

**EVALUATION OF COMPLIANCE TO THE NATIONAL HEALTH CARE WASTE
MANAGEMENT GUIDELINES OF 2008 BY HEALTH FACILITIES IN
MACHAKOS SUB COUNTY, KENYA**

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*A Research Dissertation Submitted in Partial Fulfillment for the Award of the
Master of Public Health Degree of the University of Nairobi*

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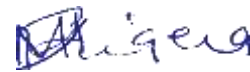
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DEDICATION

This work is dedicated to my family, my husband. Thank you for being there and according me the support that I needed.

God truly bless you all.

ACKNOWLEDGEMENT

First, I give glory to Almighty God for granting me the grace during my study at the University.

Secondly, I express gratitude to my supervisors Ms. Mary Kinoti and Dr. Richard Ayah for dedicating their time and energy to read this work. Their support and comments have resulted into the successful completion of this work. My heartfelt thanks go to my respondents for sparing their time to respond to my questions.

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Finally, yet importantly I wish to thank Jefferson for unparalleled mentorship during my study.

ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
EMCA	Environmental Management coordination Act
HAIs	Hospital-Acquired Infections
Hep. B	Hepatitis B
HCP	Health Care Practitioners
HCW	Health Care Waste
HCWM	Health care Waste Management
HF	Health Facilities
HW	Health Workers
HIV	Human Immune-deficiency Syndrome
ICC	Infection Control Committee
ICRC	International Committee of the Red Cross
IPC	Infection Prevention Control
KEPH	Kenya Essential Package of Health
KHIS	Kenya Health Information System
KNH	Kenyatta National Hospital

MOH	Ministry of Health
M & E	Monitoring and Evaluation
NEMA	National Environmental Management Authority
PATH	Project for Appropriate Technology in Health
PH	Public Health
POPs	Persistent Organic Pollutants
PPE	Personal Protective Equipment
PPS	Probability Proportional to Size
SCPHO	Sub County Public Health Officer
SDG	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences
UK	United Kingdom
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
US	United States
WH	Waste handlers
WHO	World Health Organization

Definition of Terms

Waste refers to any unavoidable by-product regarded as no longer useful after the completion of a production.

Health Care Waste refers to waste generated in the course of health care provision i.e. in diagnosis, treatment of patients, in research and laboratory activities. Includes waste generated in home-based health care provision.

Health Care Waste Management refers to the process involved from generation of waste to its final disposal. It encompasses segregation, collection, transportation, treatment and final disposal. Also involves supervision of operations involving waste management and any other after care of disposal sites.

Waste handlers refer to support staff charged with the duty of handling waste from area of waste generation to final disposal.

Health workers refer to technical staff working in a health facility or providing health care services.

Ideal incinerator refers to a functional apparatus used to burn waste material at high temperature resulting to ashes, the same should have minimal or no environmental pollution.

Training refers to formal knowledge on health care waste management with certification from a recognized authority.

Compliance refers to the process of implementing set guidelines at the health facility level

Levels of Health Care facilities refer to levels set by the Kenya Essential Package for Health (KEPH) depending on the specific activities and population served by the HF.

Level 5 Health facility refers to a regional or county referral hospital covering all level four hospitals in that region.

Level 4 Health facilities refer to a Sub County or Diocese hospital

Level 3 Health facility refers to a Health Centre, Maternity, Nursing home

Level 2 Health facility refers to a health facility, which is at a Sub location, Parish or a Dispensary.

(Kenya Health Sector Strategic & Investment Plan 2018).

ABSTRACT

Health care waste management is undoubtedly an important element in healthcare. Proper health care waste management helps in promoting safety of health workers and waste handlers through the elimination of occupational hazards. Considering that part of the waste produced by health facilities can be hazardous, there is a dire need for all health facilities to comply to the stipulated healthcare waste management policies and guidelines.

Kenya and other countries in Africa lag in implementing these policies and guidelines developed from the guide of World Health Organization (WHO). This implies that although many countries have the right policies and guidelines, weak health care waste management systems, challenges in financing and lack of the leadership's goodwill have slowed down the implementation of the same.

In this cross-sectional study, four health facilities in Machakos Sub County in Machakos County, Kenya were assessed to aid in meeting five main research objectives related to health care waste management: determining health workers' training in HCWM, evaluating health workers' knowledge in HCWM, assessing HCWM practices, investigating occupational health & safety measures in relation to HCWM and assessing financial aspects linked to HCWM.

The health facilities involved in the study were Machakos Level 5, Bishop Kioko Level 4, Mutituni Level 3 and Katumani Level 2.

Questionnaires were administered to medical specialists, medical officers, clinical officers, nurses and laboratory technicians (n=281).

The findings of the study indicated that Machakos County has not invested significantly in proper HCWM as evidenced by the low level of training at a score of 37.1%, fair knowledge at a score of 50.72%, poor HCWM practices score of 25.8%, health workers fair occupational health &

safety score of 65.0% and very poor financial aspect of HCWM score of 0%. The aggregate score on HCWM compliance was poor at 35.7%.

In conclusion, there was poor compliance to the guidelines given in the National Health Care Waste Management Plan of 2008-2012 with surprising low score in financial aspects linked to HCWM noted in all health facilities in this study.

Keywords: Kenya, Machakos County, Health Care Waste (HCW) Management

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Chapter 1: INTRODUCTION

1.1 Background of the Study

Waste generation occurs at all levels ranging from domestic, industrial and in health care facilities. The supplies used in the process of diagnosis, treatment and maintenance in health facilities (HF's) leads to the generation of waste i.e. Health Care Waste (HCW). Inappropriate health care waste management (HCWM) has been a global problem. The Bamako convention of 1991 put a ban on the importation of hazardous waste (part of HCW is hazardous) into Africa an indication that many countries were starting to show concern about improper waste handling as early as in the last century (Ogbonna, 2011).

The Basel Convention of 1992 emphasized waste minimization, control and decrease of transboundary movement of hazardous waste. Such movement was only allowed for countries with no expertise or no infrastructure to safely dispose of such waste. The convention stipulated that hazardous waste should be disposed of in an environmentally sound manner; an effort aimed at maintaining safe practices in HCWM (Nashaat, 2010).

In 1999, the need for proper waste management in developing countries was recognized. This was due to the realization that many of these countries were not giving this subject the attention it deserved hence they lacked national policies or set regulations on HCWM (Akter, & Chowdhury, 1999).

The Stockholm Convention of 2004 with 151 countries (Kenya included) being signatories stipulated that all signatory countries work towards reducing the production of Persistent Organic Pollutants (POPs) to reduce or eliminate dioxins and furans air pollution (Secretariat of the Stockholm Convention 2012).

This shows that it is a global project to reduce or eliminate environmental pollution to safeguard the health of the public universally.

The Kenyan National HCWM plan of 2008-2012 was developed using the WHO guidelines of 1999 on HCWM. This plan was developed for implementation by both private and public health facilities in the country.

Kenya is a developing country in the African continent and is characterized by challenges in HCWM. As a country, there are guidelines already set for use by health facilities on the management of waste generated. The implementation of these guidelines in our health facilities has not been done fully as it should be (Tito J. 2009).

Machakos Sub County found in Kenya has 26 formal health facilities: 1 level 5 hospital, 2 level 4 hospitals, 4 level 3 HF's and 19 level 2 HF's. There was therefore significant HCW generated in all these health facilities which required to be well disposed of (Machakos County Development Plan, 2012).

According to Pruss et al. (1999), health care waste comprises 80% non-infectious and 20% infectious category. Most of the HCW is therefore harmless if handled appropriately; mixing of the waste during generation, collection, transportation or treatment renders the whole bulk infectious. It, therefore, means if HCW is well segregated and handled respectively, there are fewer hazards to the population and environment.

There are recognized hazards that are tagged to inappropriate HCWM attributed to various factors, including lack of knowledge of the risk of HCW by waste generators and handlers, inappropriate practices like waste mixing in transportation or storing making it 100% hazardous, and inadequate use of personal protective equipment (PPE). Inappropriate final

HCW disposal methods also pose harm to people either directly or indirectly through environmental pollution (Tito 2009).

Infectious waste which is part of waste produced in health facilities has pathogens namely, bacteria, viruses, fungi and parasites which get entry into the human body through ingestion, inhalation or absorption through the skin. Once in the body these can cause infection to those exposed (Secretariat of the Stockholm convention 2012).

Chemical and pharmaceutical waste can contaminate waste if present in small quantities or could be in bulk in cases of expired products. Direct contact with skin causes irritation with itching and in severe cases can cause burns or open wounds. Inhalation of fumes from these products can also cause respiratory system irritation. Ingestion can cause abdominal disturbances and if in large doses can lead to poisoning which can be lethal.

Environmental pollution with hazardous waste can lead to detrimental effects on the health of the public and even affect the climate of a region.

All these need to be controlled to maintain a safe environment and a healthy population.

1.2 Study Objectives

1.2.1 General objective:

To evaluate health facilities' compliance to the National health care waste management guidelines of 2008 in Machakos Sub County.

1.2.2 Specific Objectives

1. To determine the proportion of health workers trained on HCWM
2. To evaluate health workers' knowledge on HCWM
3. To assess the current waste handling processes from transportation to final disposal
4. To investigate occupational health & safety measures in place in relation to HCWM
5. To assess financing aspects linked to HCWM

1.3 Study Rationale and Justification

The National HCWM plan derived from WHO guidelines lay down a framework that can be embraced by Kenya to foster appropriate HCWM. There are six main areas addressed by the plan: developing legal and regulatory framework, capacity building to increase awareness on HCWM, standardization of HCWM practices, HCWM financing, operational research on pollution reduction and monitoring/evaluation.

This implies that the plan presents solutions to challenges faced by health facilities at the County level.

Further, it is noteworthy that the HCWM plan lays a foundation for financing approaches that can be embraced by the Counties in line with WHO's core principles. The plan

advocates for specific HCWM allocation of funds. Such funding would ensure that various measurable outcomes are achieved: reducing disease burdens and fostering environmental safety, this is tantamount to economic savings in the healthcare sector.

