CLINICAL WASTE MANAGEMENT FACTORS ASSOCIATED WITH HEALTHCARE ACQUIREDINFECTIONS AMONG HEALTH CARE WORKERS IN KISUMU COUNTY, KENYA

BY

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DECLARATION

I, Violet Akinyi Otieno declare that this is my original work and it has not been presented for any degree in any other university.

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DEDICATION

This work is dedicated to my mum Edwina Atieno who shaped my life and to my family who have given me the reason to always work hard and be strong in life.

ABSTRACT

Clinical waste is a leading cause of death globally due to the increasing number of infectious diseases. Clinical wastes are generated by health facilities and may cause infection to any person coming in contact with it. Human tissue, blood or other body fluids, excretion, drug or pharmaceutical products, syringes and needles may be hazardous to persons coming in contact if not properly managed. This study aimed at assessing clinical waste management factors associated with healthcare acquired infections among HealthCare Workers in Kisumu County, Kenya. This study adopted a descriptive study design, in which 278 healthcare workers were selected using stratified random sampling to participate. Self-administered questionnaire was used for quantitative data and qualitative data was collected through key informant interview. Fishers exact test was used to determine the distribution of clinical waste management knowledge and practice factors among healthcare workers .Logistic regression analysis was used to determine the association between clinical waste management factors and healthcare acquired infections among healthcare workers. Statistically significant level was considered at $p < 0.05$. Half of the participants 143 (51.4%) were females, while majority 125 (45%) were between 36-50 years of age. Inadequate knowledge on categories of clinical waste generated [OR = 2.153 (1.287 − 3.603), p value =0.003] and inadequate knowledge on infection associated with clinical waste management generated [OR = 2.120 (1.291 − 3.481), p value =0.003].Containers were suitably located 1.554(0.922-2.618, p value 0.098 and the availability of colour coded bin liners [OR=0.791(0.438-1.427),p value =0.438] . Absence of clinical waste management committee [OR=1.565(1.055-2.571), p value =0.036] and not using personal protective equipment when handling patient resulted [OR=2.058(1.215-3.484),p value = 0.007].As a result this bad practice increases the likelihood of healthcare workers acquiring infection by almost half[OR=1.984(1.135-3.460), p value = 0.006].Approval was sought from Maseno University Ethics Review committee and written informed consent was obtained from the respondents. Conclusion ;Knowledge factors on categories of clinical waste generated, colour coding categories of clinical waste generated, infections associated with clinical waste management and categories on clinical waste generated were found to be significant in this study. The research findings will help the hospitals in better performance on clinical waste management

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LIST OF ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immune deficiency syndrome
CME	Continuous Medical Education
CO	Clinical Officer
CWs	Clinical Wastes
CWM	Clinical Waste Management
GOK	Government of Kenya
HAIs	Healthcare Acquired infections
HBV	Hepatitis B
HBC	Hepatitis C
HCWs	Health Care Workers
HIV	Human immune deficiency Virus
JOOTRH	Jaramogi Oginga Odinga Teaching and Referral Hospital
KNBS	Kenya National Bureau of Statistics
KDHS	Kenya Demographic Health Survey
KESH	Kenya Environmental Sanitation and Hygiene
KII	Key Informant Interview
KNH	Kenyatta National Hospital
MO	Medical Officer
MOH	Ministry of Health
MTRH	Moi Teaching and Referral hospital
MOH	Ministry of Health
NEMA	National Environmental Management Authority
NERC	National Ethical Review Committee
NSI	Needle Stick Injuries
OR	Odds Ratio
OSHA	Occupational Safety and Health Administration
PEP	Post-exposure Prophylaxis
PHO	Public Health officer
PPE	Personal Protective Equipment
ROK	Republic of Kenya
SPSS	Statistical Package for the Social Sciences
TB	Tuberculosis
VCT	Voluntary Counseling and Testing
WHO	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Clinical waste: Is waste from health facilities that are likely to contain infectious substances such as blood and other bodily fluids.

Clinical waste practices: Doing the right thing when handling waste, segregating transporting and treating of waste

Hazards: Chance of being injured or harmed

Healthcare acquired infections: These are infections healthcare worker might get in the process of offering services to the client or when within the healthcare setting.

Healthcare workers: Individuals who care for the patients in healthcare setting.

Waste Management: Means the actions, administrative and operational, that are used to safely handle waste.

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CHAPTER ONE
INTRODUCTION

1.1 Background Information

Clinical wastes are generated by health facilities and may cause infection to any person coming in contact with it. Human tissue , blood or other body fluids, excretion , drug or pharmaceutical products, syringes and needles may be hazardous to persons coming in contact if not properly managed(Gary ,2018). Clinical waste is a leading cause of death globally due to the increasing number of infectious diseases. (Haylamichael *et al*.,2011). Poor clinical waste management (CWM) poses danger to healthcare workers, waste handlers, patients, and the public at risk of infection, injurious effects, and accidents, in addition to destruction of the surroundings. It is critical to separate all clinical waste materials at the point of generation. (WHO, 2011). Investigation by the World Health Organization (WHO) indicated that about 8-16 million has new hepatitis B(HBV) yearly, 2.3-4.7 million hepatitis C(HCV) yearly, 80,000 to 160,000 new cases of HIV due to risky infusion and poor healthcare waste management(WHO,2015).

Clinical waste is a global issue and failure to practice or implement the standard rules and regulations on proper clinical waste management healthcare system will be in crisis leading to hospital acquired infections among healthcare workers (Hiremath *et aL.,*2017). By separating hazardous and non-hazardous clinical waste, proper CWM reduces the spread of infection (Joshi et al.,2015). Clinical waste management entails the generation, separation, gathering, storage, treatment, and final disposal of clinical waste (Ciplak & Barton, 2012).

Clinical waste has not gotten the attention it deserves in underdeveloped nations like Africa (Patwary *et al.,* 2011). Low- and middle-income countries tend to have mixed clinical and non-clinical waste handled and disposed of together which violates the CWM standard and best practices. (WHO ,2014). Due to occupational job functions, waste handlers are exposed to clinical waste often, which could lead to infection when handling waste mostly through punctures, cuts inhalation or dermal contact (Hossain *et al.,* 2013). The Kenya Environmental Sanitation and Hygiene (ROK, 2013) strategy aims to progress clinical waste management in all hospitals in Kenya. Clinical waste producers and merchant of clinical waste disposal are subject to arrange of rules and regulatory requirement (Blenkharn, 2018). Even after the formulation of policies and laws on health care waste management, many health care establishments in Kenya

still lack enforcement of legislation for handling, and disposal of clinical waste. Moreover, improper treatment or disposal of clinical wastes (CWs) such as open-air burning can constitute a significant source of pollution to the environment through the release of substances such as dioxins, furans or mercury (GOK, 2012). Where there is proper management of clinical waste, the amount of hazardous clinical waste generated from health facilities should be equal or less than 26 percent (Alwabr *et al.,* 2016b). Due to harmful exposure of clinical waste healthcare workers (HCWs) may suffer from series of diseases (Oli *et al.,* 2016). Healthcare workers who are exposed to an infected source's needle stick injury have a 30 percent, 1.8 percent, and 0.3 percent chance of contracting HBV, HCV, and HIV, respectively (Twinch,2011).

Lack of knowledge about clinical waste management is a mistake which can affect the practice of safe waste disposal and should not be ignored (Odonkor&Mahami,2020). Inadequate knowledge on CWM among healthcare workers in Kenya has been demonstrated by a study done by (Ngari,2011) despite the basic training of healthcare workers in training institution. Moreover, there is inadequate training of primary HCWs on CWM. They dispose of their waste quickly and cheaply without recourse to hygienic way of doing it (Malumfashi *et al.,*2011). Lack of knowledge about waste segregation and collection, lack of associated risk awareness were found to be factors contributing mismanagement of clinical waste in a study done in Thailand (Akkatit *et al.,* 2020). Thus, it is important to assess clinical waste management knowledge factors associated with healthcare acquired infections among healthcare workers in Kisumu county, Kenya.

An assessment of the status clinical waste management in Nyanza province, Kodiaga (2007) showed that there was lack of segregation of clinical wastes (CWs); inadequate CWs bins, inappropriate internal CWs storage facilities, inappropriate internal transport facilities, delay in CW collection, lack of Personal Protective Equipment (PPE), lack of pre-treatment of CWS before final disposal. However, in all hospitals sampled, the waste that was properly segregated was sharps, which were placed in sharp boxes. The study findings revealed that the status of health care waste management in Nyanza province was low and contributed to environmental and health impacts. A baseline survey done in 2014/2015 by Kisumu Integrated Solid Waste Management Plan (KISWaMP) revealed that the current clinical waste management procedures in Kisumu county hospitals is not satisfactory, hospitals are practicing poor CWM and poor storage

of CWs with only 3 hospitals having well-built concrete storage room. dumping is the most common method for final disposal of CWs in Kisumu county hospitals with no prior treatment of waste, the survey also revealed that its only one public hospitals that had standard incinerator the rest of the hospitals used substandard and unlicensed incinerators for CWs thus posing a threat to health and public safety. There was a need to conduct a study of clinical waste management factors associated with healthcare acquired infections among health care workers in Kisumu county, Kenya. Many literatures in Kisumu county have concentrated majorly on solid waste management leaving clinical waste behind yet clinical waste management if not properly managed may become a leading cause of death.

1.2 The Statement of the Problem

Clinical waste management are not static, new ideas emerge every time in order to strengthen clinical waste management to achieve sustainable development. WHO recommends that noninfectious waste should be at 80% and 20% infectious waste, which requires special waste treatment method nevertheless Kenya is still way below. Clnical waste management guidelines and policy are there but still there is poor CWM in public health facilities of Kenya. In Kenya only a few healthcare workers are familiar with clinical waste management policies and in many instance CWs handling is left to the least educated who normally operates without any training, guidance or supervision.

Healthcare acquired infections (HAIs) have been a major cause of illness and mortality. Healthcare acquired Infections (HAIs) prevalence and burden has been established by surveillance system in developed countries though in developing countries especially Africa the data is limited. Prevalence of HAIs in Kenya is as high as 30-50%. Healthcare workers risk acquiring infections in line of duty. About 2.5 percent, 32 percent, and 40% of healthcare workers' infections are HIV, hepatitis B (HBV) and hepatitis C (HCV) respectively. More often there is inadequate training of primary HCWs on CWM, they dispose of their waste quickly and cheaply .Many hospitals do not have waste management facilities like the colour coded bins, bin liners, storage rooms for CWS and incinerators for proper CWM. Most hospitals practice biased waste disposal and only a few practice the standard operating procedure. Clinical waste management rules are not followed by many hospitals since most hospitals dispose clinical waste disposal system without any pretreatment.

