

**FACTORS INFLUENCING ADHERENCE TO HAZARDOUS WASTE
MANAGEMENT POLICY FRAMEWORKS AMONG HEALTH WORKERS
IN PRIVATE HOSPITALS IN NAIROBI COUNTY - KENYA**

BY

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DECLARATION

I, Constantyne Chepchirchir, declare that this thesis research is my original work and has not been presented to any other institution of higher learning for any form of academic requirement. All the sources quoted in this work have been dully acknowledged using complete reference.


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DEDICATION

This work is dedicated to Assumption sisters of Nairobi, my friends and family members whose prayers and love were of great support during this period.

ABSTRACT

The global generation of hazardous waste in hospitals has recorded a significant increase in the recent past, with up to 64% of these wastes inappropriately managed in Low- and Middle-income Countries. In Kenya as well as other Low- and Middle-income countries, such improper management of this waste can lead to severe human and environmental health problems. Although healthcare workers in Kenya, have guidelines on proper management of this waste, the adherence to these policies and attendant hazardous waste management practices among healthcare workers in Nairobi County hospitals is unknown. This study, therefore, sought to investigate the factors influencing the adherence to hazardous waste management guidelines among healthcare workers in private hospitals in Nairobi County. The specific objectives of the study included; determining the level of adherence to proper HCWM practices among health workers, identifying the individual related factors that influence adherence to proper HCWM practices among health workers, and identifying the health facility-related (institutional) factors that influence adherence to proper HCWM practices in 4 selected hospitals in Nairobi County Kenya. From the population of 900 healthcare workers from 4 levels 4 facilities, random sampling was applied to identify the 90 respondents. Data analysis and reporting was done using appropriate quantitative methods. Based on the study findings, we would recommend the improvement of hazardous waste management efficiency.

List of Abbreviations

CDC- Center for Disease Control

EMCA- Environmental Management and Coordination Act

EPA- Environmental Protection Agency

HCW- Healthcare wastes

HCWM- Healthcare Waste Management

HCV- Hepatitis C virus

HBV- Hepatitis B virus

IARC- International Agency for Research on Cancer

IPC- Infection Prevention Control

ISMWM- Injection Safety and Medical Waste Management

KHSSP III- Kenya Health Sector Strategic Plan III

KLRC- Kenya Law Reform Commission

MEAs- Multilateral environmental agreements

MOH- Ministry of Health

NEMA- National Environment Management Authority

NMC- Nairobi Metropolitan City

PEPFAR- President's Emergency Plan for AIDS Relief

POP- Persistent Organic Pollutants

PPE- Personal protective equipment

UNEP- United Nations Environmental Program

WHO- World Health Organization

Operational definition of terms.

Biochemical transformation: the breakdown of compounds of enzymes.

Biodegradable substance: a substance that can be degraded by microorganisms.

Biomedical waste: any waste that is generated during diagnosis, treatment or immunization of human beings or animals or in research activities pertaining production or testing of biological products.

Chemical transformation: change of a substance through chemical reactions.

Chemical waste: waste containing chemical substances (e.g. laboratory reagents, film developer, disinfectants that are expired or no longer needed, solvents, waste with high content of heavy metals like batteries, broken thermometers and blood pressure gauges).

Clinical waste: any waste arising from provision of healthcare or bio-medical research.

Cytotoxic /genotoxic waste: waste generated during management of cancer.

Disposal site: area of land which waste disposal facilities are physically located or final discharge point without the intention of retrieval but does not mean a re-use or re-cycling plant or site.

Domestic waste: used to define waste generated from residential areas.

Environment: surroundings, including water, air, soil and their interrelationships, as well as all relationships between them and any living organisms.

Environmentally Sound Management of Waste: Taking all practical steps to ensure that waste is managed in a manner that will protect human health and the environment against the adverse effects which may result from waste.

General waste: waste that is generated from a health care facility and not from a medical procedure and therefore no infectious content in it.

Generator: any person whose activities produces health care waste or is in control of those wastes.

Hazard: a substance, mixture or substances, process or situation that have the potential to cause harm to human health or adverse effect to the environment.

Hazardous waste: a waste considered to be of special risk to human health or environment and thus requires a special kind of management.

Healthcare waste: waste that is generated during diagnosis, treatment or immunization of human beings or animals or in research activities pertaining production or testing of biological products.

Incineration: the controlled burning of solids, liquids, gaseous combustible waste to produce gases and residues containing little or no combustible materials.

Infectious waste: all kind of waste that may transmit viral, bacterial, fungal or parasitic disease to human beings, other animals and water suspected to contain pathogens that poses a risk of disease transmission for example waste contaminated with blood and other fluids, laboratory cultures and microbiological stocks; waste including excreta and other materials that have been in contact with patients infected with highly infectious disease in isolation wards.

Label: the written, printed, or graphic manner on or attached to the container or wrapper of packaged waste

Mixed material waste: waste from products containing a mixture of substances, at least one being xenobiotic or waste from the manufacturer of such products and where simple sorting may not be applied in segregation.

Packaging: the container together with the protective wrapping used to carry waste during storage and transportation.

Pathological waste: human tissues, organs or fluids; body parts; fetuses; unused blood products.

Poison: a substance that can cause a disturbance of structure or function, leading to injury or death when absorbed in relatively small amounts by human beings, animals or plants.

Prior informed Consent: the international operation procedure for exchanging, receiving and handling notification information by the competent authorities on waste.

Protective equipment: any clothes, materials or devices that are designed to provide protection to the user when handling hazardous material.

Radioactive waste: any waste material that has been, or will be, discarded as of being of no medical use or waste containing radioactive substances like unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or unsealed radionuclides; sealed sources.

Recycling of waste: the processing of waste material into a new product of similar chemical composition.

Reprocessing: the processing of waste in to a new product or different chemical composition.

Reuse: waste reused with or without cleaning and /or repairing.

Segregation: the activity of separation of waste materials for processing

Sharps waste: used or unused sharps (e.g., hypodermic, intravenous or other needles, auto-disposable syringes, syringes with attached needles, infusion sets, scalpels, pipettes, knives, blades, broken Glass.

Storage: temporary placement of waste in a suitable location or facility where isolation, environmental and health protection and human control are provided in order to ensure that waste is subsequently retrieved for treatment and conditioning and /or disposal.

Thermo-transformation: change of a substance through application of high temperature with or without pressure.

Toxic chemical: any substance which if enters into an organism through ingestion, inhalation or dermal contact is injurious, causes physiological, or biochemical disturbances or otherwise used causes deterioration of the function of the organism in any way.

Treatment: when used in reference to waste management, means, any method, techniques or processes designed to change the biological character or composition of healthcare wastes so as to reduce or eliminate its potential for causing harm.

Waste generator: any person whose activities or activity under his or her direction produces waste or if that person is not known, the person who is in possession of the waste generated.

Waste management: the activities, administrative and operational, that are used in handling, packaging, treatment, conditioning, reducing, recycling, reusing, storage and disposal of waste.

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CHAPTER ONE

1.0 Introduction

All the wastes generated within laboratories conducting medical procedures, research centers, and healthcare facilities, in addition to the waste originating from home-based healthcare services are referred to as healthcare wastes (HCW), (Muluken et al., 2014). HCW is considered hazardous when it consists of one or more of the following characteristics: contains infectious agents; it is genotoxic; contains toxic or hazardous chemicals or pharmaceuticals; is radioactive, and contains sharps (Ferreira & Teixeira, 2010). According to World Health Organization (WHO), hazardous wastes from healthcare and medical facilities cause over 250,000 HIV infections, 2 million hepatitis C virus (HCV) infections, and 21 million hepatitis B virus (HBV) infections globally (WHO, 2018). WHO further reports that if hazardous wastes are not properly managed, the risk of new infections could even be higher than the current status; HBV (30% of all new infections), HCV (39% of all new infections), and HIV (4% of all new infections) (WHO, 2018).

Waste management is defined as all the activities and actions needed to dispose of waste from its inception to its final disposal. Healthcare waste management HCWM involves the collection, segregation, treatment, transportation, and disposal of wastes (Hossain et al., 2018). It also involves the supervision of these operations and aftercare of disposal to ensure the wastes do not cause harm to persons (Snr et al., 2021). This study investigates the factors that influence the proper management of healthcare wastes to prevent these harmful effects of hazardous wastes.

Globally, United Nation Environmental Program, estimates that the amount of healthcare waste generated in health facilities, nursing homes, and research institutions will quadruple by the year 2025 (UNEP, 2020). This is attributed to increasing technological advancement and population, leading to expansion of research and healthcare institutions; hence, increasing amounts of wastes generated. UNEP (2020) further reports that over 1.5 million people die each year from healthcare waste-related diseases from hospital wastes consisting of hazardous substances. WHO reports that 80% of medical wastes are non-hazardous while the remaining percentage; hazardous (15% infectious, 5% sharps (1%) toxic chemicals,

pharmaceuticals (3%), genotoxic, and 1 % radioactive waste) (WHO, 2018). However, the global figures are not consistent with many low-and-middle-income countries, for instance, 26.5% of the waste produced in Nigeria Abah & Ohimain, (2011) and 25% in Pakistan, Ali *et al.*, (2016) are hazardous. More than half of waste generated in Kenya is also considered hazardous due to poor waste management practices within healthcare facilities (Abah&Ohimain, 2011). According to a mini-review by Ali *et al.*.,(2017), most low-and-middle-income countries have poor waste-segregation practices and limited safe waste disposal systems, leading to more than 50% of the wastes generated being considered infectious. Nwachukwu *et al.*, (2013) discussed that health care industries in Low- and Middle-income countries and especially sub-Saharan African countries are faced with enforcement and compliance as their biggest challenges, in addition to fraud and tender irregularities in Health care waste management (HCWM).

According to a study done by Fazzo *et al.*,(2017), hazardous wastes promote various types of cancer when exposed to elements from expired chemicals or mercury; can negatively influence the development of fetuses, and can also cause damage to the nervous system. Other than the threat that hazardous wastes have on human health; they can also cause a serious threat to the environment. WHO, (2020) reported that the disposal of untreated health care wastes in landfills can lead to the contamination of drinking, surface, and ground waters if those landfills are not properly constructed? The treatment of health care wastes with chemical disinfectants can result in the release of chemical substances into the environment if those substances are not handled, stored, and disposed of in an environmentally sound manner (Awad *et al.*, 2018).

In Kenya, a report by World Bank-funded Health Sector Support project on healthcare waste management (HCWM) stated that the level of HCWM performance by healthcare facilities was 14% (policies and procedures - 5.6%, management and oversight -16.2%, logistics, and budget - 20%, training and occupational health -20%, and treatment and infrastructure - 9.4%)(World Bank Project, 2020). Additionally, a survey done in 5 private healthcare facilities in Kenya found that none of the institutions had an HCWM strategic plan and only 1 had a waste management officer who headed the waste management team and conducted surveillance on waste handling within the facilities (Marege, 2014). Moreover, another research on HCWM

practices in private healthcare facilities concluded that all the waste generated within the institutions was rendered hazardous because of inadequate waste segregation and therefore all the wastes had to be treated before disposal (J. W. Maina, 2018).

Taegtmeier *et al.*, (2008) also observed that 78% of private hospitals in Kenya had waste storage facilities that were easily accessible and not secure and 90% transported waste manually, which is a serious public health risk. 55% of private medical facilities in Kenya had functioning incinerators within the facilities (Taegtmeier *et al.*, 2008). However, all the incinerators within these facilities are the De Montfort type with no measure of controlling air emissions, hence, is a great contributor to air pollution. Only 66% of private health facilities use NEMA accredited waste collectors, the rest dispose of their wastes within their premises, either by open-pit or landfill (Taegtmeier *et al.*, 2008).

Despite the existence of hazardous waste management enforcement under the Environmental Management and Coordination Act of 1999 in Kenya, proper waste management practices in hospitals have not yet been achieved (Haregu *et al.*, 2017) (Njue *et al.*, 2015). Previous studies attributed the challenge of poor healthcare waste management in Kenya to low or no budgetary allocations in the hospitals, lack of awareness on disposal regulations, poor monitoring schemes in the waste management programs, and use of poor technology (Makori, 2018). To further address the problem of HCWM in Kenya, the ministry of health (MOH) in collaboration with CDC, through PATH has developed strategies for a national strategic plan for health care facilities. The strategic plan gives the following responsibilities to healthcare facilities: to ensure that questionnaires and checklists are used to monitor HCW stream through each unit of the health facility; develop a register indicating waste movement at each section of HCW stream; to ensure that after summarization of filled checklist, the list should be collected every week and sent to district HCWM team; and hold monthly meetings with all staff at all carders to report on the progress of HCWM strategies (Ministry of Health, 2020).

Healthcare workers have a pre-eminent role in the hospital management of hazardous waste based on relevant guidelines (Caniato *et al.*, 2015; US EPA, 2014). However, several challenges exist, especially in Low- and Middle-income countries including a lack of proper regulatory enforcements owing to poor structural hazardous waste management guidelines in hospitals (Caniato *et al.*, 2015). While healthcare

workers in Kenya have positive attitudes towards good HCWM practices, their knowledge about hazardous waste handling is limited (Maina, 2018). For example, research done in Kenya reported that about three-quarters of the health workers re-cap used needles, have low immunization rates against tetanus and HBV, and the rate of needle-stick injuries was at 6% in the previous month.(Ngari, 2009). World Health Organization reported that the most common factors associated with poor HCWM practices include inadequate training in proper waste management, lack of awareness about the health hazards related to healthcare waste, absence of waste management and disposal systems, insufficient financial and human resources and the low priority given to the topic (WHO,2018).

The level of adherence to HCWM guidelines among healthcare workers and waste handlers done by Njue *et al.* (2015) in Thika sub-County reported a 16% level of adherence among healthcare workers, meaning that compliance to the set HCWM guidelines is still a big challenge in Kenya (Njue *et al.*, 2015).A study done in Kenya by Japan International Cooperation Agency reported that HCWM practices in both private and public medical and research facilities did not comply with international requirements which guaranteed safe and environmental friendly management of HCW(Rushton, 2003). The results from previous studies conducted in Kenya indicate that healthcare workers, waste handlers, patients, and the general public are at great risk of environmental and health hazards associated with HCW because of poor adherence rates. This study aims to determine the factors that influence the adherence of healthcare workers to hazardous healthcare wastes frameworks.

1.2 Problem Statement

According to WHO, millions of patients suffer injuries or die from unsafe and poor-quality health care globally every year(WHO, 2019). In 2011, the Occupational Health and Safety Agency (OSHA) reported that employees suffered about 253,700 work-related injuries and illnesses in hospitals (Jha *et al.*, 2013). This is equivalent to a rate of 6.8 injuries and illnesses for every 100 full-time employees. Although the national and county governments across nations have tried to lay down systems that have positively influenced the management of hospital waste (World Health Organization, 2018), a review by (The Center for Disease Dynamics, Economics & Policy, 2011) established that these laid down system has experienced drawbacks

since some healthcare workers are not well equipped to adhere to the policy frameworks. (Aung T et al., 2019).

