; $p<0.0001$ with a statistical significance at $p<0.05$. Table 14 below presents the results.

Table 14: Knowledge and Awareness on Proper Hospital Waste Management According to The Number of Years Worked

Waste management practice		Number of years worked/experience				Degrees of Freedom	*P* value
		0-5yrs.	6-10yrs	≥11yrs	χ2 (Df)		
At what level are sharps wastes incinerated?	N (¾ Full)	63	57	48	0.2497	2	0.8826
	N%	48	49	52			
	N(Not Full)	67	60	45			
	N%	52	51	48			
At what level are waste containers emptied?	N (¾ Full)	74	91	79	24.19	2	<0.0001
	N%	57	78	85			
	N (Not full)	56	26	14			
	N%	43	22	15			
How often do you use your hands to recap used needles?	N(always)	25	6	2	27.64	4	<0.0001
	N%	19	5	2			
	N (sometimes)	55	46	33			
	N%	42	39	35			
	N(never)	50	65	58			
	N%	38	56	62			
Are you aware of/do you adhere to the universal/conventional precaution rule?	N (yes)	56	85	72	30.89	2	<0.0001
	N%	43	73	77			
	N(no)	74	32	21			
	N%	57	27	23			
Are you aware of the Government's plan on Bio hospital waste management?	N (yes)	36	92	83	108.1	2	<0.0001
	N%	28	79	89			
	N (no)	94	25	10			
	N%	72	21	11			

Source: Field Data (2020)

4.5.4 Relationship between the Hospital Waste Training and Proper Hospital Waste Management

The current study assessed if training on hospital waste had an impact on how the healthcare personnel of Garissa County health facilities handled and managed the generated hospital wastes. The findings revealed that 21 % of the workers trained on hospital waste management were aware that sharps waste is incinerated when the container is ¾ full. After analysis, this data gave a $\chi 2$ value of 4.345(1 df); N=70; p=0.0371 with a statistical significance at $p<0.05$. On waste container emptying when ¾ full, 46 % of the workers trained on hospital waste management agreed that waste containers where emptied at ¾ full. Following statistical analysis, this data gave a $\chi 2$ value of 0.009379 (1 df); N=229; p=0.9228. This results were not statistically significant at $p<0.05$ since the p value was greater than 0.05.

Similarly, 51 % said they sometimes recapped while 98 % indicated they never used their hands to recapped used needles. These results gave a $\chi 2$ value of 69.77 (2 df); N=340; $p<0.0001$ with a statistical significance at $p<0.05$ as the p value was less than 0.05.

In terms of awareness and adherence to the conventional precaution rule, 48 % of trained workers were aware and adhered to the universal precaution rule pertaining proper hospital waste handling and management. Chi-square statistics revealed a $\chi 2$ value of 12.39 (1 df); N=130; p=0.0004 with a statistical significance at $p<0.05$.

Regarding awareness of the government's plan on biohospital waste, only 43 % of the trained healthcare personnel were aware of the government's plan on biohospital waste management. These results gave a $\chi 2$ value of 0.7017(1 df); N=340; p=0.8377 this was not statistically significant at $p<0.05$ as the p value was more than 0.05. Table 15 below presents the results.

Waste management practice		Number of years worked/experience				Degrees of Freedom	*P* value
		0-5yrs.	6-10yrs	≥11yrs	$\chi 2$ (Df)		
At what level are sharps wastes incinerated?	N (¾ Full)	15	55	70	4.345	1	0.0371
	N%	21	79	21			
	N(Not Full)	93	177	270			
	N%	34	66	79			
At what level are waste containers emptied?	N (¾ Full)	106	123	229	0.009379	1	0.9228
	N%	46	54	67			
	N (Not full)	52	59	111			
	N%	47	63	33			
How often do you use your hands to recap used needles?	N(always)	18	6	24	69.77	2	<0.0001
	N%	72	25	7			
	N (sometimes)	51	131	182			
	N%	28	72	54			
	N(never)	98	36	134			
	N%	73	27	39			
Are you aware of/do you adhere to the universal/conventional precaution rule?	N (yes)	63	67	130	12.39	1	0.0004
	N%	48	52	38			
	N(no)	62	148	210			
	N%	50	69	62			
Are you aware of the Government's plan on Bio hospital waste management?	N (yes)	28	37	65	0.7017	1	0.8377
	N%	43	57	19			
	N (no)	103	172	275			
	N%	37	63	81			

Source: Field Data (2020)

4.6 Discussion of Findings

4.6.1 Hospital Waste

The various activities taking place in a healthcare facility generate two major categories of wastes which are, general and hospital wastes. General waste arises from unspecific administrative practices, landscaping as well as food materials and their preparation. Generally, this form of waste is kindred to city and household wastes.

Medical/Hospital waste entails the different kinds wastes produced from various therapeutic procedures performed in a health facility. Such activities include injections, surgeries, dialyses, biopsies, various resections like those gangrenous tissues and organs, chemotherapy, chemotherapy, paraclinical examinations, contaminated sharps with patient's blood and other body secretions among others. These wastes are generally regarded as hazardous and infectious (Pruss *et al*., 2014).