In Kisumu County the current CWM procedures in hospital are not satisfactory, there is poor practice, poor storage of CWs and dumping is the most common method for final disposal and this is public health concern. Kisumu central sub county hospital was purposely selected as it has all the almost all the levels of hospital except 6 and it also produces the greatest amount of CWs since it has both the referral and county hospitals inclusive which generates lots of wastes as compared to other sub counties hospitals in Kisumu county. Thus it was important to do a research on Clinical waste management factors associated with HAIs among healthcare workers in Kisumu county hospital to determine the clinical waste management state in Kisumu.

1.3 Justification of the Study

There are no studies that have been done in Kisumu central sub county hospitals on clinical waste management factors associated with healthcare acquired infections among HCWs. The study is important because clinical waste management if not properly managed poses a risk to healthcare workers, patients and community at large. Adequate knowledge and good practice is crucial in preventing clinical waste hazards. In 2017 the preliminary data showed an increase in the incidence of injuries to HCWs from clinical waste exposing them to illnesses such as hepatitis B, C and HIV/AIDS which was reported in the occupational health register. Poorly disposed surgical blades, needles frequently injured HCWs. Knowledge on waste management was linked to adherence to waste management guidelines. Despite many literatures and implementation of clinical waste management policies and guidelines by national guidelines for clinical waste, NEMA and ministry of health (MOH) the percentage of healthcare workers with inadequate knowledge on colour coding and infections associated with clinical waste management is still high. Furthermore, Kenya is still way below WHO recommended standards of CWM. Due to increase clinical waste generation in health facilities within Kisumu County, it was important to assess clinical waste management factors associated with HAIs among healthcare workers. Kisumu central sub county hospitals have both referral and county hospitals producing greatest amount of wastes.

1.4 General objective

To assess clinical waste management factors associated with healthcare acquired infections among health care workers in Kisumu county, Kenya

1.4.1 Specific Objectives

    i. To assess the clinical waste management knowledge factors associated with healthcare acquired infections among health care workers in Kisumu county, Kenya.

    ii. To determine facility factors associated with healthcare acquired infections among healthcare workers in Kisumu county, Kenya.

    iii. To assess the clinical waste management practice factors associated with healthcare acquired infections among health care workers in Kisumu county, Kenya.

1.5 Research Questions

    i. What are the knowledge factors on clinical waste management associated with healthcare acquired infections among health care workers in Kisumu county, Kenya?

    ii. What are the facility factors associated with healthcare acquired infections among healthcare workers in Kisumu county, Kenya?

    iii. What are the practice factors of clinical waste management associated with healthcare acquired infections among health care workers in Kisumu county, Kenya?

1.6 Study Significance

The research findings will help the hospitals in better performance on clinical waste management. The result findings will assist the hospitals in Kisumu county to identify the gaps on clinical waste management factors among HCWs in order to shun injuries and prevent spread of healthcare acquired infections to the healthcare workers. The county policy makers will also benefit from this study in terms of making informed decision on matters pertaining clinical waste management in Kisumu County.

1.7 Study Limitation

Some respondents felt uncomfortable to give some information to the researcher due to fear of being exposed. Clinical waste is found in all hospitals but this study will only focus in government hospitals in Kisumu central sub county. Study delimitation: The challenge of confidentiality was overcome by assuring the respondents that their identities would remain confidential since the intention of the study was only for academic purposes. The results of the study cannot be generalized to private hospitals in Kisumu central sub county.

1.8 Conceptual Framework

An independent variable determines and influences the effect of a dependent variable. CWM knowledge factors, CWM facility factors, and CWM practice factors are among the HCWs.

INDEPENDENTINTERVENINGDEPENDENT

KNOWLEDGE FACTORS
- Training programme on CWM
- Universal precaution
- PEP

LEGAL FRAMEWORK
- Government rule and regulation on HCWM
- NEMA regulations

FACILITY FACTORS
- Coded bins and liners
- PPE
- Autoclaving machine
- Incinerators
- Burying
- Placenta pit
- Ash pit

HEALTHCARE ACQUIRED INFECTIONS

Hepatitis B
Hepatitis C
Other infections eg
TB
Covid 19

PRACTICE FACTORS
- Waste segregation
- Waste labelling
- Waste storage
- Waste transportation
- Waste treatment

Figure 1.1: Conceptual Framework, SOURCE: Modified by researcher

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents review of literature on clinical waste management factors associated with healthcare acquired infections among healthcare workers.

2.1.1 Knowledge Factors Associated with Healthcare Acquired Infections among Healthcare Workers

Adequate knowledge of healthcare workers on clinical waste management (CWM) has been previously associated with good practice towards CWM (Akkatit *et al.,* 2020). Adequate knowledge on CWM helps to understand the health risk associated with cwm and proper handling clinical waste for safety disposal (Mathur *et al.,* 2011). Developing countries has however reported low knowledge on CWM among healthcare workers (Uddin, 2014). Knowledge on CWM is key to its proper use and is the most important aspect according to Vaughn & Donohoe (2013).A study in Thailand revealed that knowledge for waste categories was high, as respondent categorized waste based on colour coding; for CWs is red, sharp discarded in hard container (Akkajit 2020). A study of Abdullah *et al.,* (2013) found that 79.2%of respondents at hospital in Mosul, Iraq used colour coding properly to classify and identify waste. A study done in Pakistan showed that there was poor awareness of color code system among healthcare workers (Kumar *et al.,*2013). Another study done on healthcare waste management in Ethiopia also found that only 10% of the respondents were aware of the color codes (Muluken *et al.,* 2013). WHO (2011) showed that it is important to segregate clinical waste at the point of generation. Chartier et al further confirmed that segregation at source is recommended since it helps in preventing the spread of infection and prevent injuries. Due to the absence of hospital staff training, understanding of proper waste management remained low (Kumar *et al.,* 2016). Inadequate knowledge on colour coding system was also revealed in a study done in Pakistan among healthcare workers (Kumar et *al.,* 2013). This concurred with study in Ethiopia on clinical waste management practice where only 10% of the respondents had knowledge of color codes system(Muluken*etal.,*2013).

Studies in Africa had previously revealed that more than half of healthcare workers had inadequate knowledge on clinical waste management (Kagonji & Munyele, 2016; Doylo, *et al.,*2019). Unlike the only study from South African that found higher proportion of HCWs with adequate knowledge on CWM (Olaif*et al.,*2018).Differences in on-the-job trainings among health professionals in different regions could account for the disparities in knowledge. Furthermore, absence of infection prevention knowledge among health care workers been found to hamper effective reduction of HAIs spread (Sethi *et al.,*2012).An evaluation of CWM in 24 public medical facilities in Nairobi, Kenya, revealed that knowledge of HCWs was inadequate on clinical waste management (Ngari,2011). The studies never explored the impact of Clinical Waste Management knowledge factor among Healthcare workers on Healthcare acquired infections. Hence, this study objective was to assess the relationship between CWM knowledge factor and HAIs among healthcare workers. In order to improve on CWM, the commitment of healthcare professionals to infection prevention is critical in reducing the burden of HAIs.

Table 2.1 Characterization of health-care waste

Waste category	Description and examples
Infectious waste	Waste capable of containing pathogenic agents examples includes populations in testing centers; waste from unitary units; specimens (swabs) and products in touch with patients that were tainted
Pathological waste	Blood and other body fluids: individual tissues or fats, for example, bodily parts
Sharps	Sharp waste, examples includes, needles; collections of medical instruments for surgery; sheets; cutting edges; broken glass
Pharmaceutical waste	Waste containing drug products for example drug products which are lapped or never wanted again; items defiled by or containing drug products (bottles, boxes) pharmaceutical products
Genotoxic waste	Waste containing genotoxic compounds such as waste containing cytostatic drugs (represented in the treatment of malignant disease)
Chemical waste	Synthetic substances contained, for example, waste containing reagents from testing facilities; film engineers; completed or not sufficient disinfectants; solvents
Wastes with high content of heavy metals	High-substance excess Batteries; cracked thermometers; blood pressure tests and disproportionate metals Wastes
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Recycle for material containing hazardous contaminants such as radiation treatment or laboratory liquids; contaminated plates, bags, or retentive paper; pee and excrete from the radionuclide-treated or test patients;

Source: Adopted from WHO, (2015)

2.1.2 Facility Factors Associated with Healthcare Acquired Infections among Healthcare Workers

It is important to separate garbage into several categories with care, in order to decrease quantity of harmful waste. Recognizing waste based on their origin and nature of discarding or decontamination with suitable segregation is valuable. The health facilities should provide specifically designed vessels for all kind of garbage distinguished by color-codes and suitable labeling. In (2014) the WHO suggested that health facilities give plastic bags and robust plastic vessels for contagious trash, such as empty antiseptic pots. These bags and vessels for contagious trash should contain biohazard symbol. A study done by Abahand Ohimain (2011) in Nigeria found that waste facilities are present, in good condition and well labeled. Medical facilities were required to supply plastic bags and durable plastic vessels for contagious trashes, like blank vessels of antiseptics utilized by health facilities, with the biohazard emblem clearly displayed on the bags and containers. Burn and non-burn technologies mostly used to classify healthcare-waste treatment systems, especially for infectious wastes, and each has its own set of benefits, drawbacks, and application criteria (Hossain *et al.,* 2011). Burning is the most widely promoted treatment technology for medical waste. Burning is the gold standard treatment method, albeit its increased used exclusively for the most challenging waste fractions (Blenkharn, 2011).

A study by Mbuvi *et al.,* (2022) in Kamkunji, Kenya found that only 40% of facilities utilize color coding (for infectious waste, they used yellow or red bags). One-third of hospitals lack enough on-site storage containers. All healthcare trash was frequently mixed with ordinary rubbish in open buckets lined with extremely thin plastic bags. The bags were insufficiently and, in many cases, perforated, allowing leakage and spilling. Containers were not labeled, and there was no way to distinguish between garbage generated in kitchens and waste generated in laboratory. The findings of Njue *et al.,* (2015) Kapsatet, Kenya who discovered that health centers had dug trenches. Additionally, the majority of potentially toxic compounds identified in the vicinity of health center burners were emitted during combustion, and the leftover ash included a high concentration of metallic contaminants.

Provision of bin liners and safety boxes is key aspect in segregation of medical wastes. However, according to the findings 14% and 12% of the respondents indicated they were not provided with bin liners and safety boxes respectively. Sapkota *et al*., (2014), WHO stated that infectious waste bags which are colored or labeled in accordance with the policies or regulations should be

provided as it helps the system of segregation of waste at source, into suitable color-coded high-density polythene bags and bins, for the easy identification and segregation of infectious and non-infectious wastes should be used.

