

**ASSESSMENT OF FACTORS AFFECTING HEALTHCARE WASTE  
MANAGEMENT SYSTEM IN MACHAKOS COUNTY, KENYA**

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**A THESIS SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE OF  
MASTER OF SCIENCE IN HEALTH SYSTEMS MANAGEMENT OF  
KENYA METHODIST UNIVERSITY**

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**DECLARATION**

This thesis is my unique work and has not been submitted for award of degree at any other University

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We conform that this thesis work has been submitted by the student with our permission as university supervisors

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## **DEDICATION**

This thesis is devoted to my beloved spouse Hellen N. Musango, Sons Victor Mwanja and Martin Mutisya, and daughter Charity Mumbua for their support.

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## ABSTRACT

In general, most local authorities in Kenya have been unable to cope up with the segregation, the treatment and methods of waste disposal especially healthcare waste. Health facilities in Machakos County have poor practices when it comes to the segregation of healthcare waste, its treatment & disposal; the general population, the patients, the health workers including waste handlers are exposed to certain risks such as needle stick injuries, a higher risk of infection of HIV/AIDS and hepatitis B&C. This study, therefore, focused on the reinforcement of the service delivery pillar of Health Systems, through addressing aspects of securely managing healthcare waste in medical facilities in Machakos County. The general objective of this study was to ascertain factors affecting the management system of healthcare waste in Machakos County in Kenya. The study was governed by four specific objectives; to determine the process of healthcare waste management, the role of health Managers, human resource factors, and how the implementation of healthcare waste management policy affect the management of wastes in the healthcare facilities in Machakos County. To obtain data for the study, a survey research-based study was used. Stratified random and purposive sampling techniques were used in drawing a sample size of 187 respondents. Questionnaires and interview guides were used in the collection of primary data, whereas existing literature that is related to the current research topic under study was used for the purposes of secondary data. The study findings showed that all the four independent variables healthcare waste management process health manager's role, human resource factors, and healthcare waste management policy implementation had positively and significantly influence on the management of healthcare waste system. From the findings, the health manager's role had the strongest positive and significant influence on the management of the healthcare waste system. The study concluded there is an inefficient healthcare waste management process in Machakos county health facilities, Health Managers understands their role in waste management but lack capacity building and enough funding to purchase required healthcare waste management commodities. Main human resource factors were lack of capacity building through continuous medical education on healthcare waste management and enough healthcare waste management commodities hence leading to inefficiencies on waste management. Most Health workers had little or no information on customized healthcare waste management policies and guidelines. The study recommended there a need for training on healthcare waste management to all healthcare staff and waste handlers in line with existing healthcare waste management policies for the healthcare waste management in Machakos County and in Kenya. County governments need to provide adequate budgets to health facilities to enable procurement of adequate healthcare waste management commodities and also adopt safe treatment technologies.

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## ABBREVIATIONS AND ACRONYMS

<b>AIDS</b>	Acquired Immunodeficiency Syndrome
<b>CFR</b>	Code of Federal Regulations
<b>CMEs</b>	Continuous Medical Education
<b>GOK</b>	Government of Kenya
<b>HAIs</b>	Healthcare Associated Infection
<b>HCW</b>	Healthcare Waste
<b>HCWH</b>	Health Care Without Harm
<b>HIV</b>	Human Immunodeficiency Virus
<b>IPC</b>	Infection prevention Control
<b>M&amp;E</b>	Monitoring and Evaluation
<b>NEMA</b>	National Environment Management Authority
<b>PEP</b>	Post-Exposure Prophylaxis
<b>TQM</b>	Total Quality Management
<b>USAID</b>	United States Agency for International Development
<b>WHO</b>	World Health Organization

## **CHAPTER ONE: INTRODUCTION**

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

As noted by world health organization (2014) mode, there is an existing unit of six building blocks of health systems that has the function of incorporating folks, all organizations and actions with the primary intent of the restoration, marketing or maintenance of health. This incorporates the efforts that influence the determinants of health in a similar way as a lot of direct health rising exercises. A health framework is in this way a pyramid of in public and in hand health facilities that are responsible in the deliverance of individual health services (World Health Organization [WHO], 2007).

The six building blocks (pillars) are; the first, leadership and governance which involves the making of certain vital policy structures to exist and the territory unit joined with viable oversight, the supply of adequate laws and motivating forces, alliance building, responsibility and thoughtfulness regarding framework plan; secondly, a proper working health system allowing evenhanded access to basic medical product, their scientifically sound, cost-efficient use immunizations and innovations of guaranteed quality, efficaciousness, cost-effectiveness and safety; thirdly, a decent health funding system is expected to raise sufficient resources for health, in courses in which guarantees citizens to access the required services, and an area unit that is protected against monetary catastrophe or impoverishment that may be related to getting hold of them; fourth, a well-functioning health data systems that will ensure the collection, investigation, dispersal and utilization of solid and convenient data on health status, health

determinants, execution and health frameworks; fifth, a well performing health the management framework works in exceptional ways that are straightforward, region unit responsive and efficient to achieve the best health results, given the conditions and the realistic resources, for example there are unit spare numbers and a blend of employees who are fairly distributed, competent, productive and responsive;

Finally, higher health services that are underneath the Service delivery pillar, the area unit people who deliver health interventions that are viable, protected, quality individual and non-individual to individuals who would like to use them, with minimum waste of resources whenever they are required. Health systems are governed with some immediate objectives, the course from contributions to health results is through the accomplishment of bigger access and inclusion for successful health mediations without trading off the efforts of the surety of the quality of the supplier and the safety of the intervention (WHO, 2007). Patients, medical experts and general population therefore ought not to suffer from risks related to supplier services together with handling of aid waste generated throughout medical procedures carried in our health facilities. These effective non-personal health interventions, in keeping with the research worker, includes safe management of aid waste to manage health risks identified with taking care of, treatment and transfer and zone unit the premise for this analysis that the research worker deeply entrenched into the service delivery pillar of health systems.

In developing Countries, the know how about the potential for harm resulting from the risks related to waste from the healthcare sector has currently become more eminent to all fractions of the population; the civil society, the governments and also the health

practitioners. Moreover, managers and employees in the medical area unit are expected to be take responsibility of the effects of waste from medical activating. The irregular taking care of and uncouth disposal of healthcare waste among health facilities is rampant and is a major contributor of infections which may be avoided and which bears a similarity with the public perception of poor health care standards (WHO, 2014).

Further, there have been series of debates on the administration of healthcare waste in connection to the technology used for its treatment while failing to realize that technological aspects are just but a fraction of the whole medical waste management systems which should be properly addressed. The planning, monitoring, budgeting and coaching also are necessary aspects of a practical healthcare waste management system (Health Care while not harm, 2016). Every medical facility ought to have a waste management policy that is frequently reviewed and followed. The public health professionals and the health management sector have a responsibility to develop health policies, to arrange all health information systems, and to determine future healthcare waste management policies based on the current procedures. The healthcare waste management system policies which are established by health professionals underneath the steering of aid waste management committees set out the overarching priorities. Whereas healthcare waste management system plans on entering a lot of details regarding their implementation, that is a vital procedure that is involved with the upgrading of an aid waste management system. These committees are also responsible in the establishment of normal operational procedures and coaching using different guides

that state the roles and responsibilities for workers enterprise in the waste management tasks (Stacey, 2012).

Studies in the continent of Africa indicate a struggling continent in the management of the waste that it produces. Almost all of the medical waste is disposed in open dumps without being treated. In some instances, poorly functioning incinerators are used which do not actually curb the problem of poor waste management. Individual country reports are driven by hyperbolic awareness on general solid waste streams in the continent, whereas the general image of medical waste management remains unclear in the minds of Kenyan citizens. As a result of this ignorance, information on medical waste management within the country stays at bay on shelves and solely meager in scientific literature (Udofia, Fobil, &Gulis, 2015).

The guiding principles that are used within the Republic of Kenya in the safety of injection and healthcare waste management policy are not well aligned with the international standards such as the outlined guidelines aimed at increasing the access of data and coaching medical experts, making certain of the full providence of needed commodities, limiting dangers to patients, medicinal specialists, communities and furthermore the setting through utilization of more secure gadgets and disposal strategies putting in structure structures, protective the setting through use of acceptable waste disposal strategies, perception of skilled morals and association of partners involved. “By comparison, the international principles focus on the duty of care, the defiler pays, preventative principle, previous consent, proximity and needs of various neutral teams to form monetary fund provisions for supporting management of health care waste”

(Okweso, 2016). This sets out to be a parallax in the principles that are to be achieved between the two guidelines. Both Kenya and WHO techniques accentuate reinforcing the coordination framework, support and behaviour change, the regions underlined divergence from that point forward, for instance, Kenya strategy organizes capacity building and creating data frameworks including the M & E systems while WHO methodologies stress waste minimization, reusing, developing non-incineration technology and directing research into hazard factors for exposures and their results as the better need procedures for accomplishing safe infusions and suitable waste treatment and disposal (Okweso, 2016).

According to Levendis, Atal, Carlson and Quintana (2001) hospital waste poses serious threats to environmental health because of its hazardous nature. Due to poor segregation practices taking place in Kenya, up to 50% waste in some medical facilities are found to be infectious. Enormous challenges are experienced in healthcare waste management systems in Kenya. There are grave dangers to patients on daily basis caused by indiscriminate disposal of healthcare waste (Government of Kenya [GoK], 2015). Medicinal services waste is a mounting issue in Kenya. In the recent past, the ill-advised disposal of medical waste is never again news to people in general and the extent of this circumstance has antagonistically influenced the poor as well as the distraught individuals of society. This research work subsequently intended to determine factors affecting healthcare waste management system among facilities in Machakos County, Kenya.



## **1.2 Problem Statement**

A survey by the WHO in 22 developing nations indicated that approximately 18% to 64% of healthcare facilities use inappropriate and traditional waste treatment and disposal technologies (Jovanović, Jovanović, Matić & Đonović, 2016). However, in a number of previous studies detail poor waste handling practices leading to thought that organization of waste stream as unsafe requiring proper treatment which may be higher than 10% to 25% (Udofia, et al, 2015). Unlike developed countries, most developing countries tend to have both medical and general wastes handled and disposed-off together (Da Silva, Hoppe, Ravello, & Mello, 2005) thereby breaching standards of healthcare waste management and its best practices (WHO, 2014). The African continent alone has over 67,000 healthcare facilities that generates over 283, 000 tons of clinical wastes annually (Udofia & Nriagu, 2013).

Generally, most local authorities in Kenya have been unable to cope up with the collection, the treatment and the disposal of HCW (Adipo, 2006). Machakos County, like other counties in Kenya, experiences the problem of healthcare waste management. Machakos County has poor healthcare waste segregation, treatment and disposal practices, thus increasing the risks associated with such poor practices to the health worker, patients and the general public (Ikiara, Karanja & Davis, 2004). Poor solid waste management is a general problem in Kenya and there are no controlled landfills in Machakos County and complete reliance was placed on crude, open and or uncontrolled burning.

There are currently over 110 health facilities in the county and the doctor/population ratio is about 1:62,325 indicating over-utilization of doctors which is a clear indication in this study that the amount of waste produced by the health facilities is huge posing a great challenge to its management in Machakos County (Machakos County Government, 2013). Further, crude, open and or uncontrolled burning of healthcare waste in Machakos County health facilities has exposed patients, health workers and local residents living around these facilities to air, land and water pollution through release of dioxins, furans and heavy metals that are carcinogenic to humans and lethal to ecosystems life (Nathanson, 2015). Therefore, the study aimed at determining factors affecting healthcare waste management system among healthcare facilities in Machakos County.

### **1.3 Purpose of the Study**

To determine factors affecting healthcare waste management systems among healthcare facilities in Machakos County, Kenya

### **1.4 Research Objectives**

- i. To determine the process of healthcare waste management in Machakos County
- ii. To establish the role of health managers on healthcare waste management in Machakos County
- iii. To assess the role of human resource factors on healthcare waste management in Machakos County

- iv. To examine healthcare waste management policy implementation in Machakos County

### **1.5 Research Questions**

- i. What is the process of healthcare waste management in Machakos County?
- ii. What is the role of health managers on healthcare waste management in Machakos County?
- iii. What are the human resource factors on healthcare waste management in Machakos County?
- iv. What is the healthcare waste management policy implementation in Machakos County?

### **1.6 Justification of the Study**

The management of healthcare waste management is a major problem in urban areas in Kenya and particularly Machakos County. Due to the fact that Machakos county has over 110 health facilities and doctor/population ratio is about 1:62,325 showing over-utilization of doctors, this gives clear indication that amount of waste produced by medical facilities is very huge and indirectly proportional thus posing a great challenge to its management (Machakos County Government, 2013). This study therefore sought to provide a quick assessment, by combining key informants with survey questionnaires so as to provide adequate data that can be used to pinpoint problems and hence begin the process of revitalizing the healthcare waste management systems in Machakos County.

Further, the study contributed in providing knowledge on healthcare waste segregation data that provided opportunity for the health management committees in Kenya and particularly Machakos County in gauging the needed commodities for segregation, storage, and treatment and disposal technologies. Moreover, these Committees can also use this data in the establishment of criterion data rates of waste production in different healthcare facilities and initiate a procurement specification that can be used in budgeting, planning, revenue allocation, waste management system improvement and assessment of environmental impact.

Another justification is the need for the familiarization process of the personnel handling healthcare waste with the waste's main categories. This can be done either nationally or locally by using this study and so as to make good decisions on management of healthcare waste in Machakos County and Kenya in general. This was achieved by reviewing the appropriate literature in chapter two on healthcare waste regulations and by asking respondents to give their views in the survey questionnaires and the key informant interview schedule/guide.

Further justification for conducting this study was in line with WHO agenda for reinforcing of health systems. World Health Organization recommends the supporting and the strengthening of health systems based on the six health system building blocks which includes; “service delivery, information, health workforce, vaccines and technologies medical products, financing and leadership and governance (stewardship)” (WHO, 2007). This study therefore focused on strengthening the service delivery pillar

of Health Systems, through addressing aspects of secure healthcare waste management in healthcare facilities in Machakos County.

### **1.7 Limitations of the Study**

The study faced a number of limitations however care was taken to ensure these limitations did not affect the conclusions made by the study. The study relied predominantly on primary data collected using questionnaires. People have a nature of not providing accurate and rational assessment about them hence ensuring respondent provide honest information was a major limitations of the study. However this was mitigated by informing the respondents on the purpose of the study and providing authorization from relevant institutions to enhance trust.

One limitation to this study was choosing of respondents as Machakos County has over 110 health facilities and a large number of health workers serving the local residents and other Kenyan's across the country. The researcher however overcame this limitation by purposively choosing Machakos Level 5 hospital (the only one in the County), one level-4 hospital, one health Centre (level-3) and one dispensary (Level-2), which might not be a true reflection of other facilities within the County and Country as whole.

Another limitation to this study was that the research was limited to four research objectives that included; determining how healthcare waste management process, health Managers role, human resource factors, and healthcare waste management policy implementation affect healthcare waste management in Machakos County, Kenya. This might have limited other objectives that were not included in this study. However the

researcher overcame this limitation by focusing on major objectives that were pertinent to the study topic and that had viable results. Another limitation in this study was reluctance by some of the respondents to participate in survey due to fear of victimization by their employer. However, the researcher solved this limitation by acquiring letter of permission from Ministry of Health (County Health Department) to conduct the study and obtaining permission from the respective health facilities' management to put respondents at ease in responding to the questionnaires.

### **1.8 Delimitation of the Study**

Because of the busy nature of healthcare providers in healthcare facilities, the researcher had to make appointments for the respondents to fill the questionnaire at their best convenient times such as lunch hours and evening breaks to effectively fill the same therefore making this study a success. Because of the formal procedures used by the healthcare facilities in the region, the researcher acquired introductory letter from the Ministry of Health (County Health Department) and sought permission from the healthcare facilities' management. This was to instill confidence to respondents to comfortably fill the questionnaires as they had gotten full permission from their management in participating in the study therefore making this study a success.

### **1.9 Significance of the Study**

Counties in Kenya are unable to cope up with healthcare waste treatment, transportation, minimization, segregation, collection and disposal. This study was significant in providing literature on proper healthcare waste management by identifying the best

practices including safe practices for waste handlers and health workers in Machakos County and Kenya. The study was also of great significance in contributing to academic literature on healthcare waste management system that was noted to be minimal in Kenya therefore contributing to knowledge among scholars and healthcare professionals. It will also assist policy makers in Kenya and particularly the Ministry of Health in developing or reviewing appropriate strategies and systems planned for tending to the problem and challenges of management of the healthcare waste systems in Kenya.

#### **1.10 Assumptions of the Study**

One of the assumptions recognized in this study was that the number of inhabitants in Machakos County was assessed to be 954,082 in 2002 with a development pace of 1.7% per annum as identified in Environmental Impact Assessment Project Report of Machakos. Therefore, medical waste continued to increase due to the large population increase and patients that seek medical care. Another assumption was that Machakos County does not have dedicated budgets/sufficient funding, has poor waste segregation, treatment and disposal practices thus, influencing negatively healthcare waste management, and compliance to the stipulated environmental laws by National Environmental Management Authority (NEMA) and WHO standards. The final assumption of this study is that all health facilities' adherence to the standards of healthcare waste management acceptable to human health and environment must score at least 80% and above from the response.