There are various factors that determine the amount of waste produced in healthcare facilities. They include the general conditions of the facility location, the nature of healthcare services rendered by the facility, the capacity of the hospital, socio-economic and socio-cultural status of patients among others (Askarian *et al*., 2004).

4.6.2 Hospital Waste Management Practices

Hand-Washing Facilities, Waste Storage, Waste Handling Before Treatment and Disposal in Garissa County Hospitals.

Pruss *et al.,* (2014) reckons that a temporary waste storage area should be well sanitized and secured in such a way that it is only accessible to authorized personnel so to minimize risks associated with these wastes.

This study found that most hospitals in Garissa County have temporary waste storage facilities for holding the waste before its transportation to the disposal site. It was however noted that the waste storage facilities were not big enough to accommodate the waste generated, they were poorly ventilated and lacked authorized accessibility. In most of the hospitals, hospital waste was collected on a daily basis and transported to the temporary storage area by waste handlers. These findings conformed to a previous study by the government of Kenya (2010) on hospital waste management in various hospitals, which showed that the frequency of collection of waste in most hospitals was at least once daily. Furthermore, this study indicated that 47 % of the visited medical facilities had waste storage temporary premises some of which that were disused and with leaking roofs.

Only a handful of waste storage facilities in Garissa County hospitals were fenced or had authorized accessibility. It is notable that the Government of Kenya study found that 61% of the storage facilities were fenced or had restricted entry. Additionally, these findings partly conform to a South African study that assessed the hospital waste management practices. This study showed well-secured but poorly sanitized temporary storage areas.

Research data has shown determined that the commonest mode of pathogenic transmission is by hands. Most nosocomial infections have been attributed to lack of or incorrect hand-washing habits (University of Colorado Denver, 2010). The visited hospitals in the current study had hand-washing facilities in most workstations. The presence of a hand-washing facility at every workstation is an indicator of the facility's hygiene status.

According to Pruss *et al.,* (2014), hospital waste treatment helps reduce waste volume, mass, organic compounds and the risk of associated infections. This study revealed burning as the most preferred method of hospital waste treatment. This could be attributed

to the fact that there is only one incinerator available in the whole County. Furthermore, the incinerator is not able to handle huge volumes of waste from across the County.

Hospital Waste Handling

After generation, hospital waste should be transported to a temporary storage are and subsequently to the dumpsites or incinerator. Hospital waste handling personnel should use appropriate personal protective gear, including overall gown, protective gumboots and gloves. It is imperative to use suitable and sufficient protective equipment always when handling hospital waste. Serious implications are imminent if the waste handler lacks knowledge on proper use of personal protective equipment and their importance (MoH, 2007).

The current study revealed that most of waste handlers in Garissa County healthcare facilities neither weigh nor keep records of the waste generated. Inventories of the waste generated by health facility helps determine the waste output and facilitate institution of mechanisms for storage and processing. Lack of these records deters proper waste management. It was also found that in all the visited hospitals, plastic papers and containers were being used for waste disposal. Similarly, routine waste collection schedules were absent.

Incineration of sharps waste was not performed on daily basis as only one incineration facility was present in the entire County. It was also indicated that open burning of waste was the most preferred method. These results however differ from a survey conducted by the ministry of health in 2007 that found that most hospitals were transporting and incinerating hospital waste on a daily basis and that incineration was the primary method

of waste treatment. Other methods included compost pits for nonhazardous biodegradable wastes, and shredders were only found in Kenyatta National Hospital, the Nairobi Hospital and Mater Mission Hospital. This study further highlighted that most of the health facilities did not have an alternative waste treatment option apart from incineration (MoH Kenya, 2007). Interestingly, most of the Garissa County hospitals used open burning as opposed to incineration as the most preferred method of waste treatment.

4.6.4 Factors Influencing Proper Hospital Waste Practices

Personal attributes, habits, level of education, training and environment are some of the factors that are thought to influence a person's behavior, thoughts and actions. Having a responsible behavior and adhering to the correct hospital waste management practices is an endeavor that should be held at the highest par. Kishore et al., (2000) reported that although the awareness about hazards and suitable management practices among healthcare providers globally, the level of awareness in some countries is still unsatisfactory.

Healthcare waste management and safe disposal depends on many factors including sensitization level of the health administration, managers and hospital workers, existing local legislation of healthcare waste management, and available resources. In Garissa County hospitals, due to various reasons, neither proper hospital waste management systems have been developed nor are the concerned healthcare administration, professionals and managers aware of the importance of the proper hospital waste management practices. The findings herein are synonymous to a similar study conducted in Pakistan by Arshad *et al*., (2011).

In the present world, various methods including on-site incineration, steam disinfection, microwave disinfection, autoclave disinfection, chemical/mechanical disinfection, burying and burning are used to dispose medically generated waste. In Kenya, especially Garissa County, like in the other developing world, five methods are being used for disposal of the healthcare waste; incineration, landfills, burning, burying and open dumping. It was astonishingly deduced that neither a single landfill is constructed on scientific lines nor the available incinerator in Garissa County had proper filters and scrubbers (Arshad *et al*., 2011).