The plan's proposal regarding the adoption of environmentally friendly technologies in HCW treatment is aimed at scaling down emissions of furans and dioxins by using alternative treatment options replacing incomplete combustion (HCWM Plan, 2008).

Machakos County has a total of 348 facilities, which are public, faith-based, and private offering health care services. An annual average of **4,824,478** patients was seen between 2008 -2012 across Machakos County, more than half a million of these patients were from Machakos Sub County the area of study. This gave an annual estimate of **2,542** tonnes of waste generated across the County the bulk of which was from the Machakos sub-county (KHIS, 2020). Half of this waste could have been hazardous hence requiring proper handling and safe disposal.

Health care waste has the potential to cause environmental pollution and hence adverse health effects affecting the immune, reproductive, nervous, respiratory and gastrointestinal system. This waste should therefore be managed as stipulated in the National guideline plan; regular assessment of the HF's compliance to these guidelines is mandatory as part of monitoring and evaluation of the HCWM process to ensure environmental safety.

There was a need to carry out this study in Machakos Sub County to assess the health workers' and health facilities' compliance with the set National guidelines. The Sub County was ideal since within Machakos County it was the only one with most KEPH levels of health care, which are level 2- level 5 health facilities.

Against this background, this study evaluates Health Facilities' compliance to the Kenya National HCWM Plan of 2008-2012 from transportation to the final disposal.

1.4 Problem Statement

The importance of appropriate healthcare waste management in protecting and preserving the environment and maintaining a healthy public is a top priority of Public Health concern in the whole world over. The reason being the health of the population is greatly affected by the way HCW is managed. Inappropriate healthcare waste management can lead to the transmission of more than 30 dangerous bloodborne pathogens, (Yazie et al., 2019).

In Kenya, the actual burden of hospital-acquired infections has been estimated to account for approximately 10% to 25% of all hospital admissions in public health facilities (Kenya Health Care Waste Management Standard Operating Procedures, 2016).

With the increasing population, technology, and disease burden in Kenya provision of health care services is accompanied by several challenges in HCWM related to health workers safety and environmental concerns (Kenya Health Care Waste Management Standard Operating Procedures, 2016).

There has been a significant increase in waste generated in health facilities attributed to the increasing population, number/level of healthcare facilities and use of disposable medical products (Thakur & Ramesh, 2015).

Within the period under assessment 2008 – 2012, Machakos County generated an annual estimate of **2,542** tonnes of health care waste. Disposal of waste in Machakos County for a long time has been inappropriately done; it is not uncommon to find hazardous waste disposed at open dumpsites mainly dumped at night (Ngina 2012). This increases the health risks to the population mostly drug users who may collect used needles and syringes for reuse. Children scavenge and reuse this waste sometimes as toys (Mutua, 2013).

There is a need to ensure that the operational plan on HCWM is effectively implemented by all health facilities emphasizing safe handling and disposal. The Kenyan Constitution grants every Kenyan the right to a clean and healthy environment, HCWM must be taken as a top priority by the Machakos County Leadership.

There was no study undertaken prior to this study to assess the compliance level of HCWM in Machakos County, Kenya hence the need to carry out this evaluation.

This study sought to evaluate the health care waste management Knowledge and practices to establish the compliance level to HCWM guidelines of 2008 developed for use by health facilities.

Chapter 2: LITERATURE REVIEW

The general principles of Health Care Waste are stipulated to guide all waste generators to ensure a system is set up that caters for HCWM effectively to promote safe environment and a healthy public.

These principles include, “duty of care” which states that every person handling HCW should ethically use the utmost care while performing all duties related to this task, “proximity” principle gives the guide on the two final processes of HCWM ie treatment and disposal should be at the closest site available to minimize risks linked to waste transportation, “precautionary” principle states that health safety when handling HCW is key and in case the potential of a particular risk is not ascertained the assumption that the said risk is significant should be made with the necessary protocols put into place to ensure safety and “polluter pays” principle implies that the generator of waste is entirely responsible for the safe disposal of their waste, (An Orientation Guide for Health Workers in Health Care Waste Management 2015).

2.1 Summary of National guidelines for Health Care Waste Management

According to WHO (2014), there are key steps that need to be put into practice for any health facility to be rated as managing waste appropriately. This was stipulated in the National Health Care Waste Management Plan of 2008 and updated in the National Guidelines for Safe Management of Health Care Waste 2011. These guidelines include; minimization and recycling, segregation, handling & storage, transportation, treatment, final disposal, occupational health, capacity building, budget allocation and monitoring/evaluation.

2.1.1 Minimization and Recycling

According to Pruss et al. (1999), minimization and recycling refer to the strategies that are employed to reduce the volume of HCW generated.

This can be done at source by purchasing and supplying materials which are less wasteful, managing stock well by ensuring no/few expiries, encouraging the use of recyclable products, adhering to strict wastes segregation practices to have less volume of hazardous waste & encouraging more use of oral medication instead of injectables.

2.1.2 Segregation

Segregation involves classifying waste into designated categories of waste and putting it in the right container. In Kenya HF's have adopted the three colour-coded bins and a sharps container.

The sharps' box should be a puncture- and leak-resistant container, segregation should occur at the source of waste ie at departmental or waste generation point and by the waste generator, re-sorting of HCW by non-waste generators should NEVER happen, all waste containers should be labeled by waste category type, (Pruss et al., 1999).

2.1.3 Handling and Storage

It refers to the management of waste awaiting collection. Generally the following safety measures must be applied; all those handling waste must wear appropriate PPE, sharps must never be placed in waste bags (use the sharps' box), waste must be contained in colour-coded/well-labelled plastic bags, all waste liners and sharp container should be replaced when at three-quarter full level, liners should be sealed and clearly labelled, waste

should be stored in a safe dry room not accessible by animals or unauthorized persons & a waste collection schedule should be in place (Nashaat, 2010).

2.1.4 Transportation

Refers to the process of moving collected wastes from temporal store to treatment or final disposal site. The following precautions should be taken into account, waste bins must be kept upright, different categories of waste must be transported separately to avoid waste mixing, sharps' boxes must be kept dry, health workers should be aware of the waste-collection schedule, waste should be placed in collection points for waste handlers, health facilities should have a well-defined route (avoiding heavily used routes or routes leading to food preparation/handling areas) and the same be communicated to waste handlers, for transportation of waste; used vehicles/trolleys should be decontaminated/cleaned & transporting should be done in designated vessels only, (An Orientation Guide for Health Workers in Health Care Waste Management 2015).

If transportation is being done outside the facility site, the necessary documentation should be obtained as per the HCWM regulations (Pruss et al., 1999).

2.1.5 Treatment

According to Emmanuel (2013), all HCW should be treated before final disposal to render them safe by reduction or elimination of the potential to cause harm. Treatment also aims at reducing the HCW volume.

Treatment options include incineration, where waste is burnt at temperatures of 800°C - 1200°C, sterilization by autoclaving or microwaving, chemical disinfection like the use of hypochlorite solution, encapsulation mainly for cytotoxic waste and shredding using

machine grinders to many pieces, hence reducing the volume. Laboratory infectious products must be pre-treated at the point of generation.

2.1.6 Final Disposal

This is the final step where the treated waste or waste product is either disposed into municipal landfills or buried in deep pits. Appropriately sited land fill sites are safe disposal route for health care wastes. The most important thing is to protect the water aquifers. Every day's waste is compacted and covered with soil to maintain sanitary conditions, (National Guidelines for Safe Management of Health Care Waste 201).

Disposal can also be done through burial in waste pits, placenta pits, and ash pits. Precaution measures should be taken to avoid environmental pollution (Blenkharn, 2015).

2.1.7 Occupational Health and Safety

Many injuries occur when handling waste especially if health workers are not well trained.

Any health worker who handles wastes is at potential risk of accidental injury or exposure to blood borne infections such as HIV, Hep. B, Hep. C.

To eliminate or minimize the risk of infection, health facilities must institute good Occupational health and safety measures in addition they should ensure all health workers adhere to the same. Strategies to protect health workers include, implementing standard precautions, immunizing health workers against hepatitis B, Providing PPE, managing exposures in a timely manner and eliminating unnecessary sharps and injections, (Ogbonna, 2011).

Any injury sustained should be reported to the immediate supervisor and documentation of the same done (MoH Kenya, 2012).

The health facility should have displayed Standard Operating Procedures and job aids at strategic places for those handling HCW to refer. Health Workers should always wear closed shoes when handling HCW to ensure that in case of accidental spills or exposed sharp objects their feet are protected (Etzel, 2013).

Everyone in a health facility is responsible for ensuring HCW is properly managed. It is paramount to know and understand everyone's role from administration upto the lowest level of staff handling HCW.

According to the Kenya National guidelines Ministry of Health (2012), all workers handling sharps require vaccination against Hep. B. Health Facilities should have schedules of vaccination, which should be free or highly subsidized to encourage all workers to be vaccinated.

The health facility, the Sub County and the County should have functional IPC committees that meet quarterly and the minutes generated should be well documented (MoH Kenya, 2012).

2.1.8 Capacity Building

The health workers in a health facility assigned the duty of HCWM should be technically qualified. The health facility administration should facilitate training on HCWM targeting the following; management, technical implementors, support staff and health education

promoters. The health department top leadership should customize available training materials to facilitate this process.

The department of Health should have well organized sensitization updates to address any noted knowledge gaps. The facility management should customize/disseminate HCWM guidelines and standard operating procedures to all health workers, waste handlers and the adjacent community, (MoH Kenya, 2012).

2.1.9 Budget Allocation

There should be a clear budgetary allocation with a specific HCWM budget vote line in the health facility annual budget and the health facilities should be able to quantify the cost of HCWM (MoH Kenya 2012).