2.1.3 Practice Factors Associated with Healthcare Acquired Infections among Healthcare Workers

Nurses (84.8%) had good practice compared to medical officers (67.3%) and other medical employees, according to a research at Ain Al Shams University Hospital (Hakim *et al.,* 2014). Furthermore, a comparable study in Bangalore, India, discovered that nurses' behaviors about clinical waste management were substantially greater than the housekeeping and technical employees (Madhukumar&Ramesh2012).Mathur *et al*., (2012) on clinical waste segregation found out that waste segregation was not safely done and needed urgent attention. Most other medical facilities did not separate waste into multiple waste streams into marked or color-coded containers. In Sub-Saharan African countries like Nigeria, where syringes are still commonly used and 45 percent still recap needles or syringes after use, regardless of kind of personnel, unsafe clinical waste management practices persist. Only 25.6 percent had post-exposure prophylaxis among those who had needle prick injury (Enwere & Diwe, 2014).

Continuous medical education (CME) improves practices on clinical waste management; in Jazan, Saudi Arabia, where 84.8 percent of needle and sharps disposal methods are carried out by contracting with professional businesses (Ismael *et al.,* 2014). Many hospitals have dangerous CWM practices, as evidenced by a study in Nigeria, which found that only one hospital (1.9%) followed a standard operating procedure for waste disposal, while 98.1 percent (53/54) conducted indiscriminate waste disposal. Another investigation found that hospital sanitary personnel were working without any safety equipment or inoculation (Ali *et al.,*2017a). Furthermore, non-segregated trash was illegally recycled, posing a further safety risk; clinical waste management in underdeveloped nations continues to face a number of issues. HCWs are at risk of healthcare acquired infections HAIs due to improper handling of clinical waste (Bokhoree *et al.,* 2014).

Properly managed clinical waste reduce hazardous clinical waste produced by hospitals to about a quarter or less (Alwabr *et al.,* 2016b). HCWs may contract infections, infertility, genital abnormalities, cancer, etc. Because of their hazardous contact to clinical waste (Oli *et al.,* 2016). Clinical waste separation at the source, such as at the ward bedside, in the operating room, in the

laboratory, or other room in the health facility is important (WHO, 2014). Sharps segregation is the most common procedure in Kenya, with the remainder of the trash mixed together (Mazrui, 2010). On a 24-hour basis, removal of containers full to the recommended capacity at the collection sites is encouraged. Waste should not be kept for longer than 48 hours (WHO, 2010).

Government of Kenya on assessment of the situation of waste management in Kenya in 2012 showed that good segregation practice was at only 27%, with most hospital departments mixed their waste. The wanting segregation practices coupled with Poor transport facilities (mainly wheelbarrows) used also encouraged the spillage (in 63% of hospitals visited) of waste and only helped to make the situation potential for injury and infection. A study done by Maluni *et al .,* (2018) on waste segregation Nandi, Kenya showed that more than 20% of the respondents indicated that they placed waste in the wrong bins. This indicates that the practice of waste segregation within the hospitals is not done according to the guidelines. This contravenes the MOH, (2015), which shows that segregation of clinic waste should be done according to infectious or clinical waste (hazardous waste), Non-infectious or general waste, highly infectious waste, and sharps waste. Thus it was important to determine the practices factors associated with healthcare acquired infections among healthcare workers.

Table 2.2: NEMA waste regulation Colour Codes system in Kenya

Type of Waste	Container Colour and Markings	Type of Container.
Sharps	Yellow (Marked „Sharps")	Puncture proof
Infectious	Yellow	Strong leak proof plastic bag with biohazard symbol
Highly Infectious	Red (Marked Highly Infectious)	Containers capable of being autoclaved
Non-Infectious (non-clinical)	Black	Plastic Bag or container.
Chemical and Pharmaceutical	Brown	Plastic bag or Container
Radioactive waste	Yellow with black radioactive symbol	Lead Box

Source: Waste Management Regulations. Legal Notice No. 121(WMR, 2006).

CHAPTER THREE
METHODOLOGY

3.1 Study Area

Kisumu has a population of 1,155,574 people (KNBS,2019). Kisumu county has 7 sub counties hospitals, It is located at a latitude of -0.088836 and a longitude of 34.771900. The research was conducted in Kisumu Central Sub County Public Hospitals. Kenya has a hierarchical public healthcare system with six level. Since there are no national referral hospitals in Kisumu, the county health tier system consists of five levels, with Jaramogi Oginga Odinga teaching and referral hospital being at the top. Kisumu central sub county hospitals has all the levels from 1-5 levels. The facilities include Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH), Kisumu County Hospital(KCH), Migosi Sub County Hospital, Nyalenda Health Center, Police Line Dispensary, Railways Dispensary, and Administration Police Dispensary downwards. Study are map in appendix I

3.2 The Study Design

A descriptive cross sectional study was adopted. Since the study aims at assessing CWM factors associated with healthcare acquired infections among healthcare workers in Kisumu County. The descriptive design was suitable in that it made it easier to obtain information on the characteristics of this particular issue and also the study provided bigger overview by giving the researcher ability to look at the study in many aspects for example both the qualitative and quantitative data were used to find a solution to the problem. Moreover, a single time interval was used and exposure /outcome was determined simultaneously.

3.3 Study Variable

The independent variable in this study were 1 clinical waste management knowledge factors (categories of clinical waste generated, color coding categories, infections associated with CWM, what consist of PPEs, best point for CWs segregation). 2 clinical waste facility factors (availability of colour coded bins, regular supply of liners, enough containers, storage and disposal of waste). 3 Clinical waste practice factors (CWM committee, CMEs, filling of sharp containers ,use of PPEs, discarding used needles, waste segregation, transportation of CW, waste collection). Dependent variable; HealthCare acquired infections (Hepatitis B, Hepatitis C, Hiv & Aids, hemorrhagic fever, Covid 19)

3.4 Target Population

The target population for the study was 2150 (data was retrieved from Kisumu county human resources for health information 2020) of all healthcare workers in Kisumu county.

3.5 Study Population

The study population for the study was 727 (data was retrieved from Kisumu county human resources for health information 2020) all the healthcare workers from seven facilities in Kisumu county.

3.6 Sample Size Determination

Sample size was 278as computed using formula by Fishers *et al.,* (1998)method. It was based on the target population of 727 HCWs.

Fishers *et al.,* (1998) method was used based on the following assumptions:

50% chance of success.

A 5% level of statistical significance.

A 10% non-response rate adjustment upwards.

Formula; Sample size, $n = [Z_{\alpha/2}{}^2 pq] \div d^2$

Where   Z score at 95% Confidence Interval =1.96

p= 50% since no previous studies had been done in the division.

q= 1-p = 0.5

d= desired precision level = 0.05

Then: 'n '= $[1.96^2 0.5 \text{x } 0.5] \div 0.05^2 = 384.16$

But targeted population was below 10,000, so the final sample size (nf) was calculated as follows: nf = n ÷ [1+ (n/N)] nf= correction formula for population less than 10,000, n= calculated sample from Fisher's formula, N= The population size.

Using the above formula sample size was: 727

This gives: nf= 384÷ [1+ (384/727)]

=252 plus 10% adjusted for non-response, 252 + 25.2 = 277.2; therefore, became 278

3.7 Sampling Techniques

The healthcare workers were stratified according to cadres; each cadre were represented by proportionate number of respondents depending on the number of staffs in that cadre. The total number of hospitals were 7; Coding of the hospitals was done to ensure anonymity and confidentiality (1-7). The respondents were selected proportionate to size in order to get a representative sample from all the cadres (medical officers, dentist, laboratory officers, clinical officers, nursing officers, counselors, public health officers, pharmaceutical officers and support staff. The respondents were chosen using a simple random selection procedure whereby a sequential number for each HCWs were assigned 1- 'n' and statistical package for social sciences was used to generate numbers for each cluster then the Healthcare workers who picked the randomized numbers were selected to avoid biasness and provide equal chance for every respondent to be selected in the study. The proportions were given in Table 3.1 below. Seven heads of laboratory departments from the seven hospitals were sampled using purposive sampling method. Though the CWM guideline states that the public health officers are the ones in charge of the CW in the hospitals but this was different since most of the hospitals head for Clinical Waste Management were laboratory officer and that's why I chose laboratory officers for Key Informant Interview (KII) guide since they have the same educational background and are the ones in charge of CW in the hospitals of the Kisumu county.

Table 3.1: Number of Respondents per Department

SN	CADRE	NUMBER OF STAFF	NUMBER OF RESPONDENTS
1	Medical officer	39	14
2	Laboratory officers	33	13
3	Clinical officers	46	17
4	Nursing officers	383	146
5	Counselors	42	16
6	Pharmaceutical officers	33	13
7	Public health officers	5	2
8	Dentists	7	3
9	Nutritionists	5	2
10	Support staff	137	52
	Total	727	278

3.8 Inclusion Criteria

1. All the healthcare workers in Kisumu county were included who come into contact with clinical waste.
2. Healthcare workers who had worked in the hospital for more than 6 months; this was a humble time for one to acquaint him/her with the practice.
3. Health care workers who gave consent.

3.9 Exclusion criteria

1. Healthcare workers who were either absent or on leave.

3.10 Data Collection Tools

This study used questionnaire and key informant interview (KII) guide which was adopted from previous researches (Kannur *et al.,*2014; Asante,2014; WHO, 2004).The questionnaire was divided into four parts including section 1- the socio-demographic characteristics of the study participants; section 2-clinical waste management knowledge factors associated with healthcare acquired infections among healthcare workers; section 3 -availability of clinical waste management facility factors associated with healthcare acquired infections among healthcare workers; and section 4 - clinical waste management practice factors associated with healthcare acquired infections among healthcare workers. Qualitative data was obtained using Key informant interview (KII) guide to the heads of the laboratory department in seven hospitals on issues related to clinical waste management that were not exhaustively covered in the questionnaire. The policy on clinical waste management state that Public health officers are the ones in –charge of clinical waste management but this was not what was at the hospitals since most of the clinical waste heads were laboratory officers.

3.11 Validity of Data Collection Tools

The questionnaire was read through by trained bio safety officer who had adequate knowledge on clinical waste management. Corrections were made based on the professional opinions and views. This ensured that the questions were understood and answered to give the required information for the study.