This study indicated that profession of healthcare personnel working in Garissa County hospitals had a significant influence on proper hospital waste management awareness. These results are similar to a cross sectional study carried out by Sreegiri *et al*., (2009) to assess the awareness on hospital waste management and universal work precaution among 134 healthcare workers selected randomly out of 1300 including doctors, paramedics and class IV personnel of King George hospital in Visakhapatnam. The survey showed that only 11% of doctors, 32% of paramedics and 25% of class IV personnel were aware of the appropriate methods, guidelines of hospital waste segregation and collection into differently color-coded waste bins.

The level of education of healthcare workers showed a significant influence on the level of awareness on hospital waste handling and management practices except on the frequency of hand-recapping used needles. On average University degree, holders were more knowledgeable of correct hospital waste management practices, guidelines and standards. The findings of this study contrast with those of Yadavannavar *et al.*, (2012) that found

that more than 50 % of the respondents assessed their knowledge of biohospital waste management as ‘poor’.

The number of years healthcare personnel have worked in the hospital on average indicated a significant influence on correct hospital waste management as depicted in table 4.10 above. This is attributable to the experience gained by persons who have worked for long on the need and importance of adhering to appropriate hospital waste management practices.

Biohospital waste management training has been linked to proper waste management. The current study revealed that individuals who attended training were more knowledgeable of proper hospital waste management practices and standards as opposed to those who were not trained. There was a significant influence of training on all the assessed parameters except on the level of emptying waste containers and awareness on government’s plan on biohospital waste management plan as depicted by the findings. These findings in part conform to a previous study by Vienna *et al.*, (2005) that planned training programs were effective fostering the knowledge of nursing students. Additionally, there is conformity with another study on effectiveness of planned teaching programs on biohospital waste management among 150 nurses working in Mangalore hospitals (Ruby *et al*., 2006).

4.6.5 Community Risk Exposure

In spite of the fact that treatment and disposal of hospital waste helps reduce associated risks, the release of toxic pollutants into the environment may pose indirect health risks in many ways. Landfills for instance can contaminate drinking water as a result of poor

construction. In hospital waste disposal facilities that are poorly designed, run, or maintained, occupational risks to waste handlers exist (Patil and Shekdar, 2001).

People living around hospital waste dumpsites can adversely be affected by biohospital waste exposure. Incorrect hospital waste management practices like dumping in municipal dustbins, open spaces, water bodies among other improper places results to the spread of diseases. In addition, Incinerators' emissions and open burning also lead to exposure to harmful gases which can cause cancer and respiratory diseases (de Titto *et al*., 2012).

The current study assessed the risk of exposure of communities around dumpsites to hospital waste. The results revealed a significant relationship in the females' risk due to exposure to medical waste. The study showed that young girls are at a higher risk than the older counterparts. These findings are similar to Akter's (2000) study that established that, about 5.2 million people of which 4 million are children die each year from diseases associated with hospital waste.

The hazards of exposure to hospital waste can range from gastro-enteric, respiratory, and skin diseases/infections to more fetal diseases such as HIV/AIDS, and Hepatitis (Rao, 2008; Babanyara, 2012). The current study found that persons living around waste dumpsites were exposed to skin infections thought to be caused by improper hospital waste disposal. In addition, biohospital waste contains potentially harmful microbes that can infect the general public. Other potential infectious risks may include the spread of drug resistant microbial strains from hospitals into the environment. Based on the results and the observations made during the study, urgent measures need to be taken to arrest the situation.

This study also profoundly determined that the risk exposure due to incorrect medical sharps waste disposal in the dumpsites was alarming. These was exacerbated by various activities including playing around the sites by young children and those scavenging these sites. These results are in line with Babanyara's (2012) study that found that in developing countries, other hazards arise from scavenging at waste disposal sites and the manual sorting of hazardous waste from health-care facilities by individuals living around those sites.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents conclusions and recommendations made from research findings. The chapter is presented based on the research objectives.

5.1 Summary of Findings

5.1.1 Hospital Waste Management Practices

This study found that most hospitals in Garissa County have temporary waste storage facilities for holding the waste before its transportation to the disposal site. It was however noted that the waste storage facilities were not big enough to accommodate the waste generated, they were poorly ventilated and lacked authorized accessibility. In most of the hospitals, hospital waste was collected on a daily basis and transported to the temporary storage area by waste handlers.

Only a handful of waste storage facilities in Garissa County hospitals were fenced or had authorized accessibility.

This study showed well-secured but poorly sanitized temporary storage areas.

Research data has shown determined that the commonest mode of pathogenic transmission is by hands. The visited hospitals in the current study had hand-washing facilities in most workstations. The presence of a hand-washing facility at every workstation is an indicator of the facility's hygiene status.

5.1.2 Hospital Waste Handling

The current study revealed that most of waste handlers in Garissa County healthcare facilities neither weigh nor keep records of the waste generated. Inventories of the waste generated by health facility helps determine the waste output and facilitate institution of mechanisms for storage and processing. Lack of these records deters proper waste management. It was also found that in all the visited hospitals, plastic papers and containers were being used for waste disposal. Similarly, routine waste collection schedules were absent.

Incineration of sharps waste was not performed on daily basis as only one incineration facility was present in the entire County. It was also indicated that open burning of waste was the most preferred method.

5.1.3 Factors Influencing Proper Hospital Waste Practices

Personal attributes, habits, level of education, training and environment are some of the factors that are thought to influence a person's behavior, thoughts and actions. Having a responsible behavior and adhering to the correct hospital waste management practices is an endeavor that should be held at the highest par.