## 1.11 Operational Definition of Terms

<b>Environment</b>	Is the natural, as a whole or in particular geographical area, the area in which something exists or lives
<b>Healthcare Facility</b>	Refers to an establishment providing medical or surgical care and treatment for the ill and the injured
<b>Healthcare Waste</b>	Refers to the total waste that streams from medical facilities and includes all the waste generated by laboratories, research facilities and health facilities
<b>Human Resource</b>	Refers to people and individual that work within the health systems in the health facilities
<b>Policy Implementation</b>	refer to the act of putting into practice policies regarding health waste management systems
<b>Recycling</b>	Refers to the act of processing used or abandoned materials already used in order to produce new products
<b>Segregation</b>	Is keeping of medical waste into separate containers according to type such as infectious, general waste, highly infectious, and sharps waste
<b>Treatment</b>	Any process or technique that is designed to change the chemical, physical or biological character or the composition of any infectious



waste, infectious hazardous in order to render such waste non-hazardous, or less hazardous

**Waste Disposal**

Refers to the practice of controlling waste so as to prevent any harm to the environment, injury to people or animals or long term progressive damage to health. Disposal of waste is where the sole purpose is to indefinitely store the waste for the required duration of its biological and chemical activity, such that it is rendered safe

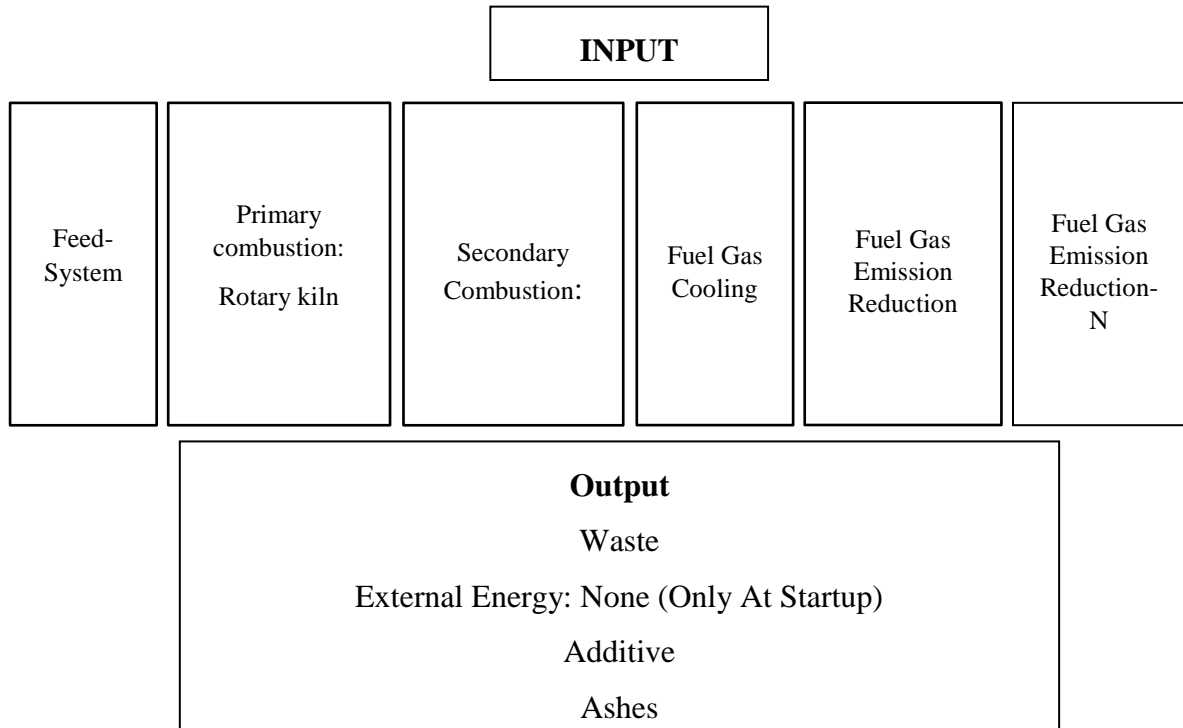
## **CHAPTER TWO: LITERAURE REVIEW**

### **2.1 Introduction**

Literature according to Burns and Grove (2003) is the written information on a subject composed of primary and secondary sources. The literature that relates to factors affecting healthcare waste management system in Machakos County, Kenya is explored in this chapter. It gives introduction to the concept of healthcare waste management systems, theoretical framework backing the study variables and conceptual framework. In addition, it contains an empirical review, the research gaps and the chapter summary.

### **2.2 Theoretical Framework**

This will framework will be the basis for this study with major theories and concepts that exist on tackling problems and or challenges explained (Mathooko & Mathooko, 2011). The researcher will narrow down on the Systems theory since it is pertinent to this study and will act as a guide to the study as shown in Figure 2.1.



**Figure 2. 1: Rotary Kiln Incineration System**

Aristotle claimed that knowledge is derived from the understanding of the whole and not that of the single parts (Aristotle’s Holism). This historic effort evolved during the last century into the so-called “systems theory” (Bogdanov, 1988; Bertalanffy, 2000; Meadows, 2008). According to the systems theory, an organization is a system that can be closed or open. It is therefore evidenced that managers who understand systems theory recognize that different systems affect a worker and that workers affect the systems around them (Midgley, 2003). The primary focus on the systems theory is on

knowledge, quality, value, environment, adaptation, relationships and complexity on healthcare waste management system (Mugo, 2017).

The firm is seen as having a set of skills and competences that enables it to produce its own knowledge and also as a learning system and (Nonaka & Takeuchi, 1995). There is a lot of learning in healthcare waste management systems in Kenya Hospitals. Its value can be expressed as the “potentiality of existence, development, evolution” (Vicari, 1992). The healthcare waste management value will be felt if all the actors are actively incorporated and at all levels within the Kenyan health facilities. When addressing quality issues, it is necessary to focus on the link between systems thinking and Complete Quality Management (TQM) (Kim and Burchill, 1992). In TQM, the foundational origination of the association is reinforced by its accentuation on the significance of the connections of the parts to the objective to be achieved (Mele & Colurcio, 2006). Use of TQM will empower the wellbeing offices to set up the best healthcare waste management frameworks which are reasonable.

There are two conceptualizations of a domain, that is; the target condition and the established condition. The earth is the framework at the large scale level, while the medical clinic is the framework at the miniaturized scale level (Brownlie, 1994). Aggressive hierarchical conduct is connected to the capacity to recognize and oversee capacities and connections, blending and legitimizing an association's advancement lined up with every single outside relationship (Christopher, 2007). The hospitals healthcare waste management teams have to actively interact within itself, its environment and the community it is servicing. In this case, open systems are the best

since they are able to grow and improve on their services. According to the viable systems approach, an organization has to be able to preserve both its stability and viability, creating its own internal environment that makes it able to respond effectively to external stimuli at all levels (Barile & Polese, 2014). The waste being generated each day increases with the population growth.

A flexible healthcare waste management system has to be put in place to deal with changes that can occur in the quantity of waste produced and in management, as well as in policies and principles. There is therefore the need for a Networked system that is based on three parameters: variety (possible variance that a phenomenon may present to the observer), variability (variety observed over time) and indeterminacy (the ability to fully understand a phenomenon) (Golinelli, 2010). Therefore, this can be applied in this study by health facilities creating networks of healthcare waste management systems so that proper channels (or best practices) can be followed through these networks.

### **2.3 Empirical Review**

This section reviews studies previously done to evaluate healthcare waste management systems. It contains a directed search of published work that includes books and periodicals are referred to as empirical literature review. Normally, “it is a comprehensive survey of previous inquiries that is related to the research questions” (Zikmund et al., 2010).

### **2.3.1 Healthcare Waste Management Process**

Manyele, and Lyasenga (2010) carried out a study on factors affecting medical waste management in low level health facilities in Tanzania SV. The study has revealed that; most of the facilities have no specific disposal sites. In Ilala, 70% of the health facilities burn wastes in poorly designed incinerators, open pit burning or on the ground while in Kinondoni, 83% of the facilities bury wastes in the pits. More than 50% of the disposal sites surveyed are not fenced and were in close proximity to human settlements. About 60 and 70% of incinerators in the surveyed facilities in Ilala and Kinondoni municipalities, respectively, are not in good working conditions, 50% of them being of low capacity with some parts missing, e.g., chimneys, ash pits, covers for waste loading and ash removing doors. Also, 9 and 47% of the health facilities in Ilala and Kinondoni, respectively, do not have the Standard Operating Procedures.

WHO (2014) stipulates that the objective of any effective healthcare waste management system should be able to provide protection to not only human health and but also the environment from hazards posed by healthcare waste management. Thus, proper management ensures the handling of infectious waste in accordance with established procedures from the point of generation to treatment and final disposal (Blackman, 2001). According to recent studies, different countries have designed different strategies of handling healthcare waste management. However, any healthcare waste management system generally follows these important elements in their respective order: healthcare waste segregation; healthcare waste storage; healthcare waste treatment; and final

disposal of treated healthcare waste (Marinkovic', Ksenija, Natas'a, Aleksandar & Tomo, 2008).

The first stage is healthcare waste segregation: Segregation aids in the minimization of the waste. In this stage, the waste is segregated into different categories at the points of generation (Sagoe-Moses, Pearson, Perry & Jagger, 2001). The second stage is Temporal Storage: Temporal storage is done for all waste from points of generation and thereafter transported either to an on-site treatment facility or to an off-site location (Luttrell, Bisesi, & Bisesi, 2003). The waste is usually appropriately stamped and just available just to approved staff (Marinkovic et al., 2008). There have not been studies showing a universally accepted standard period of time that the waste can be or should be stored prior to treatment and disposal. However, a shorter time for holding healthcare waste is usually recommended (Wiafe, Nooni, Nlasia, Diaba, & Fianko, 2015).

The third stage is treatment technique: Treatment of waste mainly aims at rendering the waste as less dangerous to human, recovering recyclable materials, and protecting the environment. Treatment alters the physical, biological and chemical features of waste and is done in accordance to rules set by local environmental protection agency (EPA). An example of treatment technique for healthcare waste is incineration which is the widely used and most preferred treatment process for healthcare waste (Marinkovic et al., 2008; Pruss, Giroult & Rushbrook, 1999). The final stage is disposal of treated waste: Disposal refers to the final resting place of treated waste, using a sanitary landfill or any other environmentally acceptable method appropriate to the local conditions and

regulations. Waste disposal is important for wastes requiring incineration, sharps, radioactive wastes and waste that can't be burned (Pruss et al., 1999).

A study conducted by Mugo (2017) on “factors influencing waste management in public hospitals in Nakuru County, Kenya”, was conducted on; Existing systems, Legal framework, Technology and Training and Public awareness. The study concluded that legal framework and technology on healthcare waste management in the hospitals had a positive influence on performance of healthcare waste management. However, the study concluded that existing system; training and public awareness on waste management had a negative influence on performance of healthcare waste management. The study recommended that the legal framework on healthcare waste management should be emphasized in order to improve on performance of healthcare waste management systems in hospitals. The study further recommended that the rules and regulations pertaining to healthcare waste management in the hospitals be adhered to improve performance. Additionally, the study recommended that waste segregation be done according to the set standards of operation to improve on performance of healthcare waste management in the hospitals. In the context of training, the study recommended that health workers be updated on handling healthcare waste. Regular workshops should also be held in order to educate health workers on healthcare waste and its management.

### **2.3.2 Role of Health Managers on Healthcare Waste Management**

Developed countries seem to have safer ways and technology set in place to deal with the hospital waste while the strategy is very different in developing countries like Kenya



(Tudor, Noonan & Jenkin, 2005). There is still a lot which needs to be done to ensure this waste is properly handled from its generation stage to the disposal phase to curb its dangers. An in-depth understanding of the hospital waste generation methods can be informative and beneficial since it would not only aid in planning but also in the enhancement of waste management system (Sabour, Mohamedifard & Kamalan, 2007).

According to WHO (2005b), “in order to have good health care waste management in a hospital, there must be a dedicated waste management team, strategic planning, a good administration, a sound organization, adequate financing, underpinning legislation, all with full participation of the trained staff”. Health care personnel are faced with the responsibility of becoming sensitive ecologically and practice advocacy for change that may reduce the amount of waste produced while maintaining quality of patient care and worker’s safety (Standards, recommended practices and guidelines, 2006).

The administration, organization and requirement of adequate legislative and financial support with trained staff positively taking part (Manila, 2007) are the key elements to sound healthcare waste practices. As per health care waste management Strategic Plan (2015-2020 the healthcare waste management Committee assumes liability for the creation and execution of the arrangements and plans and for ensuring that the office follows every legitimate commitment, where conceivable it ought to likewise go past the lawful least and intend to fulfill the best feasible guidelines. The healthcare waste management board of trustees can likewise devise fitting techniques for perceiving and compensating great conduct and checking unseemly or dangerous activities (GoK, 2015). The WCM ought to incorporate agents from senior administration, research

facilities, squander laborers, acquisition, account, restorative divisions, housekeeping and support groups. One individual ought to be assigned as the Waste Manager who liaises with each one of those associated with waste age and the board inside and outside the office (Health Care Without Harm [HCWH], 2016) to ensure that the waste management goal is achieved.

According to HCWH (2016), setting up a new system requires baseline assessment to be conducted to supplement the providence of reference data on which to base the plan. Some monitoring data may be required by the local health and environment regulatory authorities while other data can show up the successes and failures in the systems so that practices can be improved. According to healthcare waste management Strategic Plan 2015–2020, hospital waste management committees should ensure adequate resource provision so as to improve efficiency of management of waste. This can be achieved by healthcare waste management integrating budget into the yearly operational plan (GoK, 2015). Healthcare waste management policy and targets should be monitored and reviewed each year with the aim of achieving continuous improvement (HCWH, 2016). Hospital committees revising their healthcare waste management policy in line with the current National Policy on Injection Safety and medical waste management, Kenya can accomplish this.

Similarly, a study by Kungu, Njogu and Kiptoo (2016) on evaluation of health care waste management in selected health facilities in Kiambu County, Kenya was carried out. The purpose of this study was to evaluate healthcare waste management practices and compliance to the burn technology among the selected hospitals. A total of 10 (ten)

health care facilities were selected. On the location of the incinerator, the study found that most of the burners were located close to areas inhabited by people, 62.5% of all being located near agricultural areas. 50% of all the burners were built near valleys and ridges that increased the dispersion area and health risk and few were built near wooded places (37.5%). Regarding the construction of the burners, the study found that 62.5% of the health centers studied had overhead shelter and protective enclosure for them. The study also found that only 50% of the health centers had constructed pits. The study further found that most common potential harmful chemicals that can be found around the health Centre burners were emitted during combustion and the residual ash had a heavy component of metallic pollutants.

Another research which was carried out to establish medical waste management practices in Africa was done by Udofia, Fobil and Gulis (2015) in which 58 articles were reviewed in 20 nations. 30% were found to meet WHO's recommendations of safe management of HCW. From the study, it was found that the greatest compliance was indicated by "daily collection of waste from service areas" while the areas with the least compliance were "appropriate use of colour codes". Unremarkable progress in solid waste management in Africa has raised question on whether independent countries' efforts should be replaced by unified approach (Udofia et al., 2015).

Jovanović, et al (2016) focused on the influence of healthcare factors on medical waste management in Serbian hospital facilities. A special questionnaire was developed for the survey, based on the UN-WHO guidelines for the rapid assessment of medical waste management in a hospital setting. There is a direct and strong correlation between the

total number of beds, hospital days, healthcare services provided and staff members trained in the area of medical waste management, identified as the main factors that impact the management of hazardous medical waste.

### **2.3.3 Human Resource Factors on Healthcare Waste Management**

Kaur (2011) carried out a study on impact of human resource factors on perceived environmental performance. A total of two hundred and twenty three survey responses were analyzed using the SPSS computer program version 16. The results of the regression analysis suggest that management commitment, feedback and review, and empowerment have a significant positive relationship to perceived environmental performance. However, the relationship between rewards and perceived environmental performance was statistically insignificant. The knowledge of medicinal services laborers as to transfer of HCW serves in assuming a noteworthy job in its improvement. So as to survey information gaps, the required degree of preparing ought to be maintained. An investigation directed among emergency clinics of Allahabad City in India on knowledge about healthcare waste transfer uncovered that doctors, medical attendants and lab experts would be advised to information than general aides (Mathur, Dwivedi, Hassan & Misra, 2011).

Similarly, another study by Adipo (2006) was conducted on hospital waste management in Nairobi City. To study these systems, specific attention was focused on the types of wastes generated, selection and disposal methods of these wastes, and their environmental impacts. A sample size of 60 health facilities consisting of hospitals,

nursing homes, health centres and clinics were purposively selected from different areas within Nairobi city, to be used as an inference to the entire population. The study found out that waste management systems in health facilities are inadequate. They are not only unhygienic and a public health concern, but also a threat to the biological and physical environment. The study therefore recommended that the Government through the relevant authority should strictly carry out thorough inspection of health institutions and firms that are licensed and contracted by Nairobi City Council for waste disposal, to ensure that hospital waste handling, collection and disposal are carried out within the laid guidelines and are generally safe to public health and the environment. Future research on management of home based healthcare waste management has also been recommended by the study.

The personnel in the hospital including senior therapeutic staff and administrators ought to have the option to communicate the advantages of healthcare waste management according to the recommendation by WHO (2014). They ought to likewise be set up to embrace trainings and value the health, occupational safety, natural and administrative favorable circumstances. Accomplishing this result is planned for fortifying the interest and backing of other work force in preparing exercises. Separate preparing exercises can be intended for various classifications of health work force. These are mostly in two classifications of clinic supervisors and authoritative staff in charge of actualizing guidelines on healthcare waste management, and the individuals who handle waste, for example, restorative specialists, attendants, nursing collaborators and unified callings, cleaners, watchmen, helper staff and waste handlers (WHO, 2014).