A good universal health coverage (UHC) system relies heavily on patient safety and quality (PSQ). Despite this universally agreed-upon premise, significant harm is still being done, with one out of every ten patients suffering harm while obtaining health care in hospitals. However, especially in low- and middle-income nations, there is a conspicuous shortage of evidence on UHC-PSQ convergence. Institutional attempts have been made within the World Health Organization . (Alhumaid S. et al., 2021).

To assist in bridging this gap, the World Health Organization (WHO) has been established. Delivery is one of the six system blocks in WHO's Health System Framework. Each system component must also address accessibility and availability, as well as safety and quality. Universal health coverage (UHC) is often seen as an uniting platform for achieving progress on SDG 3 for health. The SDGs and the Universal Health Coverage (UHC) have produced new demands and opportunities for improving basic health care. (Triguero A. et al., 2016).

Multiple measures within and outside the health system are needed to improve frontline services. Better data and evidence syntheses, as well as expertise with various service delivery methods and novel skill-mix techniques, are all critical. In Kenya, hazardous waste management in hospitals has become a major challenge largely attributed to indiscriminate dumping, irregular collection, poor storage, and inadequate resources necessary for proper management (Kasozi & Von Blottnitz, 2010).

A report by Okwesio , (2016) indicated that hazardous waste produced in hospitals form a significant part of the waste generated in Nairobi County. Most medical and health institutions in Kenya have not adopted a sharp management system; waste reduction and initiatives for the avoidance of hazardous wastes (Calderon, 2006). Hospitals have also not installed adequate safe treatment and disposal mechanisms, hence, lack of secure methods of HCW collection and transportation (Calderon, 2006). Due to poor HCWM systems within most healthcare facilities in Kenya,

workers in support services allied to healthcare, visitors to healthcare establishments, patients in healthcare establishments or receiving home care, healthcare auxiliaries, and hospital maintenance personnel, medical doctors, and nurses are all at risk of infections from hazardous wastes (Houghton C. et al., 2020).

Generally, direct or indirect contact to hospital hazardous waste or contaminants released or emitted by HCW can lead to diseases with multi-factor etiology (Porta *et al.*, 2009). For example, epidemiological studies on acute exposures to hospital hazardous waste have presented evidence on the development of respiratory, digestive, and dermatological symptoms, also the association between chronic exposures to these waste and growth inhibitions, reproduction impairments, low birth weights, and cancer developments have been observed (Fazzo *et al.*, 2017; Porta *et al.*, 2009). In Nairobi County where hospital hazardous waste management practices are a challenge, equivalent health impacts of exposure to the waste are expected.

Despite the existence of policy frameworks on hazardous waste management in Kenya, most health facilities do not adhere to such frameworks and thus poor hazardous waste management practices among healthcare workers in Nairobi County hospitals (Ministry of Health, 2014). Factors contributing to the poor management practices of hazardous waste among healthcare workers in hospitals, especially adherence to relevant guidelines as a requisite to proper waste management practices remain largely underexplored (Haregu, 2017; Kasozi, 2010). This study therefore seeks to fill this gap by determination of these factors contributing to the poor management practices and was therefore the primary aim of the study.

1.3 Overall Objective

The overall objective was to determine the factors influencing adherence to proper health care waste management practices as stipulated in policy guidelines among healthcare workers in 4 private hospitals in Nairobi County - Kenya.

1.3.1 Specific Objectives

1. To determine the level of adherence to proper HCWM practices among healthcare workers in selected private in Nairobi County Kenya.

2. To identify the individual related factors that influence adherence to proper HCWM practices among healthcare workers in selected hospitals in Nairobi County Kenya.
3. To identify the health facility-related (institutional) factors that influence adherence to proper HCWM practices in selected hospitals in Nairobi County Kenya.

1.3.2 Research Questions

1. What is the level of adherence to proper HCWM practices among healthcare workers in selected private level 4 hospitals in Nairobi County Kenya?
2. How do individual-related factors influence adherence to proper HCWM practices among healthcare workers in selected hospitals in Nairobi County - Kenya?
3. How do institutional-related (health facility) factors influence adherence to proper HCWM practices in selected hospitals in Nairobi County - Kenya

1.4 Significance of the Study

The study here in assessed the level of adherence to hazardous waste management among healthcare workers in 4 private hospitals in Nairobi County. Results from this study will be used to improve HCWM in the hospitals under study and facilitate benchmarking among hospitals in Nairobi County and beyond, thus enabling the improvement of hazardous waste management efficiency. The ministry of health and the different bodies will use the findings to review the code of ethics, standards, conduct and practices of the members. The country's policymakers will also benefit from this study ensuring that informed decisions about healthcare waste management are reached. The outcome of the study will also help bridge the gap of knowledge and practice that exists among health care workers on waste management. The findings will also help put in place measures to aid reduce illnesses and injuries to patients and healthcare workers in health facilities and help promote environmental health facilitating a healthy environment for animals and plants thus improve quality of health.

1.5 Study Scope

The study focused on healthcare workers who had worked in the current hospital for at least six months and are in the following divisions: Head of departments, attendants and ancillary, housekeeping, waste management unit, infection control unit, and administration. Nairobi County has the largest number of hospitals in Kenya, with a significant number of hospitals faces similar (Ministry of Health, 2014; Nairobi County Government, 2014). This study focused on 4 private 1 hospitals within Nairobi consisting of 900 healthcare workers (including waste handlers) who were directly involved in the generation and handling of healthcare wastes.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Theoretical and empirical reviews are presented in this chapter in addition to a conceptual framework on factors influencing waste management by healthcare workers in private hospitals. Empirical proofs and connected theories on medical waste management are also appraised critically in this section. The section will enable the researcher to establish a rationale for the study and obtain suggestions and recommendations from other studies.

2.1 Theoretical Framework

This study was guided by the THEORY OF REASONED ACTION, THEORY OF PLANNED BEHAVIOUR AND THEORY OF SYSTEMS. Both theories provide useful information for predicting people's behaviors in planning and implementing programs (Hackman & Knowlden, 2014). These theories, therefore, helps explain how intrinsic factors like behavior and intention to perform a behavior affect health workers' adherence to HWM. Systems theory is also presented as a strategy for organizational management. Most management theories like systems theory are often implemented to increase the productivity of the organization and the quality of services (Nembhard et al., 2020). A system consists of various parts and aims to achieve a specific goal (Mele et al., 2010a). Managers should therefore understand how different systems affect workers and how workers also affect different systems. This theory is relevant to this study as it explains how the management of healthcare wastes can help improve the quality of healthcare services and how the behaviors of healthcare workers affect the management of healthcare wastes. Other theories including Health Belief Model (HBM) as outlined by Rosentock in 1974 were also reviewed. The theory operates on three postulates grounded on the belief that for any person to take an action to avoid disease he/she must first consider themselves susceptible, the disease has negative implications in their life, and considering a particular initiative may prove vital by lowering the susceptibility in the event of the disease occurrence. However, this theory did not have a direct implication to the study and was thus omitted. To determine the theories that best guided this study, a thorough analysis of other theories guided by key terms in our study was done.

2.1.1 Theory of planned behavior

This study primarily relied on the Theory of Planned Behavior (TPB) which suggest that a person's behavior is determined by their intention to perform the behavior which is a function of their attitude toward the behavior (Hackman & Knowlden, 2014). According to Hackman and Knowlden (2014), people's intention to perform a certain behavior or task is determined by their attitude towards the behavior and the subjective norms regarding the behavior. The theory of planned behavior states that behavioral achievements depend on both the intention and ability to perform such behaviors (Peters & Templin, 2010). The study will also draw on systems theory which is relevant because the adherence to the HCWM frameworks by healthcare workers depends on the internal systems placed by the health facility.

The theory is important in this study as it explains what influences the health worker's behavior to adhere to HWM practices. The theories, however, only consider the intrinsic factors that affect an individual's behavior but do not explain the institutional factors. According to Peters and Templin (2010), the limitation of this theory is that it assumes that a person has all the necessary opportunities and resources to be successful in executing the desired behavior. Godin and Kok (1996) affirm that the theory of planned behavior does not consider environmental or economic factors that may influence an individual's intention to perform a behavior. It is for this reason that this study also considered systems theory. This theory will consider both organizational and external factors that affect health worker's adherence to HWM practices that this study is interested in.

Theory of reasoned action

The TPB model's predictive efficacy for both behavioral intentions and behaviors has been supported by meta-analytic evaluations (Armitage & Conner, 2001; Godin & Kok, 1996; Sheeran, 2002). About 40–50% of the variance in intentions and 20–40%

of the variance in behavior is often explained by the hypothesis. Depending on the action and situation, the relative importance of each of the three components (attitudes, norms, and perceived behavioral control) varies. Subjective norms are usually the least reliable predictor, though this could be due to measurement difficulties or people's denial of social pressures' influence. The model is better at predicting some health behaviors and in most cases, intentions are good and will be applied in this study to determine the factors that influence adherence to HCWM practices.

2.1.2 System Theory

System theory is a strategy in the management of healthcare waste among healthcare workers that enables the exploration of different systems that affect an operation and how operations affect the systems (Wilkinson, 2011). Since there are many parts of the system that work to achieve one goal, system theory determines that if one part of the system is compromised then it affects the subsequent parts of the entire system (Wilkinson, 2011). Another study done by Meadows, (2008) claimed that since system elements are rationally connected, the events produced by parts of a system are more important in achieving the purpose of understanding the whole system. To analyze the relationship between parts of an organization (for example, healthcare workers) and their environment, the goal of an organization must be adopted as a system (Mele *et al.*, 2010b). Therefore, to obtain value, all parts of the system should work together in synchrony to achieve better and sustainable HCW management systems either within individual organizations or in the external environment (Georgiou, 2007).

This theory is relevant because the adherence to the HCWM frameworks by healthcare workers depends on the internal systems placed by the health facility. Every health institution, whether private or public must adhere to the set legal frameworks that have been passed by both the local or national government regulations. Additionally, the system approach of management stated that knowledge is not derived from understanding single parts of a problem but the whole parts of the problem (Wilkinson, 2011) and denotes that knowledge comes with doing (Arnold & Wade, 2015). Therefore, healthcare workers and organizations who follow the safety guidelines when handling HCW can develop a better system because they learn from

their mistakes. The main focus in this study was the internal existing factors and the knowledge and understanding of the existing system that affects adherence.

2.2 Empirical Review

This sections briefly highlights of studies on healthcare waste management, the key steps needed to be followed in health care waste handling, the duties of health care waste generators, impacts of hazardous waste, the principles of handling hazardous waste and factors affecting adherence to HCWM practices.

2.2.1 Healthcare Waste Management

Proper waste disposal procedures follow the following steps; generation, segregation, collection, storage, transportation, treatment, and disposal of the waste (Sapkota et al., 2014). According to Doggalli et al .,(2014) other than systematically handling the wastes, the quantity of medical waste generated should always be minimized and enough precaution taken in every step of waste generation. Segregation is the most vital step in the successful management of HCW.

A study by Babanyara, (2013) revealed that over 2 million healthcare workers globally get infected from medical waste as a result of poor adherence to waste management practices. The exposure risk of HCW may cause death from diseases like Hepatitis B or C and HIV/AIDS or other risks such as gastro-enteric, skin, and respiratory infections. The study also discussed that, due to poor adherence to policy framework by healthcare workers, admitted patients are also placed at risk from micro-organisms that are not properly contained.

Research done by Letho *et al.*, (2021) on healthcare workers in National Referral Hospital in Bhutan revealed that; although 74% of healthcare workers were aware of the medical waste management frameworks, and 98% were aware of the importance of using personal protective equipment (PPE) when handling patients, only 20% were aware of handling hazardous wastes and maximum time it should take for infectious waste to be kept in the hospital facility before disposed of. The observational cross-sectional study estimated that over 60% of wards/units/departments segregated their wastes correctly according to the national HCWM guidelines; 58% of these were not segregated into infectious and general

wastes; hence, inappropriate transport and disposal of wastes. The study concluded that timely monitoring and surveillance of the waste-handling process should be adopted by healthcare facilities to enhance safety for both healthcare workers and patients.

A study done in Al-Mansoura University Hospital, Egypt, revealed that the majority of waste handlers, nurses, and doctors used inappropriate HCW management practices related to hazardous and infectious wastes (Abdenmour & Abuelela, 2019). The study revealed that only 20% of nurses, 10% of waste handlers, and none of the doctors and heads of departments followed the correct waste handling guidelines set by the country's ministry of public health. The study discussed that the prevalence of improper waste management practices in Low- and Middle-income countries are alarming due to a lack of proper training and the delegation of the disposal of medical waste to poorly educated workers.”

Research by Malukan *et al.*, (2014) in Gondor Town in North West Ethiopia was meant to assess the factors associated with the risk perception of healthcare workers. The study found that “health care waste in Low- and Middle-income countries including Ethiopia are treated equally like any other general waste, no health care facilities had health care waste management guidelines only a limited number of health care workers had health care waste management guidelines.” Further, the researcher recommended that improvement of healthcare workers’ perception and attitude on HCWM should be achieved through constant and frequent training on waste management plans and guidelines.

Human waste management is one of the most important public health programs. It is identified by WHO among the basic steps to be undertaken to safeguard our environment. All individuals exposed to hazardous HCW are potentially at risk of being injured or infected. They include: Medical staff: doctors, nurses, sanitary staff and hospital maintenance personnel; In- and out-patients receiving treatment in health-care facilities as well as their visitors; Workers in support services linked to health-care facilities such as laundries, waste handling and transportation services; Workers in waste disposal facilities, including scavengers; the general public and more specifically the children playing with the items they can find in the waste outside the health-care facilities when it is directly accessible to them.

Health-care waste includes all the wastes generated by medical activities. It entails activities of diagnosis as well as preventive, curative and palliative treatments in the field of human and veterinary medicine. In other words, are considered as health-care waste all the wastes produced by a medical institution (public or private), a medical research facility or a laboratory. According to the Technical Guidelines on Environmentally Sound Management of Biomedical and Health-care waste provided by the Conference of the Parties to the Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal (December 2002), health-care waste is classified as follows:

A. Non risk healthcare wastes are waste including Recyclable waste, biodegradable waste, other non-risk waste. A Non-risk HCW includes all the waste that has not been infected like general office waste, packaging or left-over food. They are similar to normal household or municipal waste and can be managed by the municipal waste services. They represent between 75% and 90% of the total amount of HCW generated by medical institutions. Three groups can be established:

1. Recyclable waste which includes paper, cardboard, non-contaminated plastic or metal, cans or glass that can be recycled if any recycling industry exists in the country.

2. Biodegradable HCW which comprises for instance, left-over food or garden waste that can be composted.

3. Other non-risk waste involving all the non-risk waste that do not belong to categories

Carcasses as well as litter and animal faces from animal test laboratories, if transmission of the above-mentioned diseases is to be expected.

B. HCW requiring special attention including human anatomical waste, sharps, pharmaceutical waste (non-hazardous pharmaceutical waste, potentially hazardous pharmaceutical waste, hazardous pharmaceutical waste), cytotoxic pharmaceutical waste, blood and body fluids.