2.1.10 Monitoring and Evaluation

The process of HCWM needs periodical auditing and quarterly supervision. The relevant M/E tools; audit/supervision checklists and audit/supervision reports should be availed on request at any one time. The health facility should conduct baseline & compliance evaluations on HCWM (MoH Kenya, 2012).

2.2 Kenya Legal and Regulatory Framework

In Kenya, there are laws, policies and regulations that govern HCWM. They stipulate on; licensing of all waste disposal companies, ways of handling and disposing different waste categories as well as legal penalties against those who violate these regulations (MoH, 2012).

The MOH Kenya has made progress in streamlining HCWM in the country with key milestones being developing relevant guiding documents such as Injection safety and Waste management policy 2007, the National HCWM Plan of 2008 – 2012, National Policy on IPC 2015, National Guidelines on IPC 2015, National HCWM Strategic Plan of 2015– 2020, and the National HCWM Plan of 2016 – 2021 (Kenya Health Care Waste Management Standard Operating Procedures, 2016).

Table 1: Kenyan Legal and Regulatory Framework on HCWM

Year formulated	Legal/ Regulatory framework
1986	The Public Health Act, Cap 242 of Laws of Kenya
1999	Environmental Management Coordination Act (EMCA) No. 8
2006	Waste Management Regulation
2001	Kenya National Guidelines on Safe Disposal of Pharmaceutical Waste
2007	The Occupational Safety and Health Act
2007	National Environmental Sanitation and Hygiene Policy
2008	The National Health Care Waste Management Plan of 2008-2012
2015	National HCWM Strategic Plan
2016	National HCWM Plan 2016 – 2021
2016	Health Care Waste Management Standard Operating Procedures 2016

2.3 Conceptual Framework

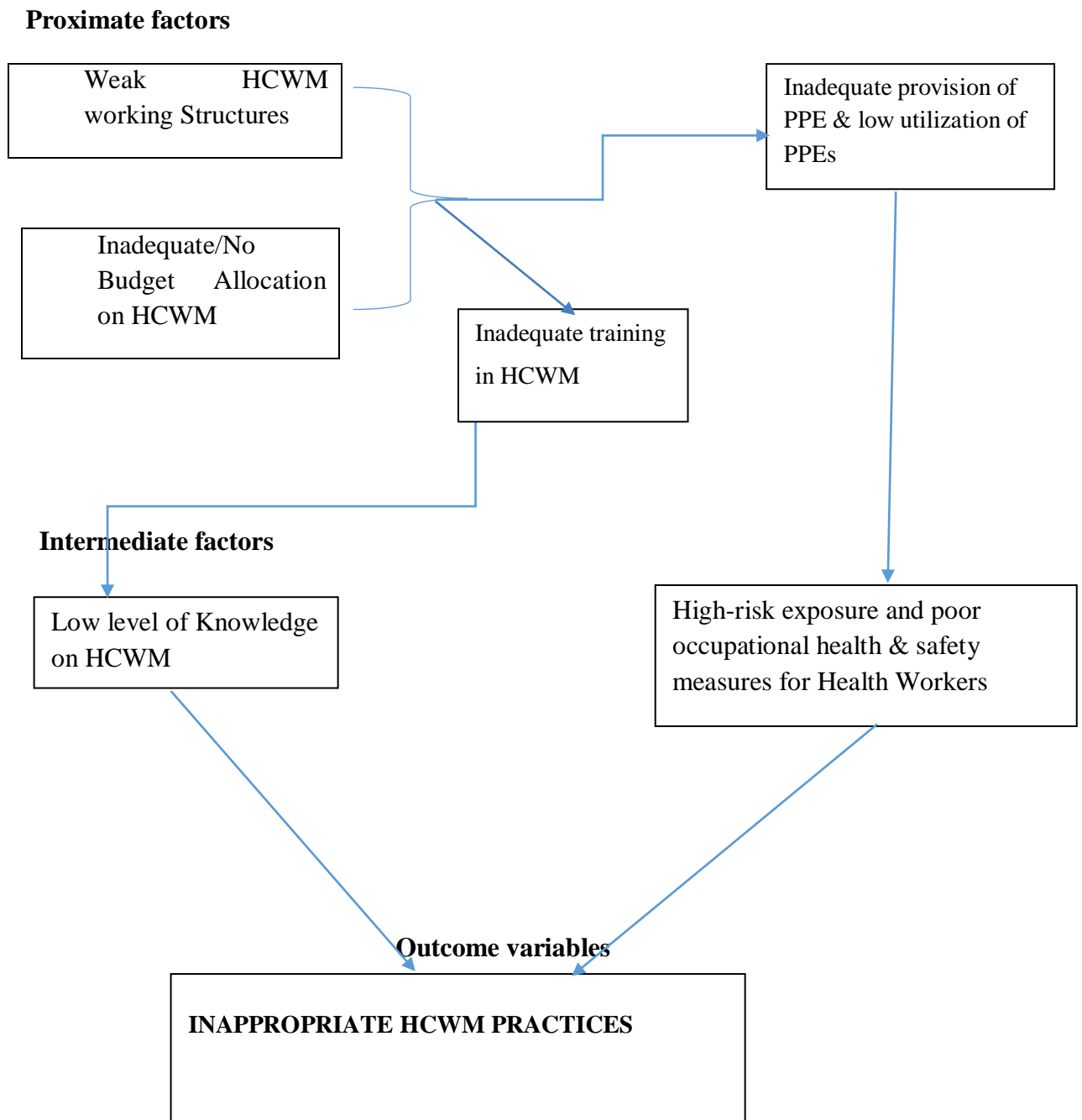


Figure 1: Conceptual Framework

(Journal of Environmental Science & Public Health 2020)

2.4 Global perspective of Health care waste management

Waste management had been neglected for a long time until WHO took it up to stipulate general regulations on its management. Studies done show that in developed countries the main challenge in HCWM is the large amount of waste produced while in developing countries the huddle is on streamlining the health systems to ensure the setting and implementation of regulations (Everson & Michelle, 2010).

The generation of waste is inevitable since waste streams cannot be eradicated in totality; thus, resulting in the need to minimize waste. The country can only attain minimization at the production, distribution and importation level of the chain of supply (The Global Fund, 2020). It is approximated that about 85 per cent of the waste material emanating from healthcare facilities results from the general waste category with the 15 per cent belonging to highly infectious and toxic radioactive materials (WHO, 2015).

It is estimated that 5.22 million people die annually because of diseases caused by exposure to health care waste of which 4 million are children (Nie et al., 2014).

2.5 Health Care Waste Management in Developed Countries

In the developed world, the main challenge encountered is dealing with an increasing volume of health care waste. In the United States (US), health care waste is ranked the third-largest source of waste and health facilities are reported to be disposing of more than 2 million tons of waste annually (Everson et al., 2010).

In the US the increasing volume of health care waste is attributed to the increased use of disposable medical supplies which became rampant in the advent of HIV-AIDS in the 1990s (Chenn et al., 2010). The trend now is for most hospitals in the US to turn to waste recycling. Half of US hospitals are now giving their single used items to

processors who sterilize and resell the same (Chenn et al., 2010). The authors also discovered that there are no extra health risks associated with these recycled products. Many developed countries are opting for alternative technology, which minimizes air pollution to replace incineration. In the US health care waste incinerator numbers have dropped by more than 95% from 1988 - 2007 (Emmanuel & Saoke, 2013).

Ireland and Portugal have eliminated the use of incinerators in their hospitals. Canada has also completely replaced incinerators with other alternatives with lesser health effects. Germany closed down all its hospital incinerators in 2002 (PATH, 2014).

Mukwakungu and Mabasa (2019) sought to identify how waste related to healthcare affected the environment in the Republic of South Africa. In terms of knowledge on healthcare waste management, nurses were the most knowledgeable followed by physicians and housekeepers respectively. Similarly, Gao et al (2018) conducted an assessment on the practices of waste management in rural China. The study was conducted in three provinces containing 21 counties.

The findings established that compliance levels on waste management were low. Less than half of the hazardous healthcare waste was packed in sealed containers or containers labelled with biohazard markings. Moreover, none of the township health centres segregated healthcare waste correctly according to the categories required by formal Chinese regulations. Many township health centres reported improper disposal methods of healthcare waste. The level of staff training was inadequate and low rates of centralized disposal in rural township health centers.

2.6 Health care waste management in developing countries

Developing countries face challenges with the ineffective system of waste disposal due to inadequate funding and lack of formal regulations. This has led to numerous health and environmental impacts with street families and children scavenging around the waste dumpsites; hence, being exposed to many health risks (Everson et al 2010).

In Nigeria, a cross-sectional study conducted in 2011 found that waste was generated at the rates of 17.89 kg/day, 7.89 kg/day and 2.3 kg/day in large, medium and small hospitals respectively. The percentage category of waste generated was 41% hazardous, 33% non-hazardous, 26% combined for large hospitals, 35% hazardous, 35% non-hazardous and 30% combined for medium hospitals and 18% hazardous, 31% non-hazardous and 51% combined in small hospitals. Most of the health facilities in the large and medium category used open dumpsites, which were not treated. Most of the health facilities in the small category used waste agents to manage their waste. Staff interview revealed that most of the health workers treated HCW as domestic waste hence poor waste segregation. No records on HCWM were available (Ogbonna 2011).

In a study done in India in 2011, it was established that hospital staff knew that HCW should be segregated and managed well from generation to final disposal, 47.5% had knowledge on waste categorization and the treatment options available; 81.9% were nurses, 76.8% were doctors, 38.5% were interns, 27.3% were lab technicians and 19.3% were support staff. Most of the staff 95.8% had knowledge on the health effects of inappropriate HCWM and 38.8% were nurses. Most health workers (87.5%) were doing segregation at the source of waste generation. Some workers were not aware of the importance of a Health Care Waste Management Team and 32.9% did not know the relevant legislation governing HCWM; 12% stated that HCWM is the responsibility of

the government and 9.9% reported that giving the responsibility of HCWM to the hospital was overburdening the hospital. Most of the staff (96.1%) was aware of the colour coding system although many were not clear on what waste is for what bin (Pronczuk de Garbino, 2011).