3.12 Reliability of Data Collection Tools

A pretest was done at Ahero county hospital to 28 HCWs representing 10% of the sample size population. The outcome was analyzed to ensure it reflected the actual state of clinical waste management at the facility. The reliability coefficient was assessed by cronbach's alpha method. Cronbach's alpha coefficient of socio demographic section, knowledge, facility and practice were: 0.97, 0.91, 0.93, and 0.92, respectively. The overall Cronbach;s coefficient of questionnaire was 0.93.As the value was above 0.7,the measurement was deemed as highly reliable.

3.13 Data Collection Procedure

The research assistants, who had at least form four certificate was recruited and taken through a sit-in training session to administer the questionnaire then as part of the practical session, during the introduction to the hospitals, his/her administration of the questionnaire to the first participant was observed to ensure compliance with the study protocol, after obtaining consent from the hospital administration. Data was collected for 2 months between June and July 2020.

3.14 Data Management and analysis

The principal researcher collected completed questionnaires from the research assistants on a daily basis and double-checked them for accuracy and consistency. On the questionnaires, study codes were used to allow respondents to be identified individually. Only principal researcher had access to recoded data, and security codes were assigned to computerized data entries. Statistical Packages for Social Sciences (SPSS version 24) was used to analyze quantitative data. Frequencies and percentages were used to explain the Socio-demographic characteristics of the respondents, Objective i; Fishers exact test was used to determine the distribution of clinical waste management knowledge factors among cadres and logistic regression was used to determine the association between knowledge factors and HAIs.

Objective ii; logistic regression was used to determine the association between CWM facility factors and HAIs among HCWs. Objective iii; Fishers exact test was used to determine the distribution of practice factors among cadres and logistic regression was used to determine the association between CWM practices factors and healthcare acquired infections among HCWs. The level of significance was considered at P <0.005%. Qualitative data from key informant interview was thematically analyzed using NVivo 1software.

3.15 Ethical Considerations

Ethical approval was sought from Maseno University Ethics Review Committee (MUERC). Permission for this research was sought from the School of Graduate Studies (SGS), Kisumu County Health Management Team, and all hospitals in Kisumu central. Written informed consent was obtained from the respondents. Participation in the study was voluntary and they were at liberty to withdraw any point of the study without any penalty. Confidentiality of the information was assured by using study identification numbers instead of names. The participants were assured that the information that they provided was for research purpose only and that their data will be reported in a way that will not identify them.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presented the analyzed data which include socio-demographic characteristics of respondents data, knowledge factors associated with clinical waste management, facility factors associated with clinical waste management and practice factors associated with clinical waste management.

4.2 Socio-demographic characteristics of healthcare workers in Kisumu County

A half 143 (51.4%) of the health care workers were females. Majority 125(45) of the respondents were between 36 – 50 years of age. Almost half 138(49.6%) had diploma, while nearly all 273(98.2%) were Christians. About two-thirds (66.2%) were married. Majority 184 (52.5%) of healthcare workers were nursing officers; moreover, most (60.8%) of the health care workers had 10 years and below experience as shown in Table 4.1.

Table 4.1: Socio-demographic characteristics of health care workers in Kisumu county

	Frequency N=278	Percentage %
Gender		
Male	135	48.6
Female	143	51.4
Age group		
20 – 35	118	42.4
>35 -50	125	45.0
>50	35	12.6
Education level		
Certificate	28	10.1
Diploma	138	49.6
Bachelor's degree	76	27.3
Post graduate	3	1.1
None	33	11.9
Religion		
Christian	273	98.2
Muslim	5	1.8
Marital Status		
Single	58	20.9
Married	184	66.2
Divorced/Separated/Widowed	36	12.9
Cadre		
Medical Officer	14	5.3
Laboratory Officer	13	4.6

Clinical Officer	17	6.1
Nursing Officer	146	52.5
Nutrition Officer	2	.7
Public Health Officer	2	.7
Counselors	16	5.8
Pharmaceutical officer	13	4.6
Support Staff	52	18.6
Dentist	3	1.1
Years of Experience		
10 years and below	169	60.8
Above 10 years	109	39.2

The specific question on whether the healthcare worker had acquired infection in the line of duty in the past 2 years was asked and the response was Yes or No and if Yes the healthcare worker was to specify which one. All the healthcare workers responded. Other infections included tuberculosis, covid 19, Hemorrhagic fever, etc. More than a third (38%) of health care workers had suffered from health care acquired infections before with hepatitis C being the bulk of the infection at 9% (Figure 4.1).
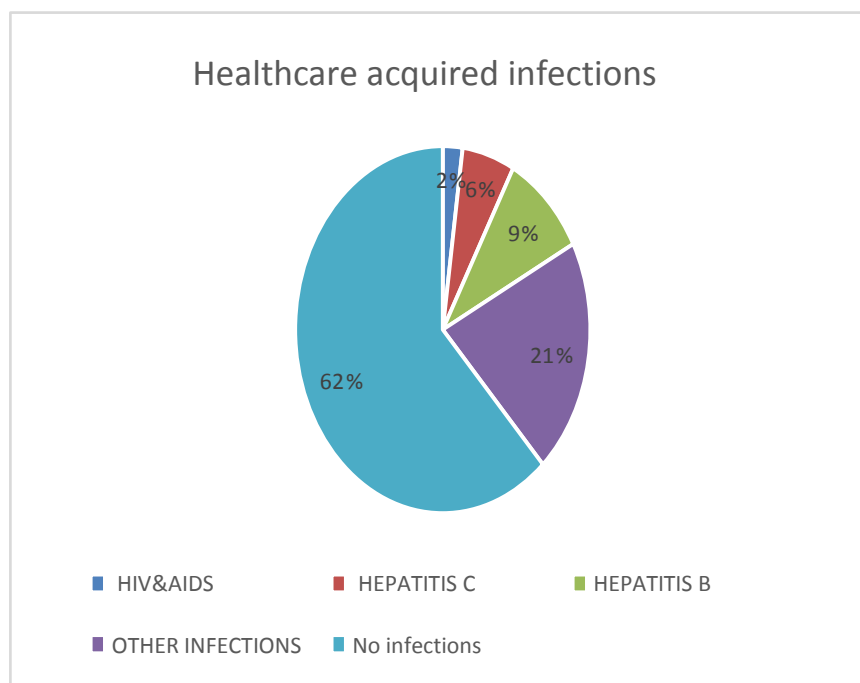
Figure 4.1: Proportion of Healthcare Workers who had previously acquired healthcare acquired infections in the line of duty in the past 2years in Kisumu county

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4.3 Clinical Waste Management Knowledge Factors

Knowledge factors were measured using number of questions in the questionnaire for knowledge section with multiple choice questions. For each correct or incorrect response to a knowledge question, a score of 1 or 0 was assigned. Total score was calculated by summing values ranging from 0-15. Overall knowledge score was divided by the number of study participants to get the average score. The scores below mean was considered inadequate knowledge and above the mean was considered adequate knowledge. The method was borrowed from other literatures who did almost similar study with this (Kumar *et al.,* 2015; Kumar *et al.,* 2016).

4.3.1 Specific questions on assessment of clinical waste management knowledge factors associated with healthcare acquired infections among healthcare workers in Kisumu

In assessing specific knowledge questions, knowledge on categories of clinical waste generated, colour coding for categories of clinical waste generated, infection associated with clinical waste management, and prevention of hospital acquired infection were associated with healthcare acquired infections. Those with inadequate knowledge on categories of clinical waste generated had risk of acquiring infections with the odds [OR = 2.153 (1.287 − 3.603), *p* value =0.003] o than those with adequate knowledge. Those with inadequate knowledge on colour coding for categories of clinical waste generated also had risk of acquiring infections than those with adequate knowledge with odds ratio [OR = 1.900 (1.151 − 3.135), *p* value =0.012] Moreover, infection associated with clinical waste management [OR =

2.120 (1.291 − 3.481), *p* value =0.003], and prevention of hospital acquired infection were more likely to get healthcare acquired infections [OR = 1.951(1.184 − 3.214), *p* value =0.009] as shown in **Table 4.2a:**

Table 4.2a: Specific questions on assessment of clinical waste management knowledge factors associated with healthcare acquired infections among healthcare workers in Kisumu county.

Specific knowledge questions	n (%)	OR (95% C.I.)	*p* value
What are the categories of clinical waste generated?			
Those who mentioned less than 4categories	73 (45.2)	2.153 (1.287 – 3.603)	**0.003**
Those who Mentioned more than 4 categories	33 (27.7)	1	
What is the colour coding for categories of clinical waste generated?			
Those who mentioned less than 4 categories	70 (44.6)	1.900 (1.151 – 3.135)	**0.012**
Those who mentioned more than 4 categories	36 (29.8)	1	
What are the infections associated with clinical waste management?			
Those who could not mention infections	67 (46.5)	2.120 (1.291 – 3.481)	**0.003**
Those who could mention infections	39 (29.1)	1	
What consist of personal protective equipment?			
Those who mentioned less than 3 equipment	78 (41.5)	1.570 (0.922 – 2.674)	0.097
Those who mentioned more than 3equipment	28 (31.1)	1	
What are the uses of personal protective equipment?			
Those who mentioned less than 2 uses	14 (42.4)	1.225 (0.586 – 2.561)	0.589
Those who mentioned more than 2 uses	92 (37.6)	1	
What is the best point for segregation of clinical waste?			
Those who got it wrong	43 (39.4)	1.096(0.668 – 1.798)	0.716
Those who got it right	63 (37.3)	1	
Do you know about clinical waste treatment and disposal?			
No	31 (41.9)	1.240 (0.721 – 2.133)	0.437
Yes	75 (36.8)	1	
Modes of transmission of hospital acquired infection			
Those who mentioned at most 3	62 (42.8)	1.511(0.927 – 2.463)	0.098
Those who mentioned more than 3	44 (33.1)	1	
Ways of prevention of hospital acquired infection			
Those who mentioned less than 2 ways of prevention	50 (48.1)	1.951(1.184 – 3.214)	**0.009**
Those who mentioned more than 2 ways of prevention	56 (32.2)	1	

4.3.2 Knowledge factors associated with healthcare acquired infections among health care workers in Kisumu county

Health care workers with inadequate knowledge on clinical waste management were two times [OR = 2.208 (1.349 - 3.616), p value =0.002] more likely to suffer from healthcare related infections compared to those with adequate knowledge as shown in Table 4.2b.