C. Infectious and highly infectious waste including infectious waste and highly infectious waste.

Discarded materials or equipment contaminated with blood and its derivatives, other body fluids or excreta from clinically confirmed infected patients or animals with hazardous communicable diseases. Contaminated waste from patients known to have blood-borne infections undergoing Haemon-dialysis (e.g., dialysis equipment such as tubing and filters, disposable sheets, linen, aprons, gloves or laboratory coats contaminated with blood. Highly infectious waste includes all microbiological cultures in which a multiplication of pathogens of any kind has occurred.

They are generated in institutes working in the fields of hygiene, microbiology and virology as well as in medical laboratories, medical practices and similar establishments; Laboratory waste (cultures and stocks with any viable biological agents artificially cultivated to significantly elevated numbers, including dishes and devices used to transfer, inoculate and mix cultures of infectious agents and infected animals from laboratories)

D. Other hazardous waste

E. Radioactive waste.

2.2.2 Key steps in health care waste management that need to be followed

1. Minimization: Refers to approaches adopted by the health facility to reduce the amount of HCW generated during delivery of services. It includes strategies to reduce unnecessary injections, as well as to recycle or reuse some of the materials.
2. Segregation: Refers to placing HCW into separate containers according to type: non-infectious or general waste, infectious, highly infectious, and sharps waste.
3. Handling and storage: Refers to steps taken to manage waste during containment and storage whilst waiting for collection or transportation to a treatment plant or disposal site.
4. Collection and transport: Refers to an organized system for removing waste from the point of generation or temporary storage to a treatment or disposal site. Waste may be transported within the health facility or to an offsite treatment plant and disposal site.
5. Treatment: Refers to rendering HCW safe for handling and final disposal. Some of the methods used include: a. Incineration: burning at high temperatures in an incinerator - 850°C to 1100°C (DE Montfort 600°C to 700°C). Sterilization using

autoclave or microwave technology, Chemical disinfection: treatment methods using a chemical such as hypochlorite solution (bleach) to render the waste safe, Shredding waste using mechanical grinders to break it down into unrecognizable pieces. This method does not treat infectious waste and should be used in conjunction with sterilization. Macerators for anatomical waste fall in this category of treatment.

6. Disposal: Refers to the final discharge of waste and residues or by-product from the treatment of waste.

2.2.3 Duties of health care waste generators.

1. Hospital project manager.

A hospital project manager has a role of setting up a working group in charge of drafting the waste management plan, appointing the local waste manager, who will supervise and coordinate the waste management plan on a daily basis, assigning duties; drawing up job descriptions, allocating financial and human resources, implementing the waste disposal plan, conducting audits and continuously updating and improving the waste management system.

2. Hospital administrator.

The hospital administrator is responsible for ensuring that stocks of consumables (bags, receptacles and containers, personal protective equipment, etc.) are permanently available, examining and evaluating costs; drawing up contracts with third parties (carriers, subcontractors), giving advice on purchasing policies with a view to minimize/substitute certain items (mercury-free equipment, PVC-free equipment, etc.), monitoring proper implementation of protective measures, supervising in the absence of the water and habitat engineer.

3. Head nurse.

The head nurse is responsible for training care staff in waste management (paying special attention to new staff members), monitoring, sorting, collection, storage and transport procedures in the various wards, monitoring protective measures and supervising the hospital hygiene and taking measures to control infection.

4. Water and waste water engineer

He /she has a role of carrying out an initial assessment of the waste situation, proposing a waste management plan to the working group (including the choice of treatment/disposal methods) that is in line with any existing national waste management plan, planning the construction and maintenance of waste storage and disposal facilities, assessing the environmental impact of waste management (monitoring contamination, conducting hydrogeological assessments, etc.), regularly analyzing risks for the personnel, supervising the local waste manager and training all other health care handlers on proper measures in health care waste management.

5. Pharmacist

The chief pharmacist is responsible for maintaining medicine stocks and minimizing expired stock, managing waste containing mercury, in the absence of the pharmacist, the hospital administrator takes over these responsibilities

6. Head of labs.

The head of laboratory is responsible for maintaining the stock of chemicals and minimizing chemical wastes and also managing chemical wastes generated.

7. Responsibilities of waste handlers.

Waste handlers should know color-coded waste-segregation system, collect filled safety boxes and used bin liners according to hospital-stipulated frequency for disposal, maintain segregation during handling and transportation, ensure waste is securely stored in a covered area until disposal, use protective equipment when handling HCW, safely transport waste to treatment site according to schedule and route, ensure a clean environment at the facility, ensure hepatitis B and any other required vaccinations are received, ensure one's safety when handling waste and report any incidents or accidents to the supervisor.

8. Responsibilities of incinerator operators.

They ought to Follow incinerator standard operating procedures, use protective equipment when handling waste, monitor and timely report supply of fuel for incinerator, record quantity and type of waste received for incineration, follow regular maintenance schedule for incinerator, ensure treated waste is safely transported to

final disposal site, hepatitis B and any other required vaccinations are received and guarantee one's safety when operating the equipment and report any incidents or accidents to the supervisor.

9. Responsibilities of autoclave operators.

It is their duty to operate the equipment in accordance with the standard operating procedures, use protective equipment when handling waste, ensure availability of appropriate supplies, keep records on waste treated, follow regular maintenance schedule and quality-assurance testing procedures, ensure treated waste is safely transported to collection point for final disposal, make sure hepatitis B and any other required vaccinations are received, make certain one's safety when operating the equipment and report any incidents or accidents to the supervisor.

The most important thing to do in order to encourage health care waste handlers to adhere to the laid-out framework and guidelines on waste segregation is to do waste segregation, putting separate containers and plastic bags with different color codes and marked with symbols. The international framework is as shown below.

Type of waste	Color coding symbol	Type of container
Household refuse	Black	Plastic bag
Sharps	Yellow and suitable symbol	Sharp's container
Waste entailing a risk of contamination	Yellow and suitable symbol	Plastic bag or container
Anatomical waste	Yellow and suitable symbol	Plastic bag or container
Infectious waste	Yellow and highly infectious symbol suitable symbol	Plastic bag or container which can be autoclaved

Chemical and pharmaceutical waste	Brown, marked with suitable symbol.	Plastic bag or container
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The reduction of waste generation is very vital in the overall attempt to ensure management of the waste reducing the amount of waste at source, choosing products that generate less waste: less wrapping material, for example, choosing suppliers who take back empty containers for refilling (cleaning products); returning gas cylinders to the supplier for refilling, preventing wastage: in the course of care, for example, or of cleaning activities, choosing equipment that can be reused such as tableware that can be washed rather than disposable. It is prohibited to reuse needles or syringes. The plastic part of syringes is recycled in some regions, but this practice is not recommended in ICRC contexts.

Purchasing policy geared to minimizing risks: This can be done by purchase of PVC-free equipment (choosing PET, PE, or PP)—see Health-Care Without Harm site.¹¹¹⁰, purchase of mercury-free equipment: mercury-free thermometers (ICRC standards), (mercury-free blood-pressure gauges), If possible, purchase of new safe injection and blood sampling systems (where the needle is withdrawn automatically), opting for the least toxic products (cleaning products, for example).

Product recycling: This can be done by recycling of batteries, paper, glass, metals, and plastic, composting of plant waste (kitchen and garden wastes), recycling of the silver used in photographic processing, recover energy for water heating.

Stock management: This entails centralized purchasing, chemical and pharmaceutical stock management aiming to avoid a build-up of expired or unused items: “first-in—first out” stock management, expiry date monitoring. Choice of suppliers according to how promptly they deliver small quantities and whether unused goods can be returned. Health-care waste includes a large component of general waste and a smaller proportion of hazardous waste.

2.2.4 Impacts of Hazardous Waste.

For serious virus infections such as HIV/AIDS and hepatitis B and C, health-care workers particularly nurses are at greatest risk of infection through injuries from contaminated sharps (largely hypodermic needles). Other hospital workers and waste-management operators outside health-care establishments are also at significant risk,

as are individuals who scavenge on waste disposal sites (although these risks are not well documented). The risk of this type of infection among patients and the public is much lower. Certain infections, however, spread through other media or caused by more resilient agents, may pose a significant risk to the general public and to hospital patients. For instance, uncontrolled discharges of sewage from field hospitals treating cholera patients have been strongly implicated in cholera epidemics in some Latin American countries.

Pathogenic microorganisms have limited ability to survive in the environment. This ability is specific to each microorganism and is a function of its resistance to environmental conditions such as temperature, humidity, ultraviolet irradiation, availability of organic substrate material, presence of predators, etc. The hepatitis B virus is very persistent in dry air and can survive for several weeks on a surface; it is also resistant to brief exposure to boiling water. It can survive exposure to some antiseptics and to 70% ethanol and remains viable for up to 10 hours at a temperature of 60°C. The Japanese Association for Research on Medical Waste found that an infective dose of hepatitis B or C virus can survive for up to a week in a blood droplet trapped inside a hypodermic needle. By contrast, HIV is much less resistant. It survives for no more than 15 minutes when exposed to 70% ethanol and only 3 to 7 days at ambient temperature. It is inactivated at 56°C (Allwood M. et. al., 1993).

Bacteria are less resistant than viruses, but much less is known about the survival of prions and agents of degenerative neurological diseases (Creutzfeldt-akob disease, kuru, etc.), which seem to be very resistant. With the exception of waste containing pathogenic cultures or excreta of infected patients, the microbial load of health-care waste is generally not very high. Furthermore, health-care wastes do not seem to provide favorable media for the survival of pathogens, perhaps because they frequently contain antiseptics. Results of a number of studies have shown that the concentration of indicator microorganisms in health-care waste is generally no higher than in domestic waste, and that survival rates are low. In evaluating the survival or spread of pathogenic microorganisms in the environment, the role of vectors such as rodents and insects should be considered. This applies to management of health-care waste both within and outside health-care establishments. Vectors such as rats, flies, and cockroaches, which feed or breed on organic waste, are well known passive

carriers of microbial pathogens; their populations may increase dramatically where there is mismanagement of waste.

Despite the fact that treatment and disposal of health-care waste reduces risks, indirect health risks may occur through the release of toxic pollutants into the environment through treatment or disposal.

Landfills can contaminate drinking-water if they are not properly constructed. Occupational risks exist at disposal facilities that are not well designed, run, or maintained.

Incineration of waste has been widely practiced but inadequate incineration or the incineration of unsuitable materials results in the release of pollutants into the air and of ash residue. Incinerated materials containing chlorine can generate dioxins and furans, which are human carcinogens and have been associated with a range of adverse health effects. Incineration of heavy metals or materials with high metal content (in particular lead, mercury and cadmium) can lead to the spread of toxic metals in the environment. Dioxins, furans and metals are persistent and bio-accumulate in the environment. Materials containing chlorine or metal should therefore not be incinerated. Only modern incinerators operating at 850-1100 °C and fitted with special gas-cleaning equipment are able to comply with the international emission standards for dioxins and furans. Alternatives to incineration are now available, such as autoclaving, microwaving, steam treatment integrated with internal mixing, and chemical treatment.

Antimicrobial resistance (AMR) could develop as a result of improper disposal of Hazardous Waste. It's resistance of a microorganism to an antimicrobial medicine to which it was previously sensitive. Resistant organisms (they include bacteria, viruses and some parasites) are able to withstand attack by antimicrobial medicines, such as antibiotics, antivirals, and anti-malarials, so that standard treatments become ineffective and infections persist and may spread to others. AMR is a consequence of the use, particularly the misuse, of antimicrobial medicines and develops when a microorganism mutates or acquires a resistance gene (WHO, 2012). In places like Nigeria most families become financially distressed after hospitalization of members of their families. Many infectious diseases risk becoming uncontrollable and could

derail the progress made towards reaching the targets of the health-related United Nations Millennium Development Goals set for 2015. When infections become resistant to first-line medicines, more expensive therapies must be used. The longer duration of illness and treatment, often in hospitals, increases health-care costs and the financial burden to families and societies (WHO, 2012). Multi-drug resistance is described as a phenomenon where a microbial pathogen resists at least three groups of antibiotics (CDC, 2005). Healthcare liquid wastes are the reservoirs of harmful infectious agents such as the pathogens and multiple drug resistant microorganisms (Sharma et al., 2010). Potential infectious risks include the spread of infectious diseases and microbial resistance from health-care establishments into the environment and thereby posing risks of getting infections and antibiotic resistance in the communities (Sharma et al., 2010). Studies have discovered trace level concentrations of antibiotics in waste water treatment plant effluents and surface waters (Kolpin et al, 2002). Long term exposure of microorganisms to low concentrations of antibiotics in waste water and surface water has the potential for the development of antibiotic resistance in these organisms (Smith et al., 1999).

Therefore, the development of antibiotic resistance in bacteria and their dissemination in the environment is of serious public health concern because an individual patient can develop an antibiotic resistant infection by contacting a resistant organism and spread in the communities. Hospitals and public health care units must safeguard the health of the community. However, the waste produced by the health care centers if disposed of improperly, can pose an even greater threat than the original diseases themselves due to the presence of concentrated forms of numerous risks including pathogenic and antibiotic resistant microorganisms (Sharma et al., 2010).

Lack of awareness about the health hazards related to health-care waste, inadequate training in proper waste management, absence of waste management and disposal systems, insufficient financial and human resources and the low priority given to the topic are the most common problems connected with health-care waste. Many countries either do not have appropriate regulations, or do not enforce them. An essential issue is the clear attribution of responsibility for the handling and disposal of waste. According to the 'polluter pays' principle, the responsibility lies with the waste producer, usually the health-care provider, or the establishment involved in related

activities. To achieve the safe and sustainable management of health-care waste, financial analyses should include all the costs of disposal

2.2.5 fundamental principles of handling health care waste.

1. Duty of care principle: This principle stipulates that any organization that generates waste has a duty to dispose of the waste safely. Therefore, it is the HCF that has ultimate responsibility for how waste is containerized, handled on-site and off-site and finally disposed of waste.

2. Polluter pays principle: According to this principle all waste producers are legally and financially responsible for the safe handling and environmentally sound disposal of the waste they produce. In case of an accidental pollution, the organization is liable for the costs of cleaning it up. Therefore, if pollution results from poor management of health-care waste then the HCF is responsible. However, if the pollution results because of poor standards at the treatment facility then the HCF is likely to be held jointly accountable for the pollution with the treatment facility. Likewise, this could happen with the service provider. The fact that the polluters should pay for the costs they impose on the environment is seen as an efficient incentive to produce less and segregate well.

3. Precautionary principle: Following this principle one must always assume that waste is hazardous until shown to be safe. This means that where it is unknown what the hazard may be, it is important to take all the necessary precautions.

4. Proximity principle: This principle recommends that treatment and disposal of hazardous waste take place at the closest possible location to its source in order to minimize the risks involved in its transport. According to a similar principle, any community should recycle or dispose of the waste it produces, inside its own territorial limits.

Segregation refers to placing HCW into separate containers according to type or categories e.g., non- infectious or general waste, infectious, highly infectious, and sharps waste). It is very important to segregate waste as it facilitates the safe handling of the waste, separates recyclable waste from hazardous waste, it ensures that the waste will be treated according to its hazards, it reduces the overall cost of waste management, including transport, treatment, and disposal and also helps in Sharp waste management.