Healthcare waste management and safe disposal depends on many factors including sensitization level of the health administration, managers and hospital workers, existing local legislation of healthcare waste management, and available resources. In Garissa County hospitals, due to various reasons, neither proper hospital waste management systems have been developed nor are the concerned healthcare administration,

professionals and managers aware of the importance of the proper hospital waste management practices.

This study indicated that profession of healthcare personnel working in Garissa County hospitals had a significant influence on proper hospital waste management awareness. These results are similar to a cross sectional study carried out by Sreegiri et al., (2009) to assess the awareness on hospital waste management and universal work precaution among 134 healthcare workers selected randomly out of 1300 including doctors, paramedics and class IV personnel of King George hospital in Visakhapatnam.

5.1.4 Community Risk Exposure

In spite of the fact that treatment and disposal of hospital waste helps reduce associated risks, the release of toxic pollutants into the environment may pose indirect health risks in many ways. Landfills for instance can contaminate drinking water as a result of poor construction.

People living around hospital waste dumpsites can adversely be affected by biohospital waste exposure. Incorrect hospital waste management practices like dumping in municipal dustbins, open spaces, water bodies among other improper places results to the spread of diseases.

The current study assessed the risk of exposure of communities around dumpsites to hospital waste. The results revealed a significant relationship in the females' risk due to exposure to medical waste. The study showed that young girls are at a higher risk than the older counterparts.

5.2 Conclusions

From this study's findings, it was concluded that on average, hospital waste generated from Garissa County health facilities is well segregated. Most of the health-care workers understood the need to sort and segregate wastes according to the correct colour code.

It was also concluded that most hospitals in Garissa County lack dedicated waste handlers who adhere to the set waste management guidelines like keeping inventory of waste generated and proper handling. The persons collecting waste from the hospitals neither weighed nor kept records of the waste. This in part may have led to the huge hips of waste in temporary holding areas and dumpsites as important information for formulating mechanisms for waste handling was lacking.

Furthermore, many hospitals in Garissa County lack suitable temporary waste holding and treatment areas that are big enough to accommodate the waste, that are well ventilated and that have authorized accessibility-this poses a health risk to the workers and the community at large.

No proper waste transportation modes/ mechanisms as wheeled trolleys with lids are not enough and the wheelbarrows used may drop infectious wastes like contaminated sharps along the way during transportation.

In most hospitals visited, the waste containers are not emptied promptly as they reach ¾ full as required, rather most were overfilled which poses a health risk to the collectors and handlers. It was also concluded that the only available incinerator was in a debilitating condition and requires urgent attention.

In terms of the levels of awareness, it was concluded that profession, level of education, number of years worked/experience, and training of healthcare workers influences proper

hospital waste handling and management. Doctors, university graduates, those who had worked for longer and those who had been trained were more aware and embraced proper hospital waste handling practices.

Finally, the persons living around waste dumpsites are exposed to a health risk including injuries from contaminated sharps, contaminated ground water and food poisoning as well as skin infections. The most vulnerable category is that of young children who play around and scavenge the dumpsites.

5.3 Recommendations

1. This study recommends that more waste handling and management equipment be availed to health facilities for efficient waste management.
2. There is need for dedicated waste handling personnel with proper training on the need to adhere to waste management guidelines
3. Healthcare personnel should be trained more on waste handling and management practices to minimize injuries and infections. Proper mechanisms should be instituted to ensure that the set standards are met.
4. The temporary waste holding and treatment areas should be rebuilt, so as they are big enough, well ventilated and their access be limited to only authorized personnel.
5. Waste dumpsites should be expanded, fenced and secured so as to minimize accessibility by young children and the general public to avoid health risk exposure.

6. The available incinerator should be serviced and maintained to perform optimally. In addition, more incineration facilities are required to ease workload on the already overwhelmed facility. Each health centre should have an incinerator to reduce the large volumes of infectious waste witnessed during the study.
7. The public especially those living around dumpsites should be sensitized of hospital waste hazards so that they can avoid these areas as some scavenge these areas for a living.

5.4 Recommendations for Further Research

From the findings the study makes the following suggestions for further studies;

1. A research to be conducted to assess the effectiveness of hospital waste management practices in public health facilities in other counties in Kenya and the World at large.
2. A research can be done to find out the cause of hospital waste management practices.

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APPENDICES

Appendix I: Informed Consent

Dear Respondent,

Please read and understand before signing the consent form below.

Title: The effectiveness of waste management practices in public health facilities in Garissa County.

By: Abdullahi A.Matan (Mount Kenya University, Kenya)

This descriptive cross-sectional study aims at establishing the effectiveness of waste management practices in public health facilities in Garissa County. The results may be of importance to the local health policy makers, medical regulatory authorities, medicine dealers, health providers, donors and all other stakeholders involved in medical sector as it may provide valuable information to effectively plan, manage and supervise safe disposal of hospital waste. This study and its procedures have been approved by the Graduate School board, the school of Public Health, Mount Kenya University. The procedure includes voluntary participation and responding honestly and accurately. All information given will be confidential and anonymous. The study data will be analyzed by the researcher and the results will be presented to Mount Kenya University as part of the requirement for the degree of Master of Public Health.