It is widely recognized that the outputs of informal and formal training activities will be enhanced by carrying out training needs assessment on skills and knowledge before implementing any training plan. By knowing the principle job responsibilities of hospital and administrative actors, the expert competence analysis and the self-assessment of health workers, it becomes possible to tailor training activities to the relevant needs of the Ministry of Health staff, including the needs of individual health workers (GoK, 2017).

Poor handling habits or practices during waste generation, packaging, storage, transportation, treatment and disposal can bring about environmental pollution and increase the risk of contracting infectious diseases such as AIDS, hepatitis, cholera and tuberculosis among others. Many individuals in the management level in healthcare facilities abdicate the role of management of healthcare waste to the poorly educated and lowest category of workers who are either not trained or have very little training if any, which is a mediocre and less helpful strategy when handling healthcare waste (WHO, 2005).

A survey was carried out Manyele and Anicetus (2003) in Tanzania from 2003-2005 to study the existing healthcare waste management systems in hospitals during a nationwide healthcare waste management training programme. This was done to enable health workers establish healthcare waste management systems in their health facilities aimed at improving the prevention and control of infectious diseases as well as well as reducing the occupational health hazards. The study recommended proper management

and training regarding the level of awareness and best practices on healthcare waste management to cover all carders of health workers in the country.

#### **2.3.4 Healthcare Waste Management Policy Implementation**

A study carried by Mathur, Patan and Shobhawat (2012) focused on need of biomedical waste management system in hospitals-An emerging issue-a review. A total about 2.65 tonnes of healthcare wastes are produced each day in Ulaanbaatar (0.78 tons of medical wastes and 1.87 tons of general wastes). The medical waste generation rate per kg/patient-day in the inpatient services of public healthcare facilities was 1.4–3.0 times higher than in the outpatient services ( $P < 0.01$ ). The waste generation rate in the healthcare facilities of Ulaanbaatar was lower than in some other countries; however, the percentage of medical wastes in the total waste stream was comparatively high, ranging from 12.5% to 69.3%, which indicated poor waste handling practices.

A number of institutions and policies in Kenya deal with healthcare waste management. Ministry of public health and sanitation was established to guide health professionals and other stakeholders in provision of safe injections and proper management of waste so as to protect health providers and community from injuries (Ministry of Health, 2007). The Waste Management Regulations 2006, anchored under the Environmental Management and Co-ordination Act 1999, imposes duty of care on the occupier of premises where healthcare waste management is handled to take measures to ensure that such waste is handled without adverse effects on human health and to the environment and natural resources (GoK, 2006). The implementation of the Occupational Safety and

Health Act, 2007 is a concern of the Ministry of Labor which provides for healthy and safe workplace for all workers (GoK, 2007). The Public Health Act Cap 242, part IX deals with sanitation and housing, which imposes responsibility on local authorities (now County Governments) to take measures in the maintaining of a clean and sanitary condition in their areas.

One of the strategies created is the National Policy on Injection Safety and Medical Waste Disposal (2007) which has a statement of purpose of guaranteeing wellbeing of laborers, patients, and their network and to keeping up a sheltered situation through the advancement of safe infusion practices and appropriate management of related healthcare waste management. This was the principal archive of the Ministry of Public Health and Sanitation that is unequivocal on the need to address healthcare waste management issues. The arrangement illuminates the need to advocate for help and usage of legitimate administration of healthcare waste management among others. The arrangement has a portion of the core values which incorporate: establishment of organizational structures at all levels for the proper implementation of injection safety and related healthcare waste management policies, the policy also addresses the need for environmental protection through appropriate waste disposal methods, minimization of risks to patients, health workers, communities and the environment and advocating for the strengthening of the necessary human resource capacity through training and sensitization for safe waste handling and disposal (Ministry of Health [MOH], 2007).

The need for appropriate financial mobilization and allocation of the key components for the policy implementation is one of the key policy strategies indicated in this policy. For



example, the provision of equipment for waste management and sustained supplies through strengthened logistics system addresses the need for commensurate investment in waste handling requirements. Advocacy for best waste management practices through behavior change communication is a key element according to the recommendations of the unique strategy. The National healthcare waste management Plan 2008-2012 (MOH, 2008) for Kenya underscores the need for serious involvement of health managers at all levels of health care service delivery system in order to invoke the desired high level commitment. “The implementation of this plan over the five years (2008-2012) was envisaged to result in the improvement of health care waste management and the general cleanliness within the health care facilities and hence reduce hazards and risks associated with poor healthcare waste management in the community” (MoH, 2007).

Moreira and Günther (2013) conducted a study on the assessment of medical waste management at a primary health-care center in São Paulo, Brazil. The study results total waste generation increased 9.8%, but it was possible to reduce the volume of non-recyclable materials (11%) and increase the volume of recyclable materials (4%). It was also possible to segregate organic waste (7%), which was forwarded for production of compost. The rate of infectious waste generation in critical areas decreased from 0.021 to 0.018 kg/procedure. Many improvements have been observed, and now the PHC complies with most of legal requirements, offers periodic training and better biosafety conditions to workers, has reduced the volume of waste sent to sanitary landfills, and has introduced indicators for monitoring its own performance.

### **2.3.5 Healthcare Waste Management System**

For decades, health related professionals and health workers have realized the need to protect themselves and the general public from exposure to healthcare waste risks (Abor & Bouwer, 2004). Healthcare waste has often been defined differently by different countries, research scientists, international NGOs and other global institutions (Nema, Pathak, Bajaj, Singh, & Kumar, 2011). However, this study adopts the definition of WHO (2014) that healthcare wastes comprise all the waste produced within healthcare facilities, laboratories and research centers and related to medical procedures.

Globally, studies indicate that the amount of general waste generated will quadruple by year 2025. According to Akter, Acott, and Chowdhury (1999) an aggregate of 5.2 million individuals (counting 4 million children) pass on every year from waste-related infections. “Healthcare waste, poses serious threats to environmental health due to its hazardous nature” (Levendis et al., 2001). The substances which are hazardous in the waste include infectious material, pathological, chemicals and sharps (Askarian, Vakili, & Kabir, 2004). The amount of healthcare waste being generated is rising rapidly in developing countries as a result of expansion of healthcare services, escalating the problems caused by improper Healthcare waste management. Moreover, the technological and financial tools that ensure proper waste management is not firmly in existence (Kungu, et al, 2016). Georgescu (2011) reported that incomplete waste treatment, inappropriate ash disposal and dioxins emissions, are as a result of healthcare establishments where healthcare waste is incinerated, open burnt, and exists widespread deficiencies in the operation and management of small-scale medical waste incinerators,

which can be even 40,000 times higher than emission limits set in international conventions.

According to WHO (2016), approximately 15% of healthcare waste is infectious, 80% is nonhazardous while the remaining 5% is comprised of sharp, pharmaceutical, toxic chemicals and radioactive waste. Notable, those figures are not consistent with developing nations and with the “remaining 5% made up of sharps (1%), toxic chemicals, pharmaceuticals (3%), genotoxic, and radioactive waste (1%). Unfortunately, these traditional estimates are not consistent for many developing Countries, for example 26.5% of HCW delivered in Nigeria is perilous, 25% in Pakistan and 2%–10% in other sub-Saharan Africa nations (Azage & Kumie, 2010). Here in Kenya, it is common to discover up to half of HCW in certain facilities is infectious because of poor waste isolation practices.

According to WHO (2015) there are four guidelines of healthcare waste management includes; obligation of consideration standard which stipulates that any individual taking care of or overseeing risky substances or related hardware is morally in charge of utilizing the most extreme consideration in that task; Precautionary rule administers wellbeing and security insurance when the size of a specific hazard is questionable, it ought to be accepted that this hazard is critical, and measures to ensure wellbeing and wellbeing ought to be structured as needs be, Proximity guideline suggests that treatment and transfer of waste should happen at the nearest conceivable area to its source so as to limit dangers connected to the transportation of waste; and Polluter pays rule which infers that all makers of waste are dependable the safe and ecologically solid transfer of

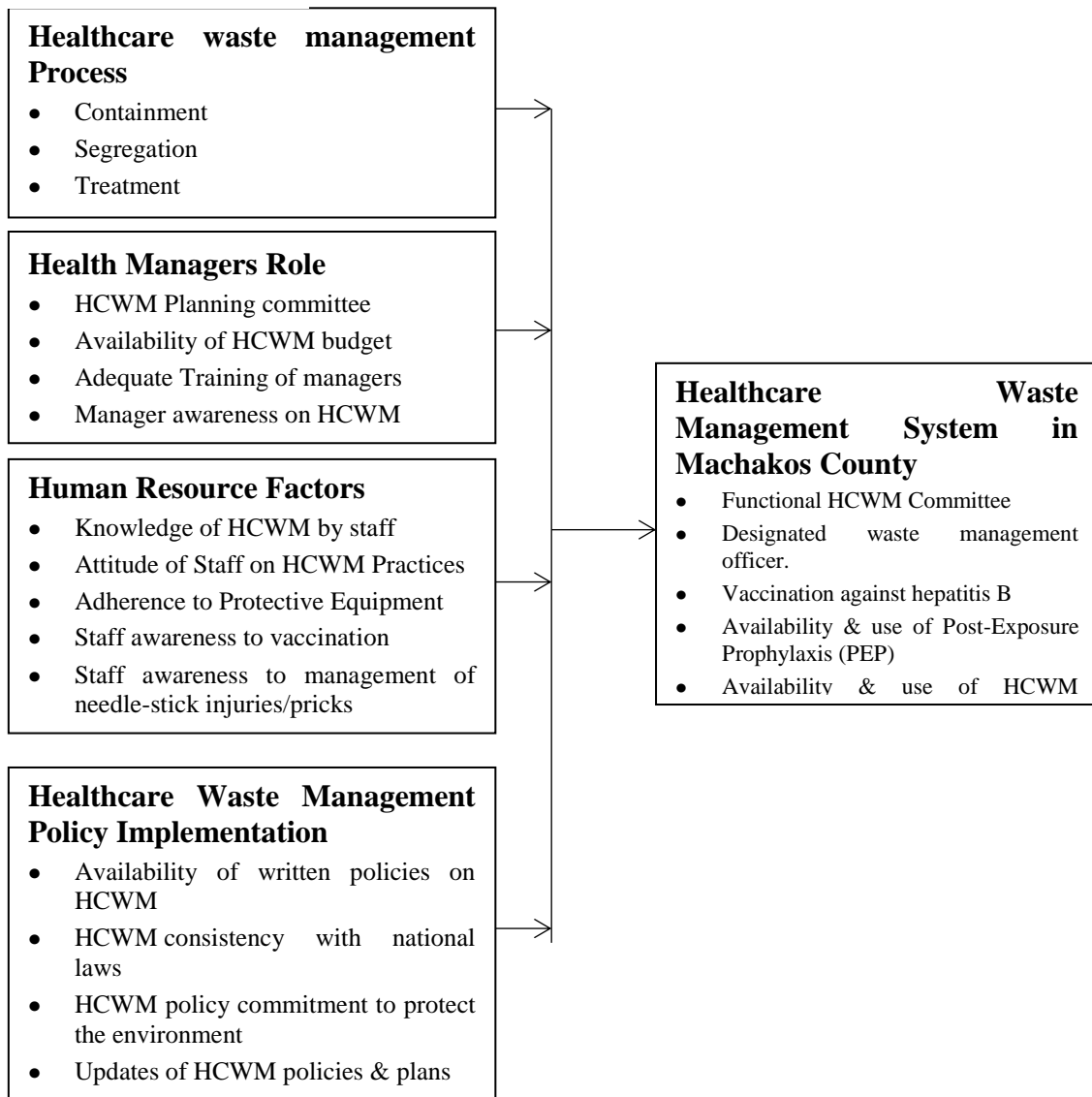
the waste they create. Twinch (2011) argues that the treatment and disposal mean posited need considerable financial and technical resources and legal model which in most case are lacking in the devolved function of health sector in the counties despite the fact that known means of managing the waste, mostly described in manuals and other literature.

## **2.4 Conceptual Framework**

It is a framework the represent a theory and presented as a model in which the variable and their relationships are translated into visual picture (Oso & Onen, 2009). As shown in Figure 2.1, this study postulates that healthcare waste management system (dependent variable) was a function of four main determinants namely, HCWM process, health manager's role, human resource factors and healthcare waste management policy (independent variable).

## Independent

## Dependent Variables



**Figure 2. 2: Conceptual framework**

## **2.5 Research Gaps**

In Kenya, a number of studies have focused on the effect of waste to the environment. Most of these studies have been carried out in major urban centers of the country and have been inclined towards municipal, domestic and industrial wastes leaving behind healthcare waste (Adipo, 2006). This study therefore sought to fill this gap by establishing factors affecting healthcare waste management system in Machakos County, Kenya.

An Assessment carried out in 2012 in GOK facilities that was supported by USAID determined that healthcare waste management is non-compliant. A combination of qualitative and quantitative analysis were used in which the result indicated that compliance and adherence of government regulation and WHO principles were absent to varying degree for all the 111 facilities under survey from the main components expected in healthcare waste management. The assessment found out that all the 111 sampled facilities were noncompliant based upon the five deal breaker criteria. Noncompliance was also the overwhelming factor for each of the fifteen units across all facilities. Level 3 and 4 facilities in Kenya were worse off than level 5 facilities which were also non-compliant in healthcare waste management as well. Two Level 6 facilities surveyed in Nairobi and Eldoret were also found to be non-compliant. Asymptotically, noncompliance held true despite variations in geography, facility size, donor, level and reputation (USAID, 2012). There is no empirical evidence that can show whether the hospitals in Kenya have improved or not with respect to the compliance in healthcare waste management; it is not clear if healthcare waste management systems have had a

positive effect or not. Therefore, this study sought to fill these gaps by establishing factors affecting healthcare waste management system in Machakos County, Kenya.

Another noted gap by this study is that recently, it has come to the realization of scholars and researchers that there exists a poor waste management system in health facilities in the country. This was brought to light by the media in early 2004, when 25 fetuses and other wastes from an unknown hospital were found wrapped in black polythene bags ready to be dumped in Nairobi River. These and many other incidences have increased concern not only on the waste management systems in hospitals, but also on the composition of hospital wastes (Adipo, 2006). This study therefore sought to fill this gap by establishing factors affecting healthcare waste management systems in Machakos County, Kenya.

Lastly, Makokha (2002) stated that most hospitals are affected by financial constraints, which limit their efforts to improve on the healthcare waste management practices. The study tried to investigate whether the argument is true for both public and private hospitals, and other underlying factors that negatively affected sound solid waste management in hospitals. Makokha (2002) recommendation for a more detailed assessment on the environmental impacts of waste from hospitals, and consequent advice to the hospital management authorities on effective waste management systems that have least effects on the environment formed part of the gap for the present research.

## **CHAPTER THREE: METHODOLOGY**

### **3.1 Introduction**

This chapter explains research methodology that was applied in this study, including, a research design description, target population, sample size, sampling technique, research instrument, and data collection technique, data collection techniques, operational definition of variables and the methods of data analysis used.

### **3.2 Research Design**

This is where a structured investigation is designed in order to provide some answers to the research questions (Cooperrider & Schindler, 2008). Survey design was adopted in the study. This was suitable for this research since data for both variables (independent and dependent) can be collected by the means of the questionnaire and some key informant guide (Orodho, 2003).

### **3.3 Target Population**

This is the total number that is actually being surveyed in the study population (Mugenda & Mugenda, 2003). Machakos County estimated population is 1,098,584 people living in 264,500 households in the region and covers the ground area of 6,208 KM<sup>2</sup>. The density of the population is 177 persons per MK<sup>2</sup>. Machakos County has over 110 health facilities. Due to limited resources, the study only focused on Machakos Level 5 hospital (the only one in the County), one level 4 hospital (Matuu Sub-County Hospital), and one health Centre (Kithimani level 3) and one dispensary (Ndalani



Level2). This included health staff, waste handlers, waste equipment operators and health facility managers (illustrated in Table 3.1.).

**Table 3.1: Target Population**

<b>Designation</b>	<b>Total Population</b>	<b>Proportion %</b>
Doctors	74	9%
Nurses	392	50%
Medical Lab Officers	35	4%
Clinical Officers	39	5%
Public Health Officers	5	1%
Pharmacist's	5	1%
Waste Handlers/Cleaners	127	16%
Others	110	14%
<b>Total</b>	<b>787</b>	<b>100%</b>

### **3.4 Sample and Sampling Techniques**

The study sampled 150 respondents 19% of the accessible population recommended with help of none other than social researchers who regularly recommend that 10-30 % of the population to be accessed is enough, and for statistical data analysis at least 30 of this cases are required (Mugenda & Mugenda, 2003). Therefore, the current sample size was a good representation of the entire population.

Stratified sampling technique was used where health workers from four-selected healthcare facilities within Machakos county participated in the survey. This technique was considered appropriate for the study as stratified random sampling technique does help in achieving the intended representation for various subgroups in the given population, with generalization that only contain minimal bias (Sekaran, 2010).