Hassan, Tudor and Vaccari (2018) conducted a case study on health care waste management in Sudan. A total of eight health care facilities from both rural and urban areas were used as the target population. The research findings concluded that there was inadequate training among health practitioners, limited policies, shortage or improper usage of personal protective equipment, high rates of needle stick injuries and low vaccination rates among health care workers.

Wafula, Musiime and Oparia (2019) analysed the impact of management of healthcare wastes among healthcare workers and the associated factors in the main healthcare facilities in Kampala, Uganda. The study adopted a cross-sectional survey in 8 healthcare facilities in Kampala. Interviews were conducted amongst nurses, midwives, medical officers, laboratory personnel, counsellors and social workers on the socio-demographic characteristics, knowledge, attitude and practices on health care waste. The result findings established that knowledge on health care waste was high at 71%. The data derived from hospitals, health care centres of level IV, III and II identified the main waste streams as sharps, pathological wastes, infectious wastes and general wastes. Moreover, it was established that health workers with diploma had more satisfactory waste management practices in comparison to those with higher secondary education. health workers who had received training in health care waste management were found to have satisfactory health care waste management practices.

A good percentage (80%) of the respondents wore appropriate protective clothing.

The health workers satisfaction with health care waste management was at 74%.

Ali, Wang, Chaudhry and Geng (2017) conducted a study on health care waste management with a specific focus on developing countries in Asia, Africa, Latin America, Europe and Latin America. The research findings established that health waste management legislation in these countries is wanting mainly due to lack of knowledge or lack of adherence while implementation. Health waste quantity was found to be considerably increasing annually, waste was segregated based on colour-coded bags, labelled containers or bags. Knowledge on hazardous effect on inhalation, exposure to chemicals was found to be low with needle stick injuries remaining unreported and unregistered.

Khan, Cheng, Khan and Ahmed (2019) analysed the impact of health care waste management in developing countries of Asia. The research established that the inadequate training of health practitioners resulted in inappropriate handling of waste which resulted in health risks. Further outdated incineration plants were required to be replaced by new plants to avoid the emission of toxic gases.

In a study done in Uganda, the key factors causing inappropriate HCWM were identified as weak health care systems with low/no specific budgetary allocation to HCWM, low levels of knowledge & awareness linked to low training opportunities and inadequate provision & utilization of PPEs (Journal of Environmental Science & Public Health 2020).

2.7 Health Care Waste Management in Kenya

In a study done in 2010 in Nairobi Kenya, it was noted that the HCW generation rate was higher than the documented rates of hospitals in developing countries. This was

attributed to poor waste segregation; Most HF's (97%) segregated waste into 2 categories i.e. sharps and other waste termed infectious meaning waste was mixed making the amount of infectious waste to be more. Less than 10% of HF's did recycling of pharmaceutical bottles and 35% of HF did record-keeping of HCWM (Mazrui, 2010).

Less than half (41%) of health facilities hired private companies dealing with general waste to manage their waste while 27% hired private companies who deal with medical waste to manage their waste. Most hospitals managed their own waste; 21% incinerated the waste and 11% used open dumpsites located within the hospital (Mazrui 2010).

The MoH (2012) carried out a cross-sectional study in 4 provinces: Nairobi, Central, Rift Valley and Western. The study found out that few health facilities did waste minimization because segregation and recycling were not done. Segregation was best done only of sharps waste with 95% of health facilities having the proper sharp containers. Segregation and packaging of other waste were poorly done and waste containers and bins were not labelled. Good segregation of waste was done in only 27% of hospitals. Transportation of waste within the health facilities was done using wheelbarrows and this led to waste spillage with > 50% of health facilities reporting waste spillage. There were 47% of health facilities with waste storage rooms within the hospitals but most of them were disused rooms with leaking roofs and in a poor state to adequately store HCW.

The commonest mode of waste treatment was incineration with 62% of health facilities doing on-site incineration but 25% of incinerators were below the recommended NEMA standards. The other HF's contracted private companies to manage their HCW outside the facility (MoH, 2012).

Other health facilities did open dumping and few Nairobi hospitals had shredding as a waste treatment option before final disposal.

In 50% of health facilities, the final disposal sites and the area around them were kept clean; 64% of dumpsite had good site selection, 12% had fairly good site selection and 24% had been sited inappropriately (Mazrui, 2010).

On PPE generally, waste handlers used heavy-duty gloves and gumboots but only 37% of HF's provided respirators, face masks, helmets, and plastic goggles (MoH Kenya, 2012). Training had been done in 61% technical staff and 65% waste operators. There was adequate staff deployment for HCWM in 57% of HF's, 16.7% of HF's had Annual Operational Plans (AOP) on HCWM and most HF's had no idea how much money was used in HCWM (MoH Kenya 2007).

Kimani (2013) in his study done in Nairobi on waste management and environmental deterioration found out that 42% of soil sampled around the Dandora dumpsite had lead levels exceeding the recommended WHO set the standard. Other metals included cadmium, copper; mercury and zinc were also in high levels of PH significance.

Incidences of diseases that are affected by environmental pollutants were high i.e. respiratory, gastrointestinal and dermatological diseases. There were increased levels of lead in blood samples of children living around the Dandora dumpsite. Half of the children tested had haematological abnormalities of low haemoglobin levels and abnormal red blood cells (Kimani 2007).

Njue, Cheboi and Oiye (2015) sought to determine the level of adherence to healthcare waste management by nurses and waste handlers in Thika. A cross-sectional descriptive research design was incorporated for the study with qualitative and quantitative data

obtained from the 286 nurses and 114 waste handlers from the 34 public health care facilities available in the sub-county. The research findings established that 43% of the respondents adhered to the set guidelines on healthcare waste management with 21% consisting of nurses and 22% being waste handlers. Over 75% of the respondents depicted knowledge on health care waste management with nurses being more conversant than waste handlers. The lack of an effective waste management system was attributed to insufficient resources and poor incinerator capacity.

Njiru, Mutai and Gikinju (2013) assessed the awareness and practice regarding healthcare waste management among health care personnel in Kenyatta National Hospital (KNH). The study respondents consisted of doctors, nurses and support staff who worked in the hospital for a period of more than 6 months. The research findings concluded that the level of awareness of healthcare waste management was highest amongst nurses at 65%, support staff at 55% and doctors at 51%. In relation to practices, the results confirmed that most healthcare personnel were conversant with healthcare waste management practices with doctors being the least aware. Most of the respondents were comfortable with the measures put in place by the institution to control waste management with 59% rating at the good, 40% at fair and 1% at poor.

With the elaborate health care system in Kenya ranging from Level 1 – Level 6; The Country provides integrated curative care, preventive and promotion of health care, rehabilitative care, and supportive activities to almost 90% of the population. At the national and county level hospitals where expert services are provided, there is an emission of extremely infectious and superior waste at a fast rate.

Due to the poorly developed waste segregation practices, up to 50% of the waste classified as being infectious is as a result of less than 10% of health care waste which is

considered infectious (MoH Kenya, 2016).

Othiogo (2014) analysed the effect of healthcare waste management with the case study conducted in Mater Hospital in Nairobi. The study adopted an observational and descriptive research design with a stratified sampling technique adapted among doctors, nurses, radiologists, pharmacists, lab assistants, administrative staff, teaching staff and support staff. The research findings concluded that there was adequate training and awareness of personnel regarding the handling of healthcare waste. Matter Hospital complied with Environmental Management and Coordination Act rules and regulations on healthcare waste management.

Muthoni, Nyerere and Wangari (2016) investigated the level of knowledge management among practitioners in Kenyan hospitals. The study was conducted in Kenyatta National Hospital which is a public hospital and Kikuyu Mission Hospital which is a private hospital. The questionnaires were administered to 246 respondents. The findings concluded that knowledge management was highest amongst healthcare professionals in both hospitals. Doctors at Kenyatta Hospital with experience of 1-5 years were most knowledgeable with their counterparts with experience of 5-10 years at Kikuyu Mission Hospital being most knowledgeable. The level of education was highest amongst doctors and public health officers and was more conversant with the theoretical rules and regulations. Knowledge on technical issues such as segregation and familiarity with biohazard was highest amongst nurses and clinical officers.

Njiru (2015) investigated the level of awareness and practice on healthcare waste management among health care practitioners at Kenyatta National Hospital, Kenya. The study adopted a cross-sectional descriptive research design with the target population consisting of 244 personnel which consisted of doctors, nurses and support staff from

casualty, orthopaedic and general surgery departments. The level of awareness on healthcare waste management was at 51% with nurses being most knowledgeable at 54.5%, support staff at 51.5% and doctors at 48%. The level of awareness of segregation practices was at 44%. The result findings concluded that education had a significant influence on waste management practices moreover there was a significant relationship between training and awareness on correct practices.

Finally, there was a significant relationship between profession and awareness on proper practices and standards of healthcare waste.

2.8 Public Health significance of Inappropriate HCWM

Presence of sharps in waste if not well contained can lead to prick injuries and transmission of infections like HIV and Hepatitis B (Pruss et al 1999). When waste is incinerated at sub-optimal temperatures below 800°C some waste with plastic chloride, toxic chemicals like dioxins and furans are produced that get into the air leading to air pollution and have detrimental health effects affecting the immune, reproductive and neurological systems (ICRC 2011).

According to Nashaat, (2010) waste containing heavy metals getting to the soil through open dumping, burying or deposited particles of burnt matter lead to seeping and pollution of underground water. These metals if ingested accumulate in the body and at levels beyond the standard limits will cause ill health ranging from abdominal disturbance, neurological and carcinogenic effects.

2.9 Health care waste categorization

According to World Health Organization (2014) waste generated in a health facility is of different categories and requires segregation in order to be well managed (Table 2).