Consent

I have read, understood and voluntarily consent to participate in this study. I have understood the nature and purpose of this study and that my identity will not be revealed in the study.

Subject's signature: ..... Date: .....

Department:.....

I have explained the nature and purpose of this study to the above subject in writing and have sought his/her understanding for informed consent.

Researchers Signature:_____ Date:_____

Appendix II: Questionnaire for the Health workers

The main purpose of this study is to asses of the effectiveness of Hospital Waste Management in the Public Health Facilities in Garissa County. As a respondent you are requested to provide honest and truthful information in your best knowledge. This research is for academic purpose only.

Code No……. Section I: Demographic Information

1. Gender

Male ( ) Female ( )

2. What is your highest level of education?

Primary ( ) Secondary ( )

Tertiary Level (Diploma/Higher Diploma) ( )

University (undergraduate Degree / Postgraduate Degree) ( )

3. How long have you worked in the hospital?

0 – 5 years ( )

6 – 10 years ( )

11 – 15 years ( )

16 – 20 years ( )

4. What type of health facility are you working at?

Referral Hospital ( )

Sub-County Hospital ( ) Dispensary ( )

Health Centre ( )

Other specify……..

Section II: Waste management practices

5. Please tick in to indicate the types of wastes that are generated by your health facility

Waste type	**Yes**	**No**
General wastes e.g. office, laundry, dirty and linen, domestic, from kitchen.		
Pathological wastes e.g. tissues, organs, body parts, human fetuses, blood and body Fluids		
Infectious wastes e.g. cultures and stocks of infectious agents from laboratories, waste from survey and autopsy and dialysis from infected patients		
Chemical wastes e.g. discarded solids, liquid chemicals, e.g. from diagnosis, experimental work, cleaning etc		
Sharps e.g. needles, blades, broken glass etc		
Pharmaceutical wastes e.g. drug and chemicals that have expired		
Genotoxic wastes e.g. DNA staining dye -ethidium bromide		
Other types of wastes (specify)		

Hospital waste Segregation

6. Are wastes segregated?

Yes ( ) No ( )

7. When does waste segregation takes place?

At the beginning near the source ( ) After waste is collected ( )

At the waste storage place in the hospital ( )

8. Using the following scale please tick one that best describes your opinion

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
There are separate containers for different types of wastes					
Waste collection containers are enough					

The Waste collection containers are suitably located					
Containers are labeled Appropriately					
Wastes are separated before disposal					

9. Who segregate hospital wastes?

Cleaning workers ( ) Medical staff ( ) Cleaning workers and medical staff ( ) I don't know ( )

10. At what level are hospital wastes transported for incineration?

Level	CODE
Completely Full	****
¾ Full	***
½ Full	**
¼ Full	*
Don't Know	X

11. How often do you recap used needles by your hand?

Always	***
Sometimes	**
Never	X

12. Are you aware of the Government's plan on biomedical waste handling and management?

Yes ( ) No ( )

13. Does this health facility have a temporary premise for hospital waste handling and management?

Yes ( ) No ( )

14. Do you handle the generated hospital waste temporarily before it is treated and/or disposed?

Yes ( ) No ( )

15. For how long is the hospital waste held before collected for disposal or incineration?

One day ( ) Two days ( ) Three days ( ) One week ( ) Over a week ( )

16. Does this facility's waste handler weigh and keep records of the generated waste?

Yes ( ) No ( ) I don't Know ( )

17. Does this hospital have a hand-washing facility?

Yes ( ) No ( ) I don't know ( )

18. Does this hospital have a waste storage facility?

Yes ( ) No ( ) I don't know ( )

19. Is your waste storage facility

a. Fenced ? Yes ( ) No ( ) I don't know ( )

b. Big enough? Yes ( ) No ( ) I don't know ( )

c. Well ventilated? Yes ( ) No ( ) I don't know ( )

d. Accessible only by authorized workers? Yes ( ) No ( ) I don't know ( )

20. What type of containers do you use for hospital waste packaging and disposal?

Plastic ( ) Metallic ( ) Any other ( ) specify _____

I don't know ( )

21. At what level do you empty the waste containers?

¼ Full ( ) ½ Full ( ) ¾ Full ( ) Completely full ( ) I don't know ( )

Waste Transportation

22. Are the waste collection containers mobile?

Yes ( ) No ( )

23. Are containers identified and distinguished?

Yes ( ) No ( )

24. Are waste sacks subjected to tear?

Yes always ( ) Sometimes ( ) Rarely ( ) No ( )

25. Who is responsible for the transportation of wastes out of the facility?

.....

.....