The study sample was also drawn from the strata which comprised of the various categories of health staff in the four selected facilities. Sample was drawn from the strata which comprised of Doctors, Nurses, Medical Lab Officers, Clinical Officers, Public Health Officers, Pharmacists, Waste Cleaners, and other staff in Machakos County. On the other hand, the power of selective sampling lies in selection of cases with rich information (key informants) for in-depth study of factors related to the key issues under study (Kombo & Tromp, 2006). Therefore, only Machakos Level 5 hospital (the only one in the County), one level-4 hospital, one health centres (level-3) and a single dispensary (Level-2) were purposefully selected in this study excluding other health facilities in the region that the researcher notes to have viable information necessary to assist in this study. According to Ahmed, Mahfouz and Fdul (2011), a sample should be sufficient so as to capture the desired effect sizes and represent a population. This study will be guided by the model proposed by Kothari (2004).

$$n = \frac{z^2 pqN}{(N - 1) e^2 + z^2 pq}$$

Where:

n = is the desired sample size when the target population is < 10,000

z = standardized normal deviations at a confidence level of 95.0% which is 1.96

p = the proportion in the target population that assumes the characteristics being sought.

In this study, a 80:20 basis will be assumed which is a probability of 80% (0.8).

q = The balance from p to add up to 100%. That is 1-P, in this case was 20% (0.2)

e =margin of error which is 0.05.

N = the population to be sampled which is 787.

The effective sample population for the study is derived as:

$$n = \frac{1.96^2 \times 0.8 \times 0.2 \times 787}{(787-1)0.05^2 + 1.96^2 \times 0.8 \times 0.2} = 187$$

Therefore, the desired sample size was 187 respondents. The study adopted simple stratified random sampling. Stratification was done based on the cadre of the respondents, and then within each cadre the study adopted simple random sampling. The names of the all the respondents were written in folded in a pot then the researcher randomly selected those that participated in the research. The sample of the study was as shown below;

**Table 3.2: Sample Size**

<b>Workers Designation</b>	<b>Target Population</b>	<b>Sample</b>
Doctors	74	18
Nurses	392	93
Medical Lab Officers	35	8
Clinical Officers	39	9
Public Health Officers	5	1
Pharmacists	5	1
Waste Handlers/Cleaners	127	30
Others	110	26
<b>Total</b>	<b>787</b>	<b>187</b>

**Source: Human Resource Records, April 2018, Machakos County**

### **3.4.1 Inclusion and Exclusion Criteria**

The study included all the health workers working in the health facilities within Machakos County that deal with health waste management systems at any stage. Health workers in health facilities within Machakos County that are not involved in health waste management systems were excluded from the research. The selected respondents that did not consent to the participation in data collection were also excluded from the study.

### **3.5 Data Collection Instruments**

The primary and secondary data were applied. Primary data was gathered using two research instruments consisting semi-structured questionnaire having both open-ended and closed questions, and an open ended/structured key informant schedule/interview guide for the four selected healthcare facilities to measure and compare similarity of facilities. Semi-structured type of questionnaire was appropriate for this study as per the

recommendation of by Gay (1992) who insists, that open-ended questions offer the respondents freedom to relay their views or perspective and also to make proposition, on the other hand closed-ended questions initiate specific responses and facilitate easy analysis of the data. The questionnaire exploited a five- point Likert scale in particular Strongly Agree (SA), Agree (A), Disagree (D), Neutral (N), and Strongly Disagree (SD). This allowed the researcher to draw conclusions based on comparisons made from the responses.

Oral interviews were conducted where the medical superintendents, public health officers' in-charge, and health administrators in the four selected health facilities in Machakos County were also interviewed since they dealt directly with health facility matters and are overseer of the records. Interviews were applied to evoke information on factors affecting healthcare waste management systems in Machakos County. Secondary data containing appropriate information was captured from available documentations in related research reports, journals, books, internet from hospital websites, conference reports, strategic plan, policy and procedure manual, government publications, employee performance reports and other internet materials available.

### **3.6 Data Collection Procedure**

After preparing the questionnaires, firstly the researcher conducted a pre-test study at Ngara and Rhodes Health Centers in Nairobi County. Then the researcher contacted the respective health facilities management with an introductory letter from the university and Clearance from Machakos County Department for Health Services to collect data

using the questionnaires. The researcher explained to the top management staff in respective health facilities in Machakos County on the purpose and intention of study. Researcher then delivered the questionnaires to respective respondents. The respondents were able to fill the questionnaires and for those who were not able to fill them on time were granted a maximum of one week then the questionnaires were to be collected. Researcher made efforts by contacting the top management of the respective health facilities to help him collect the questionnaires therefore saving time and resources making the study a success.

### **3.7 Pilot Test**

A pre-test study was undertaken on 15 health workers in Ngara Health Center and 15 health workers in Rhodes Health Center that translates to 20% of the actual sample size. This was deemed appropriate according to recommendations by Kothari (2004) who observed a successful pre-test study utilizes 10% to 30% of ideal sample size. After pre-testing, questionnaire was redrafted to integrate the feedback that was dispensed by respondents.

#### **3.7.1 Reliability of the Research Instruments**

According to Kothari (2004) the reliability of a measuring instrument depends on the consistence of the results it generates. A reliable measuring tool does contribute to validity, but a reliable instrument need not be a valid instrument. Reliability of the questionnaire was analyzed through Cronbach's alpha coefficient that ranges between 0.00 and 1.0. According to Tavakol and Dennick (2011), value of 0.70 and beyond is

admissible for exploratory research. The coefficient is calculated from Cronbach's alpha is:

$$\alpha = \frac{kr}{(1 + k - 1)r}$$

Where k=the number of indicators or the number of items

$r$  = the mean inter-indicator correlation

The value 1 gets for  $\alpha$  = usually specify the percentage of reliable variance. The findings in Table 3.3 indicated that all variables had a Cronbach's coefficient above 0.70, indicating that items of the questionnaire had a high consistency.

**Table 3.2: Reliability Analysis**

<b>Variables</b>	<b>Reliability Cronbach's</b>	
	<b>Alpha</b>	<b>Comments</b>
HCWM Process	0.775	Accepted
Health Manager's Role	0.703	Accepted
Human Resource Factors	0.771	Accepted
HCWM Policy Implementation	0.713	Accepted

### 3.7.2 Validity of the Research Instrument

This is the extent to which those distinctions found with a measuring tool mirror true variations among those being tested (Kothari, 2004). According to Gay (1992), validity is established by expert judgment technique. In this case, the questionnaire was created in close discussion with the university supervisors and research experts.

### **3.8 Variables Operationalization**

**Healthcare Waste Management Process:** This was measured using four items indicative of HCW management process effectiveness. The items capture waste segregation and containment, and treatment and disposal, whether a clear path of waste handling from minimization to disposal is clearly defined. The researcher applied five-point Likert scale in which 5 = Strongly Agree (SA), to 1 = Disagree (SD) for the responses under section C of the questionnaire.

**Health Managers Role:** This was measured using five items that captured how healthcare waste management Planning is conducted, the resources allocated on healthcare waste management, provision of adequate waste segregation commodities, and finally healthcare waste management policies and procedures adopted by the hospitals in the region. The researcher applied a five-point Likert scale in which 5 = Strongly Agree (SA), to 1 = Disagree (SD) for the responses under section D of the questionnaire.

**Human Resource Factors:** This was measured using five items which measured health worker's Knowledge of their HCW system, health worker's attitude towards HCW management system adopted, and the practice of health workers on the health-care wastes management system adopted by the hospitals. The researcher applied a five-point Likert scale in which 5 = Strongly Agree (SA), to 1 = Disagree (SD) for the responses under section E of the questionnaire.



**Healthcare Waste Management Policy implementation:** This was measured using five items which measured healthcare facilities policy on establishment of healthcare waste management committee for the implementation of injection safety and other related medical waste; minimization of risks policy is aimed to ensure safety of health-care staff, patients using safe disposal techniques; and prescribing policy for strengthening of the necessary health human resource capacity through quality training and sensitization for safe means in waste disposal. The researcher applied a five-point Likert scale in which 5 = Strongly Agree (SA), to 1 = Disagree (SD) for the responses under section F of the questionnaire.

**HCWM System:** This is the dependent variable and was measured using one dimension. The HCW management systems in healthcare facilities was measured by checking availability of functional healthcare waste management /IPC Committee, Waste Management Officer, vaccination against Hepatitis B & availability & use of PEP, healthcare waste management supervision checklist, healthcare waste management plan, training plan on healthcare waste management and availability and use of PPEs, for healthcare waste management. The researcher applied a five-point Likert scale in which 5 = Strongly Agree (SA), to 1 = Disagree (SD) for the responses under section G of the questionnaire.

### **3.9 Data Analysis and Presentation**

For a wider projection in output of the data applied in the study, simple descriptive statistics such as the value in percentages have an appreciable advantage over other

complex statistics values (Bell, 2010). The study utilized descriptive statistics (percentages, frequencies, mean and standard deviation) to analyse quantitative data, while inferential statistics (correlation, regression and normality test) was quantified to give insight on the variables relationship between independent variables and dependent variable using SPSS Version 25 that was the latest computer program. The choice to use regression and correlation analysis in likert scale was informed by argument of Sullivan and Artino (2013) that provided evidence on the legitimacy of likert scale in medical research. According to Sullivan and Artino (2013) descriptive statistics and inferential tests can be used to analyze Likert scale responses. However, to describe the data, means are often of limited value unless the data follow a classic normal distribution and a frequency distribution of responses will likely be more helpful. Furthermore, because the numbers derived from Likert scales represent ordinal responses, presentation of a mean to the 100th decimal place is usually not helpful or enlightening to readers.

Quantitative raw data was altered to eliminate inconsistencies, summarized and coded for simple classification. Qualitative raw data was analyzed using the content analysis. Qualitative data collected from the open-ended questions and comment boxes was grouped into several clusters of the given responses based on resemblance to the major notions emerging and dispensed in outlined explanations for those which could not be clustered and tabulated. Qualitative data was analyzed through thematic analysis and content analysis. The regression equation used in this study was as follows;

$$Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where Y; is the healthcare waste management System

$X_1$  is healthcare waste management process index

$X_2$  is health manager role index

$X_3$  is human resource factors index

$X_4$  is healthcare waste management policy implementation index

$\beta_1, \beta_2, \beta_3$  and  $\beta_4$ , level for sensitivities in the dependent variable caused by changes in independent variables

$\varepsilon$  = Error Terms

### 3.10 Research Ethics

Before the process of data collection all the necessary authorization letter were obtained. The researcher first obtained authorization from the Kenya Methodist University which was used to obtain research permit from National Commission for Science, Technology and Innovation. The researcher further sought permission from the management of Electricity generating firm to enable easy access to the Nairobi Offices for data collection. The researcher sought the informal consent from the individuals before the questionnaires were administered. Throughout the data collection process the researcher ensured that privacy, confidentiality and anonymity aspects of ethic research were adhered to. For instance no respondent was required to write their name on the questionnaire and also the researcher assured the respondents that information they provide would not be shared with third parties for other purpose besides academics. Only respondents that provided informal consent were allowed to carry on with the survey.

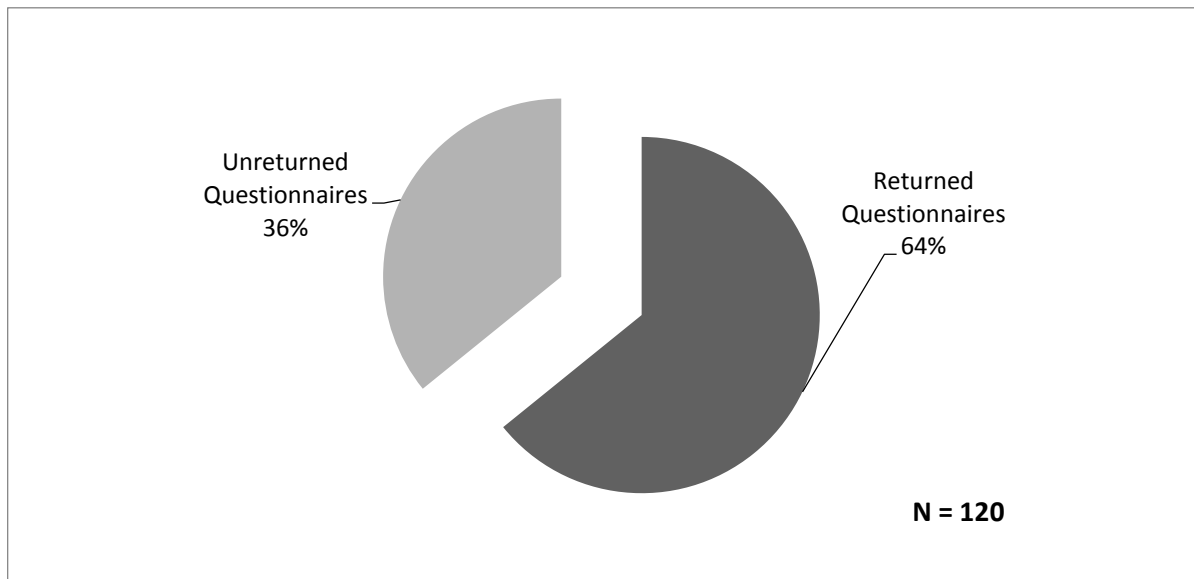
## **CHAPTER FOUR: RESEARCH FINDINGS, INTERPRETATION AND DISCUSSION**

### **4.1 Introduction**

The chapter analyzed the results of the raw data collected from the field. The chapter further presented results analyzed by various tools in the form of tables and figures to display the statistics. Finally, the study analyzed and discussed each objective based on their order of precedence in the conceptual framework.

### **4.2 Response Rate**

A total sum of 187 questionnaires were given out in which 120 were successfully submitted by respondents giving a response rate of 64% (120) as shown in Figure 4.1. Mugenda (2008) and provided the classification of response rate as follow: over 85% shows excellent, 70%-85% shows very good, 60%-70% shows acceptable and below 50% shows not acceptable. Therefore, this response rate was a very good presentation of the sample and the representation of entire population.



**Figure 4.1: Response Rate**

### **4.3 General Characteristics of Respondents**

The respondent's general characteristics for the study incorporated the gender of respondents, the age category, education level, current position and length of service in current health-care facility.

#### **4.3.1 Gender Distribution of Respondents**

Male were the majority of the respondents who participated in this study with- 58% (69) representation and only 42% (51) were female as shown in Table 4.1. This shows that the four selected healthcare facilities in Machakos County had a higher patient's number of male respondents than female participating in the study. However, the number of male respondents was not a big margin with female patient's respondents. This could be attributed to the fact that the healthcare facilities considered gender disparity or the

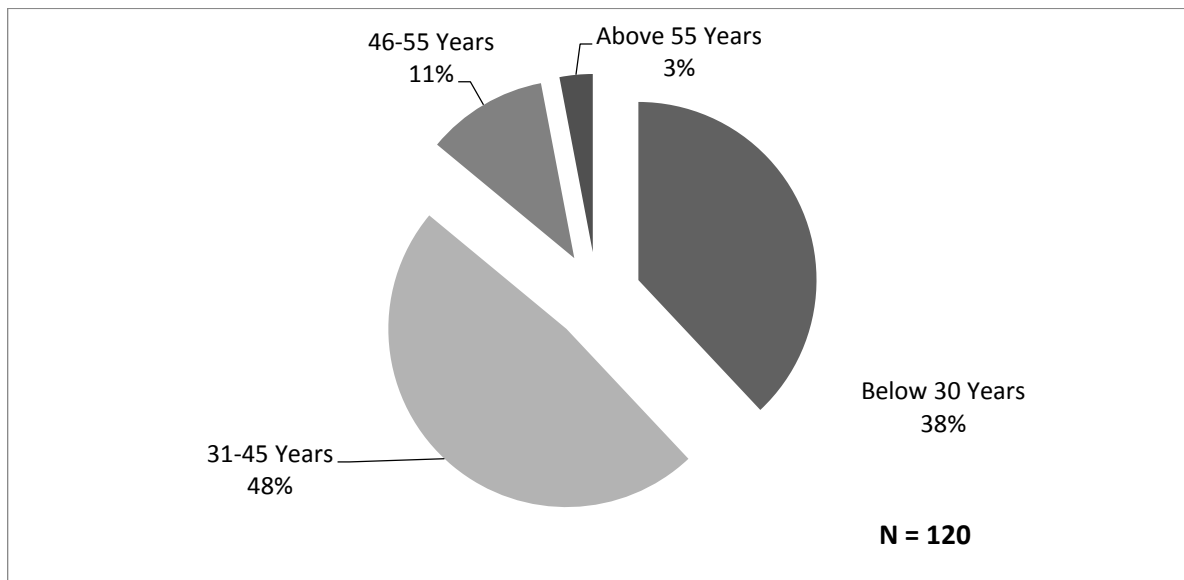
participant's respondents were somewhat equally distributed giving better results in gender distribution for the study. The finding on gender of respondents in the four selected healthcare facilities was in disagreement with Ørnemark and Oluoch (2010) who found that the health care administrations in Kenya are all characterized by significant gender inequality among healthcare workers. Therefore, it can be noted that gender inequality has improved in the healthcare facilities in Machakos County due to the small margins of male to female health workers.

**Table 4.1: Gender Distribution of Respondents**

<b>Gender</b>	<b>Frequency</b>	<b>Percentage</b>
Male	69	58%
Female	51	42%
<b>Total</b>	<b>120</b>	<b>100%</b>

#### **4.3.2 Age Category of Respondents**

Among the respondents that participated in the study, 48% (58) were of age between 31-45 years, followed by 38% (45) aged below 30 years, 11% (13) were aged between 46-45 years, while only 3% (4) were above 55 years of age as presented in Table 4.2. Thus, most of the respondents were of age between 31-45 years in the four selected healthcare facilities in Machakos County. The findings on age bracket are concurrent with Das and Biswas (2016) who found in their study that majority (60.6%) of the total population under study belonged to an age group of 21–30 years at the hospitals, thus indicating in their findings that the average age of all the subjects (healthcare workers) was 31.80 years with standard deviation of 10.34.