Table 4.2b: Association between clinical waste management knowledge factors and healthcare acquired infections among healthcare workers in Kisumu county

	HAI			
	Yes n (%)	**No n (%)**	**OR (95% C.I.)**	**p value**
Inadequate Knowledge	62 (48.1)	67(51.9)	2.208 (1.349 - 3.616)	0.002
Adequate Knowledge	44 (29.5)	105(70.5)	1	

4.3.3 Distribution of waste management knowledge factors among Healthcare workers in Kisumu county

Majority of respondents Nutritionists (100%), support staffs (88.5%), and pharmaceutical officers, had inadequate knowledge on clinical waste management as shown in Table 4.2c

Table 4.2c: Distribution of waste management knowledge factor per cadre among Hcws in Kisumu county

Cadre	Waste Management		Fisher exact test value	Fisher exact-p value
	Adequate knowledge	**Inadequate Knowledge**		
Medical officers	11 (78.6%)	3 (21.4.6%)	83.478	0.003
Dentist	2 (66.7%)	1 (33.3%)		
Laboratory Officers	11 (84.6%)	2 (15.4%)		
Clinical officers	8 (47.1%)	9 (52.9.1%)		
Nursing Officers	97(66.4%)	49 (33.6%)		
Nutritionists	0(0.0%)	2 (100.0%)		
Public Health Officers	1(50.0%)	1(50.0%)		
Pharmaceutical officers	4(30.7%)	9(69.3%)		
Counsellors	9 (56.3%)	7(43.7%)		
Support staffs	6 (11.5%)	46 (88.5%)		

4.3.4 Thematic analysis on Knowledge on Clinical Waste management

The key informants interviewed supported the value of creating CWM awareness among HCW (Table 4.2d). They admitted that some of the healthcare workers did not have adequate knowledge on clinical waste management; while some lack the knowledge on handling clinical waste despite sensitization on clinical waste. However, some of the healthcare workers had not been trained.

Table 4.2d: Thematic analysis of Knowledge on Clinical Waste management

Categories	Codes	Condensed meaning units
Transmission of Health care Acquired infections (HAIs)	Sources of HAIs transmission	Diseases transmitted through health-care-waste
	HAIs via contaminated reusable objects	HAIs via other modes of transmission
Prevention of HAIs	Use of PPE	Frequent and proper use PPEs
	Hygiene practice is very important	Frequent and proper hand washing
Awareness stepwise process of proper CWM	Awareness stepwise process of proper CWM	Awareness regarding removal, transport and disposal of waste

The key informants stated that,

"Some health care workers do not know the extent of risk associated with clinical waste management thus they do not want to follow the policy of clinical waste management" KII3.

"Some health care workers do not know the proper ways of clinical waste management thus mixing waste putting others into risk, instead of segregating waste at the source" KII 5.

"Some health care workers lack knowledge on how to handle clinical waste despite the sensitization on clinical waste" KII 1.

"Not all healthcare workers have been trained on clinical waste management thus knowledge level on clinical waste and prevention of HAI varies" KII 7.

4.4 Clinical Waste Management Facility Factors Associated with HAIs

4.4.1: Facility factors associated with healthcare acquired infections among healthcare workers in Kisumu county.

The analysis of specific clinical waste management facility (Table 4.3a).

Table 4.3a: Specific questions on facility factors associated with healthcare acquired infections among healthcare workers in Kisumu county.

CWM facility		n (%)	OR (95% C.I.)	*p* value
Colour coded liners	No	5 (41.7)	1.298 (0.378 – 4.455)	0.679
	Yes	101 (38.0)	1	
Liners regular supply	No	23 (33.8)	0.791(0.438 – 1.427)	0.438
	Yes	83 (39.5)	1	
Separate containers	No	36 (45.0)	1.532(0.898 – 2.615)	0.118
	Yes	70 (35.4)	1	
Containers enough	No	40 (37.7)	1.016 (0.611 – 1.689)	0.952
	Yes	66 (38.4)	1	
Containers suitably located	No	41 (45.1)	1.554 (0.922 – 2.618)	0.098
	Yes	65 (34.8)	1	
Containers labeled	No	52 (38.0)	0.968 (0.588 – 1.595)	0.898
	Yes	54 (38.3)	1	
Containers in good condition	No	20 (37.7)	0.930 (0.489 – 1.771)	0.825
	Yes	86 (38.1)	1	

4.4.2 Clinical Waste Management Facility Factors Associated with HAIs

Table 4.3b shows that availability of clinical waste management facilities had no association with healthcare acquired infections in Kisumu county [OR=1.291 (0.786-2.122), *P* value =0.313. The health facilities are in charge of providing facilities such bags and containers for infectious wastes identified by color-codes and marked with biohazard symbol. This study demonstrated that availability of clinical waste management facilities had no association with healthcare acquired infections in Kisumu central sub county hospitals.

Table 4.3b: Association between clinical waste management facility factors and healthcare acquired infections among healthcare workers in Kisumu county

		Yes (%)	No%	OR (95% C.I.)	*p* value
CWM facility availability	No	44 (41.9)	61(58.1)	1.291(0.786 – 2.122)	0.313
	Yes	62 (35.8)	111(64.2)	1	

4.4.3 Thematic analysis on clinical waste facility factors associated with HAIs

The key informants eluded that even though in some health facilities clinical waste management facilities are there, they may not be adequate to support clinical waste management. Some of

them were in bad state that needed replacement (Table 4.3c). They admitted that some of the HCWs did not have adequate knowledge on CWM; but some lacked the knowledge on handling clinical waste despite sensitization on clinical waste. However, some of the healthcare workers have not been trained.

Table 4.3c. Thematic analysis on Availability of Clinical Waste management facilities

Categories	Codes	Condensed meaning units
Liners	Colour coded liners	Lack of colour coded liners
	Liners regular supply	Lack of regular supply liners
Containers	Separate containers	Separate containers
	Containers enough	Containers enough
	Containers suitably located	Containers not suitably located
	Containers labeled	Lack of labelling containers
	Containers in good condition	Some containers not in good condition
Storage room/dumping site	Clinical waste storage room	Sorry state of storage room
	Dumping site	Lack proper dumping site
Incinerator	Incinerator	Lack incinerator
Prevention	PPEs	Lack of proper PPEs for managing waste

The key informants from health facilities with challenges in clinical waste management facilities had the following to say:

"The sharps box starts getting torn because at times water leaks in that room leading to spillage" KII 6

"Inadequate supply of clinical waste facilities like bin liners and colour coded bins which leads to mixing of clinical waste putting health care workers at risk" KII 3

"Inadequate waste segregation materials i.e., colour coded bin liners and bins" KII 7

"Insufficient or lack of clinical waste facilities like colour coded bins liners which sometimes are out of stock and inadequate supply of colour coded bin" KII 4

"Lack of infection prevention control materials for instance the colour coded bin and bin liners" KII 2

"Lack of proper dumping sites we do not have incinerator and our dumping site is not well built thus exposing both the hospital staffs and community at risk of clinical waste infection" KII 3

"Since in this facility we do not have incinerator, the sharp box waste could sometimes take long due to lack of transport means to facilitate transportation. We take them to Kisumu county hospital for incineration since we do not have incinerator" KII 6

"Lack of proper PPEs when managing waste, sometimes gloves, gum boots gowns etc. are not available forcing HCWs to work without the equipment" KII 5

4.5 Clinical waste management Practice factors associated with HAIs

Practice objective was measured using 16 practice questions and for each correct response 1 point was awarded to the participant and 0 point for incorrect respectively. The overall practice score was divided by the number of study participants (278) to get the average score. Bad and good practice were awarded practice scores below and above the mean, respectively (Karmakar, S *et al.,*2016).

4.5.1 Specific questions on determining clinical waste management practices factors associated with healthcare acquired infections among healthcare workers in Kisumu County

Bad practices such as presence of clinical waste management committee in a facility [OR = 0.639 (0.389 – 0.948),*p* value =0.036]; handling and caring for patient using PPE [OR = 0.486 (0.287 – 0.823), *p* value =0.007]; always using PPE when handling clinical waste [OR = 0.484 (0.282 – 0.831), *p* value =0.008];quick disposal of used needles, sharps and slides [OR = 0.395 (0.197 – 0.791), *p* value =0.004];recapping the used needles before discarding [OR = 0.535 (0.221 – 0.884), *p* value =0.028]; use of trolley to collect and transport CW within the hospital [OR =0.632 (0.376 – 0.897), *p* value =0.043] increase the likelihood of health care workers suffering from healthcare acquired infections as shown in Table 4.4a.

Table 4.4a: Specific questions on determining clinical waste management practices factors associated with healthcare acquired infections among healthcare workers in Kisumu county

Practices		n (%)	OR (95% C.I.)	*p* value
Is there clinical waste management committee in this facility?	Yes	39 (32.2)	1	**0.036**
	No	67 (42.7)	1.565(1.055-2.571)	
How often do you conduct CMEs on clinical waste management?	Always	5 (41.7)	1	0.931
	Not always	101 (38.0)	0.948(0.280-3.206)	
How is sharp container filled?	¾ fill	40 (30.8)	1	0.128
	>/< ¾ fill	66 (44.6)	1.504(0.889-2.545)	
What do you use when handling and caring for patient	PPE	27 (16.6)	1	**0.007**
	None PPE	47 (40.2)	2.058(1.215-3.484)	
How frequent do you use personal protective equipment when handling clinical waste?	Always	28 (16.9)	1	**0.008**
	Not always	49(43.2)	2.066(1.203-3.546)	
After how long does the used needle, sharps and slides discarded?	< 1 minute	12 (22.2)	1	**0.004**
	>1 minute	94(42.0)	2.532(1.246-5.076)	
How do you discard used needles?	After recapping	32 (22.7)	1	**0.028**
	Without recapping	74 (41.1)	1.869(1.131-4.525)	
Do you dispose waste in a specified colour coded container?	Always	40 (33.6)	1	0.377
	Not always	66 (41.5)	1.269(0.747-2.155)	
How is clinical waste collected and transported within the hospital?	Using Trolley	53 (27.3)	1	**0.043**
	None trolley	53 (43.4)	1.582 (1.115-2.660)	
How often is waste collected?	Everyday	69 (35.6)	1	0.376
	After a day or more	37 (44.0)	1.285 (0.737-2.237)	

4.5.2 To determine clinical waste management practice factors associated with healthcare acquired infections among health care workers in Kisumu County

Bad clinical waste management practice exposed health care workers to healthcare acquired infection. Bad practice increases the likelihood of healthcare worker getting healthcare acquired infection [OR = 1.948 (1.135 – 3.460), *p* value = 0.006)] (Table 4.4b).