26. Which of the following means is used to transport the wastes?

Motor vehicle ( ) Wheeled trolleys ( ) Wheelbarrow ( ) Any other (Specify)-

Treatment

27 Are wastes treated prior to disposal?

Yes ( ) No ( )

28. What methods is used to treat wastes from your facility? Incineration ( ) Autoclaving ( ) Burning ( ) Burial ( ) Others( ) Specify_____

29. Are there special equipment for hospital waste handling and management? Yes ( ) No ( ) I don't know ( )

30. Does this facility have a routine schedule for hospital waste collection?

Yes ( ) No ( ) I don't know ( )

31. How often is hospital waste collected from this hospital? Daily ( ) weekly ( ) Monthly ( ) I don’t know ( )

32. How often is hospital waste incinerated?

Daily ( ) weekly ( ) Monthly ( ) I don’t know ( )

33. How many waste incinerators does this hospital have?

One ( ) Two ( ) Three ( ) Four ( ) More than Five ( ) I don’t know ( )

34. What is the capacity of the available incinerator(s)?

<30Kgs ( ) 40-80 Kgs ( ) 100-180Kgs ( ) 200-400Kgs ( ) 500-750 Kgs ( ) over 800 Kgs ( )

35. What is the current condition of the available incinerator(s): Good ( ) Fair ( ) I don't know ( )

36. Suggest ways of improving the current situation of waste management within the hospital

……

…

……

…

Section III: Health risk due to exposure of the hospital waste to the community

37. Is the community around the damp sites exposed to health risk?

Yes ( ) No ( )

If yes what health risks is the community around the damp sites exposed to?

……

…

……

…

38. What suggestions would you give to reduce the health risks exposed to the community around the damp sites?

……

…

……

…

Section IV: knowledge and awareness on hospital waste management among care personnel

39. Have you been trained on hospital waste management?

Yes ( ) No ( )

40. Are you trained on proper clean up procedures?

Yes ( ) No ( )

41. Were you trained in infection control during your professional training?

Yes ( ) No ( )

42. Are you given clear work procedures/guidelines in your job cadre?

Yes ( ) No ( )

43. Does the institution participate in the general improvement of environment in the surrounding area?

Yes ( ) No ( ) Don't know ( )

Appendix III: Questionnaire for the community

The main purpose of this study is to asses of the effectiveness of Hospital Waste Management in the Public Health Facilities in Garissa County. As a respondent you are requested to provide honest and truthful information in your best knowledge. This research is for academic purpose only.

Code No……. Section I: Demographic Information

1. Gender Male ( ) Female ( )

2. What is your highest level of education?

No formal education Primary ( ) Secondary ( )

Tertiary Level (Diploma/Higher Diploma)( )

University (undergraduate Degree / Postgraduate Degree)( )

3. What is your Age bracket?

Under 25 ( )

26 – 35 ( )

36 – 45 ( )

46 – 55 ( )

56 and Above ( )

4. Suggest ways of improving the current situation of waste treatment in the damp site

……

…

……

……..

Section II: Health risk due to exposure of the hospital waste to the community

5. Are/Have you been exposed to health risk?

Yes ( ) No ( )

If yes what health risks are/have you been exposed to?

……

…

……

…

6. Using the following scale please tick one that best describes your opinion on the health risk you are exposed to due to exposure of the hospital waste

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Risk of getting cancer and respiratory diseases due to exposure to					
Risk of damage to the nervous system and immune system from the plastic wastes which scavenge on openly					
I am at risk of getting injuries from Sharps					
I am at risk of getting skin problems					
The damping sites my contaminate groundwater and drinking water					
Risk of food poisoning causing health					
Plastic pollution may increase the chance of infertility and imbalance in					

7. What suggestions would you give to reduce the health risks you are exposed to?

……

…

……

…

8. Have ever seen the health facilities participate in the general improvement of environment in the surrounding area?

Yes ( ) No ( )

Appendix IV: Observation Checklist

Observation	**Yes**	**No**
Separate area for segregation		
Proper containers for transport of waste within hospital		
Whether the guidelines/ charts for the management of hospital related		
Whether appropriate containers with appropriately colored bags		
Whether waste handling staff wears Personal Protective Equipment e.g;		
Check for the general cleanliness and maintenance of the facility		
Are washable dishes and utensils used?		

Appendix V: ERC Clearance

Mount Kenya University

SEPTEMBER 15, 2016

Ref. No. MKU/ERC/0245

CERTIFICATE OF ETHICAL CLEARANCE

This is to certify that the proposal titled **"ASSESSMENT OF THE EFFECTIVENESS OF HOSPITAL WASTE MANAGEMENT PRACTICES BY PUBLIC HEALTH FACILITIES IN GARISSA COUNTY, KENYA"**, whose Principal Investigator is Mr Abdullahi Abdikadir Matan (MPH/2014/76328 has been reviewed by Mount Kenya University Ethics Review Committee (ERC), and found to adequately address all ethical concerns.

Mr Francis W. Makokha
for Secretary, Mount Kenya University ERC

Sign: _____ **Date:** 15/09/2016

Dr Francis W. Muregi
Chairman, Mount Kenya University ERC

Sign: _____ **Date:** 15/09/2016

Mount Kenya University
Director, Research & Development
& Development
P. O. Box 342 - 01000, Thika

Appendix VI: Postgraduate Letter

Mount Kenya University

SCHOOL OF POSTGRADUATE STUDIES

REF: MPH/2014/76328

15th September, 2016

The Director, Research Coordination Division
National Commission for Science, Technology & Innovation
Utalii House, 8th & 9th Floor
P.O.Box 30623- 00100
Nairobi

Dear Sir/Madam,

RE: DR. ABDULLAHI ABDI KADIR MATAN - REGISTRATION NO. MPH/2014/76328

The purpose of this letter is to introduce the above named student who is pursuing Master of **Public Health (Epidemiology and Biostatistics)** in the Department of **Epidemiology and Biostatistics** in the School of **Public Health.**

The title of his research project is **"Assessment of the Effectiveness of Hospital Waste Management Practices Public Health Facilities in Garissa County, Kenya."**

He has been cleared by the university's Ethics Review Committee (certificate attached) and now has to proceed to the field to collect data for his research project in the course of this semester **(September, 2016 – November, 2016).**

Any assistance accorded to him will be highly appreciated.