Table 2: Health Care Waste Categories

Category	Type of Waste	Treatment and Disposal Options
Infectious waste	Suspected to contain bacteria, fungi, viruses, parasites. Includes lab cultures, soiled waste from ward, infected human tissue or fluid.	Incineration/Deep burial
Pathological waste	Human tissues, organs, body parts, dead fetuses & experimental animals used in research.	Incineration/Deep Burial
General waste	Office waste like papers, kitchen waste i.e. food remains	Can be treated as domestic waste, disposal at municipal dump sites
Sharps waste	Needles, Syringes, scalpels, blades, glass. Considered hazardous.	Chemical Disinfection Autoclaving/ Microwaving, Mutilation and Shredding/Deep burial
Pharmaceutical waste	Discarded or expired drugs, contaminated equipment, ineffective drugs)	Incineration/disposal in landfills or deep burial
Cytotoxic waste	Containing genotoxic elements; anticancer drugs or metabolites from patients using these drugs	Encapsulation/ deep burial
Radioactive waste	Could be in solid, liquid or gaseous form containing radionuclide elements.	Incineration/ deep burial or landfills
Wastes with high content of heavy metals	Include cadmium from batteries used in automated BP machines, mercury from broken thermometers and dental amalgam	Incineration/deep burial
Pressurized containers	From cylinders used to store gases	Consider recycling
Chemical Waste	Include lab reagents, disinfectants and solvents.	Chemical disinfection and discharge into the drains

Source: (WHO 2014)

Chapter 3: METHODOLOGY

3.1 Study Area

The study was done in Machakos Sub County which is in Machakos County. Machakos County comprised of seven other Sub Counties. This Sub County had 26 reporting health facilities; private, mission and public health facilities. The Sub County lies in the southern part of Machakos County bordering Kathiani to the North and East, Mbooni to the South and Athi River to the West. It covered an area of (821.7 sq km) and was divided into 2 administrative divisions i.e. Central and Kalama (Machakos Development plan 2012).

The majority of the inhabitants lived in urban and peri-urban areas forming about 52% of the population and 48% in the rural areas.

The prevailing local climate is semi-arid and the landscape is hilly, rising from an altitude of 1,000 to 1,600 metres above sea level. The Sub County experience erratic and unpredictable rains of less than 500mm annually, with short rains in October through to December and long rains in late March to May. The main means of transport is the road. The poverty level in Sub-County was at 59.6 % against a national average of 45.9% based on KIHBS (2019).

According to Machakos County Development Plan, (2012), the health facilities in the Sub County comprised of Machakos Level 5 Hospital. Level 4 Hospitals include Bishop Kioko Catholic (mission), and Shalom Hospital. Level 3 health facilities included the New Ngei road Nursing Home, Muumandu, Kola, and Mutituni Health Centers. Level 2 health facilities included Kimutwa, Mua, Machakos Prison, School for the Deaf, APDK,

Approved school, Katumani, Muvuti, Kamuthanga, AIC Kyasila, AIC Ngelani, St. Josephs, Kalama, Kititu, Nzaini, Kiitini, Makyau, Kyawalia and St. Micheal dispensaries.

3.2 Reasons for the Choice of the Study Area

The sub-county was selected because it has the highest number of healthcare facilities of different KEPH levels providing various healthcare services thus forming a basis for evaluating health facilities' compliance to the national healthcare waste management guidelines of 2008.

3.3 Study Design

This was a descriptive cross – a sectional study done to evaluate the current practice in HCWM against the recommended guidelines in the HCWM plan of 2008 -2012 in 4 HFs of different levels at Machakos Sub County – Machakos County.

3.4 Study Population

The study population comprised of 4 HFs from different levels i.e., 2, 3, 4 and 5. Study participants involved at the time of the study were; doctors, clinical officers, nurses and lab technologists working in the health facilities

3.4.1 Inclusion criteria of study subjects

Health workers selected from the health facility who accepted to participate in the study.

3.4.2 Exclusion criteria of study subjects

This study excluded the following:

Selected facilities whose administrators did not consent to participate in the study; health workers on leave and those who declined to participate in the study.

3.4.3 Dependent variables:

Non-compliance to National HCWM guidelines in the HCWM plan of 2008 – 2012.

3.4.4 Independent variables

These include; Level of training in HCWM among health workers, knowledge on healthcare waste management, waste handling practices from transportation to final disposal, occupational health & safety matters in healthcare waste management and financial aspects linked to healthcare waste management.

3.5 Sampling Procedure

3.5.1 Sample size determination

A total of 4 health care facilities were selected one from each KEPH level as recommended in the WHO HCWM rapid assessment tool, which suggests that one or two health care facilities be selected from each group (Pruss et al 2001). The sample size formula by Dobson was used to calculate the total sample size of all the health workers used in the study (Dobson 1984).

$n = Z^2 P (1-P) / d^2$ Where n=sample size

P=the estimated average percentage of HCWM compliance in public HF's taken as 47%

Z=critical value corresponding to 95% CI obtained from the table of standard Normal distribution (1.96)

d=degree of precision desired, set at $\pm 5\%$ (For this study 0.05 has been used to substitute in the formula: -

$n = 1.96^2 \times 0.47 (1-0.47) / 0.05^2$

$$=1.96^2 \times 0.47 \times 0.53 / 0.05^2$$

$$N=383$$

Because this was a finite population the following formula was used (Fisher et al 2001).

$$nf = n(383) / 1 + n(383) / N$$

$$= 383 / 1 + 0.5$$

$$= 383 / 1.5$$

$$= 255 \text{ (10\% non-response)}$$

$$= 281$$

3.6 Sampling Method

Stratified Random Sampling was used to select the HF's that took part in the study. The HF's were ranked into 4 levels as per KEPH and one HF was selected from each level by simple random sampling by writing the names of the health facilities in small papers and randomly picking one (Pruss et al 2001). A total of 4 HF's were selected.

An inventory of all health workers per health facility per cadre was obtained. The sample size for each of the 4 HF's was calculated using the health workers' number (of the selected cadres) in a health facility divided by the total number of health care workers (of selected cadres) in the 4 health facilities multiplied by the sample size (281).

Each health workers' category sample number was calculated using the number of health workers per cadre in a health facility divided by the total number of health workers of selected cadres in the same health facility multiplied by sample allocated in that health facility. A simple random sampling was done using a random sampling frame to select health workers per cadre for each health facility to participate in the study.

This gave the exact proportion to be allocated & catered for probability proportional to size (PPS) sampling avoiding skewing.

However, the current health system structure of using health facility level of care to determine the cadre to deploy gave the nurses a higher chance of being found as the most/only cadre in the lower levels of care.

3.7 Data collection tools and instruments

Data collection was done in the months of March, April and May 2014 after attaining permission from the County Health Director Machakos County.

Quantitative data was collected using both open headed and closed headed questionnaires which were administered by the principal investigator and research assistants. The respondents to the questionnaire included; health workers who are the principal generators of health care waste i.e. medical specialists, medical officers, clinical officers, nurses and lab technologists. The questionnaire assessed the knowledge of set standards in HCWM in the National Plan of 2008-2012.

A pre-test of the questionnaire and the checklist was carried out in the neighbouring Athi River Sub County (it neighbours Machakos Sub County to the West) at Athi River level 3 HF 2 weeks before the actual data collection to allow for adjustments. The pretest was done in the English language and the respondents were the same as stipulated in the questionnaire; medical specialist, medical officer, clinical officer, nurses and lab technologists. They all had tertiary education qualifications.

The principal investigator in the selected HF's used an observation checklist. The main purpose was to assess the actual practices of HCWM in the HF's. The principal

investigator observed the actual HCWM practices within the facilities from the transportation of HCW from sites of collection to final disposal against the set standard guidelines of 2008. Additionally, an observation was done of evidence of budgetary allocation for HCWM, evidence of functional Infection Prevention Committee (IPC), evidence of HCWM monitoring & evaluation tools and evidence of guidelines displayed at strategic sites.

Training of the research assistants on the use of study tools was done prior to the pilot study.

3.8 Data Processing and Analysis

Data from the questionnaires and the observation checklist were analyzed using Statistical Package for Social Sciences (SPSS) version 21 software. Data were entered into the SPSS template, then cleaning was done, and finally, analysis was done. Descriptive statistics were used to present the data in the form of frequency tables and percentages. Chi-square test was used to test for association between the training, knowledge, occupational health & safety of health workers and the respondent's occupation. The level of significance was fixed at 0.05.

There were five specific objectives that were analyzed each with specific indicators, the total number of indicators assessing compliance of HCWM was 17. The performance of these indicators was measured against the pre-determined criteria of 0 - 49 % rated as poor, 50 – 74% rated as fair and above 75% rated as good to measure compliance level, (National Health Care Waste Management strategic plan 2015 - 2020).

There were five specific objectives with different variables to be measured by a key study instrument to generate several indicators (Table 3).

Table 3: summary of specific objectives, variables, instrument and analysis

SPECIFIC OBJECTIVES	VARIABLE	INSTRUMENT	INDICATOR
To determine proportion of health workers trained in HCWM	Level of formal training	Questionnaire	% of health workers trained in HCWM % of health workers trained in IPC % of health workers trained in injection safety
To evaluate health workers' knowledge on HCWM	Correct definition of HCWM processes from transportation to final disposal Knowledge on right person responsible for HCWM	Questionnaire	% of health workers able to correctly define specified HCWM processes % of health workers with knowledge that all health workers have a responsibility in HCWM
To assess HCW handling processes from transportation to final disposal	Correct waste handling processes	Observation check list	% of health facilities handling HCW correctly % of health facilities with M/E tools % of health facilities utilizing M/E tools % of health facilities with SOPs/job aids displayed % of health facilities with HCWM policy guidelines

SPECIFIC OBJECTIVES	VARIABLE	INSTRUMENT	INDICATOR
To investigate occupational health & safety measures in place in relation to HCWM	<p>PPE provided by Health Facility to Health Workers</p> <p>PPEs utilized by health care workers in HCWM</p> <p>PPEs utilized by WH</p> <p>Vaccination of health workers against Hep. B</p> <p>IPC Committee functional</p>	<p>Observation</p> <p>Checklist</p> <p>Questionnaire</p>	<p>% of health workers provided with PPE by the health facility</p> <p>% of health Workers utilizing PPEs in HCWM</p> <p>% of health facilities where WH utilized PPEs</p> <p>% of health workers vaccinated against Hepatitis B</p> <p>Proportion of Health Facilities with functional IPC Committee</p>
To assess financing aspects linked to HCWM	<p>Specific budget vote line on HCWM in current financial year</p> <p>Evidence of estimated annual HCWM cost</p>	<p>Observation</p> <p>Check list</p>	<p>% of health facilities with a specific budgetary allocation for HCWM</p> <p>% of health facilities with estimated annual cost of HCWM</p>

3.9 Minimization of biases and errors

The potential errors and biases were minimized by training all research assistants on the study objectives and methodology. Pretesting of the data instruments was done and ambiguities were rectified before the actual collection of data. Random selection of participants and strict supervision of the research assistants by the principal investigator during data collection also reduced bias.