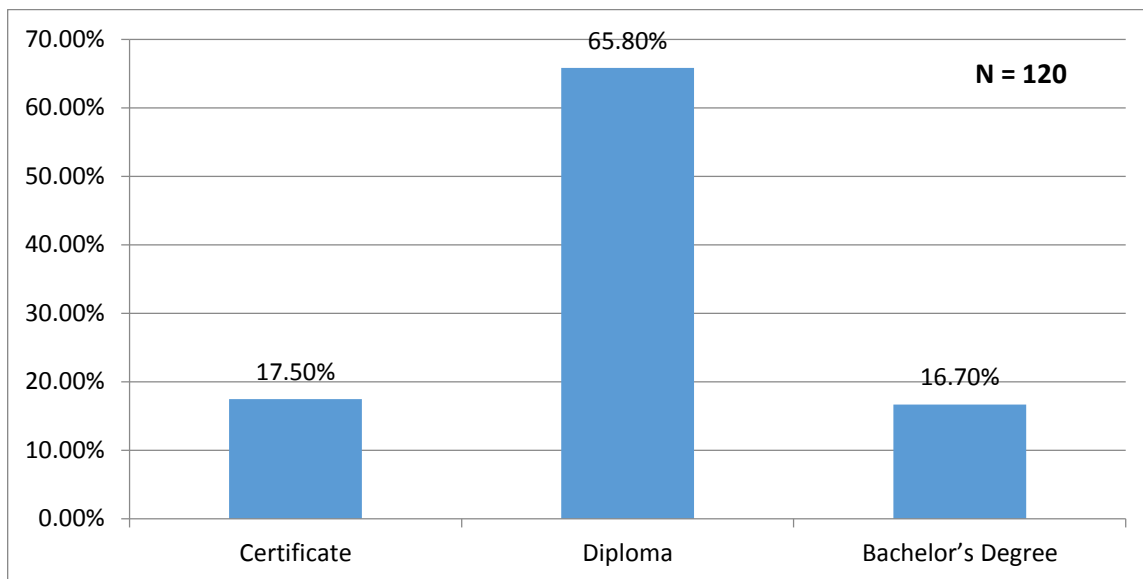


**Figure 4.2: Age Category of Respondents**

#### **4.4.3 Education Level of Respondents**

The better part of the respondents involved in this study, 65.8% (79) were diploma holders, followed by 17.5% (21) were certificate holders, while only 16.7% (20) were first-degree holders. This study lacked respondents who had attained master's degree and PhD respectively as presented in Table 4.3. Thus, majority of respondents were diploma holders in the four selected healthcare facilities in Machakos County. The findings on level of education are in concurrence with Nazli et al. (2014) who found out in their own study that when basing on the level of education, most of the respondents (healthcare workers) were majorly Diploma holders in Hospital Batu Pahat and further concluded in their findings that hospitals are supposed to institute regular short training

and education to medical doctors, laborers, nurses and last but not least the waste handlers of the concession enterprises. Therefore, these results could act as a guiding principle for health facilities in Machakos County who posed similar results.



**Figure 4.3: Education Level of Respondents**

#### **4.3.4 Current Position of Respondents**

The largest proportion of the respondents who did partake in the study, 94.2% (113) were health staff, followed by 4.2% (5) who were waste handlers, while only 1.6% (2) were health facility administrators as shown in Table 4.4. Therefore, larger part of the respondents was health staff in the four selected healthcare facilities in Machakos County. This could be attributed to the fact that the questionnaire generalized on health staff not giving them categories of health staff limiting them all together under one category- health staff. In support of this argument generalization of all health staff



involved with healthcare waste was included to represent categories of healthcare staff (Doctors, Nurses, Medical Lab Officers, Clinical Officers, Public Health Officers, and Pharmacist's, others) who their cadres were not included in the questionnaire as indicated in the target population in chapter three.

**Table 4.2: Current Position of Respondents**

<b>Respondents Occupation</b>	<b>Frequency</b>	<b>Percentage</b>
Health Staff	113	94.20%
Health Facility Administrator	2	1.60%
Waste Handler	5	4.20%
<b>Total</b>	<b>120</b>	<b>100%</b>

#### **4.3.5 Length of Service in Current Health Facility**

The respondents were requested to indicate their length of service in current health-care facility. Majority of the respondents who participated in this study, 49.2% (59) had served between 5 to 15 years, then 45.0% (54) who had served below 5 years, while 5.8% had worked for 16 years and above and 2.7% (7) of the respondents failed to disclose their length of service in the study health facilities as shown in Table 4.5. Therefore, majority of the respondents had served between 5 to 15 years at their current health facilities. The findings on experience are in support of this finding, Omari (2015) notes that employees with more experience have exposure in respective industry; moreover, this period is relatively satisfactory to provide reliable data. Therefore, the respondents in this study had clear information of HCW management systems adopted

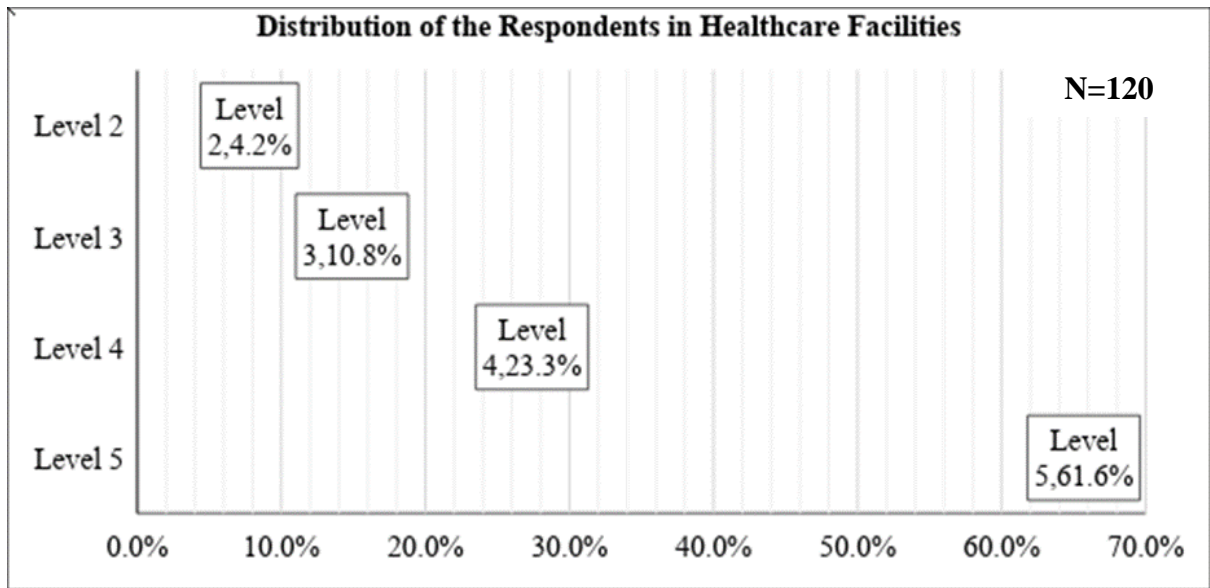
by their healthcare facilities and thus provided accurate insight on the status and condition of their HCW management at their facilities.

**Table 4.3: Length of Service in Current Health Facility**

Respondents Experience	Frequency	Percentage
Below 5 Years	54	45.00%
5-15 Years	59	49.20%
16 Years & Above	7	5.80%
<b>Total</b>	<b>120</b>	<b>100%</b>

#### **4.3.6 Distribution of the Respondents**

In context of this study, the highest proportion of respondents from the selected four healthcare facilities in Machakos County were received from Level 5 (Machakos Level 5 Hospital) with 61.6%, followed by Level 4 (Matuu Hospital) with 23.3%, followed by Level 3 (Kithimani Health Center) with 10.3%, and the least was Level 2 (Ndalani Dispensary) with 4.2%, as demonstrated in Figure 4.4. Findings on high response turn out in Level -5 could be attributed to the fact that it is the biggest healthcare facility in Machakos County therefore; having a larger number of healthcare staff than the other, three selected facilities in the County.



**Figure 4.4: Distribution of the Respondents in the Health Facilities in Machakos County**

#### **4.4 Descriptive Analysis Results**

##### **4.4.1 Healthcare Waste Management Process**

The researcher sought to determine the process of health-care waste disposal and management among healthcare facilities in Machakos County. The mean score indicates the level of agreement by respondents among the aspects of healthcare waste management process in the selected four health facilities in Machakos County as presented in Table 4.4.

**Table 4.4: HCWM Process**

HCWM Process	SA	A	N	D	SD	Mean	Std. Dev
There are separate containers (Bins) for different types of wastes.	33.3	59.2	4.2	3.3	0	4.23	0.422
Healthcare waste is segregated before treatment & disposal.	15.8	69.2	5.8	5	4.2	3.88	0.621
Healthcare waste is treated before it is finally disposed of.	10.8	55	14.2	11.7	8.3	3.48	0.903
The path for handling waste from segregation to final disposal is clearly indicated in the facility.	9.2	65.8	11.7	13.3	0	3.71	0.806

As illustrated in Table 4.4, it was found that, 59.2% of the respondents indicated to have separate containers (bins) for different categories of waste in their health facility. Similarly, 69.2% of the respondents specified that the health-care toxic waste was segregated before treatment and disposal in their healthcare facilities. It was also found that 55.0% of the respondents indicated that healthcare waste was treated before it was finally disposed of in their healthcare facilities. It was further established that 65.8% of the respondents indicated that path for handling waste from segregation to final disposal is clearly indicated in their facility. The finding revealed that separate containers (Bins) for different types of wastes had the highest mean score among the other factors to influence healthcare waste management system among the four selected health facilities in Machakos County. The findings concur with Jang et al. (2006) who reported that

segregation of healthcare waste must be engaged at the point of generation and be disposed of with regard of the relevant regulations and classifications.

The researcher wanted to determine the perception of the respondents on various categories of healthcare waste segregated in their health facility. The respondents indicated to be segregating their waste and categorized them as general waste, infectious, and highly infectious when segregating the waste into the bins. The findings can be supported by Abor, (2012) who conducted a study in Ghana and revealed that both public and private hospitals segregated their waste into different categories, by first distinguishing the waste kind and so separating non-infectious or general waste from infectious waste.

The researcher sought to establish the perception of the respondents on the healthcare waste Containers used by healthcare facility. The respondents indicated to be using mostly color-coded bins, sharps containers, improvised local containers and safety boxes at their health facility. These results are supported by GoK (2015) who noted that the use of colour coding and marking helps to easily segregate and identify the different categories of waste. Segregation therefore contributes to safer handling of waste by clearly associating a specific colour with a specific category and its associated hazard.

The researcher sought to establish the perception of the respondents on waste treatment technologies used by healthcare facility. The respondents indicated to be using mostly open burning, burning chamber, composite pit, placenta pits and incineration at their Healthcare Facility. The findings are similar to a study by Kungu et al. (2016) who

found out that health centers had constructed pits. The study further found that most common potential harmful chemicals that can be found around the health centre burners were emitted during combustion and the residual ash had a heavy component of metallic pollutants.

The researcher sought to establish the perception of respondents on the challenges encountered when using healthcare waste equipment at Healthcare Facility. The respondents indicated mostly to be at risk of getting infections, lack of continuous medical education in handling healthcare waste equipment and lack of adequate bin liners provided by their healthcare facility and some of the waste equipment was not all weather proof therefore bad weather was also a challenge. The findings are supported by WHO (2011), who noted that inadequate knowledge concerning health hazards materials related to HCW, inadequate education on proper techniques in managing waste, absence of a systems for waste disposal, insufficient human resource and financial resources and finally the little priority offered to the topic of healthcare waste are the most faced problems associated with healthcare waste.

The researcher also intended to determine the perception of responder on methods used in final waste disposal by Health Facility. The respondents indicated mostly to be using deep pit burying, and open burning as common methods used by their Healthcare Facilities. The findings can further be supported by Udofia and Nriagu (2013) who further notes that open uncontrolled burning of medical waste by most Kenyan hospitals has affected local residents living around healthcare facilities in terms of air, land and

water pollution through release of dioxins, furans and heavy metals that are carcinogenic to humans and lethal to ecosystems life.

#### 4.4.2 Health Managers Role

The researcher sought to establish roles of health managers' on healthcare waste management system among health facilities in Machakos County. The mean score indicates the level of agreement among respondents on health managers' roles in the selected four health facilities in Machakos County as shown in Table 4.5.

**Table 4.5: Health Managers Role**

<b>Health Managers Role</b>	<b>SA</b>	<b>A</b>	<b>N</b>	<b>D</b>	<b>SD</b>	<b>Mean</b>	<b>Std. Dev</b>
There is a department within the institution responsible for healthcare waste management planning.	17.5	65.8	7.5	8.3	0.8	3.91	0.81
There is budget for healthcare waste management.	8.3	56.7	15	15.8	4.2	3.49	1.00
Healthcare waste segregation bins are adequate.	2.5	64.2	20	10.8	2.5	3.53	0.82
healthcare waste management segregation bin liners are adequately provided.	4.2	66.7	15.8	10.8	2.5	3.59	0.84
There is healthcare waste management policies and procedures adopted.	0.8	58.3	29.2	10	1.7	3.47	0.76

The findings revealed that 65.8% of the respondents indicated to have a department within their healthcare facility responsible for healthcare waste management planning, similarly 56.7% of the respondents indicated to have budget for healthcare waste management in their health facilities. It was found that 64.2% of the respondents indicated healthcare waste segregation bins were adequate in their health facilities, similarly 66.7% of the respondents indicated healthcare waste management segregation bin liners were adequately provided in their health facilities. It was also found that 58.3% of the respondents indicated that there was healthcare waste management policies and procedures adopted by their health facilities. The finding revealed that healthcare waste management policies and procedures adopted had the highest mean score among the other factors to influence healthcare waste management system among the four chosen healthcare facilities in Machakos County. The findings concur with the contention by Stacey, (2012) who noted that health facilities should have department responsible for healthcare waste management and planning.

#### **4.4.3 Human Resource Factors**

The researcher sought to establish how factors such as human resource influence healthcare waste management system among health facilities in Machakos County. The researcher wanted to determine the perception of respondents on the roles of management of health facility on HCW management. The respondents indicated that management was responsible for planning, budgeting, facilitating training and provision of commodities of healthcare waste management. The mean score indicates the



agreement level of respondents concerning the human resource factors in selected four health facilities in Machakos County as shown below in Table 4.6

**Table 4.6: Human Resource Factors**

<b>Human Resource Factors</b>	<b>SA</b>	<b>A</b>	<b>N</b>	<b>D</b>	<b>SD</b>	<b>Mean</b>	<b>Std. Dev</b>
High level of healthcare waste management knowledge by the staff of the institution.	10	63.3	15	11.7	0	3.72	0.801
Health workers show concern to healthcare waste management practices adopted.	5	77.5	14.2	3.3	0	3.84	0.55
Provision of training to health workers on healthcare waste management regularly.	2.5	66.7	17.5	10.8	2.5	3.56	0.818
All Health workers are aware of the vaccination for protection against risks of healthcare waste management.	10.8	59.2	15.8	13.3	0.8	3.66	0.874
All health workers are aware of the management of needle-stick injuries/pricks.	11.7	65.8	14.2	7.5	0.8	3.8	0.774

The results of responses in Table 4.6 confirmed that 63.3% of the responders had high level knowledge on HCW management; similarly, 77.5% indicated that health workers show concern to HCW management practices adopted in their health facilities. It was found that 66.7% indicated that there was provision of training to health workers on HCW management regularly. It was also found that 59.2% of the respondents indicated that all their health workers were self-aware of the vaccination for protection against

risks of HCW management, similarly 65.8% of the respondents indicated that all their health workers were aware of the management of needle- stick injuries/pricks in their health facilities. The finding revealed that health workers concern to healthcare waste management had the highest mean score among the other factors to influence HCW management system among the four chosen health-care facilities in Machakos County. These findings are in consensus with the study by Soyam et al. (2017) who found out that all health workers had good attitude towards bio-medical management of waste. Nursing staff were best among all health workers in Delhi.

The researcher intended to determine the perception on awareness on any three of the four principles of healthcare waste management. Majority of the respondents were not aware, leaving the question blank, however the remaining few who had knowledge indicated precautionary, duty of care, and proximity and polluter pay principles. The researcher intended to determine the perception of the responders on the methods the health facilities use on HCW management awareness of health workers. The respondents indicated to be using posters and charts explaining healthcare waste management, continuous medical education and prompt supervision of healthcare waste management staff. The findings can be supported by Nazli et al. (2014) who in their study recommended that continual education and monitoring techniques by supervisors should be administered so as to ensure compliance on the use of personal protective equipment and other safe working processes.

The researcher intended to determine the perception of the responders on their best recommendations to improve HCW management awareness program in their health

facilities. The respondents recommended frequent updates in healthcare waste management and refresher training of health staff and waste managers in their health facilities. The findings can be supported by Askarian et al. (2004) who noted that quality training of health workers promotes awareness and knowledge on proper toxic waste handling and disposal of the clinical waste in hospitals.