Thank you.

Mount Kenya University
School of Postgraduate Studies
P. O. Box 342 - 01000 Thika

Dr. Cecilia Kimani
Dean, School of Postgraduate Studies

Enc

Appendix VII: NACOSTI Authorization

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349, 3310571, 2219420
Fax: +254-20-318245, 318249
Email: dg@nacosti.go.ke
Website: www.nacosti.go.ke
When replying Please quote

9th Floor, Utalii House
Uhuru Highway
P. O. Box 30623-00100
NAIROBI-KENYA

Ref: No. NACOSTI/P/16/1227/13820

Date: 28th September, 2016

Abdullahi Abdikadir
Mount Kenya University
P.O. Box 342-01000
THIKA.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Assessment of the effectiveness of hospital waste management practices by public health facilities in Garissa County Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Garissa County** for the period ending **28th September, 2017.**

You are advised to report to **the County Commissioner, the County Director of Education and the County Director of Health Services, Garissa County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Garissa County.

The County Director of Education
Garissa County.

Appendix VIII: Research Permit

THIS IS TO CERTIFY THAT:
MR. ABDULLAHI - ABDIKADIR
of MOUNT KENYA UNIVERSITY, 0-70100
Garissa,has been permitted to conduct
research in *Garissa County*

on the topic: *ASSESSMENT OF THE EFFECTIVENESS OF HOSPITAL WASTE MANAGEMENT PRACTICES BY PUBLIC HEALTH FACILITIES IN GARISSA COUNTY KENYA*

for the period ending:
28th September,2017

Permit No : NACOSTI/P/16/1227/13820
Date Of Issue : 28th September,2016
Fee Recieved :ksh 1000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.
2. Government Officer will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2) hard copies and one (1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

REPUBLIC OF KENYA

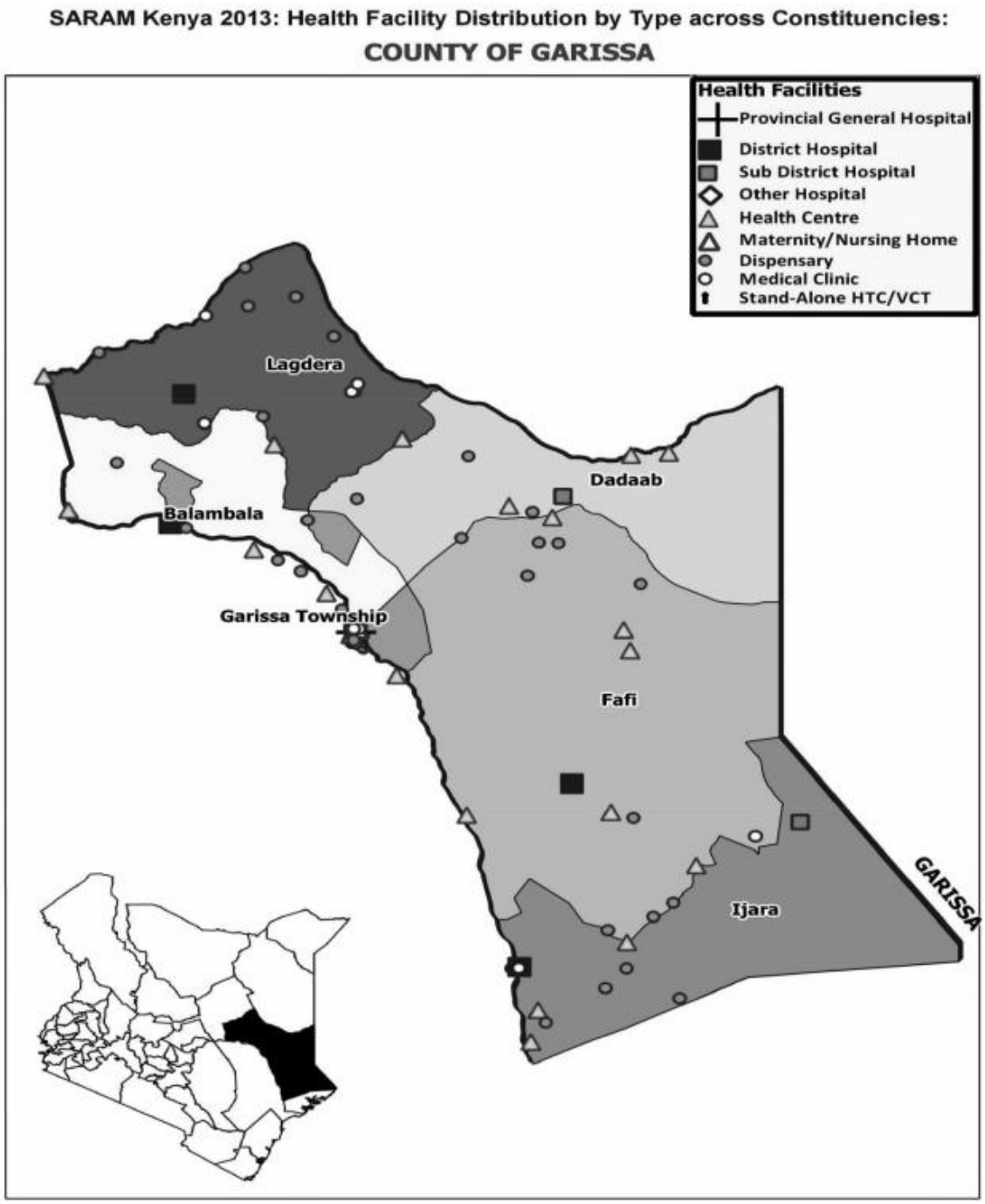
National Commission for Science, Technology and Innovation