Sharp waste must be immediately contained after use in order to prevent injury. The primary way to contain sharps is by using safety boxes and needle removers when available in the health facility

A safety box is a puncture- and leak-resistant container for disposal of sharps. It is important to use a safety box when handling sharps as sharps can cut or puncture the skin, and, if they are contaminated, they can cause infections or diseases, including hepatitis B, hepatitis C, and HIV. If not properly disposed of, scavengers may also collect and reuse sharps waste. Reusing syringes and needles results in high risk of infection or disease transmission.

The right steps on how to use a safety box

1. Follow assembly instructions printed on the box.
2. Keep safety box within arm's reach at each place where injections are given.
3. Remove cannula/needle from IV set and place sharp in safety box.
4. Dispose of the used syringe into the small opening in the safety box immediately after use.
5. Do not recap and do not collect syringes for later disposal.
6. Fingers should never be placed inside the box.
7. Close the flap on the small opening of the box when it is three-quarters full. Do not overfill.
7. Fill safety box only once and then destroy.

The items that can be placed in a safety box include; Syringes with needles, syringes with needles removed (if using a needle remover), infusion needles, cannula, suture needles, scalpel, blades, broken ampoules, other categories of sharps and cannulas should be disposed of in specially designed sharps containers. These include; chest tube introducers, biopsy needle, central line introducer, fistula needles and cord clumps.

2.2.6 Handling of health care waste

Handling is the process of packing and moving waste materials at the points of generation. It is done by generators and handlers of waste as it entails holding pieces

of waste in bins located near the points of waste generation. In general, the following measures should be taken when handling HCW:

1. Health workers handling waste must wear appropriate personal protective equipment (PPE) when handling waste.
2. Sharps must always be placed in injection safety boxes and never be placed in waste bags.
3. Waste must be contained in color-coded and well-labelled plastic bags.
4. Waste bags must not be overfilled (fill to approximately three-quarters of capacity).
5. The volume of waste bag should not exceed 55 liters.
6. At the point of waste generation, excess air should be expelled from the bag without compacting the contents, prior to closure using a bag tie.
7. All bags should be held away from the body by the closed top of the bag, and
Placed directly into a mobile garbage bin or trolley.
8. Where waste bags are sealed and stored pending collection, they should be in a secure place with restricted access.
9. A waste collection schedule should be in place.

Storage is the temporary containment of waste in a secured area before collection for treatment and/or disposal. Storage requirements must meet the criteria set by technically trained personnel. The storage time must not exceed 24 hours, any storage of waste, including sharps, before treatment or collection for offsite disposal should be in a secure location designated for the purpose.

There should be a water supply for cleaning purposes, the area should be clearly demarcated and have a sign warning trespassers, the storage area should have impermeable, hard-standing floor with good drainage; it should be easy to clean and disinfect the storage area should afford easy access for staff in charge of handling waste, it should be possible to lock the storage area to prevent access by unauthorized persons with easy access required for waste-collection vehicles, the area should have protection from the sun, the storage area should be inaccessible to animals, insects,

and birds and there should be good lighting and ventilation (passive ventilation at a minimum)

Collection is the assembly of waste packages from different sections to one point.

Collection is meant to avoid accumulation and decomposition of waste in an area.

Guiding principles in collection of waste include: Removal of waste liner bags from the service point and taking them to a storage or disposal area for waste should not be allowed to accumulate at the point of production. For this reason, a routine schedule for waste collection should be established as part of the HCWM plan, health care workers should ensure that waste liner bags are tightly closed or sealed when they are about three-quarters full, light-gauge liner bags can be closed by tying the neck, but heavier-gauge bags probably require a plastic sealing tag of the self-locking type, Liner bags should not be stapled closed.

Transportation refers to moving collected wastes from temporary storage area to treatment or disposal site. HCW can be transported to a treatment site within the hospital (known as “onsite”) or outside (known as “offsite”).

When moving waste from one place to another, either onsite or offsite, the following precautions should be taken: Boxes of waste must be kept upright; avoid direct contact of safety boxes with other waste or medical supplies in the same vehicle, Safety boxes must be kept dry, all health workers should be aware of the waste-collection schedule, waste should be placed in collection points to ensure that the waste handlers do not enter the wards/departments as they move end route, health facilities should have a clearly defined route for transportation of waste. (Nagin, N. et al., 2012. The transport routes should avoid food preparation and heavily used areas, after transport, decontaminate and clean vehicle surfaces, consequently, HCW should be transported in designated vessels only. (Michela M. et al., 2008)

2.2.7 Treatment of health care waste.

Treatment is the process of rendering HCW safe by reduction or elimination of the potential to cause harm and reduction of the volume. HCW should be treated prior to disposal to ensure protection from potential hazards posed by the waste. To be effective, treatment must reduce or eliminate the risk present in the waste so that it no longer poses a hazard to persons who may be exposed to it. The common methods of treatment are incineration, steam sterilization, chemical disinfection, autoclaving, and

microwave irradiation. Other methods that can be used include encapsulation and energization and shredding. Laboratory infectious products must be pre-treated at the point of generation as per the National Biosafety and Biosecurity Guidelines.

Disposal refers to the final discharge of waste and residues or by-product from the treatment of waste. Municipal landfills are a designated site for disposal of municipal waste in a controlled manner to minimize pollution to ground water, land, and air. Disposal can also be done through burial in waste pits, placenta pits, and ash pits. Liquid waste is discharged through the conventional sewer line.

2.2.8 Adherence to Healthcare Waste Management practices in private hospitals in Kenya.

In Kenya, private health care facilities range from level 4/5 hospitals, health centers, dispensaries, nursing, and maternity homes, to health clinics/medical centers which offer integrated care, rehabilitative and supportive care to clients and patients Calderon, (2006). According to (2006, (2020), “the waste generated from hospitals is considered a serious issue since it may have harmful effects either on human beings or to the environment (environment support human beings, this means that the human beings would suffer more either way). Effects of such hazardous wastes on humans can occur through direct or indirect contact (Akhtar, I. et al., (2016).

Research done by Mogo, (2017) established that wastes from some private hospitals within Nakuru were found in municipal waste disposal sites that are considered less harmful. The study cited a lack of proper systems for handling wastes including segregation, transportation, treatment, and disposal within such hospitals, which lead to high amounts of wastes, hence, high risk to the waste handlers and the public (Mugo, 2017). To properly handle hazardous wastes produced from a hospital, an understanding of factors that influence the process must be explored. Njue *et al.*, (2015) stated that to plan and enhance the waste management system, health care facilities must have an in-depth understanding of methods of waste generation.

Mugo (2017) noted that, although the Kenyan government has recognized the mishandling of the medical wastes and has made efforts to create a working system that would reduce the risks associated with it, there is still no sustainable system

developed to be used by both public and private health facilities. This is associated with more and complex services done in high-level healthcare facilities. Therefore, the same waste management system used for small facilities cannot be adopted by high-level health institutions. 15 incinerators have been licensed in Kenya for waste disposal, this is not enough because one incinerator is shared among 10 institutions, hence, ineffective (Nagin *et al.*, 2012). The financial constraints faced by private hospitals limit their efforts on efficient and sustainable waste management practices in their premises (Borrowy, 2020). The proposal herein is meant to understand the factors that contribute to such limitations in the management of wastes in private hospitals.

2.2.9 Individual factors influencing adherence to HCW Management practices.

Effective management of HCW among healthcare workers requires continuous learning of factors that affect the management of wastes within a healthcare system (Meadows, 2008). The study focused on how knowledge of the type of healthcare wastes and their associated risk affect adherence to HCWM policy frameworks. Ali stated that healthcare workers who know and understand the existing HCW management systems can abide more by the set guidelines. A study done by Joseph *et al.* (2015) suggested that healthcare workers need to be trained on good HCWM practices since it is a dangerous activity that could put both their lives, patients, and the general public at risk of infections. The recommendations from this study were similar to that of Ozder *et al.* (2013), which showed that; training of staff, both technical and non-technical, is critical for the proper and appropriate management of biomedical waste.

Brief educational and training interventions are effective in changing the perception and actions of pharmacists according to the survey done on knowledge and attitude of pharmacists on HCWM practices (Sullivan. 2009). In this study, a pharmacist received educational training on good HCWM practices and the results were a high improvement on how they handled wastes. A similar study was conducted in India by Rhadar, (2012) on tertiary healthcare providers regarding their attitude towards biomedical waste management. The study discussed that the first step towards developing a positive perception of good HCWM practices was offering training and awareness on the required set standards towards HCWM. (Borowy, I. et al., (2020). From the findings in the two studies, it can be concluded that healthcare

workers with adequate knowledge express better HCW practices than those with less knowledge.

A study done by Baaki et al, (2017) on healthcare workers in General Hospital in Anambra Nigeria, assessed the knowledge and practice of medical waste management among healthcare workers. It was established that the lower cadres of workers (such as health assistants) had little knowledge on handling medical wastes and policy framework governing HCWM, unlike the high health cadres (doctors and nurses) who were well conversant with good HCWM practices. Another study conducted in India in a tertiary care hospital of West Bengal to assess the awareness and knowledge of healthcare workers (junior doctors) revealed that; “only 29.5% had the knowledge of various methods of final disposal of Biomedical (BM) waste and only 76.4% knew about various types of color-coded bags for collection of BM waste” (Sharma et al., 2013). The researchers concluded that special emphasis should be given to junior healthcare providers when conducting intensive training and monitoring programs (Sharma et al., 2013).

Mochungong et al. (2010) conducted a study in northwest Cameroon on the infectious nature of HCW produced from the facility and their impact on the environment and public health. The study found out that, 73% of inadequate HCWM handling practices were caused by a lack of sufficient knowledge among clinical health workers. Further, more than 5% of clinical workers in North West Cameroon had insufficient knowledge of national or international policies on the safe handling of medical wastes. A survey conducted in Tanzania by Isaac (2018) to study the medical waste management practices among health workers as the way to reduce nosocomial infections in Tanzania hospitals found that high knowledge levels among healthcare workers were directly related to good and safe HCWM practices. Healthcare facilities in Irbid have inappropriate HCW handling, storage, and disposal compared to other developed countries according to a survey conducted in north Jordan by Bdour *et al.* (2007). The study concluded that both healthcare workers and waste handlers lacked sufficient training on efficient HCWM and education on how to effectively use protective equipment, hence, poor waste handling practices.

2.2.10 Institutional factors influencing adherence to HCW Management practices.

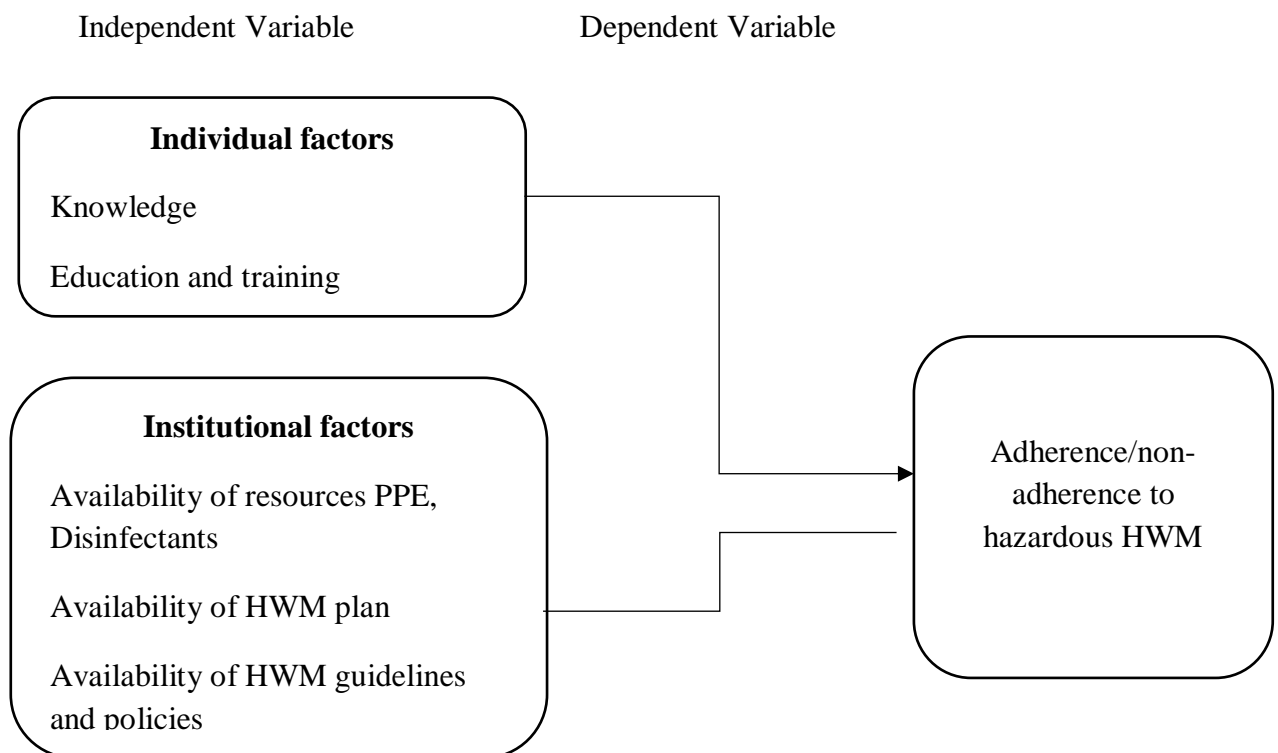
A study done in Uganda on Factors Affecting the Infectious Waste Management System on Practice Disposal Waste Among Health Workers revealed that most of the health workers (56.9%) did not adhere to the HCWM guidelines and policies existing in their health facilities (Affiant *et al.*, 2020). The findings of the study reported that the provision of personal protective equipment (PPEs), the supply of disinfectants, availability of HCWM plan in a hospital, availability of staff and waste handlers, the presence of overall supervision of the HCWM system at the hospital, and the availability of HCW service providers were significant health facility factors associated with adherence to proper HCWM practices (Affiant *et al.*, 2020a). The study further showed that the level of adherence was highest (31.8%) in health facilities that had more than 25 Staff and waste handlers to handle HCW and highest (50.0%) among health workers that reported not being provided with personal protective equipment. Another study that was investigating the factors influencing adherence to proper healthcare waste management practices in Wakiso District, Uganda also showed that the level of a health facility also played a role in adherence of proper HCWM practices (Babi rye *et al.*, 2020) reported that full adherence to proper HCWM practices was highest (19.7%) in health facilities at the hospital level.

Another study done on the adherence to healthcare waste management guidelines among nurses reported that institutional infrastructure like the type of incinerator, burning status, screening, and maintenance was important to the level of adherence (Niue *et al.*, 2015a). In this study, most respondents (80%) associated well-maintained (28%) and protected (29.8%) incinerator, modern controlled air (30.1%), and complete burning (30.7%) with full adherence to proper HCWM practices. This, therefore, indicates that the problems in effective clinical waste management are contributed by insufficient resources and poor incinerator capacity. A qualitative and quantitative study done in Cameroon to determine the impacts of environmental exposure and public health on poor clinical waste treatment and disposal reported that resources allocation, incinerator capacity, and awareness and training are the key challenges in waste management in Low and Middle-income countries (Ikome & Mochungong, 2011).