#### **4.4.4 Healthcare Waste Management Policy Implementation**

The researcher sought to establish HCW management policy implementation in health facilities in Machakos County. The mean score indicates the level of agreement by respondents among the aspects of HCW management policy implementation in the selected four healthcare facilities in Machakos County as shown in Table 4.7.

**Table 4.7: Healthcare Waste Management Policy Implementation**

HCW management Policy Implementation	SA	A	N	D	SD	Mean	Std. Dev
Healthcare facility has written policies dealing with HCW management. The policies, plans, manuals, and/or written procedures are consistent with national laws, regulations, and any permits.	9.2	56.7	15.8	15	3.3	3.53	0.97
Healthcare facility policy explicitly mentions a commitment to protect the environment. The HCW management policies and/or plans are reviewed or updated at least once a year.	6.7	56.7	22.5	12.5	1.7	3.54	0.86
There are policies and plans related to healthcare waste management included in occupational health and safety.	4.2	61.7	20.8	11.7	1.7	3.55	0.82
	0	58.3	21.7	15.8	4.2	3.34	0.89
	4.2	61.7	16.7	16.7	0.8	3.52	0.85

The findings in Table 4.7 revealed that 56.7% of the responders had indicated that their health facilities had developed policies tackling challenges in healthcare waste management, similarly 56.7% of the respondents indicated that the policies, manuals, plans, and/or written procedures are on the other hand consistent with national regulations, laws, and permits in their health facility. It was found that 61.7% of the respondents indicated that their health facility policy clearly mentioning total commitment guard and protect the environment, and 58.3% of the respondents indicated

that healthcare waste management policies and/or plans are updated or reviewed over time of at least once every year at their health facilities.

It was also found that 61.7% of the respondents indicated that there were policies and plans related to healthcare waste management included in occupational health and safety policy in their health facilities. The finding revealed that healthcare facility policy mentioning commitment to protect the environment had the highest mean score among the other factors to influence healthcare waste management system among the four selected healthcare facilities in Machakos County. The findings can be supported by the Waste Management Regulations 2006, under the EMCA 1999, which grants responsibility of care on the occupant of premises where healthcare waste is handled to take necessary measures to ensure that such waste is handled appropriately without effects on human health and to the surrounding environment and natural resources (GoK, 2006).

The researcher intended to determine the perception of the responders on their awareness on healthcare waste management Policy documents in their health facilities, if they believed they are comprehensive and indicate gaps if not comprehensive. Most of the responders clearly specified to be lacking knowledge on the existing policies on healthcare waste management in their healthcare facility. However, some of the respondents indicated that, the policy was too short as it lacked detailed content on healthcare waste management in their healthcare facility as a major gap. The findings on lack of awareness on healthcare waste management policy by healthcare staff act as lesson from GoK (2015) who noted in the healthcare waste management Strategic Plan

2015-2020 in the third strategic priority objective to put in place capacity-building/training strategies and programs for health workers and waste managers on healthcare waste management policy.

#### **4.4.5 Health Care Waste Management System**

The researcher sought to establish the HCW management system among the selected four health facilities in Machakos County. The mean score indicates the level of agreement among respondents on the aspects of healthcare waste management system among the selected four health facilities in Machakos County as shown in Table 4.8.

**Table 4.8: Health Care Waste Management System**

HCW Management System	SA	A	N	D	SD	Mean	Std. Dev
There is a Functional HCWM/IPC Committee in the facility.	15.8	56.7	10.8	13.3	3.3	3.68	1.00
There is a designated Waste Management Officer in the facility.	15	67.5	8.3	5	4.2	3.84	0.89
I have been vaccinated against Hepatitis B.	19.2	56.7	5	11.7	7.5	3.68	1.14
Post-exposure prophylaxis (PEP) was administered to me upon getting accidental need prick or injury.	14.2	49.2	10	10.8	15.8	3.35	1.30
My facility provides adequate personal protective gears (PPEs) for healthcare waste handling.	11.7	58.3	16.7	10.8	2.5	3.66	0.91
There is a healthcare waste management supervision checklist in my facility.	2.5	42.5	29.2	18.3	7.5	3.14	1.00
My facility has an approved healthcare waste management plan.	8.3	34.2	38.3	14.2	5	3.27	0.98
My facility has an approved healthcare waste management training plan.	4.2	27.5	39.2	20	9.2	2.98	1.01

The findings revealed that 56.7% of the respondents indicated that their health facilities had a functional healthcare waste management /IPC Committee, 67.5% indicated that there was a designated Waste Management Officer in the facilities, 56.7% indicated that they had been vaccinated against Hepatitis B. It was found that 49.2% of the respondents

indicated that PEP was administered to them upon getting accidental need prick or injury. It was also established that 58.3% of the respondents indicated that their facilities provides adequate PPE for healthcare waste handling, 42.5% of the respondents indicated that their facility had a healthcare waste management supervision checklist, however 34.2% of the respondents indicated not to be sure if their facilities had an approved healthcare waste management plan. It was further established that 27.5% of the respondents indicated not to be sure if their facilities had an approved healthcare waste management training plan. The finding revealed that availability of a designated Waste Management Officer in the facilities had the highest mean score among the other factors to influence healthcare waste management system among the four selected health facilities in Machakos County.

From the assumptions in this study, it was observed that the state of performance of healthcare waste management system is poor based on observation from the highest average score of 55.1% for workers agreeing on first six indicators and remaining two indicators on workers remaining neutral on whether facilities have work plans and training plans was 38.8 (Table 4.10), this reflecting a decimally less than the 80% plus benchmark, reflecting poor state of healthcare waste management in Machakos County health facilities. This finding is in agreement with healthcare waste management Strategic Plan 2015-2020 which appreciates that the poor management of healthcare waste in Kenya hospitals exposes health-care workers and the community to risk of infection and a need for healthcare waste management systems to be incorporated by health facilities with the guidance of WHO six pillars for health systems.



#### 4.4.6 Status of HCWM System among Health Facilities

The respondents were asked to describe healthcare waste management System Status in their health facilities in Machakos County as shown in Table 4.9. The findings revealed that majority of the respondents 58% indicated good, followed by 38% average, and least was 5.6% who indicated excellent among their healthcare facilities in Machakos County. The majority 58% indicating as good is still far below the assumption of this study that the performance of healthcare waste management system should be 80% and above.

**Table 4.9: Status of HCWM System**

<b>Respondent's perception on Status of HCWM System in HCF</b>	<b>Frequency</b>	<b>Percentage</b>
Poor	4	3%
Average	45	38%
Good	70	58%
Excellent	1	1%
<b>Total</b>	<b>120</b>	<b>100%</b>

This interview was conducted on Medical Superintendent, public health officer in-charges, nursing officer's in-charge and health administrators and recorded for the four selected healthcare facilities in Machakos County. Each facility was visited and the researcher interviewed key informants.

## **4.5 Inferential Analysis**

This sector elaborates the outcome on normality test; correlation and regression analysis for all selected four health facilities in Machakos County (Sullivan, & Artino (2013).

### **4.5.1 Normality Tests for All Variables**

The key statistical procedures such as regression, correlation, analysis of variance, and t tests are based on the key assumption that our data is from a normal distribution (Adefisoye et al., 2016). There are several methods used to test if data are normally distributed. The graphical and test methods are the techniques that can be used to assess the general normality. However, graphical presentation strategies offer us with some information regarding the form of the distribution, however don't guarantee that the distribution is normal and don't take a look at whether or not the difference between the traditional distribution and also the statistical distribution is important. Therefore, this study used Shapiro-Wilk test, which is a formal statistical test that usually provides more reliable results than graphical analysis. The study focused on Shapiro-Wilk test with the argument that it is the most powerful and omnibus test in most statistical situations. In the recent years, the test has become the preferred test of normality due to its good power characteristics as compared to a wide range of other alternative tests. Further argument is that for data set smaller than 2000 elements, it is commended to use the Shapiro-Wilk test (Chen et al., 2009). According to Field (2009), when the Sig. value of the Shapiro-Wilk Test is greater than 0.05, ( $p > 0.05$ ) the data shall be normally

distributed. However when it is less than 0.05, ( $p < 0.05$ ) the data significantly deviates from properties of normal distribution.

**Table 4.10: Test of Normality**

Variables	Shapiro-Wilk		
	Statistic	Df	Sig.
HCW management Process	0.78	120	0.329
Health Managers Role	0.88	120	0.475
Human Resource Factors	0.775	120	0.550
HCW management Policy Implementation	0.743	120	0.630

a. Lilliefors Significance Correction

The test of normality in Table 4.10, the Shapiro-Wilk test now shows that all the four variables had P-values greater than 0.05 that is; healthcare waste management process 0.329, health manager's role 0.475, human resource factors 0.550 and healthcare waste management policy implementation 0.630. This study, therefore, concluded that the data sets for the four variables were normally distributed hence subsequent analysis could be carried out.

#### 4.5.2 Correlation Analysis

When the independent variables are two or more, the multiple correlations are the key analysis that will be conducted to elaborate the relationship. Therefore, this study used multiple correlations analysis. The value of the correlation coefficient ( $r$ ) is in a region between  $-1$  and  $+1$ . When the characteristics are perfectly associated (perfect positive association) with each other, the coefficient to apply will be  $+1$ , and when they are perfectly disassociated (perfect negative association), the coefficient to apply will be  $-1$ .

When the characteristics are perfectly independent of each other, the coefficient of association will now be 0. As outlined, when the probability (p) is less than 0.01 ( $p < 0.01$ ) then it is considered to be statistically significant. When the probability is greater than 0.01 ( $p > 0.01$ ) then the relationship is not statistically significant (Kothari, 2004). For this study, Pearson correlation coefficient (r) was carried out to assess the correlation analysis among the variables of interest. Correlation Coefficient tests whether there is an inter-dependency among the four predictor variables (healthcare waste management process, health manager's role, human resource factors, and healthcare waste management policy implementation) and whether the predictor variable were related to the response variable (healthcare waste management system) at 95% confidence interval 2-tailed as illustrated in Table 4.11.

**Table 4.11: Correlation Matrix**

		HCW Management System	HCWM Process	Health Managers Role	Human Resource Factors	HCWM Policy
HCW Management System	Pearson Correlation	1				
HCW management Process	Pearson Correlation	0.149	1			
Health Managers Role	Pearson Correlation	.564**	0.118	1		
Human Resource Factors	Pearson Correlation	.307**	0.17	.593**	1	
HCWM Policy	Pearson Correlation	.500**	0.023	.563**	.352**	1
	Sig. (2- tailed)	0.000	0.802	0.000	0.000	
	<b>N</b>	<b>120</b>	<b>120</b>	<b>120</b>	<b>120</b>	<b>120</b>

\*\* Correlation is significant, at 0.01 level (2-Tailed).

Table 4.11 results show the value of correlation between healthcare waste management process, health manager role, human resource factors and healthcare waste management policy implementation, and healthcare waste management system among health facilities in Machakos County. The outcome revealed there is no statistical significance, but weaker positive relationship between the health-care waste management process and health-care waste management system ( $r = 0.149$ ,  $p > 0.001$ ). However there was statistical significance and stronger positive relationship between health manager role and healthcare waste management system ( $r = 0.564^{**}$ ,  $p < 0.001$ ), similarly there was a statistical significance and stronger positive relationship between human resource factors and healthcare waste management system ( $r = 0.307^{**}$ ,  $p = 0.001$ ). It was also revealed that there was a statistical significance and stronger positive relationship between health-care waste management policy and healthcare waste management system ( $r = 0.500^{**}$ ,  $p < 0.001$ ). All the predictor variables had positive relationships with the response variable hence all can explain healthcare waste management system of healthcare facilities in Machakos County. However, healthcare waste management process did not have a statistically significant association but a weaker positive relationship with the dependent variable. These results were further statistically analyzed- Multiple Regression Analysis.

### **4.5.3 Multiple Regression Analysis**

Although the correlation coefficient explains the relationship between variables of interest, it does not entail any causal interrelation between them, hence we further

explore other statistical tools to help demonstrate specific attributes of the relationships (Mugenda & Mugenda, 2003). In this study, multiple regression was applied because more than two predictor variables were incorporated (Kothari, 2004). The target of this analysis was to recognize those predictor variables simultaneously related with the response variable (healthcare waste management system) and to approximate the separate and distinct influence of each independent variable on the dependent variable.

**Table 4.12: Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.864a	0.746	0.662	0.163

a. Predictors: (Constant), HCW Management Policy Implementation, Human Resource Factors, HCW Management Process, Health Manager Role

From the regression summary results in Table 4.12, the R Square is 0.746, which shows that HCW management system was affected by HCW management process, health manager's role, human resource factors, and healthcare waste management policy implementation. This indicated that there was a variation of 74.6% on healthcare waste management system with healthcare waste management process, health manager role, human resource factors, and HCW management policy implementation. The remaining 25.4% indicates that there are other factors which affected healthcare waste management system of the selected four health facilities in Machakos County that were not studied in the current study.

ANOVA<sup>a</sup> test was also computed to test whether the model truly works in describing the association within variables as proposed in conceptual model. F test was measured to find the overall likelihood of the relationship between the response variable and all the predictor variables occurring by chance. The higher the F-values, the lower the P-values, and hence high significance of the model in describing the relationship. A P-value less than level of confidence of 0.05 denotes a high and significant relationship. When p-value is greater than 0.05, it implies that none of the predictor variables project the response variable; implying that the model is not functional.

**Table 4.13: ANOVA Test**

Model		Sum of Squares	df	Mean Sum of Squares	F	Sig.
1	Regression	1800.038	4	450.01	17.496	.000b
	Residual	2957.828	115	25.72		
	Total	4757.867	119			

a. Response Variable: HCWM System

b. Predictor Variable: (Constant), HCW management Policy Implementation, Human Resource Factors, HCW management Process, Health Manager Role

The findings in Table 4.13 show the ANOVA test outcome as the Mean Sum of Square was 450.010. The F-test outcome was 17.496 with significance value of 0.000. This means that probability of these results occurring by chance was less than 0.01 ( $p < 0.01$ ). Thus, a significant relationship was between the response variable (HCW management System) and the four predictor variables (HCW management process, health manager's role, human resource factors, and HCW management policy implementation) with a degree of freedom (df) as 4.00 as shown.

In multiple regressions, the t-test is utilized in finding out the probability of the relationship within each of individual predictor variables and the response variable occurring by chance. In comparison, the F-test is utilized to find out the overall probability of the relationship between the dependent variable and all the independent variables occurring by chance. The t distribution table and the F distribution table are used to determine whether a t-test or an F-test is significant by comparing the results of the t distribution and F distribution respectively, given the degrees of freedom and the pre-defined significance level (Saunders *et. al.*, 2009).

**Table 4.14: Regression Coefficients**

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	11.401	4.841		2.355	0.211
HCW management Process	0.793	0.213	0.103	3.723	0.000
Health Manager Role	0.986	0.234	0.436	4.207	0.000
Human Resource Factors	0.155	0.219	0.065	0.706	0.002
HCWM Policy Implementation	0.480	0.156	0.275	3.086	0.000

a. Dependent Variable: HCW management System

From the results in Table 4.14, the t-test results for the coefficient of multiple determination for the four independent variables were 2.355, 3.723, 4.207, 0.706 and 3.086. Therefore, the probability of these results occurring by chance was less than 0.005, being less than 0.01 for the four independent variables; HCW management process, health managers' role, human resource factors, and HCW management policy implementation. This means that the multiple regression coefficient for the four independent variables were statistically significant at (p<0.01) level.



The coefficients or beta weights for each variable allows the researcher to compare the relative importance of each independent variable. In this study, the unstandardized coefficients and standardized coefficients were given for the multiple regression equations. However, discussions were based on the standardized coefficients. Standardized coefficients simply represent regression results with standard scores. The standardized regression equation uses the z-scores for both the dependent and independent variables. There is no constant (or intercept) in this equation and the  $\beta$  (called the beta weight) is substituted for the beta (called the regression coefficient) (Gelman, 2008). The Beta values ( $\beta$ ) are the values for the regression equation for predicting the dependent variable from the independent variables.

The standardized regression equation is;

$$Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Becomes:

$$Y = 0.103X_1 + 0.436X_2 + 0.065X_3 + 0.275X_4 + \varepsilon$$

Where Y; is the HCW System

$X_1$  is HCW management process index

$X_2$  is health manager role index

$X_3$  is human resource factors index

$X_4$  is HCW management policy implementation index

$\varepsilon$  =error term (takes into consideration others factors not included in the model that affect HCW management)

From the Table 4.16 it is noted that all the four independent variables HCWM process ( $\beta = 0.103$ ;  $p < 0.001$ ), health manager's role ( $\beta = 0.436$ ;  $p < 0.001$ ), human resource factors ( $\beta = 0.065$ ;  $p < 0.005$ ), and HCW management policy implementation ( $\beta = 0.275$ ;  $p < 0.001$ ) positively and significantly influence healthcare waste management System. From the findings health manager's role had highest strong positive and significantly influence on healthcare waste management System. An explanation of not using different multiple regression analysis in this study to compare results of the four selected health facilities in Machakos County and using general multiple regression analysis for the four healthcare facilities can be found in the sample sizes. Thrush (2012) observed that an analysis was more precise when it is based on a large sample and argues that the bigger the sample the better the results.