Assuring the health management and the health care workers on confidentiality helped control bias. An observation checklist was used to document the status of the health care waste management within the health care facilities and the information gathered was used to correlate the questionnaire findings.

3.10 Ethical consideration

Approval to carry out the study was sought from the Kenyatta National Hospital/University of Nairobi College of Health Sciences research and ethics committee; approval number P300/5/2013. The Ministry of Health and emergency services in Machakos County granted the permission to conduct this study. Study subjects, in this case, signed informed written consent HF in charges and health workers after a clear explanation of the purpose of the study.

3.11 Study limitations

This study was limited to the following: Selection bias resulted from the fact that only health workers who were available during the study period participated in the study. Due to the current health system structure most study subjects were nurses since they are the cadre found in L2/L3. The study was limited to health facilities in Machakos Sub County hence its findings cannot be obviously generalized to other parts of the County.

Chapter 4: RESULTS

This chapter presents the study findings obtained from the study. The analysis of data collected for this study was completed using the Statistical Package for Social Sciences (SPSS). The analysis was completed using descriptive statistics, which includes measures of central and variation and use of graphical representations such as pie charts and bar charts. Inferential statistic has also been used in form of Chi-Square tests for independence in investigating the difference in HCWM knowledge/practice between the health workers occupation.

4.1 Sociodemographic characteristics of the respondents

Majority of the respondents (217/281) 77.22% were from Machakos level 5, followed by Bishop Kioko Level 4 and the least number of participants 1.07% (3/281) were from Katumani Level 2 (Table 4).

Participants' gender representation is as follows; 39.86% (112/281) are female, and 60.14% (169/281) of the participants are male (Table 4).

Most of the participants about 50% of the participants out of 281 were within the age of 19 to 30 years and 38.08% (107/281) were between 31 to 45 years while 12.10% (34/281) were within 46 to 60 years (Table 4).

With respects to occupation 71.17% (200/281) of the participants were nurses, 10.32% (29/281) lab technicians, 8.90% (25/281) clinical officers, 5.34% (15/281) medical officers and 4.27% (12/281) were medical specialists (Table 4).

On health care workers experience most of the participants, 76.87% (216/281) were between 1 to 10 years, 12.1% (34/281) between 11 to 20 years, 8.90% (25/281) between 21 to 30 years and 2.14% (96/281) were between 31 to 40 years (Table 4).

Table 4: Sociodemographic summary

Sociodemographic	Category	Frequency	Percent
Facility Name	Machakos Level 5	217	77.22
	Bishop Kioko Level 4	52	18.51
	Mutituni Level 3	9	3.20
	Katumani Level 2	3	1.07
Gender	Male	112	39.86
	Female	169	60.14
Age group	19 - 30	140	49.82
	31 - 45	107	38.08
	46 - 60	34	12.10
Occupation	Medical specialists	12	4.27
	Medical officer	15	5.34
	Clinical Officer	25	8.90
	Nurse	200	71.17
	Lab Tech	29	10.32
Years of Experience	1 - 10	216	76.87
	11 - 20	34	12.10
	21 - 30	25	8.90
	31 - 40	6	2.14

4.2 Capacity Building on Various Health Priorities

The study examined the health workers' post-employment training on various health priorities within the previous three and half years (3.5 years).

Data analysis showed, 28.5% (80/281) of the respondents reported to have received post-basic training. Among the cadres none of the medical specialist had received any post-basic training, 55.2% (16/29) of the lab technicians had received post basic training, 40% (6/15) of the medical officers reported having received post-basic training, 26.5% (53/200) of the nurses reported to have received post-basic training and the least 20.0% (5/25) of the clinical officers reported to have received post-basic training.

The Pearson Chi-Square found a significant difference for cadres who had received post-basic training as determined by $\chi^2 = 20.399$, $p = 0.0004$.

General score on post basic training was 28.5% (80/281) which is poor compliance level (Table 5 & Fig.2).

HIV/AIDs related training had the highest respondents trained at 60.0% (48/80), Infection prevention control training was at 51% (41/80), HCWM training was at 41.3% (33/80), Injection safety training was at 19% (15/80) and reproductive health training was the least at 9.0% (7/80) (Table 5).

On Infection Prevention training among the cadres 100% (6/6) of the medical officers reported to have received this training, 80.0% (4/5) of the clinical officers had received this training, 68.8% (11/16) of the laboratory technicians had received this training and the least 37.7% (20/53) of the nurses had received this training (Fig.2).

A Chi-Square for independence between cadres who received training in infection prevention was found to be significant as determined by $\chi^2 = 15.7226$, $p = 0.001$.

Analysis on post basic training indicated that out of 80 respondents, only HIV/AIDs at 60% (48/80) and infection prevention & control at 51% (41/80) were rated fair while all the others were rated poor including training in HCWM at about 41% (33/80) (Table 5).

4.3 HCWM Training among the Health workers

This study established that a total of 41.3% (33/80) of the health workers had undertaken HCWM training, none of the medical specialists had undertaken any training in HCWM. Among the cadres who had trained in HCWM, the medical officers were the highest in HCWM training at 50% (3/6), followed by the nurses at 43.3% (23/53) being trained in HCWM, 40% (2/5) of the clinical officers were trained in HCWM and the lowest was lab technologists 31.3% (5/16) trained in HCWM.

Most of the training done was the health facility's initiative at 94.4%, among the cadres all medical officers & nurses HCWM training came about as an initiative by the health

facility while the least 66.7% (2/3) of the clinical officers training was as a result of facility initiative (Table 5).

All the scores had poor level of compliance except for the medical officers which was fair compliance level (Table 5 & Fig. 2).

Table 5 : Respondent' Score on Training Priorities and in HCWM by MOH Indicators

Training priority	% Trained		% Not Trained	MOH indicators (KHCWM SP, 2015-2020)	
				0-49= poor	50-74%= Fair
HIV/AIDs	60.0		40.0		✓
Malaria	15.0		85.0	✓	
IPC	51.0		49.0		✓
Reproductive Health	9.0		91.0	✓	
TB	21.0		79.0	✓	
HCWM	41.3		58.7	✓	
Injection Safety	19.0		81.0	✓	
HCWM training by cadre	% Trained	% Facility Initiative			
Medical specialists	0	0	12.0	✓	
Medical officers	50.0	100.0	50.0		✓
Clinical officers	40.0	66.7	60.0	✓	
Nurses	43.3	100.0	56.7	✓	
Lab. Tech.	31.3	80.0	68.7	✓	
Total	41.3	94.4	58.7	✓	



Figure 2 : Respondent' Score on Various Training Priorities per Cadre

4.4 Knowledge on HCWM Processes

The different cadres of health workers were assessed on their understanding on different processes of HCWM mainly; transportation, storage, treatment options, final disposal and responsible person for HCWM.

The Kenya 2008 HCWM guidelines state that HCW should be transported separately as segregated in different bins using designated trolleys, should be stored in lockable inaccessible room, should be treated before disposal and should be finally disposed into a landfill or buried into a deep pit. Further, all health workers have a direct responsibility in HCWM.

Data analysis on health care waste transportation showed that 74.3% (200/269) of health care workers responded rightly that each health care waste category should be transported separately. Among the cadres 82.1% (23/28) of the lab technicians, 80.0% (12/15) of the medical officers, 76.0% (19/25) of the clinical officers, 73.2% (145/198) of the nurses and the lowest 57.1% (4/7) of the medical specialist rightly reported that health care waste

should be transported separately. Generally, on right HCW transportation the score was fair compliance (Table 6, Fig.3).

On storage 44.1% (120/272) respondents rightly stated that HCW should be stored before disposal. Among the cadres the highest 75% (9/12) medical specialist and the lowest 53.3% (8/15) medical officers reported that health care waste should be stored before disposal.

A Chi-Square test for independence for cadres and whether health care waste should be stored before disposal was found to be significant as determined by $\chi^2 = 13.0631$, $p = 0.01$.

Generally, on whether HCW should be stored or not before disposal the score was poor compliance (Table 6 & Fig.3).

On correct HCW storage 16.3% (20/123) of respondents stated rightly that HCW should be stored in lockable inaccessible room. Among the different cadres none of the medical specialists knew the correct storage for HCW, the clinical officers had highest score at 23.5% (4/17) correctly stating that HCW should be stored in a lockable inaccessible room.

A chi-square for independence between cadres and correct storage for health care waste was found to be significant as provided by $\chi^2 = 24.065$, $p = 0.028$.

The general score on correct method of HCW storage was poor level of compliance (Table 6 & Fig.3).

On treatment option majority of the respondents 91.5% (257/281) stated rightly that incineration is the treatment option used in their health facility. All medical specialists rightly stated that incineration is the treatment option used in their health facilities, the lowest was clinical officers at 76.00% (19/25). The overall score on treatment option is good compliance (Table 6 & Fig.3).