2.3 Conceptual Framework

The conceptual framework brings both dependent and independent variables together while predicting how the variables are related to one another. According to NIH (2020), dependent variables are influenced and determined by independent variables. In this study, independent variables are; the individual factors affecting adherence and institutional factors affecting adherence, HCWM practices within these private health facilities in Nairobi. Dependent variables are the factors that the study purposes to measure, in this case, the dependent variable is the status of adherence to hazardous waste management frameworks in private level 4 hospitals.

Figure 1: The conceptual framework



2.4 Operationalization of variables

Operationalization is the outline of how concepts will be measured, it involves the identification of specific indicators that represent ideas and concepts that the study will measure. The variables in this study are; existing systems, legal framework (legislation, policy, and guidelines), and level of knowledge. Measurements of level of knowledge was done by assessing whether healthcare workers are adequately trained and whether they comply with the standards. Measurements on proper

practices was done by assessing whether healthcare workers follow guidelines in the segregation, collection, and storing of wastes. Legislation and policy were measured by assessing whether healthcare workers had adequate knowledge of the HCWM policy guidelines. Existing systems were measured by assessing the availability of waste segregation labeling, storage, treatment, transportation, and disposal programs.

Table 1: Operationalization

Variable	Type of variable	Indicators	Measures	Scale of measure	Tools for data collection	Types of analysis
Individual factors	Independent	-Level of awareness/knowledge/training	HCWM system in place in the private hospital	Interval and Nominal	Questionnaire	Percentages and Frequencies
Institutional factors	Independent	-Availability of HCW management plan -Provision of personal protective equipment & disinfectants - Availability HCW service provider -Supervision	Understanding of the rules & regulations	Interval and Nominal	Questionnaires	Percentages
Adherence to hazardous waste management guidelines	Dependent	Commitment to follow the guidelines Consistency in following the HCWM guidelines put in	Commitment and consistency	Interval and Nominal	Questionnaires, Document analysis.	Percentages and Frequencies

		place by the institution and the government				
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2.5 Gap Analysis

The research papers analyzed in the empirical review had different findings, views, and recommendations on hazardous waste management by healthcare workers. The majority of the studies tackled healthcare worker's understanding/knowledge of healthcare waste management practices but there was little attention on the adherence to guidelines and framework provided by the facility or the governing bodies. Moreover, the study that tackled adherence to medical waste guidelines was not done in Kenya. Notwithstanding, the studies that assessed the knowledge of healthcare workers on proper waste management practices had different findings. For instance, a study done by Olaifa *et al.*, (2018) found that healthcare workers were highly knowledgeable on proper HCWM practices. While, Maina (2018), revealed that the majority of healthcare workers had inadequate knowledge of medical waste management practices. A study done by Maina *et al.* (2015), revealed that private hospitals had inadequate waste segregation of healthcare wastes, this was linked to poor adherence to waste management policy guidelines. A report by the Kenyan government revealed that only 25% of private healthcare facilities in Kenya had proper healthcare waste segregation. Therefore, the study aimed to assess healthcare workers' adherence to the waste management policy framework.

Figure 2; Research gaps

Study Empirical	Findings	Research Gap
<p>Aboelnour, A., & Abuelela, M. H. (2019). Increase adherence to waste management policy at a healthcare facility in Egypt. <i>Bulletin of the National Research Centre</i>, 43(1). https://doi.org/10.1186/S42269-019-0065-2</p>	<p>The study revealed that the majority of waste handlers, nurses, and doctors used inappropriate HCW management practices related to hazardous and infectious wastes.</p>	<p>The study utilized the basic six sigma breakthrough problem-solving methodology to examine the root cause of the problem in a healthcare facility in Egypt while this study utilized quantitate</p>

		design for Kenyan health facilities.
Afriyanto, Pitaksanurat, S., Junggoth, R., & Setiyadi, N. A. (2020b). <i>Factors Affecting the Infectious Waste Management System on Practice Disposal Waste Among Health Workers in Bengkulu Hospital</i> . 101–109. https://doi.org/10.2991/AHSR.K.200612.013	The study found an association between working hour/day, attitudes, and knowledge of personal health hospitals to the medical waste management practices	This study focused on the healthcare facilities rather than healthcare workers as in my study.
Ali, M., Wang, A., & Chaudhry, N. (2016). Management of wastes from hospitals: A case study in Pakistan. <i>Waste Management & Research : The Journal of the International Solid Wastes and Public Cleansing Association, ISWA</i> , 34(1), 87–90. https://doi.org/10.1177/0734242X15616474	This research observed poor waste segregation, storage, and transportation practices at all surveyed hospitals.	The study was done in a different setting, Pakistan, while this study was conducted in Kenya.
Baaki, T. K., Baharum, M. R., & Akashah, F. W. (2017). Critical success factors of medical waste management implementation in healthcare facilities in Nigeria: A case study. <i>Journal of Design and Built Environment</i> , 17(1), 18–35. https://doi.org/10.22452/JDBE.VOL17NO1.2	The study found training, sensitization, and awareness was considered to be the most critical factor, followed by environmental legislation in compliance with international environmental rules/regulations; and specific and elaborate regulations concerning medical waste.	The study did not consider institutional factors affecting adherence to healthcare which was of interest in this study.

<p>Babirye, J., Vuzi, P., & R. Mutekanga, D. (2020). Factors Influencing Adherence to Proper Health Care Waste Management Practices among Health Workers in Wakiso District, Uganda. <i>Journal of Environmental Science and Public Health</i>, 04(02). https://doi.org/10.26502/jesph.96120088</p>	<p>Findings drawn from this study highlighted financial waste segregation awareness of risks involved in MWM, lack of specialized MWM staff, and lack of appropriate legislation as the major causes for poor medical waste management.</p>	<p>This study focused more on the risks of poor medical wastes management practices to human health and the environment, rather than the factors affecting adherence to those practices.</p>
<p>Mugo, L. N. (2017). <i>Factors Influencing Waste Management In Public Hospitals In Nakuru County, Kenya</i> .</p>	<p>The study concluded that the legal framework and technology on healthcare management in hospitals had positive influence on healthcare waste management while existing systems, training, and public awareness had negative influence.</p>	<p>The study setting was in Nakuru County while this study focused on Nairobi</p>
<p>Sharma, A., Sharma, V., Sharma, S., & Singh, P. (2013). Awareness of biomedical waste management among health care personnel in jaipur, India. <i>Oral Health and Dental Management</i>, 12(1), 32–40.</p>	<p>The results showed that there was a poor level of knowledge and awareness of biomedical waste generation hazards,</p>	<p>The study was conducted in Jaipur, India, which is a different study setting from this study.</p>

	legislation, and management among health care personnel.	
Wafula, S. T., Musiime, J., & Oporia, F. (2019). Health care waste management among health workers and associated factors in primary health care facilities in Kampala City, Uganda: a cross-sectional study. <i>BMC Public Health</i> 2019 19:1, 19(1), 1–10. https://doi.org/10.1186/S12889-019-6528-4	The study found that the healthcare workers with previous training on HCW management and those who thought HCW management was important were more likely to have satisfactory HCW management practices.	The study was done in primary health care facilities in Kampala City, Uganda, which is a different study setting from this study.

2.6 Summary

The in-depth literature review provided in this chapter has brought into context all the aspects related to healthcare workers' adherence to hazardous waste management guidelines. The theoretical framework section presented the theoretical grounding of the study on the Theory of Reasoned Action/Theory of Planned Behavior and Systems Theory. The empirical literature review analyzed literature conducted in the same area of study as this one, and we have concluded the empirical review by presenting a summary of the gaps.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

The chapter discusses various research methods and various components of the research methodology applied in this research. The study's research design, study area, sample size and sampling procedures, data collection, and analysis methods are outlined in this chapter.

3.1 Research Design

According to Akhtar, "Research design is the arrangement of conditions for the collection and analysis of data in a manner that aims at combining relevance to the research purpose with economy in procedure." In this study we used descriptive research design whereby a survey was conducted using questionnaires as the main tools for data collection.

3.2 Population and Sampling

3.2.1 Population

In this study, healthcare workers from various cadres, who were responsible for offering direct care to the patients and those offering cleanliness services within this selected level 4 private hospitals in Nairobi Metropolitan were sampled. The inclusion criteria were; healthcare workers who had worked in the current hospital for at least six months and are in the following divisions: Head of departments, attendants and ancillary, housekeeping, waste management unit, infection control unit, and administration. The 4 selected private hospitals within Nairobi consisting of 900 healthcare workers (including waste handlers) who were directly involved in the generation and handling of healthcare wastes.

3.2.2 Sample size calculation

The technique of selecting a sub-group from the target population is called sampling; therefore, the targeted population is represented by the sample population. This procedure describes the sample size, sampling frame, sampling unit, and sampling plan. According to Banerjee & Chaudhury (2010), the use of a sampling population instead of the entire population is to realize the study objectives within minimized resources. The study adopted the sample size determination formula as defined by Mugenda (Ministry of Health, 2014):

$$n = \frac{N}{1 + N(e)^2}$$

Where;

n is the sample size of the study

N is the study population

e is the level of precision

Using the above formula, the sample size was calculated as follows

$$N = 900$$

$$e = 10\%$$

$$n = \frac{900}{1 + 900(0.10)^2}$$

$$n = 90$$

Plus 10 healthcare workers to cater for absents/non-responsive actors.

The study used a sample size of 100.

3.3 Sampling Techniques

Systematic stratified sampling was employed in this study (Mugenda, O. et al., (2003). The target population for this study of 90 participants was systematically sampled within 4 private institutions. 10 participants were included to cater for absent participants totaling to 100. To select individuals who were directly involved in the management of healthcare wastes, homogenous sampling (purposive sampling) was adopted. The Slovin's Formula is given as follows: $n = N / (1 + Ne^2)$, where n is the sample size, N is the population size and e is the margin of error. The sample included 20 heads of department, 5 from each selected hospital (20%), 12 attendants and ancillary 3 from each hospital (12%), 20 housekeepers 5 from each hospital (20%), 28 waste management unit 7 from each hospital (28%), 8 infection control unit 2 from each hospital (8%), and 12 administrators/managers 3 from each hospital (12%) giving a total of 100%.

3.4 Research Site

Kenya healthcare system is categorized into six distinct levels; level one - community (village/family unit/household), level two - dispensaries/clinics, level three - health centres, nursing homes, maternities, level 4 - sub-district and district hospitals, level five - provincial hospitals, level six - national referral hospitals. Level 4 hospitals in the Kenyan health system include sub-county hospitals and medium-sized private / mission (faith-based) hospitals. This study focused on 4 selected level 4 private hospitals.

Nairobi Metropolitan City (NMC) is sub-divided into 17 sub-counties. The study will be done in 4 level-4 private hospitals within Nairobi Metropolitan City (NMC). One of these hospitals is within the central side, one on the eastern side, one within the western region, and one on the Southern side of Nairobi. These included; Avenue Hospital parklands, Alamin Hospital, Reliance Hospital, and Belleview Hospital. Each of these hospitals was sampled using systematic and purposive sampling techniques as described above.

3.5 Data Collection Techniques

Research outcomes were quantified through the collection of primary data using questionnaires. Data was collected by interviewing healthcare workers from various departments/wards/units to gather information on HCWM practices. The participants in this study were purposively selected. Questionnaires were the main tool for data collection.

3.5.1 Questionnaires

According to (Kabir, 2016), questionnaire surveys are the typical methods of collecting descriptive data. Structured questionnaires with open and closed-ended questions were administered to 100 healthcare workers and waste handlers. 20 questionnaires were distributed to the head of departments in the 4 hospitals, 12 to the attendants and ancillary, 20 to housekeeping, 28 to waste management unit, 8 to infection control unit, and another 12 to the hospital administrations. Questionnaires were used to seek the view of healthcare workers and to question their knowledge of HCWM practices, guidelines, and framework including waste generation, handling, storing, transporting treatment, and final disposal. Questionnaires are time-saving and

gave the respondent time to think about their answers; hence, minimized errors that would derail the process of data analysis.

3.5.2 Review of Documentary

Policy documents of sampled level 4 private hospitals within Nairobi were not assessed either in hard copy or soft copies. However, the respondents were asked if they were aware of the regulations on proper waste management. Key documents on guidelines on health care waste management include: National Health Care Waste Management Plan 2015 to 2020; National Guidelines for Safe Management of Health Care Waste 2011; Injection Safety and Waste Management Policy; Kenya Health Sector Strategic Plan III (KHSSP III), 2012–2018 and Kenya Health Policy 2012 to 2030.

3.5.3 Validity and Reliability

Validity measures the future purpose of the study and how accurate and meaningful the study is based on the research results obtained. Mohajan (2017) defines the validity of the study as the correctness and reasonability of the data based on the results that accurately reflect the concepts being measured. To make sure that the results obtained from the study accurately reflected the concept, expert opinion from course supervisors and researchers who have done similar studies using similar data collection instruments was required. Useful adjustments to the research instruments were made after a pilot study and assessment measures were matched to the study's research questions to achieve validity.

On the other hand, the reliability of instruments is the degree to which the data collection and analysis tools produce stable and consistent results. According to Mohajan (2017), "test-retest reliability is a measure of reliability obtained by administering the same test over a while to a group of individuals and an extent to which a questionnaire, test, observation or any measurement procedure produces the same results on repeated trials." In this study, a pilot study was conducted to find the reliability of data collection and analysis tools and the procedures of administering them to participants. The formula by Kuder & Richardson (1937), was used to assess the reliability of data collection tools and procedures of administration. The formula is:

$$r = \frac{K}{K-1} \left[1 - \frac{\sum_{i=1}^K p_i q_i}{\sigma^2 X} \right]$$

Where p_i is the proportion of correct responses to the test item i ,

q_i is the proportion of incorrect responses to the test item i (so that $p_i + q_i = 1$),

The variance of the denominator is:

$$\sigma^2 X = \frac{\sum_{i=1}^n (X_i - X)^2}{n}$$

Where n is the total sample size. The sum of squares is divided by degrees of freedom ($n - 1$) and the probability is multiple by;

$$\frac{n}{n-1}$$

The Cronbach alpha coefficient correlations of existing systems of HCW management and legal framework (legislation, policy, and guidelines) were also calculated, and if it falls <1.0 , the tools of assessing them will be deemed reliable.

3.6 Data Analysis

Broadsheets of paper were used to code the data collected using questionnaires. Microsoft Excel software and Statistical Package for Social Science (SPSS) were used to process and analyze all the data collected. The data was presented in tables and graphs. Frequencies and percentages were used as tools of data analysis. Validation of data was done to determine that the correct number of questionnaires were applied to respondents. The questionnaires were then edited to assess the response rate. Pearson's chi square test was computed to find association between independent and dependent variables and a p value of less than 0.05 was considered statistically significant.