RESEACH CLEARANCE PERMIT

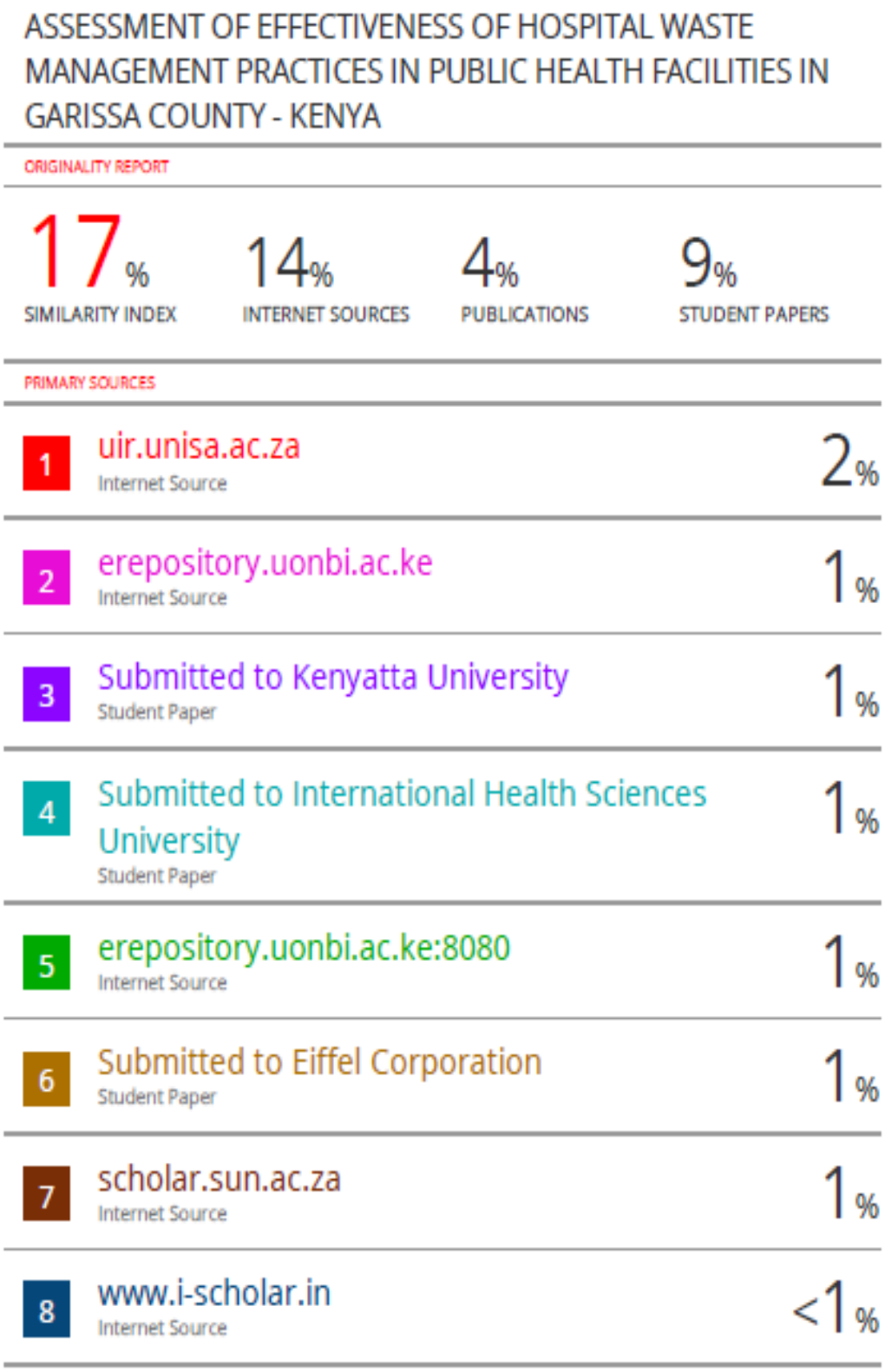
Serial No.A 11125

CONDITIONS: see back page

Appendix IX: Map of Study Area



Appendix X: Similarity Index



ASSESSMENT OF EFFECTIVENESS OF HOSPITAL WASTE MANAGEMENT PRACTICES IN PUBLIC HEALTH FACILITIES IN GARISSA COUNTY - KENYA

ORIGINALITY REPORT

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