On final HCW disposal method 99.6% (266/267) of the respondents gave erroneous HCW final disposal options, none of the respondents knew the right final HCW disposal option used in the health facility. This score is poor compliance (Table 6).

On who is responsible for HCWM 78.3% (220/281) respondents rightly reported that all health workers were responsible for HCWM. Among the cadres all medical specialists and medical officers rightly reported that HCWM is the responsibility of all health workers. Some clinical officers 32.0% (8/25) reported that HCWM is not the responsibility of health workers. This score is good compliance (Table 6, Fig.3).

With reference to knowledge on HCWM processes, knowledge on storage before disposal, ideal storage practices and final disposal methods the score was poor compliance (Table 6).

With reference on knowledge concerning HCW transportation separately the score was fair compliance, on correct treatment options as well as the fact that HCWM is a responsibility for all health workers the score showed good compliance (Table 6).

Table 6: Respondents Average Knowledge score on HCWM Processes by MOH indicators

HCWM Process	Correct Knowledge		MOH indicators (KHCWM SP, 2015-2020)		
	% YES	% NO	0-49=poor	50-74%= Fair	>75% =good
HCW Transported Separately	74.3	25.7		✓	
HCW Storage before disposal	44.1	55.9	✓		
Correct HCW Store	16.3	83.7	✓		
HCW Treatment option	91.5	8.5			✓
Final disposal	0	99.2	✓		
HCWM Responsibility for All Health Workers	78.3	21.8			✓

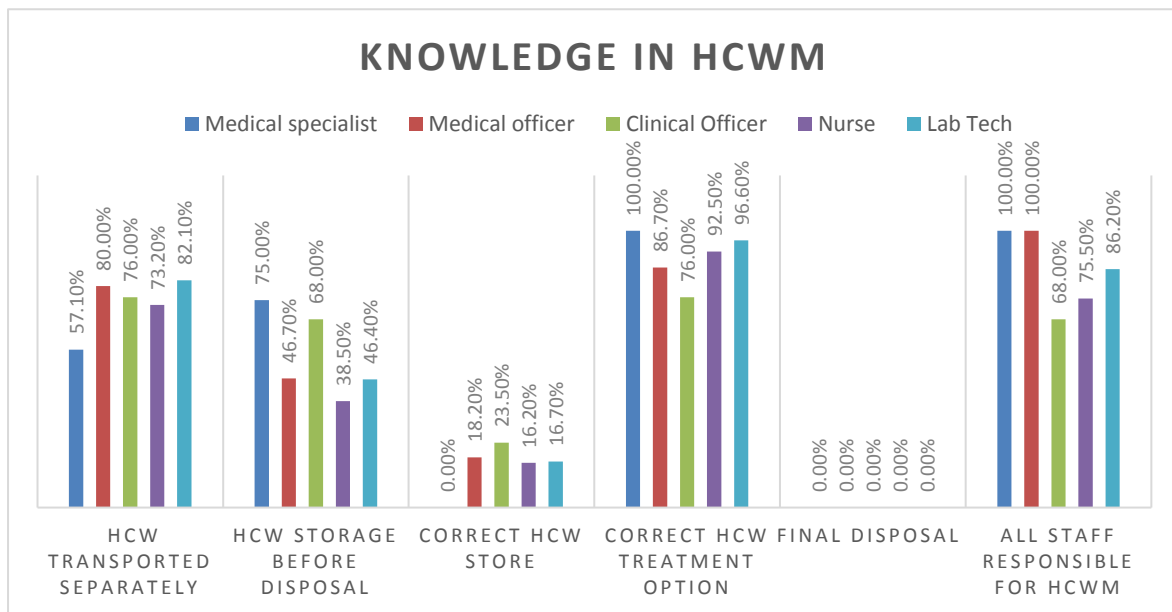


Figure 3: Respondents' Knowledge score on HCWM Processes per Cadre

4.5 Health Facilities HCWM Practices

An observation at the health facility level was done at the four health facilities involved in this study. Fourteen aspects of HCWM were observed; transportation, storage, waste categorization, available treatment option, state of incinerator where present, final disposal site, utilization of PPEs by waste handlers, availability of HCWM policy guidelines, availability of SOP's & job aids on HCWM strategically displayed, the availability of M/E tools, utilization of M/E tools, evidence of annual estimated cost on HCWM, availability of specific vote line in annual facility budget and evidence of functional IPC Committee instituted (Table 7).

On HCWM handling practices, all health facilities INAPPROPRIATELY transported HCW together without separation into the various categories designated in the Kenya HCWM guidelines; general, infectious, highly infectious and sharp.

On Waste categorization, level 3 and 5 health facilities rightly categorized waste into general, infectious and sharps, the other levels categorized HCW into 2 categories, sharps and no sharps.

On HCW treatment options the lowest level of care Level 2 used open burning since they lacked an incinerator, Level 3,4, & 5 treated their HCW by incinerating ALTHOUGH only the highest level of care, had an ideal incinerator. All health facilities erroneously did open simple pit as a final HCW disposal method.

The average score on HCWM handling practices was 29.2% (175/6). This score is poor compliance (Table 7).

Concerning policy guidelines on HCWM in either soft or hard copy, none of the health facilities had HCWM SOPs/job aids displayed at strategic sites. This score was poor compliance (Table 7).

Concerning availability and utilization of M/E tools for HCWM, none of the health facility demonstrated having these tools hence none was utilizing these tools. This score was poor compliance (Table 7).

In Summary, HCWM policy guidelines were found in 100% of the facilities which was rated good while all the other aspects were poorly rated. Infact, none of the health facilities had or utilized monitoring and evaluation tools and none had SOP's /job aids displayed (Table 7).

4.6 Financing aspects of HCWM in Health Facilities

An observation was done on above in the four health facilities involved in this study, the aspects assessed were; evidence of specific HCWM vote line in the health facility annual budget and the health facilities' estimation of HCWM cost for the year of study.

It was surprising to note that none of the health facilities had a specific HCWM budget vote line and further none of the health facilities had estimated the cost of HCWM for the year of study. This score is poor compliance (Table 7).

In respect to financial aspects, none of the health facilities had an annual HCWM budget for the year of study hence rated poor.

Table 7: Health facilities' Score on HCWM Practices by MOH indicators

Health Care Waste Management Practice	% Average	% Average	MOH indicators (KHCWM SP, 2015-2020)		
	YES	NO	0-49=poor	50-74%= Fair	> 75% =good
Health Facilities handling HCW Correctly	29.2	70.8	✓		
Health Facilities with M/E Tools	0	100.0	✓		
Health Facilities Utilizing M/E Tools	0	100.0	✓		
Health Facility with SOP's/Job aids Displayed	0	100.0	✓		
Health Facilities with HCWM Policy Guidelines	100.0	0			✓
Health facilities with a specific HCWM vote line	0	100.0	✓		
Health facilities with estimated HCWM cost	0	100.0	✓		

4.7 Occupational Health and Safety

On occupational health and safety, five aspects were assessed; PPE provision, PPE utilization, Hep. B vaccination, Health facilities where waste handlers utilized PPE in HCWM and presence of functional IPC Committees.

On PPE provision by the health facilities 85.8% (241/281) respondents stated that PPE was provided daily by the health facility, among the different cadres all medical specialists were provided with PPE and the lowest cadre was medical officers at 80% (12/15). The score is good compliance (Table 8 & Fig.4).

On PPE utilization 86.0% (240/279) of health worker utilized PPE, among the cadres all medical specialists used PPE daily and the lowest cadre was clinical officers at 80% (20/25), this score is good compliance (Table 8 & Fig.4).

On Hep.B Vaccination 78.3% (217/277) of the respondents had been vaccinated against Hepatitis B. Among the different cadres the medical officers were highest at 93.3% (14/15) and the medical specialists were lowest at 33.3% (4/12). A chi-square test for independence between the provision of Hepatitis B vaccination among cadres was found to be significant as determined by $\chi^2 = 20.704$, $p = 0.00$. Generally, the score on Hep.B. vaccination was good compliance for all cadres except the medical specialists who were rated poor, overall score was good compliance (Table 8 & Fig. 4).

Further in 75% (3/4) of the health facilities Waste handlers utilized PPE in HCWM. The score was good compliance (Table 8).

Moreover, it was surprising to note that none of the health facilities had a functional IPC committee, this score was poor compliance (Table 8).

On average, PPE provision & use, Hepatitis B Vaccination and Health facilities where WH utilized were above 75% hence rated good compliance but none of the facilities had IPC committees and so rated poor compliance (Table 8).