The strength of the relationship between the dependent variable (Y) and a series of independent variables were statistically measured using regression analysis. According to Hanson (2010), "regression analysis is used to determine the extent to

which two or more independent variables affect the dependent variable.” The regression formula is:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + u$$

Y is the dependent variable (adherence to HCWM policy framework by healthcare workers)

a is the Y -intercept, occurring when $X_1 = X_2 = X_3 = 0$

X is the variable that predicts Y

X_1 is existing systems

X_2 is the legal framework

X_3 is the level of knowledge

b is the slope

u is the regression residue.

3.7 Ethics

The study obtained the permit to research from the school research committee, in addition to NACOSTI approval/certification to conduct research using human participants. The following guidelines were followed:

- Ensuring arrangement with the respondents, prior physical visit for the data collection process.
- Informants' consent was very vital. The respondents were informed about the purpose of the study before the information was collected from them.
- Proper names of the informants were not included in the report to ensure confidentiality.
- Freedom to withdraw from the study was granted to respondents if they felt to do so at any time during the study.

CHAPTER 4: RESULTS OF THE STUDY.

4.1 Introduction

This chapter presents the analysis and interpretation of the study findings. The results are presented in tables and graphs. 100 Healthcare workers, managers/administrators and waste handlers were recruited to participate in the study. The statistical data analysis is in accordance with the specific objectives of this study. The overall objective of this study was to determine the factors influencing adherence to proper health care waste management policy framework among healthcare workers in 4 private level 4 hospitals in Nairobi County-Kenya. The specific objectives of the study are determining the level of adherence to proper HCWM practices among healthcare workers in selected private level 4 hospitals in Nairobi County Kenya, to identify the individual related factors that influence adherence to proper HCWM practices among healthcare workers in selected level 4 hospitals in Nairobi County Kenya, and to identify the health facility-related (institutional) factors that influence adherence to proper HCWM practices in selected level 4 hospitals in Nairobi County Kenya.

The sample size of this study was 100 participants consisting of 20 heads of departments, 12 attendants and ancillary, 20 housekeepers, 28 participants from waste management units, 8 members from infection control unit, and 12 hospital administrators/managers. 100 questionnaires were fully responded to and returned to the researcher. This provided for a response rate of 100 percent. Regarding the statements of Babbie (2002), any response rate which is above fifty percent is considered adequate for statistical data analysis thus the response rate of this study was within the acceptable limit.

Data from the questionnaires were entered into SPSS version 25. To address any errors, data cleaning was implemented with reference to the questionnaires to address any missing or erroneous data. This was aimed at addressing any errors of omission and commission. And ensuring that the data needed was collected. Once the data was

cleaned, analysis was conducted. For the descriptive statistics which involved the generation of summary statistics, Charts, and any necessary tables were implemented. To establish relationships between variables, the cross-tabulation of variables was implemented, with corresponding statistics for Pearson's Chi-squared tests for independence of variables also noted. This was achieved using SPSS' 'Crosstab' function and correlation analysis. At a 95% confidence level, two variables were deemed statistically dependent if the corresponding p-value for the Pearson's was less than 0.05. Various variable relationships were analyzed. However, only statistically significant relationships which are of importance to the study are presented below.

4.2 Socio-demographic characteristics of the respondents

Respondents totaling 100 were recruited. Most 63.0% (n=63) of them were between 20-30 years of age. Out of the 100 participants, 59% (n = 59) were females. Respondents with diploma level education were the majority 40% (n =40). The highest number of respondents had between 1-5 years of experience, 53% (n=53). Most of the respondents were from the housekeeping and waste handling department, 52% (n=52). A majority of the respondents were nurses. 34% (n=34). More than half, 53% (n=53) of the respondents had never attended any training on waste management. Of those who had attended, 33% of them had attended a training on waste management. 95% of the respondents had had 0-5 needle stick injuries in the past 12 months. A majority of the respondents, 81% (n=81), had vaccinated themselves against hepatitis B and tetanus. The socio-demographic characteristics of the respondents are as shown below in table (Table 1.0).

Table 2: Socio-demographic characteristics of respondents.

Characteristics	Number	Percent (%)
Age in years		
20-30years	63	63
31-40years	30	30
41-50 years	5	5
51 years and above	2	2
Gender		
Male	41	41

Female	59	59
Level of education		
Certificate	38	38
Diploma	40	40
Degree	19	19
Masters	3	3
Years of experience		
Below 1 year	21	21
1-5 years	53	53
6-10years	14	14
11 years and above	12	12
Training on waste management		
Yes	47	47
No	53	53
Training attended		
Ipc	16	16
Waste management	33	33
None	51	51
Number of needle stick injuries		
0_5 injuries	95	95
6_10injuries	3	3
11-15injuries	2	2
Whether vaccinated		
Yes	81	81
No	19	19

Profession/designation.

A majority of the respondents were nurses (34%). Doctors, administrators, laboratory, housekeeping, physiotherapy and nutritionists comprised 10%, 3%, 4%, 47% and 2% respectively. 19% of the respondents worked in none of the hospital departments and 26% of them worked in other departments.

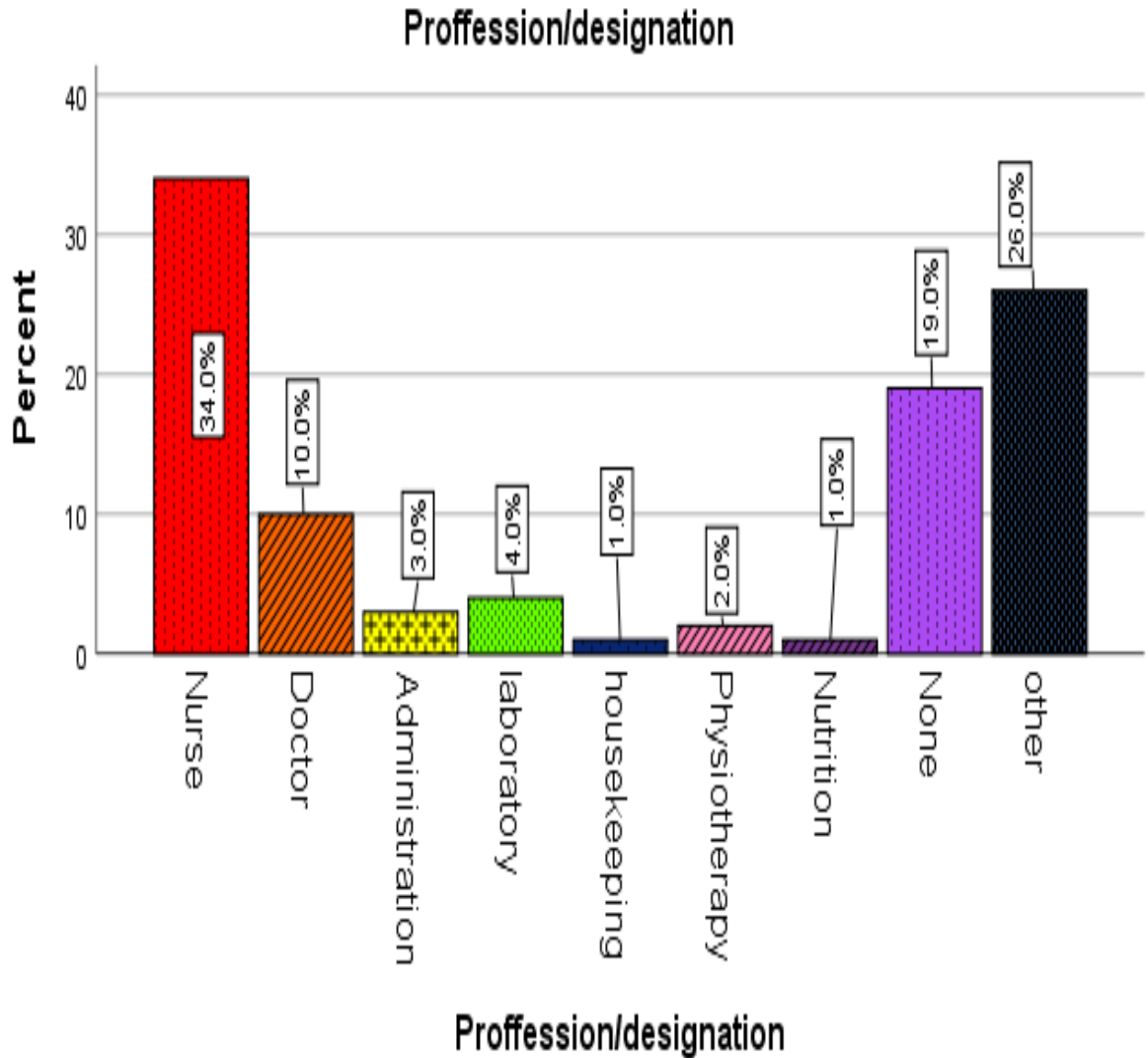


Figure 2: profession

On the practices on hazardous waste management, there was a significant difference among nurses and other waste handlers including doctors, administration, laboratory personnel, housekeeping, pharmacists, physiotherapists and nutritionist on awareness of the maximum time for medical waste to be kept in the hospital premises being 48 hours ($\chi=14.730$, $df=8$, $p=0.065$), application of methods of medical waste treatment ($\chi=19.88811$, $df=8$, $p=0.010$), the correct bag for intravenous sets, catheters and tubes, ($\chi=23.039$, $df=8$, $p=0.003$) guidelines for color coding ($\chi=24.551$, $df=8$, $p=0.002$), awareness of medical waste regulation ($\chi=32.734$, $df=8$, $p=0.000$) with a positive bias on nurses.

4.3 Institutional related factors that influence adherence to proper health care waste management.

4.3.1 Level of understanding of the system used by the hospital in waste management

More than 87% (n=87) a half of the respondents understood clearly the system used by the respective hospital in waste management.

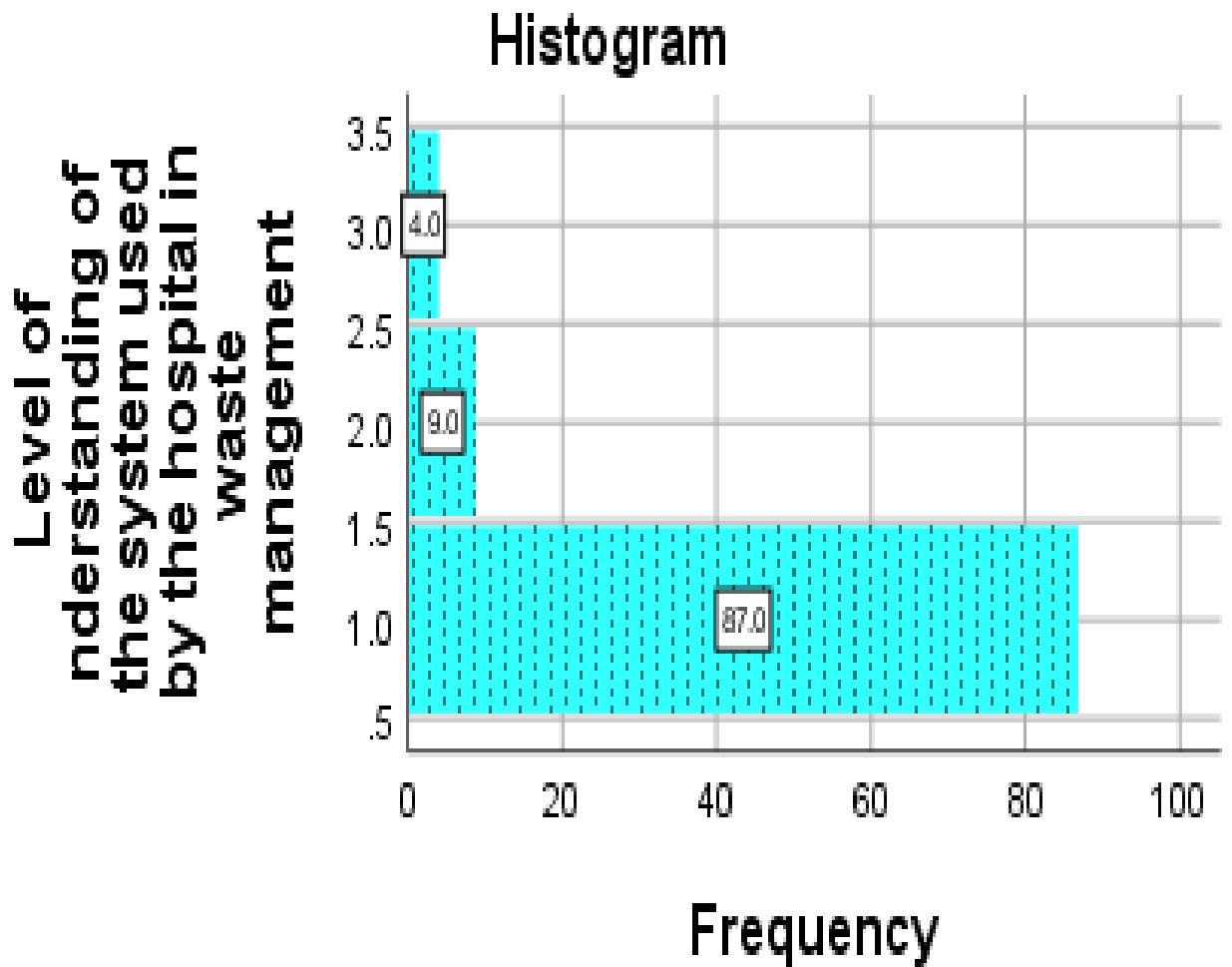
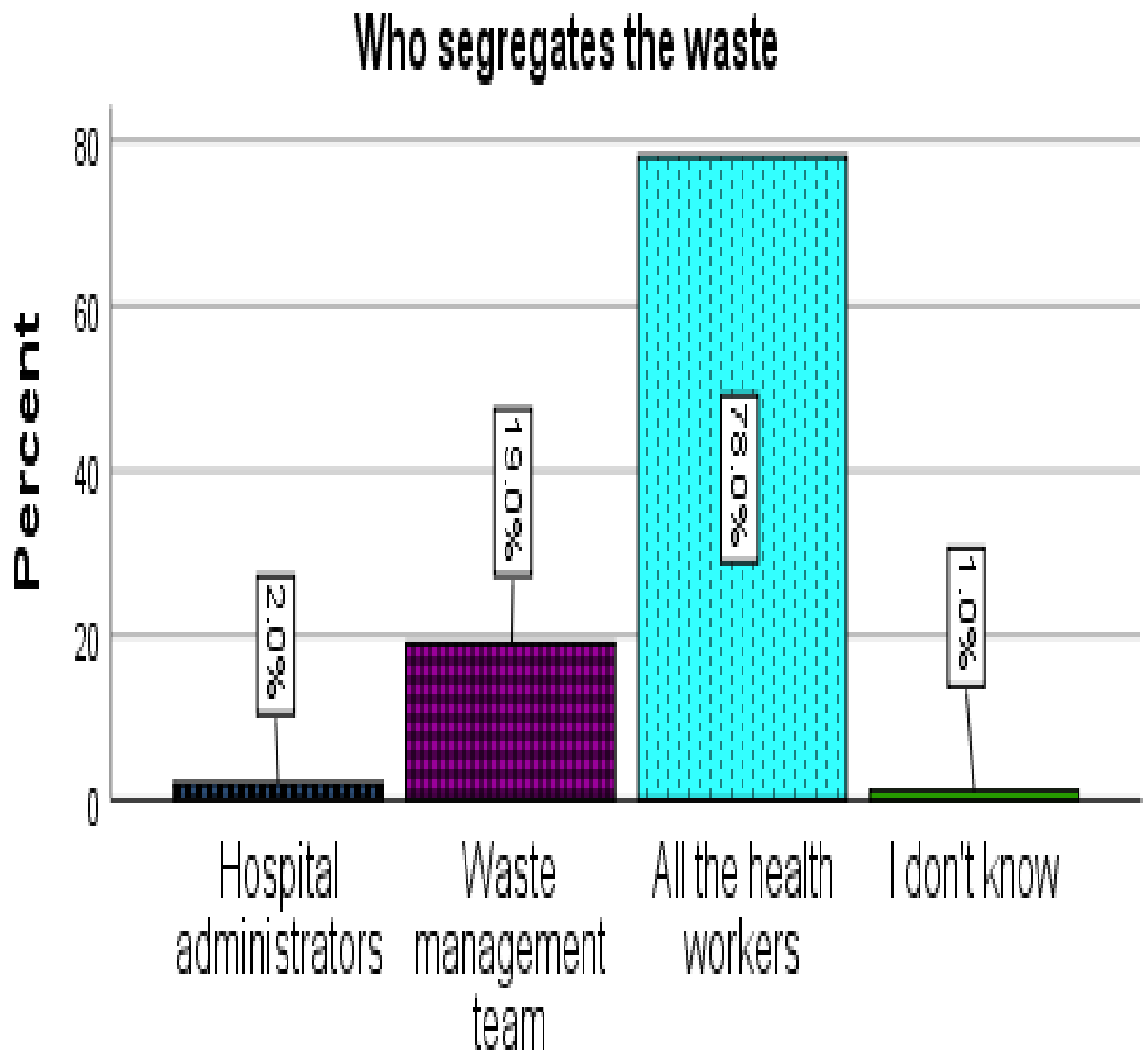