Table 4.4b: Association between clinical waste management practices factors and healthcare acquired infections among healthcare workers in Kisumu County

	Yes (%)	No (%)	OR (95% C.I.)	*p* value
Good practice	23 (27.4)	61(72.6)	1	0.006
Bad practice	83 (42.8)	111(57.2)	1.984(1.135-3.460)	

4.5.2 Distribution of clinical waste management practices factors among the cadre

Majority of Laboratory technicians and technologies (53.8%), counsellor (58.8%) and Support staff (35.3%) had inadequate practices on waste management as shown in Table 4.4c

Table 4.4c: Distribution of clinical waste management practices factors by cadre

Cadre	Clinical Waste Management			
	Bad practice	Good practice	Fisher exact test value	Fisher exact-*p* Value
MOs	5 (35.47%)	9(70.6%)	12.723	0.034
Lab Officer	7 (53.8%)	6 (46.2%)		
Clinical Officer	4 (23.5%)	13 (76.5%)		
Dental Officer	1(33.3%)	2(66.7%)		
Nursing Officer	35 (24.0%)	111 (76.0%)		
Nutrition Officer	1 (50%)	1 (50%)		
Public health Officer	1 (50%)	1 (50%)		
Pharmaceutical Officer	3 (23.1%)	10 (76.9%)		
Counsellor	10 (62.5%)	7 (37.5%)		
Support staff	19 (36.5%)	33 (63.5%)		

4.5.3 Facility practices regarding Clinical Waste Management

Participants agreed that providing CME on CWM, waste separation and well-labeled waste containers, waste storage room management, and the availability of an incinerator would help health facilities improve their CWM practices. They deliberated on various issues related to the training of HCW on CWM, littering of waste in the compound, poor CWM practices, and vaccination against hepatitis HAI as shown in Table 4.4d.

Table 4.4d: Theme C: Facility practices regarding Clinical Waste Management

Categories	Codes	Condensed meaning units
Health facilitie practices related to CWM	CME on CWM	Periodic training of HCW on CWM
	Waste-segregation and color coding	Filling limit of waste bins and bags
	Disposal of used (contaminated) instruments	Littering and scattering of waste
	Accumulation of waste	Delay in removal and transport
	Clean looking waste thrown behind hospital building	Open burning of waste in hospital Backyard
	Waste storage room	Management of waste storage room
	Incinerator	Waste disposal at small places
Practices related to protection from occupational hazards	Protection from accidental pricks and cuts	Demand for Personal Protective Equipment (PPE)
	Vaccination	Vaccination against hepatitis B

4.5.4 Health Facility practices related to CWM

4.5.4.1 Training on CWM

The key informants believe that sensitizing health workers on discarding clinical waste would help health workers make sound judgment with regard to CWM, they claim the CWM training is usually as CME by qualified staffs and each department in the health facility organizes for their CME on CWM based on their schedule time.

"First by doing sensitization to all health care workers we try to ensure that all healthcare workers are at least sensitize and can make sound judgment when discarding the clinical waste" KII 1.

"CWM training is usually done as a CME by the qualified staffs who are professionals. The persons responsible for providing CME are our clinical waste management team for this hospital me included" KII 6

Every department organizes for their CME depending on their availability as per their CME schedule" KII 4

4.5.4.2 Disposal of used (contaminated) instruments and accumulation of waste

Most of the key informants claimed to have adequate facilities for clinical waste management in their facilities; however, at times when collection of the waste is delayed, because some rely on collection from sub county offices, you may find wastes littered on the compound behind the health facility. Otherwise, they usually try to keep the waste in a well secured lockable storage rooms managed and accessed by only authorized people, where they wait for transportation.

"*We keep them in a locked room in sub county offices while some wastes that can be burn are burnt*" KII 6

"*We keep them in a locked room as we wait for the collection from the sub county offices and take them to the storage room where they will be sorted*" KII 7

"*It's only support staffs and clinical waste management committee accessing the room. It is under key and lock*" KII 4

"*Our clinical waste storage is well secured from both people and scavengers since it is always under key and lock*" KII 3

"*We have the storage room where they are kept as they wait for transportation, but in case it is not collected it will always be collected the following day and taken to various site of disposal and treatment*" KII 6

4.5.4 Practices related to protection from occupational hazards

The key informants claimed that they try to order adequate PPE for health care workers, as this is believed to be the best way to protect health care workers from occupational hazard. However, at times inadequacy of funds limit their availability.

Even though some facilities have succeeded in vaccinating their health care worker against hepatitis B, some are still to do that, especially when HCWs have to meet the expense.

We try to ensure the there are enough PPE for all our staff; however, at times we are overwhelmed, especially when we are operating on constrained budget. But we always try our best to ensure that at no time we'll lack PPE" KII 4.

"Lack of proper PPEs when managing waste, sometimes gloves, gum boots gowns etc are not available forcing HCWs to work without the equipment" KII 5

"At least 2 healthcare workers have completed the hepatitis B vaccine dosage" KII 2.

"For us to get the vaccine we have to buy it ourselves so we are still planning as a facility in order to buy the 10-dosage hepatitis B vaccine and we cost share" KII 4.

"The only problem some health care workers do not complete the vaccine course; which should be 3 doses. Some leave it at 1st dose others leave it at the 2nd dose injection the rest no yet is when they are looking for money to buy the vaccine" KII 1

"The true picture of the number of health care workers who have received vaccination in this facility is not known" KII 7

4.5.4.4 Implementation of CWM

Most (5) of the health facilities had CWM committee, which consist of representatives from all the department. Moreover, they have specific personnel dealing with management of waste. However, at times the committee members are overwhelmed with workload that they fail to sensitize members on clinical waste management as expected. Most of these health facilities have protocol tool to follow in case of an accidental exposure.

"All the departments in this hospital have a representative to help in implementation of good clinical waste management" KII 5.

"High work load making it at times overwhelming even to sensitize other people on clinical waste management" KII 7.

"We have the personnel who only deal with waste at the disposal and treatment site KII 1

"For instance, the noninfectious wastes are normally burnt then the sharp box are taken to KCH for incineration" KII 3

"In every department there is a protocol tool to follow in case one suffers needle stick injury this act as a guide on what to do in such incidences" KII 4

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CHAPTER FIVE

DISCUSSION

5.1 Clinical waste management knowledge factors associated with healthcare acquired infections among health care workers in Kisumu county

Adequate knowledge of healthcare workers on clinical waste management (CWM) has been previously associated with good practice towards CWM (Akkatit *et al.,* 2020). However, this study found that majority of health care workers had inadequate CWM knowledge, especially support staff, counsellor, nutritionist, and pharmaceutical officers. More so, earlier studies have shown knowledge inadequacy in colour coding in Pakistan (Kumar *et al.,* 2013), Ethiopia (Muluken*etal.,*2013), and Iraq (Abdullah & Al-mukhtar, 2013). Studies in Africa had previously revealed that more than half of healthcare workers had inadequate knowledge on clinical waste management (Kagonji& Manyele, 2016 ; Doylo, et al.,2019). Unlike the only study from South African that found higher proportion of HCWs with adequate knowledge on CWM (Olaif *et al.,*2018).

Differences in on-the-job trainings among health professionals in different regions could account for the disparities in knowledge. Furthermore, absence of infection prevention knowledge among health care workers been found to hamper effective reduction of HAIs spread (Sethi *et al.,*2012). Moreover, this study demonstrates that CWM knowledge inadequacy increase the likelihood of suffering from HAI by 2 compared to those with adequate knowledge. More so inadequate knowledge on categories of clinical waste generated, colour coding for categories of clinical waste generated, and prevention of hospital acquired infection were more likely to get healthcare acquired infections. Thus, there is need to enhance CWM knowledge among healthcare workers in order to reduce the risk of HAIs. It has also been revealed that the absence of hospital staff training, understanding of proper waste management remained low (Kumar *et al.,* 2016) and affects prevention of HAIs. Therefore, in order to improve on CWM, the commitment of healthcare professionals to infection prevention is critical in reducing the burden of HAIs.

5.2 Facility Factors Associated with Healthcare Acquired Infections among Healthcare Workers

According to a study conducted in Kamkunji,Kenya by Mbuvi *et al.,* (2022), only 40% of facilities use colour coding (for infectious waste, they used yellow or red bags). A third of hospitals did not have enough on-site storage containers. All clinical waste was frequently mixed

with regular garbage in open buckets lined with extremely thin plastic bags. The bags were insufficient and, in many cases, easily perforated, allowing for leakage and spillage. There were no labelled containers, and there was no way to differentiate between garbage generated in kitchens and waste generated in laboratories. Interestingly, this study displayed no association clinical waste management facilities with healthcare acquired infections in Kisumu county . Moreover, provision of bin liners and safety boxes is key aspect in segregation of clinical wastes and 14% and 12% of the respondents indicated they were not provided with bin liners and safety boxes respectively. Sapkota *et al*., (2014), stated that infectious waste bags which are colored or labeled in accordance with the policies or regulations should be provided as it helps the system of segregation of waste at source, into suitable color-coded high-density polythene bags and bins, for the easy identification and segregation of infectious and non-infectious wastes should be used.

The hospitals are in charge of providing facilities such bags and containers for infectious wastes identified by color-codes and marked with biohazard symbol. This study demonstrated that availability of clinical waste management facilities had no association with healthcare acquired infections in Kisumu county hospitals. This analysis of specific clinical waste management facility further confirmed this.

5.3 Clinical waste management practice factors associated with healthcare acquired infections among health care workers in Kisumu central sub county hospitals

Bad practice increases the likelihood of a healthcare workers becoming ill by half. Furthermore, findings in this study showed non usage of personal protective equipment (PPE) when handling client ,frequency of using PPE increases the likelihood of acquiring infection this is comparable to a study hospital sanitation personnel were working without any safety equipment (Ali et al 2017a)

Unsafe clinical waste management practices persist in Sub-Saharan African countries such as Nigeria, where syringes are still commonly used and 45 percent still recap needles or syringes after use, regardless of personnel type (Enwere and Diwe, 2014) this is comparable to findings of this study where recapping needle after use among healthcare workers was significant putting healthcare workers at risk of acquiring infections. This is confirmed by a study done in mauritus where Healthcare workers were vulnerable to healthcare acquired infections as a result of improper clinical waste disposal (Bokhoree et al., 2014). Moreover, this study found that

practices such as absence of clinical waste management committee in a facility, non usage of PPE when handling and caring for patient , not always using PPE when handling clinical waste, delay in disposal of used needles, sharps and slides, recapping the used needles before discarding, not using trolley to collect and transport CW within the hospital increases the likelihood of healthcare workers suffering from healthcare acquired infections. Properly managed clinical waste reduces hazardous clinical waste produced by hospitals to about a quarter or less (Alwabr *et al.,* 2016b). Healthcare workers may contract infections, infertility, genital abnormalities, cancer, etc. Because of their hazardous contact to clinical waste (Oli et *al.,* 2016).