The finding of this study supports that of Manyele, and Lyasenga (2010) who found that most of the facilities have no specific disposal sites. In Ilala, 70% of the health facilities burn wastes in poorly designed incinerators, open pit burning or on the ground while in Kinondoni, 83% of the facilities bury wastes in the pits. The finding agrees with Mugo (2017) also the study concluded that existing system; training and public awareness on waste management had a negative influence on performance of healthcare waste management. The study recommended that the legal framework on healthcare waste management should be emphasized in order to improve on performance of healthcare waste management systems in hospitals.

The study found that human resources management and policy impact positively on HCW management. These findings are consistent with those of Sabour et al., (2007) still

a lot which needs to be done to ensure this waste is properly handled from its generation stage to the disposal phase to curb its dangers. Similarly Kungu et al., (2016) found that 62.5% of the health centers studied had overhead shelter and protective enclosure for them.

The study finding supports Jovanović, Jovanović, Matic and Đonović (2016) who found a direct and strong correlation between the total number of beds, hospital days, and healthcare services provided and staff members trained in the area of medical waste management, identified as the main factors that impact the management of hazardous medical waste. Adipo (2006) study found out that waste management systems in health facilities are inadequate. They are not only unhygienic and a public health concern, but also a threat to the biological and physical environment. Mathur, Patan and Shobhawat (2012) also found that percentage of medical waste in the total waste stream was comparatively high, ranging from 12.5% to 69.3%, which indicated poor waste handling practices.

The qualitative data collected from interview with key respondents showed that facilities lacked funds to train their health workers and to purchase commodities for healthcare waste handling, poor storage and disposal of healthcare waste, inadequate funds to purchase waste handling commodities (waste segregation color coded bins & liners, storage and transportation in-house), and there was lack of awareness among staff on healthcare waste. The facility had a brick-burning chamber for treatment & disposal of healthcare waste management, facility lacked healthcare waste, treatment equipment and inadequate and substandard storage facility of healthcare waste management, lacked

knowledge on disposal of drugs and low awareness on waste handling among their health workers were some of the HCW management system Challenges in Health Facilities in Machakos County.

The research also interviewed key informants on Knowledge, Attitude and Practices among health workers on HCW management in Health Facilities. The finding showed that majority indicated that health workers showed positive attitude in HCW management, however there was no system in place to inform patients on HCW management handling, they pointed out that health staff knowledge on HCW management handling was still a challenge.

On Policies of HCW management in County/Nationally on Health Facilities, Key informants in Machakos Level-5 hospital, Kithimani Health Center Level-3, and Ndalani Dispensary Level-2 who were interviewed indicated that health workers & waste handlers seemed to lack knowledge on Policies of HCW management as they refrained from answering the question on the same. However key informants in Matuu Level-4 hospital who were interviewed indicated their facility lacked adequate funds for dissemination of HCW management policy at facility and their staff lacked knowledge on the policies since there were no orientations on the same. On knowledge on Principles of HCW management, Key informants noted that.

“Some of the health workers lacked knowledge on principles of healthcare waste management as they refrained from answering the question on the same. This could be attributed to the observation the researcher made that the facilities lacked mastery in

HCW management planning due to lack of knowledge on principles of HCW management”

On Risks from healthcare waste handling / interventions taken, Key informants in Machakos Level-5 hospital who were interviewed indicated that staffs were at risk of needle- stick injuries/pricks. However, risk was managed by providing continuous medical education and use of PPEs. Key informants in Matuu Level-4 hospital who were interviewed indicated that staffs were at risk of needle- stick injuries/pricks. However, risk was managed by using PPEs. Key informants in Kithimani Health Center Level-3 who were interviewed indicated that staffs were at risk of Nosocomial infections, and needle- stick injuries/pricks. However, risk was managed by using PPEs, and safety boxes. Key informants in Ndalani Dispensary Level-2 who were interviewed indicated that their staff and patients were at risk of exposure to HCW due to spillages and pricks while handling needles. However, risk was managed by using PPEs and referred their staff for PEP in Level 4 in case they got needle- stick injuries.

The study asked the key informants on Health Manager Roles on HCW management, Key informants in Machakos Level-5 hospital who were interviewed indicated that their facility had no checklist on healthcare waste management Key informants in Matuu Level-4 hospital who were interviewed indicated that “Supervision checklist used by IPC committee to supervise HCW handling, facility using supervision checklist, monthly and quarterly facilitation reports. Health facilities was using Calls and Memos to staff and had supervision checklist”

The study further sought to find out from the key informants about the Planning for HCW management. Key informants in Machakos Level-5 hospital who were interviewed indicated that planning on HCW management was done only by PHO in charge of hospital. Key informants in Matuu Level-4 hospital who were interviewed indicated that planning on healthcare waste management was only done when need arises/ ad hoc basis. Key informants in Kithimani Health Center Level-3 who were interviewed indicated that the IPC committee was responsible for planning including supervising and providing feedback on HCW management. Key informants in Ndalani Dispensary Level-2 who were interviewed indicated that staff lacked knowledge on HCW management planning.

The study also asked the respondents whether there was training on healthcare waste management. Key informants in Machakos Level-5 hospital who were interviewed indicated that training was occasionally done due to lack of funding. Key informants in Matuu Level-4 hospital who were interviewed indicated that on-job training using CMEs was facilitated by IPC committee. Key informants in Kithimani Health Center Level-3 who were interviewed indicated that training was occasionally done due to lack of funding. Key informants in Ndalani Dispensary Level-2 who were interviewed indicated that their staff had no training of healthcare waste management. Key informants in Machakos Level-5 hospital who were interviewed indicated that the facilities lacked adequate funds and dedicated budget. Key informants in Matuu Level-4 hospital who were interviewed indicated that their facility got resource allocation only for outsourcing waste collection to private contractors. Key informants in Kithimani Health Center

Level-3 and Ndalani Dispensary Level-2 who were interviewed indicated that resources allocated were inadequate to cater for healthcare waste handling and equipment.

## **CHAPTER FIVE: SUMMARY, CONCLUSIONS & RECOMMENDATIONS**

### **5.1 Introduction**

The chapter contains summary of the findings, conclusion made and recommendations to improve the HCW management system among the four selected health facilities in Machakos County and in Kenya. The chapter also outlines the suggested areas for further research.

### **5.2 Summary of the Findings**

#### **5.2.1 Healthcare Waste Management Process**

The findings revealed that the health facilities have had separate containers for different types of wastes, HCW management was segregated before treatment and disposal, healthcare waste management was treated before final disposal, and there was a path for handling waste from segregation to final disposal clearly indicated by the four selected health facilities in Machakos County. On the categories of how healthcare waste management is segregated in health facilities, healthcare waste was categorized into general waste, infectious, and highly infectious when segregating into bins. On the HCW management Containers used by healthcare facilities, Color coded bins, sharps containers, improvised local containers and safety boxes were the most commonly used HCW management containers by the by the health facilities. The results of correlation and regression analysis revealed that healthcare waste process had a significant and positive effect on HCW management.



### **5.2.2 Health Managers Role**

The findings revealed that some of the health facilities had a department responsible for HCW management planning, some had budget for healthcare waste management, and some had adequate healthcare waste segregation bins. It was found that there were healthcare waste management policies and procedures adopted by some the health facilities. On the roles of management of health facilities on healthcare waste management, management was responsible for planning, budgeting, facilitating training and provision of commodities of healthcare waste management in the healthcare facilities. On the waste treatment technologies used by health facilities, qualitative analysis found that open burning, burning chamber, and unapproved incineration were the most commonly used waste treatment technologies by the healthcare facilities.

On the challenges encountered when using healthcare waste equipment at healthcare facilities, risk of getting infections, lack of continuous medical education in handling healthcare waste equipment and lack of adequate bin liners provided by their health facility were the most common challenges encountered by the healthcare facilities. On methods used for final waste disposal by health facilities, deep pit burying, and open burning were common methods used. The results of correlation and regression analysis revealed that human manager had a significant role on HCW management.

### **5.2.3 Human Resource Factors**

On respondents' recommendations to improve HCW management awareness program in their health facility, frequent updates in HCW management and refresher training of

health staff and healthcare waste handlers were the most recommended methods for the health facilities. The findings revealed that health workers had high level of knowledge on HCW management, health workers showed concern to HCW management practices adopted, and they were provided training on healthcare waste management regularly. It was found that healthcare workers were using protective equipment provided to safely dispose healthcare waste, and health workers were aware of the vaccination for protection against risks of healthcare waste management. It was also found that health workers were aware of the management of needle- stick injuries/pricks in their health facilities.

On the perception on awareness by respondents on any three of the four principles of healthcare waste management, majority of the respondents were not aware, however the remaining few who had knowledge indicated precautionary, duty of care, and proximity and polluter pay principles. On the methods healthcare facilities uses on healthcare waste management awareness of healthcare workers, qualitative analysis found that posters and charts explaining healthcare waste management, continuous medical education on healthcare waste management and prompt supervision of healthcare waste management staff were the most commonly used methods by the health facilities.

#### **5.2.4 Healthcare Waste Management Policy Implementation**

The findings revealed that the health facilities had written policies dealing with HCW management, and their policies, plans, manuals, and/or written procedures are consistent with national laws, regulations, and any permits. It was found that the health facilities

policy explicitly mentions a commitment to protect the environment, and that healthcare waste management policy and/or plans were reviewed or updated at least once a year. It was further established that the healthcare facilities have policies and plans related to healthcare waste management included in occupational health and safety policy.

On testing respondent's awareness to healthcare waste management Policy documents in their health facility, and if they believed they are comprehensive and indicate gaps if not comprehensive, qualitative analysis found that majority of the respondents indicated to be lacking knowledge on the existing policies. However, some of the respondents indicated that the policy was too short as it lacked detailed content on healthcare waste management as a major gap.

The researcher sought to establish the healthcare waste management system among the selected four health facilities in Machakos County. The findings revealed that some of health facilities had a functional HCW management /IPC Committee, some had a designated waste management officer, and some health workers had been vaccinated against Hepatitis B. It was found that PEP was administered to health workers upon getting accidental need pricks or injury. It was also established that the health facilities provided adequate personal protection equipment for healthcare waste handling, and some had a healthcare waste management supervision checklist. However, some health workers were not sure if they had an approved healthcare waste management plan. It was further established that health workers were not sure if their facilities had an approved healthcare waste management training plan. On determining healthcare waste

management system status in the health facilities in Machakos County, qualitative analysis found that the status was good.

### **5.3 Conclusion**

The study made conclusion based on the specific objectives;

#### **5.3.1 Healthcare Waste Management Process**

The study made conclusions based on chapter four and summary of the findings. The study concluded that health facilities staff lacked continuous medical education in handling healthcare waste and lacked adequate bin liners for healthcare waste segregation. The study further concluded that some health facilities lacked funds for purchasing equipment, all lacked approved waste treatment equipment and relied on outsourcing outside services and some had small brick incinerators not capable of handling HCW generated. The study also concluded that health facilities had inadequate and substandard storage facilities.

#### **5.3.2 Health Managers Role**

The study concluded that health managers in the health facilities seemed to lack knowledge on healthcare waste management principles therefore lacking mastery in healthcare waste management planning. The study also concluded that there was no supervision checklist on HCW management in some health facilities health workers lacked knowledge in healthcare waste management planning, and planning of healthcare waste management only done when need arises in some health facilities. This could be

attributed to lack of training on planning, lack of adequate and dedicated budget for healthcare waste management planning. The study concluded that despite positive attitude by healthcare workers in healthcare waste management, lack of training could be a contributing factor to lack of knowledge on disposal of drugs, low awareness on waste handling and segregation among healthcare workers in the health facilities.

### **5.3.3 Human Resource Factors**

The study concluded that majority of the healthcare workers to be lacking knowledge on the existence of such healthcare waste management policies. This could be due to lack of knowledge on policies of healthcare waste management by some of the key informants that were interviewed and also as a result of not sharing/disseminating this knowledge to their healthcare workers that look upon them for guidance. State of healthcare waste management system: This study concluded that healthcare workers were not sure if they had an approved healthcare waste management and training plans.

### **5.3.4 Healthcare Waste Management Policy Implementation**

The study concluded that health facilities lack of adequate funds and dedicated budget could negatively affect the status of healthcare waste management in the health facilities. This implies that the health facilities would not be able to put better facilities, purchase better equipment and train healthcare workers on better ways of handling healthcare waste.

## **5.4 Recommendations**

On open burning of healthcare waste used by the healthcare facilities, the study recommends adopting best available technologies of treatment/disposal of healthcare waste that are alternative technologies to incinerators or burn technologies as this would reduce environmental pollution. On challenges encountered by the healthcare facilities in disposing healthcare waste, first the study recommends a need for health facilities to provide protective equipment to healthcare workers as this would reduce risk of exposure to infections/injuries while handling healthcare waste.

The study also recommends that proper training should be done on the management that regard to the awareness and also the practices that cover all the carders of health workers among healthcare facilities in Machakos County and in the country. This can be accomplished by assessing knowledge gaps of different category of health workers to help address different training needs that they require in healthcare waste and reduce risk of exposure or accidents to health workers and waste handlers. On facility management role, the study recommends that health facility management teams should facilitate refresher training after critical review of existing practices concerning waste management -that is, the phases of segregation, storage, collection, transport, treatment and disposal, develop/adopt, and disseminate guidelines and standard operating procedures to both the waste handlers and health care workers.

On lack of knowledge by healthcare workers on principles of HCW management and on existing policies on HCW management at the healthcare facilities in Machakos County,

the study finds it fit to recommend the need for frequent updates in HCW management and refresher training of healthcare staff and waste handlers on HCW management policies in health facilities in Machakos County and in Kenya. In support of these recommendations, the study further recommends that all health facilities in Kenya adhere to the National Policy on Injection Safety and Medical Waste Management, (2007) where the policy has an objective of spelling out the need for the advocacy of both the support and implementation that is needed to properly manage healthcare waste among others.

Some of the principles that guide the implementation of the 2007 policy include; Establishment of organizational structures at all levels for all the implementation of injection safety and related medical waste, the policy also addresses the need to protect the environment by applying the appropriate methods for waste disposal, minimization of risks to health workers, patients, communities and the environment as a whole through the use of safer injection devices, safer sharp waste disposal methods and also by strengthening of the necessary human resource capacity through training and sensitization for safe waste disposal and also by use of an advocacy approach.

### **5.5 Areas for Further Research**

This study was limited to four objectives, these being to establish influence of healthcare waste management process, health manager's role, human resource factors and healthcare waste management policy on HCW management system among the four selected health facilities in Machakos County. Other research objectives which might

have a significant effect have not been included in the study. Therefore, future studies could attempt to cover other objectives that were not included in this study.

This study was limited to four public selected health facilities in Machakos County similar studies can be conducted in other health facilities such as the private hospitals, other public hospitals so as to establish a basis for comparison of the findings obtained from different health facilities in Kenya. This study only focused on factors affecting health-care waste management systems in Machakos County, Kenya. Future studies could focus on different technologies that may be in the treatment and disposal stages of health-care waste or the awareness on health-care waste to communities surrounding healthcare facilities as this are upcoming topics that need literature on addressing the emerging issues.



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## APPENDICES

### Appendix I: Informed Consent

**Kenya Methodist University**

**P. 0 Box 267-60200**

**MERU, Kenya**

**RE: Informed Consent**

**Dear Respondent,**

My name is *Michael Mwania* I am an MSc student from Kenya Methodist University. I am conducting a survey titled: *Factors Affecting Healthcare Waste Management Systems in Machakos County*.

The findings obtained will be used in the strengthening of the healthcare waste management systems not only in Kenya but also in other developing countries in Africa. Asymptotically, all countries and communities will greatly benefit from the advancement of the quality of healthcare waste management services. This research proposal plays a critical role in the strengthening of health systems as it is bound to create new ill generate new ideas and perceptions in the healthcare waste management area that will in the long run aid the decision makers in making decisions involved with research.

#### **Procedure to be followed**

Participation in the study is centered on asking of some question to the respondents and also in the accessing of the hospital departments so as to address the six pillars concerned with the health system. The information received from the respondents will be recorded in a questionnaire checklist.

The decision to participate on not to participate in this study is purely personal and I promise no victimization or any form of penalty will be held against the non-participants, neither will it have any effect at the place of work.

Just a note to remember that participation in the study is voluntary. However any questions that are related to the study may be asked at any time. It is also not mandatory for you to answer all the questions on the questionnaire if you are feeling uncomfortable to do so. You as the respondent is free to stop the interview at any time and also pull out of the study for your own reasons with no consequences attached.

#### **Discomforts and risks.**

You may find that some of the questions that you will be asked during the interview to have been based on an intimate subject which may make you feel uncomfortable. If such



a case happens, you are free to refuse answering or you can also stop the interview. The interview is expected to take a maximum of 40 minutes.

### **Benefits**

Participation in this study will aid the government of Kenya in strengthening of its health systems which will act as a good example to other developing countries that are in the same level with Kenya. Every member of the community is bound to benefit from this study because of the improvement in the healthcare systems. This field attachment is aimed at generating new knowledge in the healthcare management so as to inform decision makers to make better decisions which are also based on research findings.

### **Rewards**

No reward will be awarded to the participants of this study.

### **Confidentiality**

The interviews will be held within the hospital but in a private setting. No name will be recorded and all the answers given in the interviews will be anonymous and kept safely away within the university premises. Your name will not be recorded on the questionnaire and the questionnaires will be kept in a safe place at the University.

### **Contact Information**

In case of any questions about the study, the following supervisors may be conducted:  
*Mr. Musa Oluoch and Mr. Fredrick Kimemia* of Department of Health Systems Management of Kenya Methodist University, Main campus.