Figure 3: systems used by the hospital in waste management

4.3.2 Waste segregation.

More than half (78%) of the participants knew that segregation of waste is a role of all health workers.



Who segregates the waste

Figure 4: waste segregation

4.3.3 Waste labeling.

52% of the respondents knew that waste labeling was done by all health workers.

Who labels the waste

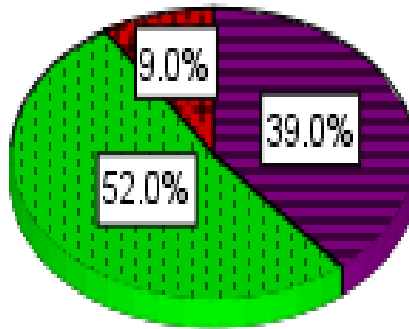
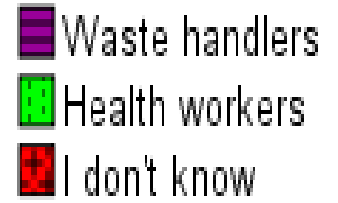


Figure 5: waste labelling

4.3.4 practices of waste management

48% of the respondents acknowledged that waste labeling is done at the site of segregation. Outsourcing was the most common method of dealing with waste. 62%. Sanitary staff were mostly involved in hospital waste disposal n=49%

Table 3: Practices of waste management

Variable	Number(N)	Percent (%)
Place of waste labeling		

At the segregation site	48	48%
At the storage place	9	9%
Where generated	43	43%
Methods used in dealing with waste management		
Sterilization	10	10%
Use of chemicals	2	2%
Incineration	24	24%
Burying	2	2%
Outsourcing	62	62%
People involved in actual waste disposal		
Sanitary staff	49	49%
Casual laborers	10	10%
Trained personnel	41	41%

4.3.5 Presence of an incinerator

Only 20% of the facilities had an incinerator.

Whether the hospital have incinerator or not

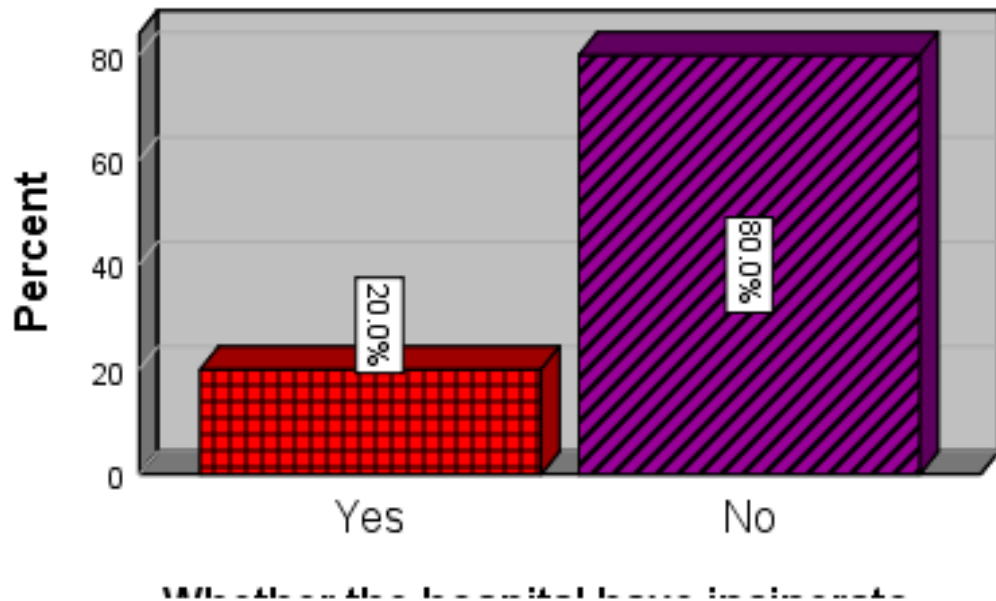


Figure 6: presence of incinerator

4.4 level of adherence to healthcare waste management.

The number of respondents with a high level of adherence was 24%. More than half of the respondents had a low level of adherence.

whats the level of adherence

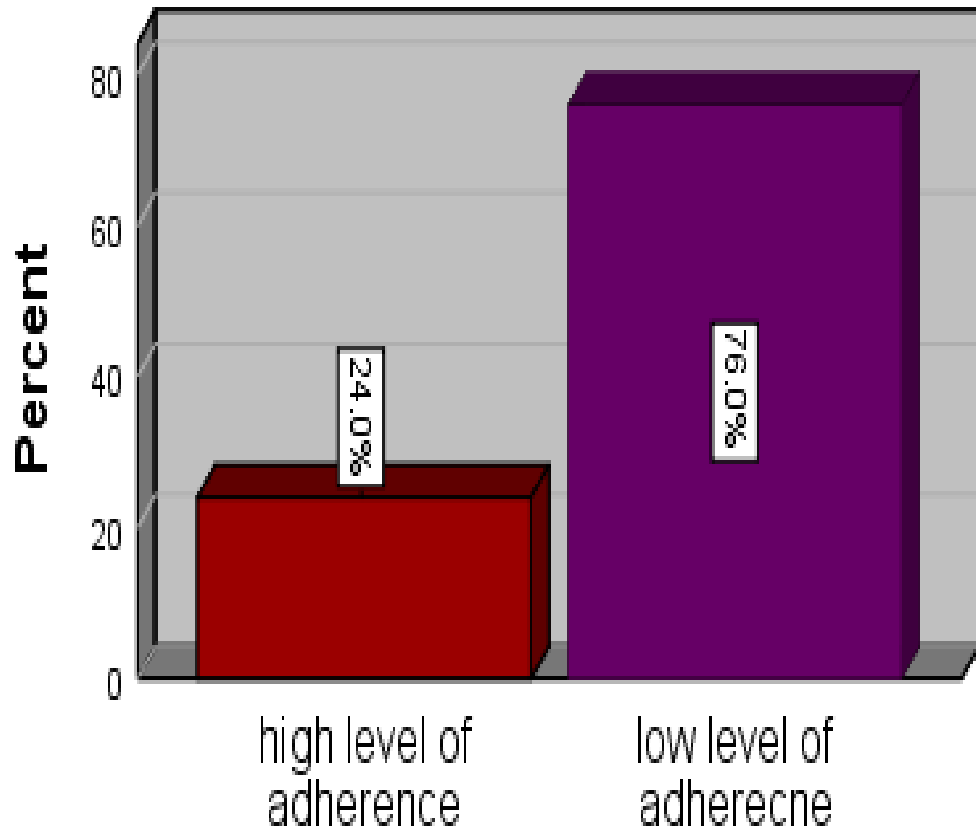


Figure 7: level of adherence

4.4.1 Knowledge /awareness on hazardous waste management.

There was a relatively high level of awareness on the practices regarding hazardous waste management policy frameworks as shown in table 2.0 below

Table 3: knowledge /awareness on hazardous waste management

Variable	Very high (%)	High (%)	Average (%)	Low n (%)	not at all n (%)
----------	---------------	----------	-------------	-----------	------------------

Awareness of medical waste segregation	44	22	15	9	10
Knowledge of biohazard symbol	64	8	11	3	14
Eight categories of medical waste	27	25	31	2	15
guidelines for color coding in work place	53	18	12	6	11
Puncture proof containers for sharps	71	14	9	5	1
The correct bag for disposal of cytotoxic drugs	38	20	8	7	27
The correct bag for intravenous sets, catheters and tubes	56	13	13	8	10
Aware if HIV can be transmitted through medical waste	89	8	2	0	1
Awareness of medical waste regulation	44	22	15	9	10
Aware that hepatitis B and C can be transmitted through medical waste	88	7	3	1	1
Knowledge if PPEs are necessary when handling medical waste	89	7	3	0	1
When to discard medical waste from the bin	66	16	8	4	6

Application of methods of medical waste treatment	50	18	18	5	9
Necessity of disinfection of medical waste	73	14	5	2	6
Use of bleaching solution 0.5% for disinfection	62	17	10	3	8
Maximum time for medical waste to be kept in hospital premises is 48 hours	46	12	21	7	14

4.5 level of adherence to healthcare waste management with regards to attendance of training on HCWM.

Those who had attended training on health care waste management had a higher level of adherence to proper HCWM as compared to those who had not attended a training before as seen in figure 11 below.

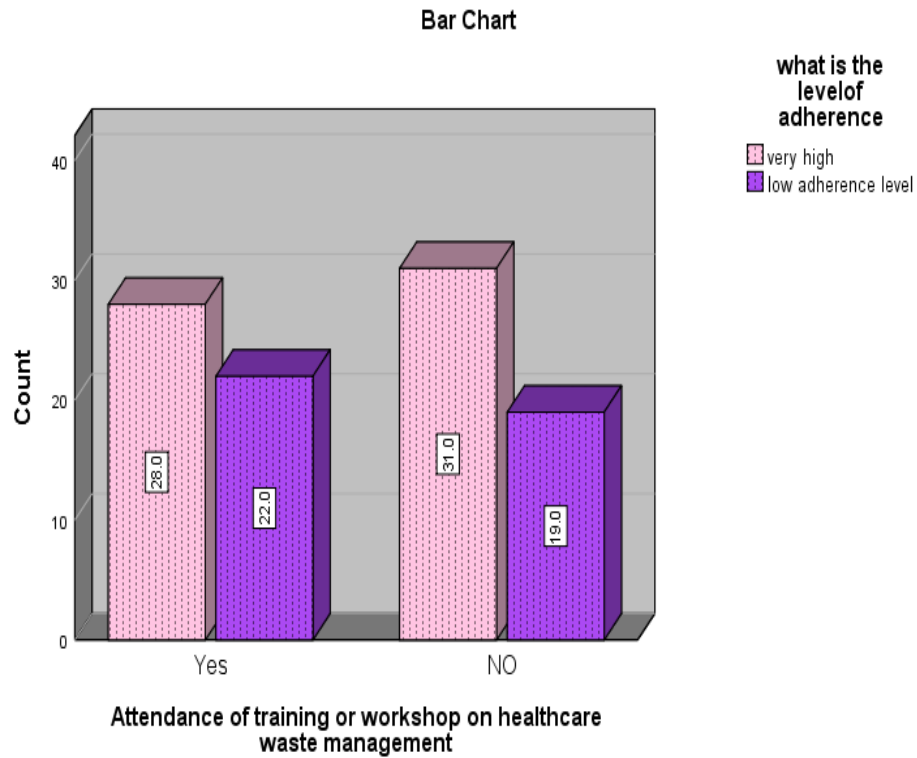


Figure 11. Level of adherence in relation to attendance of training on health care

4.6 Level of adherence in relation to socio-demographic factors affecting adherence to factors waste management.

According to this study, level of education was significantly related to adherence to proper HCWM practices. ($p=0.005$). Vaccination status for hepatitis B and tetanus was also significant to level of adherence to HCWM. ($P=0.040$). Although the association was not significant at p value <0.05 , a majority of the respondents who had a high level of adherence to health care waste management were female and respondents between 20-30years of age.

Table 4: Level of adherence in relation to socio-demographic factors affecting adherence to factors

Variable	Level of adherence	TOTAL	Chi(x2)	Df	P
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	High level of adherence	Low level of adherence				
Gender	N (%)	N (%)				
Male	6(25.0%)	35(46.1)	41(100)	3.342	2	0.068
Female	18(75.0)	41(53.9)	59(100)			
TOTAL	24(100)	76(100)	100(100)			
Age						
20-30years	16(66.7)	47(61.8)	63(63)	0.750	3	0.861
31_40years	7(29.2)	23(30.3)	30(30)			
41-50years	1(4.2)	4(5.3)	5(5)			
51 years and above	0(0)	2(2.6)	100(100)			
TOTAL	24(100)	76(100)	100(100)			
Level of education						
Certificate	15(62.5)	23(30.3)	38(38.0)	12.774	3	0.005
Diploma	5(20.8)	35(46.1)	40(40.0)			
Degree	2(8.3)	17(22.4)	19(19.0)			
Masters	2(8.3)	1(1.3)	100(100)			
TOTAL	24(100)	76(100)				
Years of experience						
Below 1 year	5(20.8)	16(21.1)	21(21)	1.616	3	0.656
1-5years	15(62.5)	53(53)	53(53)			
6-10years	2(8.3)	14(14)	14(14)			
11 years and above	2(8.3)	12(12)	12(12)			
TOTAL	24(100)	100(100)	100(100)			
Area of work						
Emergency room	1(4.2)	9(11.8)	10(10)			
Medical/surgical	0(0)	18(23.7)	18(18)	16.168	9	0.063
Pediatrics	0(0)	2(2.6)	2(2)			
Oncology	0(0)	1(1.3)	1(1)			
Lab	0(0)	4(5.2)	4(4)			

Pharmacy	0(0)	1(1.3)	1(1)			
Critical care	1(4.2)	3(3.9)	4(4)			
Dialysis	0(0)	2(2.6)	2(2)			
Obs /Gynae	2(8.3)	4(5.3)	6(6)			
Housekeeping	20(83.3)	32(42.1)	52(52)			
TOTAL	24(100)	74(100)	100(100)			
Training on waste management						
Yes	9(37.5)	40(52.6)	49(49)	1.671	1	0.196
No	15(62.5)	36(47.4)	51(51)			
TOTAL	24(100)	76(100)	100(100)			
Training attended						
IPC	2(8.3)	14(18.4)	16(16)	2.120	2	0.347
Waste management	7(29.2)	26(34.2)	33(33)			
None	15(62.5)	36(47.4)	51(51)			
TOTAL	24(100)	76(100)	100(100)			
Number of needle stick injuries in the past 12 months						
0-5 injuries	23(95.8)	72(94.7)	95(95)	1.691	2	0.429
6-10 injuries	0(0)	3(3.9)	3(3)			
11-15injuries	1(4.2)	1(1.)	2(2.0)			
TOTAL	24(100)	76(400)	100(100)			
Whether vaccinated for hepatitis B and Tetanus or not						
Yes	16(66.7)	65(85.5)	81(81)	4.216	1	0.040
No	8(33.3)	11(14.5)	19(19)			
TOTAL	24(100)	76(100)	100(100)			

4.7 Individual related factors in relation to participation in health care waste management

This study found a true significance between attendance of training and adherence to the biomedical symbol, medical waste regulation, guidelines on color coding, correct bags for intravenous sets, catheters and tubes and application of methods of medical waste treatment. ($p=0.035$, $p=0.002$, $p=0.032$, $p=0.010$) respectively. These variables were thus deemed dependent.