For example, Government of Kenya on assessment of the situation of waste management in Kenya in 2012 showed that good segregation practice was at only 27%, with most hospital departments mixed their waste. The wanting segregation practices coupled with Poor transport facilities (mainly wheelbarrows) used also encouraged the spillage (in 63% of hospitals visited) of waste and only helped to make the situation potential for injury and infection. This study also found an association to HAIs for those who did not use trolley as a form of transport for clinical waste .Therefore, Continuous medical education (CME) improves practices on clinical waste management; in Jazan, Saudi Arabia, where 84.8 percent of needle and sharps disposal methods are carried out by contracting with professional businesses (Ismael *et al.,* 2014).

The study found that sharps were either filled up to ¾ or >/< ¾ this is comparable to a study in kenya where sharps segregation is the most common procedure in Kenya, with the remainder of the trash mixed together (Mazrui, 2010). The mixture of waste together could be due to lack of sensitization on clinical waste or poor attitude towards clinical waste management practice.

CHAPTER SIX
CONCLUSION AND RECOMMENDATION

6.1 Conclusion

1. Knowledge is key to appropriate clinical waste management , resulting into reduced risk of healthcare acquired infections . Knowledge factors on categories of clinical waste generated, colour coding categories of clinical waste generated, infections associated with clinical waste management and categories on clinical waste generated were found to be significant in this study. Majority of respondents Nutritionists (100%), support staffs (88.5%), and pharmaceutical officers, had inadequate knowledge on clinical waste management whichincreased risk of suffering from HAIs compared to those with adequate knowledge. The HCWs with inadequate knowledge on clinical waste management were most likely to acquire HAIs.

2. Facility factors like colour coded bin liners , regular supply of bin liners ,separate containers for different type of waste , labelling ,and containers being in good condition was found to be adequate and was not associated with healthcare acquired infection among healthcare workers. However, it was found that in some hospitals, clinical waste management facilities like colour coded bins, bin liners and containers were not adequate to support clinical waste management and some were in bad state that needed replacement. Moreover, key informant admitted that inadequacy of funds limited the availability of facilities.

3.Bad practice in this study increases the likelihood of healthcare worker getting healthcare acquired infection . Bad practices like non usage of gloves when handling waste /clients ,taking more than 1 minute to discard needle, recapping were found to be increasing the likelihood of acquiring healthcare acquired infections by half. Majority of Laboratory technicians and technologies, counsellor and Support staff had inadequate practices on waste management.

6.2 Recommendations

1 Frequent training on clinical waste management factors and associated healthcare acquired infections among healthcare workers should be done especially to the nutritionists, support staffs and pharmaceutical officers; Enhancing training on CWM will improve the knowledge of HCWs on CWM.

2 Clinical waste facilities coded bins ,bin liners should not be missing at the hospitals In order to minimize risk on exposure to clinical waste.

3   There is need for support supervision to those handling waste to avoid recapping ,enhancing clinical   waste management committee to help in improving the practice of clinical waste management practice in order to reduce healthcare acquired infections .

6.3 Suggestion for future research

1. The study suggest for further studies on clinical waste management associated with healthcare acquired infections among patients.
2. The study suggest further studies on clinical waste management legal framework in hospitals

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APPENDICES
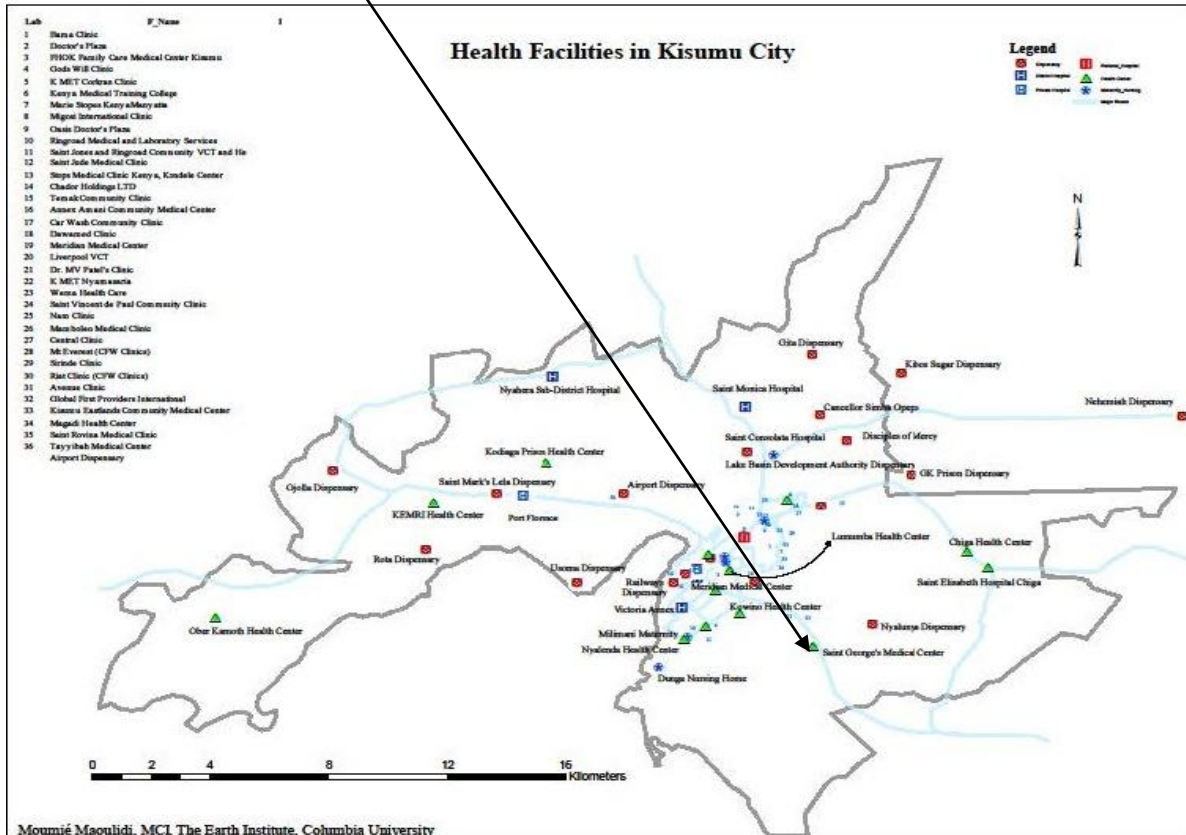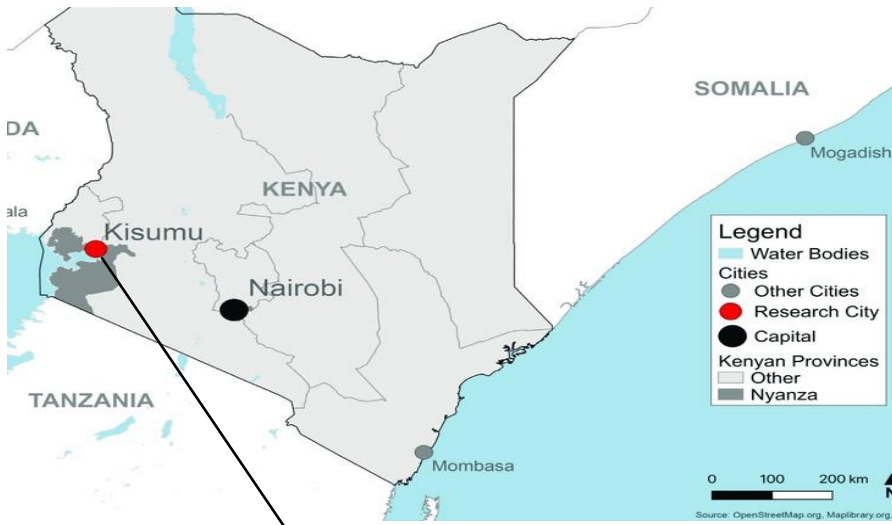
APPENDIXI :Study Area

Figure 3.1 Map of the study Area, SOURCE; Survey of Kenya GIS 2013

Appendix II: Informed Consent Form for the Respondents

The Researcher's name is Violet A. Otieno, currently carrying out this study: - Assessment of clinical waste management factors associated with healthcare related infections among health care workers in Kisumu central sub county hospitals. The aim of this study is to establish the clinical waste management practices in place and identify areas improve in its management. You have been identified to participate in this study; therefore, your consent is needed. You will spare 20 minutes of your time to respond to questions in the questionnaire. The study is a low risk one and there are no anticipated risks. Although there are no direct benefits to the study participants, the information, which they provided, shall be useful in informing the strategies to reduce healthcare-associated infection in the working environment.

I wish to assure you that the data being collected in this study will be used for the intended purpose only.

In case of any questions, do not hesitate to contact Violet A. Otieno (Principal Investigator) through +254712824364

Identification

     Respondents' code_____

     Name of health facility_____

     Signature: _____

     Date: _____

     Type of health facility

- i.   Dispensary
- ii.   Health Centre
- iii.   Sub county
- iv.   County hospital
- v.   Referral hospital

Appendix III: Questionnaire

SECTION 1: Demographics

1. Participant Gender? a) Male ( ) b) Female (   )

2. Age of participant in years?

3. What is the highest level of Education attained?

a) Certificate level (   )b)Diploma level   (   ) c) Bachelor's degree (   ) d) Post-graduate (   )

e) None of the above (   )

4. Which Religion do you belong to?

a) Christian ( )b)Muslim (   )c) Others specify……………..

5. What is your marital status?

a) Single/Never Married ( )b)Married/Living as Married ( )c) Divorced /Widowed/Separated ( )

6. What is your cadre? Tick where appropriate.

A	Medical officer	
B	Laboratory officer	
C	Clinical officer	
D	Nursing officer	
E	Nutritionist	
F	Public health Officer	
G	Counselor	
H	Pharmaceutical Officer	
I	Support staff	

7. Length of duration worked in years?

SECTION 2: Knowledge On Clinical Waste Management

1. What are the categories of clinical waste generated?

a) Sharps () b) Infectious ( )   c) Highly infectious ( )   d) Noninfectious (   ) e) Chemical and

pharmaceutical ( ) f) Radioactive waste ( )

2. What is the colour coding for categories of clinical waste generated?

Waste	Colour coding	Yes	No
Sharps	Yellow or white marked sharps, puncture proof.		
Infectious	Yellow		
Highly infectious	Red		
Non infectious	Black		
Chemical and pharmaceutical	Brown		
Radioactive waste	Yellow with radioactive symbol		

3. What are the infections associated with clinical waste management?

a) HIV( ) b) Hepatitis B ( ) c) Hepatitis C ( ) d) TB ( ) e) Cuts/pricks (   ) f) Cancers ( )

g) Malaria ( ) h) others (specify)……………………………………………………..