### **Participant's Statement**

I acknowledge that the statement above is in line with my participation in the study and has been fully answered to the best of my knowledge and satisfaction. I have also been given the liberty to ask any questions that I may feel appropriate. I also acknowledge that participation in this study is entirely my choice and that I have not been coerced by anyone. I also affirm that my responses will be kept in a safe place and I am at liberty to leave the study at whatever time that I choose. I understand that failure to participate or walking away from this study will not cause me any form of victimization or change the way in which I operate with my colleagues at work.

Name \_\_\_\_\_ of \_\_\_\_\_ Participant \_\_\_\_\_  
Date \_\_\_\_\_  
Signature \_\_\_\_\_

### **Investigator's Statement**

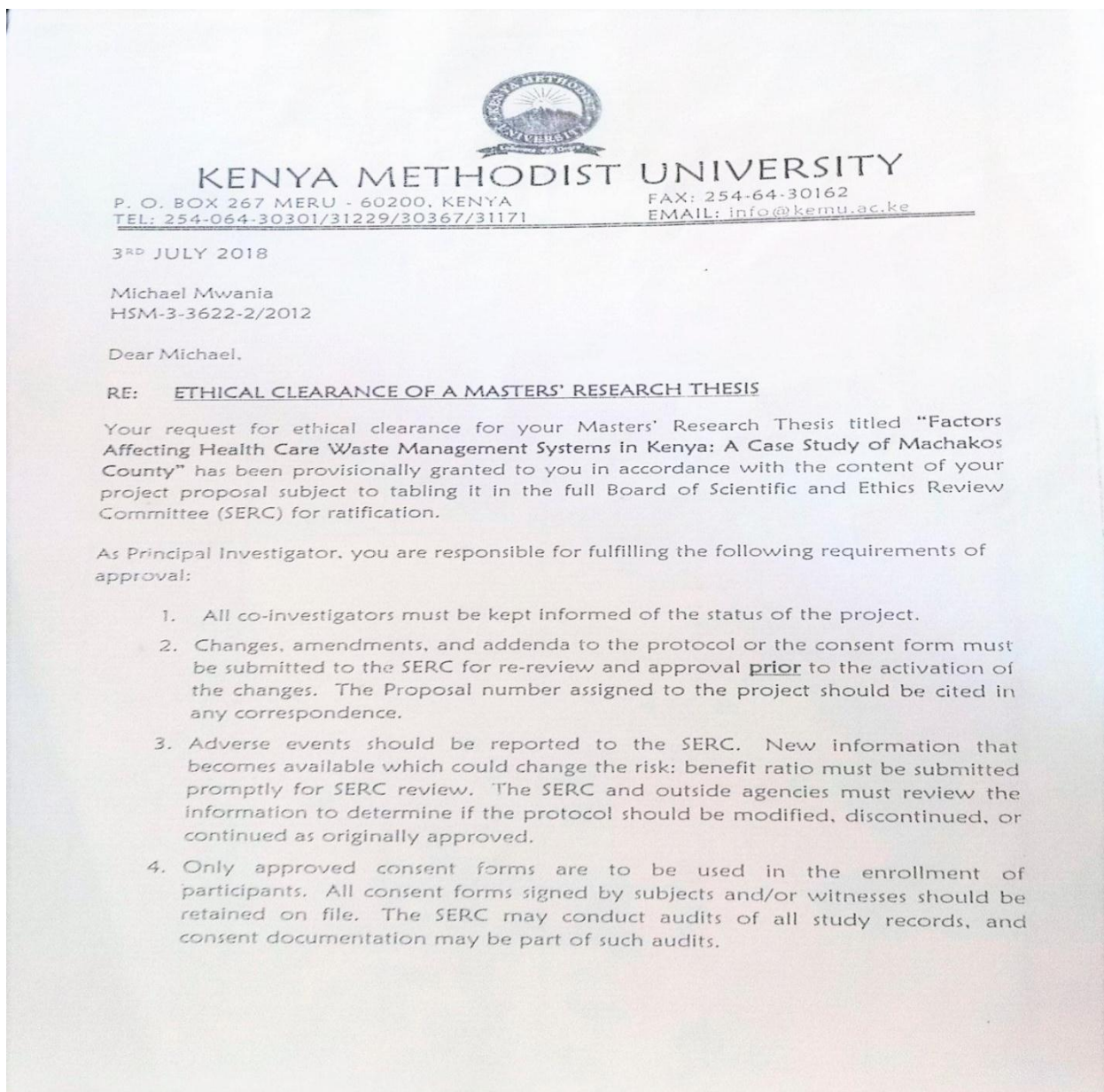
I, the undersigned have clearly explained to the participant of what is expected in the study and all the benefits and risks that are involved

Name \_\_\_\_\_ of \_\_\_\_\_ Interviewer\_\_\_\_\_

Date\_\_\_\_\_

Interviewer Signature\_\_\_\_\_

## Appendix II: Letter of Ethical Clearance for KEMU



5. SERC regulations require review of an approved study not less than once per 12-month period. Therefore, a continuing review application must be submitted to the SERC in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion will result in termination of the study, at which point new participants may not be enrolled and currently enrolled participants must be taken off the study.

Please note that any substantial changes on the scope of your research will require an approval.

Yours sincerely



DR. WAMACHI  
Chair, SERC

cc: Director, RI & PGS

## Appendix III: Research Authorization Letter from NACOSTI



### NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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

NACOSTI, Upper Kabete  
Off Waiyaki Way  
P.O. Box 30623-00100  
NAIROBI-KENYA

Ref. No. **NACOSTI/P/19/07392/26366**

Date: **20<sup>th</sup> February, 2019**

Michael Musango Mwanja  
Kenya Methodist University  
P.O. Box 267- 60200  
**MERU.**

#### **RE: RESEARCH AUTHORIZATION**

Following your application for authority to carry out research on “*Factors affecting Healthcare Waste Management Systems in Kenya. A case of Machakos County*” I am pleased to inform you that you have been authorized to undertake research in **Machakos County** for the period ending **20<sup>th</sup> February, 2020**.

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

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

  
**BONIFACE WANYAMA**  
**FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The County Commissioner  
Machakos County.

The County Director of Education  
Machakos County.

## Appendix IV: Study Questionnaire

### SECTION A: INSTRUCTIONS TO RESPONDENTS

This questionnaire seeks to evaluate healthcare waste management systems in Kenya using Machakos County as a case study. This is an academic survey and the information obtained through this questionnaire will be treated confidentially and not used for any other purpose other than academic research. Please attend to all the questions in this questionnaire. Please mark where appropriate or fill in the required information on the spaces provided.

### SECTION B: GENERAL CHARACTERISTICS OF RESPONDENTS

<b>1</b>	<b>Gender Distribution</b>	
i	Male	
ii	Female	

<b>2</b>	<b>Age Category</b>	
<b>i</b>	Below 30 Years	
<b>ii</b>	31-45 Years	
<b>iii</b>	46-55 Years	
<b>iv</b>	Above 55 Years	

<b>3</b>	<b>Level of Education</b>	
i	Certificate	
ii	Diploma	
iii	Bachelor's Degree	
iv	Master's Degree	
v	PhD Degree	

vi	Other Specify:	
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<b>4</b>	<b>Current Position</b>	
i	Health Staff	
ii	Health Facility Administrator	
iii	Waste Handler	
iv	Waste Equipment Operator	
v	Other Specify:	

<b>5</b>	<b>Length of Service in Current Health Facility</b>	
i	Below 5 Years	
ii	5-15 Years	
iii	16 Years & Above	

**SECTION C: HEALTHCARE WASTE MANAGEMENT PROCESS**

<b>6</b>	<b>Please indicate your response by ticking in the appropriate column by opting from a scale where: 1= Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5= Strongly Agree.</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
i	There are separate containers (Bins) for different types of wastes.					
ii	Healthcare waste is segregated before treatment & disposal.					
iii	Healthcare waste is treated before it is finally disposed of					
iv	The path for handling healthcare waste from segregation to final disposal is clearly indicated in the facility.					

<b>7.</b>	<b>Please list below the main categories and examples in each category, into which HCW is segregated in your healthcare facility.</b>

<b>8.</b>	<b>Please indicate the kind of HCW containers you use in your healthcare facility.</b>

<b>9.</b>	<b>Please state the type of waste treatment technologies you use in your healthcare facility. Onsite(Within facility)_____ Offsite(Outside facility)_____</b>

<b>10</b>	<b>Please indicate the challenges you have using the healthcare waste equipment in</b>
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	<b>your healthcare facility.</b>

<b>11</b>	<b>Please state the methods you use for final waste disposal.</b>

**SECTION D: HEALTH MANAGERS ROLE**

<b>12</b>	<b>Please indicate your response by ticking in the appropriate column by opting from a scale where: 1= Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5= Strongly Agree.</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
i	There is a department within the institution responsible for HCWM planning					
ii	There is a dedicated budget for healthcare waste management					
iii	Healthcare waste segregation bins are adequate					
iv	HCWM segregation bin liners are adequately provided					
v	There is HCWM policies & procedures adopted					

<b>13</b>	<b>Please state the roles of management of health facility as far as injection safety and appropriate HCWM.</b>

**SECTION E: HUMAN RESOURCE FACTORS**

		<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
<b>14</b>	<b>Please indicate your response by ticking in the appropriate column by opting from a scale where: 1= Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5= Strongly Agree.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
i	High level of HCWM knowledge by the health workers of the institution					
ii	Health workers show concern to HCWM practices adopted					
iii	Provision of training to health workers on HCWM is done regularly					
iv	Use protective equipment provided to safely dispose medical waste.					
v	All Health workers are aware of the vaccination for protection against risks of HCWM					
vi	All health workers are aware of the management of needle- stick injuries/pricks					

<b>15</b>	<b>Please state any three of the four principles of HCWM</b>

<b>16</b>	<b>Please state the methods your healthcare facility uses on HCWM awareness of health workers and waste handlers.</b>
i	
ii	
iii	

<b>17</b>	<b>Please share your thoughts and ideas on how best to improve on the HCWM awareness/practices program in your healthcare facility.</b>

**SECTION F: HEALTHCARE WASTE MANAGEMENT POLICY IMPLEMENTATION**

<b>18</b>	<b>Please indicate your response by ticking in the appropriate column by opting from a scale where: 1= Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree,</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

	<b>5= Strongly Agree.</b>					
i	Healthcare facility has written policies dealing with healthcare waste management					
ii	Facility policies, plans, manuals, and/or written procedures are consistent with national laws, regulations, and any permits					
iii	Healthcare facility policy explicitly mentions a commitment to protect the environment					
iv	healthcare waste management policies and/or plans are reviewed or updated at least once a year					
v	There are policies and plans related to healthcare waste management included in occupational health and safety					

<b>19</b>	<b>Are you aware of any HCWM policy documents, guidelines or strategy documents currently available/in use in Kenya? Yes_____ or No_____</b>
i	If yes, do you believe they are comprehensive enough in content? Yes_____ or No_____
ii	If no, what are the gaps? Please state the gaps

**SECTION G: HEALTH CARE WASTE MANAGEMENT SYSTEM**

<b>20</b>	<b>Please indicate your response by ticking in the appropriate column by opting from a scale where: 1= Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5= Strongly Agree.</b>	<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

i	There is a Functional HCWM/IPC Committee in the facility					
ii	There is a designated Waste Management Officer in the facility					
iii	I have been vaccinated against Hepatitis B.					
iv	Post-exposure prophylaxis (PEP) was administered to me upon getting accidental need prick or injury					
v	My facility provides adequate personal protective gears (PPEs) for healthcare waste handling					
vi	There is a healthcare Waste management supervision checklist in my facility					
vii	My facility has an approved Healthcare Waste Management plan					
viii	My facility has an approved Healthcare Waste Management training plan					
<b>21</b>	<b>In general, how would you rate Health Care Waste management System Status in your Health Facility?</b>					
	Very Poor_____ Poor_____ Average_____ Good_____ Excellent_____					

**THANK YOU FOR TAKING SOME TIME TO PARTICIPATE DURING THIS SURVEY**

**Appendix V: Interview Schedule**

**Key Informant Schedule/Guide**

**SECTION A: PERSONAL CHARACTERISTICS OF HEALTH FACILITIES**

Name of Facility \_\_\_\_\_

Physical Address: \_\_\_\_\_

Number of Health Workers: \_\_\_\_\_

Indicate Facility Level: \_\_\_\_\_

**SECTION B: DISCUSSION POINTS WITH KEY INFORMANTS ON HEALTH CARE WASTE MANAGEMENT SYSTEM** (Medical Superintendent, Public Health Officer In-charges, & health administrators, nursing officer's in charge and IPC coordinators).

1. Waste management in health facilities in Kenya has numerous challenges, right from minimization to final disposal. Can you explain some of the challenges in your facility?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Can you comment on knowledge, attitude and practices of health workers and patients on waste handling in the facility?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. National and County policies on HCWM may have gaps in their application and or use in health facilities. Can you comment on the case of your facility?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. There are International guiding principles on HCWM domesticated in Country policies. Can you comment on these principles and how they are applied in your facility?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. There are health risks associated with handling of waste in your facility. Can you comment on these risks and how they are managed in your facility?

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6. Support supervision is a usual activity by managers in health facilities. Can you comment on the tool(s) used and feedback mechanisms used HCWM

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7. Planning is one of roles of facility managers. Can you comment on HCWM planning in your facility?

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8. Training and appraisal of health staff is one of the activities envisaged in HCWM policies in Kenya. Can you comment on what is in place in your facility regarding the same?

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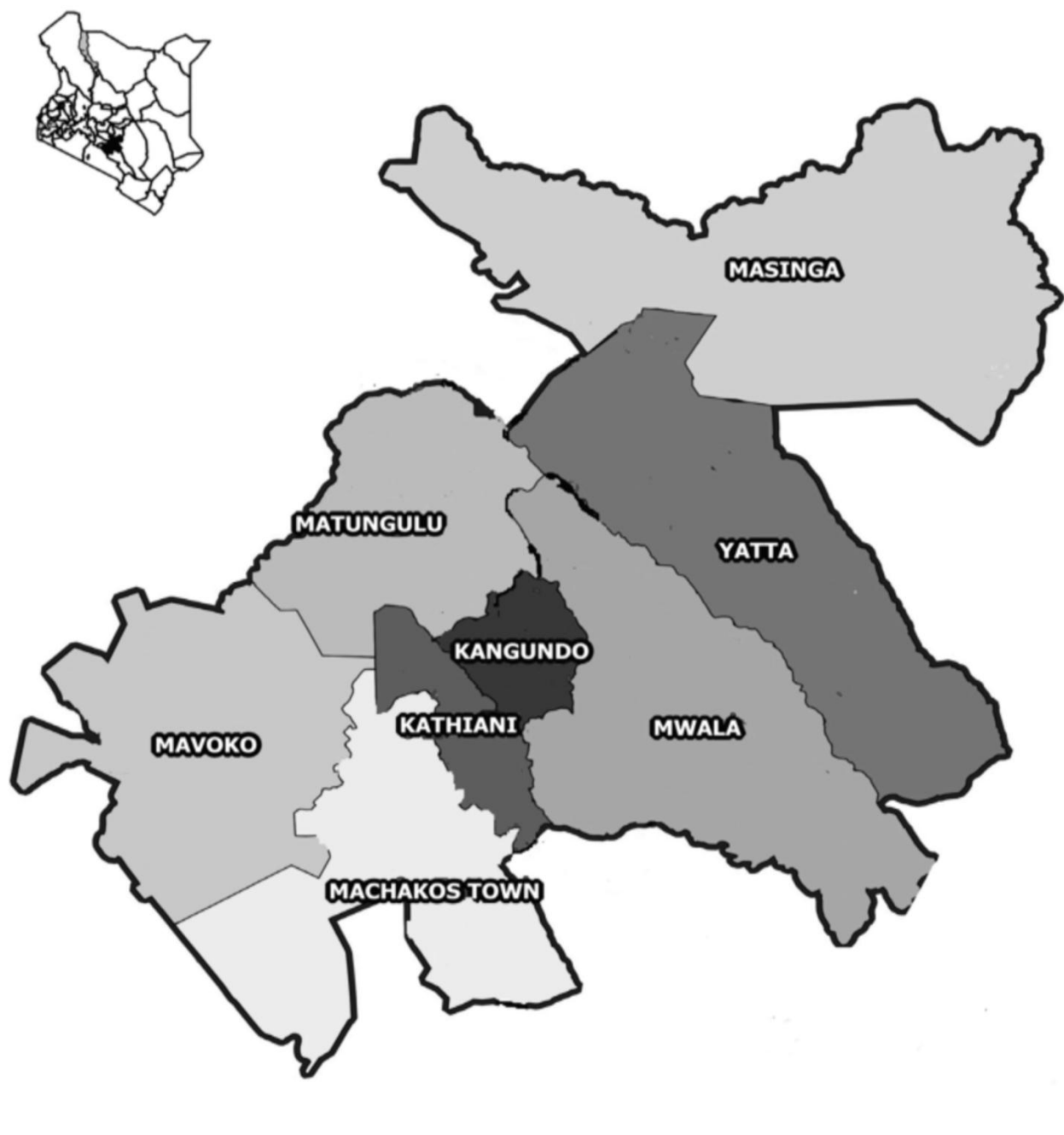
9. Provision and allocation of adequate funds for facilities' health services is a challenges in Kenya. Can you comment on the case of your facility regarding HCWM?

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**Appendix VI: Geographical Location of Machakos Sub-Counties**



**Source: Kenya National Bureau of Statistics, 2009**