Table 5: Individual related factors in relation to participation in health care waste management

Variable	attendance of training or workshops on waste management.		TOTAL	Chi(x2)	Df	P
	Yes N (%)	no N (%)				
Awareness of medical waste regulation						
Fully aware	38(76.0)	28(56)	66(66)	4.456	1	0.035
Partially aware	12(24)	22(44)	34(34)			
TOTAL	50(100)	50(100)	100(100)			
Knowledge of the biohazard symbol						
Fully aware	43(86.0)	29(58)	72(72)	9.722	1	0.002
Partially aware	7(14)	21(42)	28(28)			
TOTAL	50(100)	50(100)	100(100)			
guidelines for color coding in workplace						
Fully aware	41(82)	71(71)	71(71)	5.877	1	
Partially aware	9(18)	29(29)	29(29)			
Total	80(100)	100(100)	100(100)			
The correct bag for Iv sets, catheters and tubes						
Fully aware	39(78)	29(58)	68(68)	4.596	1	0.032
Partially aware	11(22)	21(42)	32(32)			
Total	50(100)	100(100)	10(100)			

Aware that hepatitis B and C can be transmitted through medical waste						
Fully aware	48(96)	47(94)	95(95)	0.211	1	0.646
Partially aware	2(4)	3(6)	5(5)			
TOTAL	50(100)	50(100)	100(100)			
Application of methods of medical waste treatment						
Fully aware	40(80)	28(56)	68(68)	6.618	1	0.010
Partially aware	(20)	22(40)	32(32)			
TOTAL	50(100)	50(100)	100(100)			

CHAPTER 5:

DISCUSSION, CONCLUSION AND RECOMMENDATIONS.

5.0 Introduction

The main objective of the study was to determine the factors influencing adherence to proper Healthcare waste management practices among healthcare workers in 4 private level 4 hospitals in Nairobi County - Kenya. In this study some expected findings were reported as well as other relationships and trends.

5.1 Level of adherence to proper HCWM practices among healthcare workers.

Knowledge and awareness on proper health care waste management is key in the actual practice and adherence to proper HCWM. In the Sub - Saharan African countries. The study established adherence to proper HCWM at 60%. The level of adherence to HCWM guidelines among health care workers and waste handlers in a study done by Njue et al., (2015) established a 16% level of Njue et al, 2020 found a 43.1% adherence to HCWM guidelines in a study on factors affecting the infectious Waste Management system on practice of waste disposal in Uganda. A study done by the ministry of health highlighted that despite the policy frameworks on hazardous waste management put in place, most Healthcare workers do not adhere to such a framework. (Ministry of health, 2014). According to this study, the level of adherence was at 24%. These findings are below the WHO recommended standards of adherence that aims at 80%. This can be attributed to the difference in study participants and the research setting and is also relative to the high number of respondents who have never attended a training/workshop on HCWM. (53%).

In a study done on healthcare workers in a National Referral Hospital in Bhutan by Letho et al. (2021), 74% of the Healthcare workers were aware of the medical waste management frameworks and 98% were aware of the importance of PPEs when handling patients. In this study, the findings on the same was slightly lower. 66% of the health care workers were aware of the medical waste management and 96% of them were aware of the importance of using Personal protective equipment (PPE). Sharma et al., (2013) conducted a study on awareness and knowledge of healthcare workers on methods of biomedical final disposal and found a 76.4% awareness on the

various types of color-coded bags. The findings from this study were slightly lower at 71% awareness on the guidelines provided for color coding. This can be attributed to the low level of awareness of the 8 categories of medical waste at 27%.

A study done in Pakistan by Kumar R, et.al, 2015 on effectiveness of intensive healthcare waste management among health professionals established that training could be an effective intervention for improving knowledge attitude and the practice of proper health care waste management. Attendance of training /workshops is key in reinforcing proper HCWM. This study found a true significance between attendance of training and adherence to the biomedical symbol, medical waste regulation, guidelines on color coding, correct bags for intravenous sets, catheters and tubes and application of methods of medical waste treatment. ($p=0.035$, $p=0.002$, $p=0.032$, $p=0.010$) respectively. These variables were thus deemed dependent.

5.2 institutional related factors that influence adherence to proper HCWM.

More than a half of the respondents understood clearly the system used by the respective hospital in waste management and that waste segregation was a role of all health workers (87% (n=87), 78% (n=78) respectively. Waste labeling at most cases was done mostly at the site of segregation. (48%). Out-sourcing was the most common method of dealing with waste (67%). A study done by Maneli et.al, (2003) established very few hospitals had fire brick incinerators being done by untrained casual laborers. Tietmeyer et al. (2008) in his study found a 55% prevalence of incinerators within medical facilities in Kenya. In this study, only 20% of the institutions had an incinerator. This can be attributed to out-sourcing being the most common method of dealing with waste among these facilities. Nearly half of the people involved in actual hospital waste disposal were sanitary staff. (49%)

5.3 Individual related factors that influence adherence to proper HCWM practices among healthcare workers.

63% of the respondents were aged between 20-30 years and a majority of the respondents with high adherence to HCWM were also within this age bracket. 53% of the respondents had 1-5 years of experience. 59% of the respondents in this study were female. This is similar to the findings from a study done in Uganda on factors

influencing adherence to proper HCWM practices among healthcare workers where 58.8% of the respondents were female. (Josephine et. al, 2020). Although gender was not statistically significant to adherence to HCWM, most of the personnel who had a high adherence to HCWM practices are female ($p=0.068$).

In this study, nurses were more likely to have higher adherence to HCWM practices as compared to other waste handlers in different departments. This can be linked to the presence of on-site HCW segregation containers at their waste generation points hence were more motivated to segregate the hazardous waste.

5.4 Applying theory of reasoned action to factors influencing adherence to proper HCWM practices among healthcare workers in private level 4 hospitals in Nairobi County.

The theory of reasoned action suggests that a person's behavior is determined by their intention to perform the behavior with a belief that the behavior will lead to the intended outcome. The findings of this study agree with this theory clearly elaborated by the positive relationship between attendance of training and workshops on proper HCWM and the practices geared towards the same. Those who had attended trainings and workshops on health care waste management had a higher likelihood of adherence to proper HCWM as compared to those who had not. Furthermore, they had a greater awareness on the measures necessary for proper. Healthcare waste management including medical waste segregation, biohazard symbol, color coding, disposal of cytotoxic waste and catheters and many more. This study thus confirms the suggestion of the theory of reasoned action that if people evaluate the suggested behavior as a positive attitude and if they think others want them to perform the behavior, this results in a higher intention and are more likely to perform the behavior. According to this theory the intentions may not always result in behavior depending on ability factors and barriers to action. This is true evidenced by the low levels of adherence to proper HCWM despite the high level of awareness on the practices and the existing hospital framework and policies.

5.4 Conclusion.

The findings from this study show that the level of adherence to hazardous waste management policies among healthcare workers in private level four hospitals in

Nairobi County is low. Despite the high level of awareness by the health workers on the important measures of collection, segregation, treatment, transportation and disposal of waste, the level of performance on the same is low. This is greatly attributable to negligence and unfavorable attitude towards healthcare waste management practices among healthcare workers.

5.5 Recommendations

This study has shown that the level of adherence towards Proper HCWM is still very low among private level 4 hospitals in Kenya. This is related to both individual and facility related factors. In light of this, it is recommended that:

1. Continuous workshops and training on utilization of the available policy frameworks and guidelines on hazardous waste management need to be reinforced as a better strategy to mitigate the low adherence levels.
2. The health care delivery models and societal structures need to be improved highly in order to mitigate the burden of COVID 19 on hazardous waste management given the enormous burden posed by this pandemic and any other public health challenge to avoid watering down the efforts made.
3. Prioritization and allocation of resources to interventions with maximum impact on hazardous waste management needs to be done.

5.6 Further research

This study has identified a wide gap in institutional related factors affecting adherence to hazardous waste management policies in level 4 hospitals and hence further research needs to be carried out.

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APPENDIX I

LETTER OF INTRODUCTION

Strathmore University – Business School

Ole Sangale Road

Madaraka Estate

Nairobi

Dear Participant,

RE: REQUEST FOR PARTICIPATION

I am currently a master student of healthcare management at Strathmore Business School doing a research on the factors that influence adherence to Hazardous Waste Management policy frameworks among health workers in private level 4 hospitals in Nairobi County.

Kindly participate in this interview. The responses you give will be for academic purposes only and will be treated with ultimate privacy and confidentiality.

Thank you in advance.

Yours sincerely,

Signed 

APPENDIX II

INFORMED CONSENT FORM

I confirm that I have read and understood the information about the project as provided in the information sheet. I understand that my participation is voluntary and that I am free to withdraw from the project at any time. I understand that any information recorded in this study will remain confidential and no information that identifies me will be made public.

I confirm that all my concerns about the study have been adequately addressed and understood and that I voluntarily agree to participate in this study without any pressure.

Participants Signature..... Date.....

I confirm that I have explained the objectives and nature of the study in detail and the participant has voluntarily accepted.


Investigator Signature. .Date.....

Sincerely,
Constantyne Chepchirchir.
Email; constantyne.chepchirchir@strathmore.edu

Republic of Kenya
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 531932

RESEARCH LICENSE




This is to Certify that Sr.. constantyne Chepchirchir Bett of Strathmore University, has been licensed to conduct research in Nairobi on the topic: **Factors influencing Adherence to Hazardous Waste Management Policy Frameworks among health workers in private level 4 hospitals in Nairobi County-Kenya for the period ending : 15/November/2022.**

License No: NACOSTI/P/21/14100

Applicant Identification Number: 531932

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code



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APPENDIX IV



1st November 2021

Chepchirchir Constantyne,
conbett08@gmail.com

Dear Chepchirchir,

RE: Factors Influencing Adherence to Hazardous Waste Management policy frameworks among health workers in private level 4 hospitals in Nairobi County-Kenya

This is to inform you that SU-IERC has reviewed and **approved** your above **SU-master's** research proposal. Your application reference number is **SU-IERC1188/21**. The approval period is **1st November 2021 to 31st October 2022**.

This approval is subject to compliance with the following requirements:

- i. Only approved documents including (informed consents, study instruments, MTA) will be used
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-IERC.
- iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-IERC within 48 hours of notification
- iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-IERC within 48 hours
- v. Clearance for export of biological specimens must be obtained from relevant institutions.
- vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- vii. Submission of an executive summary report within 90 days upon completion of the study to SU-IERC.

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

Yours sincerely,

for: Prof Fred Were,
Chairperson; SU-IERC



Ole Sangale Rd Madaraka Estate. PO Box 59857-00200, Nairobi, Kenya. Tel +254 (0)703 034000
Email admissions@strathmore.edu www.strathmore.edu

INTERVIEW GUIDE

INTERVIEW GUIDE FOR HEALTHCARE WORKERS ON THEIR ADHERENCE TO HEALTHCARE WASTE MANAGEMENT PROCEDURES.

Part I: Demographic information

Direction: Please fill your information's below.

1. Gender

Male

Female

2. Age

..... Years

3. Level of education

Certificate

Diploma

Bachelor's degree

Higher than Bachelor's degree

Others

4. Years of experience Years..... Months

5. What is your current place of work/area of specialty?

Emergency Room

Pharmacy

Medical/Surgical

Critical Care

Pediatrics Dialysis

Oncology Obstetrics/Gynecology

Laboratory

Others

Please specify.....

6. What is your profession/designation?

.....

7. Have you ever attended training or workshop concerning waste management?

Yes

No

8. If yes to question No. 7,

Please specify.....

9. How many needle stick injuries reported in the past 12 months?

.....
10. Did you vaccinate yourself against hepatitis B and tetanus?
 Yes No

Part II: Existing waste management system

1. Do you understand clearly the system used by the hospital in waste management?

Yes No I don't know

2. Who does the segregation of waste?

Hospital administrators
Waste management team
All the health workers
I don't know

3. Who labels the waste?

Waste handlers
Health workers
I don't know

4. Where is the labelling of waste done?

At the site of segregation
At the storage place
Where generated

5. Which methods are used in dealing with waste management in the set up? (Tick all that applies)

Sterilization
Use of chemicals (bleach)
Incineration

Burying

Other.....
.....

If you ticked incinerator, do you know if this hospital has one?

Yes No

6. Who are involved in the actual disposal of hospital waste?

Sanitary staff

Casual laborers

Trained personnel

Part III: Knowledge/Awareness on health care waste management

1. Have you ever attended any training/workshop on HCWM?

Yes No

2. To what extent do you participate in the following Health Care Waste Management?

(HCWM) activities?

Please in each case tick your response using the scale 1 to 5

5-Very High, 4=High, 3=Average, 2=Low, 1= Not at all

Parameters	Aware	Not Aware
Are you aware of regulation on medical waste management		
Do you know about the biohazard symbol		
Can you name eight categories of medical waste		
Can you list down the guidelines provided for color coding in workplace		

What is puncture-proof container for sharps		
What is the correct bag for disposal of cytotoxic drugs		
What is the correct bag for intravenous sets, catheters, and tubes		
HIV/AIDS can be transmitted through medical waste		
Hepatitis B and C can be transmitted through medical waste		
Personal protective measures are necessary while handling medical waste		
When do you discard medical waste from the bin		
Do you know about methods for medical waste treatment		
Disinfection of medical waste is necessary		
Bleaching solution 0.5% is used for disinfection of infectious medical waste		
The maximum time for medical waste to be kept in hospital premises is 48 hours		