4. Do you know about personal protective equipment? a) Yes ( )   b) No( )

5. What consist of personal protective equipment? a) Gloves ( )b) Mask ( )c) Goggles ( )d)

Gown (   )e) Rubber boots ( )f) Heavy duty gloves ( )

6. What are the personal protective equipment used for? a) When handling a patient ()

b) During a procedure ( ) c) When handling waste (   )   d) Not sure ( )

7. What is the best point for segregation of clinical waste? a) Generation point ( ) b) During

    transportation ( )   c)Disposal point (   )d) Treatment point (   ) e) In all stages ( )

8. Do you know about clinical waste treatment and disposal? a) Yes ( )   b) No (   )

9. If yes which ones? a) Autoclave(   )   b)Incinerator (   )   c)Burning (   )   d) Land fill   (   )

    e)Chemical disinfection   (   )

10. According to clinical waste management (management and handling) rules, waste should not

    be stored beyond)12 hours ( )   b)24 hours ( )   c)48 hours ( )   d)72hours ( )

11. What is the mode of transmission of hospital acquired infection? a)Airborne (   ) b)Contact

    with blood and body fluid ( )c)Needle prick ( ) d)Contaminated instruments ( )

    e) Contaminated hands ( ) f) Not sure ( )

12. What are the ways of prevention of hospital acquired infection a)Hand hygiene ( ) b) PPE (   )

    c)Proper disposal of waste (   ) d)Processing of instruments (   ) e)Isolation (   )

13. What are the levels of clinical waste management?

    a)   Generation ( ) b)Segregation (   ) c) Transportation (   ) d) Storage (   ) e) Treatment ( )

14. Have you ever been trained on clinical waste management? a) Yes ( ) b) No ( )

15. The approximate proportion of infectious waste among total waste generated from a health care

    facility is? a)10-20% ( )b) 30-40% ( )c)50-60% (   )   d)80-90% ( )

SECTION 3: Clinical Waste Facilities.

16. In your department do you have matching colour coded liners? a) Yes(   )b) No (   )

17. Do you have regular supply of liners and safety boxes for management of waste? a) Yes ()b)

    No (   )

18. Are there separate containers for different types of wastes? a) Yes(   )   b) No (   )

19. Are the waste collection containers enough? a) Yes(   ) b) No (   )

20. Are the waste collection containers suitably located? a) Yes() b) No (   )

21. Are the containers above labeled appropriately? a) Yes ( ) b) No (   )

22. Are the waste collection containers above in good condition? a) Yes(   ) b) No ( )

SCETION 4: Practices On Clinical Waste Management

23. Is there clinical waste management committee in this facility? a) Yes ( ) b) No ( )

24. How often do you conduct CMEs on clinical waste management? a) Always (   ) b)
Sometimes (   ) c) Never (   ) d) Not sure

25. What do you use when handling clinical waste and while caring for patient?

a) Bare hands (   )   b) Universal precaution (   )   c) Personal protective equipment ( ) 26.
How are sharp container filled? a) Fully filled ( )   b) To the fill –line3/4 ( ) c) Half way ( )

27. How frequent do you use personal protective equipment when handling clinical waste?

a)   Always( ) b)Sometimes (   ) c) Never ( ) d) Not sure ( )

28. After how long does the used needle, sharps and slides discarded?

a) Less than 1minute ( )   b) More than 1 minute (   )

29. Used needles should be   discarded? a) After recapping ( )   b) Without recapping ( )

30. Do you dispose waste in a specified colour coded container?

a)   Always( )   b) Sometimes (   ) c)Never( )   d) Not sure ( )

31. What should `be done to expired chemicals and pharmaceutical drugs?

a)   Burn( )   b)Return to pharmacist ( )   c)Discard ( )

32. How is clinical waste collected and transported within the hospital?

a)   Using trolley( ) b) Using bare hands ( ) c) Using wheelbarrow ( ) d) Using cart ( )

    33. How often is waste collected? a) Once a week () b) Twice a week ( ) c) Everyday (
) d) Every second day ( )

35. Is there a incinerator at your facility a) Yes ( ) b) No ( )

If no what do you do with your clinical waste…………………

36.Have you ever suffered from any healthcare acquired infection in the line of duty in the past 2
years? a) Yes b) No

If yes which one (specify)………………………………….

37.Have you completed vaccination course for Hepatitis B? a) Yes ( )   b) No ( ) 37. Have
you ever suffered needle stick injury in the line of duty? a) Yes ( )   b) No ( )

If yes how did the incident happen? Continue with below question.

a)Poor disposal of needle(   ) b)Individual carelessness/accidents (   )

c) Cannot remember (   )   d) others specify………………………..

Did you take post exposure prophylaxis after prick? a) Yes(   )   b)No (   ) c)N/A (   ) Did you fill the incident book? a) Yes ( )   b) No (   )   c) N/A ( )

Appendix IV: Interview Guide: Head of Laboratory

1. Are you aware of the requirements outlined in the Waste Management Regulations (Legal Notice No.121) on clinical waste management?

2. Are healthcare workers trained on clinical waste management?

3. How many injuries related to clinical waste have been reported by healthcare workers and waste handlers in the past 12 months?

4. The Clinical Waste Management Code of Practice requires that all healthcare workers and operatives should be offered hepatitis B vaccination. How many health workers in your institution received the vaccination?

5. If clinical waste is not collected as per schedule what do you do with it?

6. Is clinical waste storage accessible to any person or scavenger?

7. How is the disposl of used (contaminated) instrument and accumulated waste done?

8. Who is responsible for providing a continuous clinical waste training for healthcare workers?

9. How do you manage risks associated with clinical waste?

10. What are the problems that you encounter in managing clinical waste?

11. What are the ways that helps in implementation of clinical waste management?

Appendix V: Ethical Approval

MASENO UNIVERSITY ETHICS REVIEW COMMITTEE

Tel: +254 057 351 622   Ext: 3050   Private Bag – 40105, Maseno, Kenya
Fax: +254 057 351 221   Email: muerc-secretariate@maseno.ac.ke

FROM: Secretary - MUERC   DATE: 4th May, 2020

TO: Violet Akinyi Otieno   REF: MSU/DRPI/MUERC/00819/19
        PG/MPH/PH/00079/2013
        Department of Public Health
        School of Public Health and Community Development
        Maseno University
        P. O. Box, Private Bag, Maseno, Kenya

RE: Assessment of Clinical Waste Management Associated with Health Care Workers in Kisumu Central Sub county Hospital. Proposal Reference Number MSU/DRPI/MUERC/819/19

This is to inform you that the Maseno University Ethics Review Committee (MUERC) determined that the ethics issues raised at the initial review were adequately addressed in the revised proposal. Consequently, the study is granted approval for implementation effective this 4th day of May, 2020 for a period of one (1) year. This is subject to getting approvals from NACOSTI and other relevant authorities.

Please note that authorization to conduct this study will automatically expire on 3rd May, 2021. If you plan to continue with the study beyond this date, please submit an application for continuation approval to the MUERC Secretariat by 15th April, 2021.

Approval for continuation of the study will be subject to successful submission of an annual progress report that is to reach the MUERC Secretariat by 15th April, 2021.

Please note that any unanticipated problems resulting from the conduct of this study must be reported to MUERC. You are required to submit any proposed changes to this study to MUERC for review and approval prior to initiation. Please advice MUERC when the study is completed or discontinued.

Thank you.

Dr. Bonuke Anyona,
Secretary,
Maseno University Ethics Review Committee.

Cc: Chairman,
Maseno University Ethics Review Committee.

MASENO UNIVERSITY IS ISO   9001:2008 CERTIFIED

Appendix VI: NACOSTI Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 161103

Date of Issue: 28/May/2020

RESEARCH LICENSE

This is to Certify that Miss.. violet akinyi otieno of Maseno University, has been licensed to conduct research in Kisumu on the topic: Assessment of Clinical Waste Management Associated with Health Care Workers in Kisumu Central Sub county Hospital. for the period ending : 28/May/2021.

License No: NACOSTI/P/20/5022

161103
Applicant Identification Number

Director General
NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY &
INNOVATION

Verification QR Code

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

Appendix VII: County Government of Kisumu Approval

COUNTY GOVERNMENT OF KISUMU

Telegrams 'PROIMEDI'
Tel 254-057-2020105
Fax 254-057-2025176
E-mail kisumucdh@gmail.com

County Director of Health
Kisumu
P O Box 721-40100
KISUMU

DEPARTMENT OF HEALTH

REF: GN 133 VOL IV/381

Date: 27ᵗʰ May, 2020

The CEO – JOOTRH
Med. Supts. – KCRH,
SCMOH – Kisumu Central

RE: APPROVAL FOR RESEARCH STUDY "ASSESSMENT OF CLINICAL WASTE MANAGEMENT ASSOCIATED WITH HEALTHCARE WORKERS IN KISUMU".

This is to inform you that **Violet A. Otieno** Maseno University student has been authorized to conduct the above study within our health facilities - (JOOTRH, KCRH, Migosi SCH, Nyalenda HC, Railways Dispensary, AP line and Police line Dispensaries)
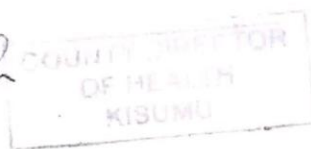
This office has reviewed her proposal to conduct the above study and support its implementation.

We further ask Violet to share her findings with this office in both hard & soft copies after the study

Please accord her the necessary assistance.

Fredrick Oluoch
Director - Public Health
Kisumu County

CC   Violet A. Otieno

From the County Director of Health office

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Appendix VIII: School of Graduate Studies approval

MASENO UNIVERSITY
SCHOOL OF GRADUATE STUDIES

Office of the Dean

Our Ref: MPH/PH/00079/2013

Private Bag, MASENO, KENYA
Tel:(057)351 22/351008/351011
FAX: 254-057-351153/351221
Email: sgs@maseno.ac.ke

Date: 12th November, 2019

TO WHOM IT MAY CONCERN

RE: PROPOSAL APPROVAL FOR VIOLET AKINYI OTIENO — MPH/PH/00079/2013

The above named is registered in the Master of Public Health in the School of Public Health and Community Development, Maseno University. This is to confirm that her research proposal titled "Assessment of Clinical Waste Management Associated with Healthcare Workers in Kisumu Central Sub County Hospitals." has been approved for conduct of research subject to obtaining all other permissions/clearances that may be required beforehand.

Prof. J.O.Agure
DEAN, SCHOOL OF GRADUATE STUDIES

Maseno University   *ISO 9001:2008 Certified*