Table 8: Health facilities' Score on Occupational Health & Safety by MOH indicators

Occupational Health & Safety Characteristics	% YES	% NO	MOH indicators (KHCWM SP, 2015-2020)		
			0-49= poor	50-74%= Fair	>75% = Good
PPE Provision	85.8	14.2			✓
PPE utilized	86.0	14.0			✓
Hep B Vaccination	78.3	21.7			✓
Health facilities where WH utilized PPE	75.0	25.0			✓
Health facilities with IPC Committees	0	100.0	✓		

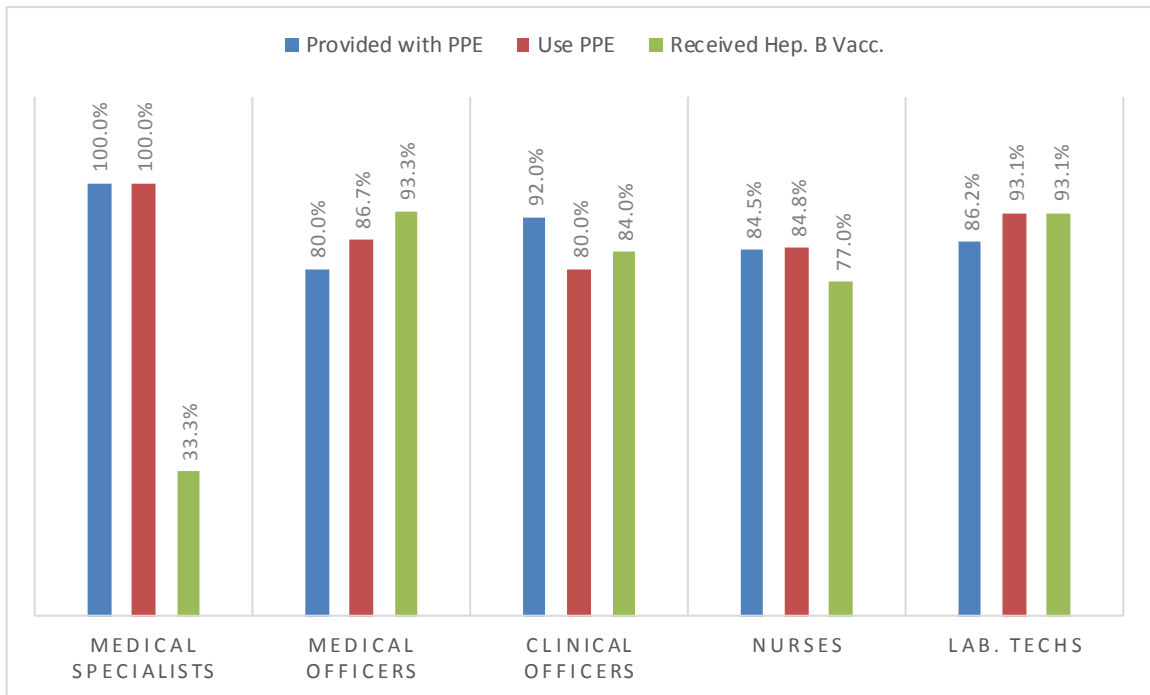


Figure 4: Respondents' score on Occupational Health & Safety per Cadre

4.8 Summary of results by objectives

Generally, on compliance performance per objective, training scored 37.1%, knowledge on HCWM scored 50.72%, occupational health & safety measures while handling HCW scored 65.0%, practices on HCWM processes from transportation to final disposal scored 25.8% and financing aspects linked to HCWM scored 0%. The overall compliance the score was 35.7% (Table 9).

Three objectives were rated poor; training on HCWM, practices on HCWM & financing aspects.

Two objectives were rated fair; knowledge on HCWM and occupational health & safety measures when handling HCW.

The overall compliance score was poor.

Table 9 : HCWM Summary Compliance Indicators per objective

	SPECIFIC OBJECTIVE	INDICATOR	Compliance (%)	Aggregate (%)
1.	To determine proportion of health workers trained in HCWM	Percentage of Health workers trained in HCWM	41.3	37.1
		Percentage of Health workers trained in IPC	51.0	
		Percentage of Health workers trained in Injection Safety	19.0	
2.	To evaluate health workers' Knowledge in HCWM	Percentage of Health workers giving correct definition of HCWM processes from transportation to final disposal	45.2	50.72
		Percentage of Health workers with knowledge on right person responsible for HCWM	78.3	
3.	To investigate occupational health & safety measures in place in relation to HCWM	Percentage of Health workers vaccinated against Hep. B	78.3	65.0
		Percentage of health workers provided with enough PPEs	85.8	
		Percentage of health workers utilizing PPEs	86.0	
		Percentage of health facilities with WH utilizing PPE's	75.0	
		Percentage of health facilities with functional IPC Committee	0	
4.	To assess the current waste handling processes from transportation to final disposal	Percentage of Health facilities handling HCW Correctly	29.2	25.8
		Percentage of Health facilities with M/E tools	0	
		Percentage of Health facilities utilizing M/E tools	0	
		Percentage of Health facilities with SOPs/Job aids strategically displayed	0	
		Percentage of Health facilities with HCWM Guideline policy document	100.0	
5.	To assess financing aspects linked to HCWM.	Percentage of facilities with specific budget allocation on HCWM	0	0
		Percentage of health facilities with a costed HCWM for that year	0	
COMPLIANCE PERFORMANCE				35.7

Chapter 5: DISCUSSION

This chapter presents a discussion of the main findings of the study on compliance by health facilities to the National health care waste management guidelines of 2008 in Machakos Sub County.

5.1 Healthcare Workers' Training on HCWM

Based on the findings of this study, it was clear that generally capacity building has not been prioritized. On post basic training on various health priorities, it was found that only 28.5% (80/281) had received training. This was low compared to 71.5% (201/281) of the respondents who had not received post-basic medical training. These findings imply that healthcare facilities in the county have not invested significantly in training of health workers in different health priorities such as healthcare waste management. This can be attributed to the health care financing model adopted in the county. The decentralization of healthcare in Kenya implies that cash-starved devolved units are not keen in undertaking large scale training initiatives.

The findings in Table 5 show that 41.3% (33/80) of health workers had received HCWM training and Fig.2 indicated that only 50% (3/6) of medical officers, 40% (2/5) of clinical officers, 43.3% (23/53) of nurses and 31.3% (5/16) of lab technicians had received training in HCWM. This was lower compared to training in other areas. For instance, 60% (48/80) (rated as fair compliance) of respondents had received HIV related post basic training. These findings imply that even though the Ministry of Health has developed and disseminated policy guidelines on healthcare waste management in the country, reluctance in implementation poses the biggest threat in the country's healthcare progression unto attainment of highest standards level.

Findings of the study demonstrated that the level of capacity building among the health workers on HCWM related trainings was low at 41.3% (33/80) having been trained; the guidelines state that for good compliance at least 75% (211/281) of health workers should be trained on HCWM and have periodic updates. This was too low and hence rated as poor compliance to the set standards. This resembled a study done by Khan, Cheng, Khan and Ahmed (2019) which established that inadequate training of health practitioners resulted in inappropriate handling of waste, which resulted in health risks in Asian developing countries.

It was surprising to note that none of the medical specialist had received any HCWM related training despite their high level of education, advanced age/more experience in service & high chance of them being the facility in charges; consequently, the knowledge level for this cadre was wanting compared to the other cadres. This was attributed to the busy schedule of this category of health workers and the assumption that HCWM was not as important as clinical service delivery. Them being the heads of health facilities and having no training in HCWM would trickle down to the lower-level category of staff.

Similar findings were reported by a study done in Uganda by Wafula, Muusine and Opara (2019) that showed diploma holders had better knowledge in HCWM than study participants with higher secondary education. This can be linked to the assumption that healthcare waste management is not part of medical specialists' job description. This can also be attributed to the fact that most specialists refrain from attending trainings due to their busy schedules in offering health care since all of them felt they had a responsibility in HCWM.

The lack of personal initiative among healthcare workers to attend workshops and trainings makes it difficult for healthcare organizations to manage contemporary issues linked to

healthcare waste management in the country. Further, it is important to note that there is more emphasis on healthcare waste management among diploma holders compared to their counterparts with degree and masters' graduates (Nkonge et al., 2014).

5.2 Healthcare Workers' Knowledge on HCWM Processes

On knowledge assessment, of the six aspects factored three of them were rated poor (HCW storage, correct storage & HCW final disposal), one aspect was rated fair ie HCW right transportation and two aspects were rated good (HCW treatment option and HCWM responsibility by all health workers). An average score of 50.72% rated fair was demonstrated. The guidelines state that at least 75% of health workers to have adequate knowledge on HCWM; the result was fair however, it requires more improvement. On final HCW disposal, this was the aspect with least level of knowledge with none of the responses being in the affirmative.

In a study done by Njiru (2015) there was a similarity with only 51% of the respondents having adequate knowledge and a relationship between training and level of knowledge demonstrated. This study concurs with a study done in Kenya; Rift Valley, Central and Western provinces which showed that many (61%) of health workers had been trained on HCWM (MoH 2007). This is stagnant, since several years later the percentage has not improved significantly; this may mean that Counties have not taken HCWM as a key priority. The county need to up its game and invest more in trainings especially on HCWM hence improving knowledge levels among the health workers.

The County and the Ministry of Health should work towards creating awareness on the legal implications of improper healthcare waste management.

5.3 Assessing Current Healthcare Waste Management Practices

On HCWM practices five aspects were assessed in this study, four of the aspects had poor compliance (HCW handling processes, availability & use of M/E tools and display of SOPs/job aids).

The remaining aspect (availability of HCWM Policy guidelines) had good compliance. The overall compliance score was poor. This resembled a study done in Nairobi 2010 that demonstrated that 97% of health facilities assessed erroneously categorized waste into only two categories: sharps and non-sharps.

None of the health facilities complied to the guidelines of transportation, resembling a study done in 2012 by MoH in 4 provinces - Nairobi, Central, Rift Valley and Western that demonstrated that all health facilities transported HCW without differentiating into the right categories and utilized wheelbarrows, more than 50% of them reported waste spillages. Although the Ministry of Health has developed guidelines related to healthcare waste management, the findings of this study indicated that poor incineration, crude dumping, and mixing different categories of wastes are still rampant phenomena in Machakos and the rest of the country. This poses a risk to the human population, the environment and culminates in poor health.

It was surprising to note that the lowest level of care (25%) was the only facility that had the right HCW store, lockable and inaccessible to unauthorized people, contrary to what was expected.

On treatment option incineration was the waste treatment option used by most health facilities, the lowest level of care facility inappropriately did open burning as their treatment option. However, only the highest-level of care facility (25%) had a functional incinerator. This is like a

study done by MoH 2012 which showed 62% of health facilities used incineration as the treatment option and 25% of them were demonstrated as not ideal.

The study also points to the existent shortcomings in segregation of health care waste, failure to rightly segregate waste increases the bulk of hazardous waste increasing the cost of HCWM and the risk involved in handling such health care waste.

On final disposal option all the facilities inappropriately did simple pit disposal of treated waste. This differed from the assessment done in 2012 by MoH that demonstrated more than 50% of health facilities assessed had an appropriate final disposal site. There is need to improve on this process of HCWM since this determines to a large extent the risks exposure to the public and to the environment.

5.4 Occupation Health and Safety

On health workers occupation health & safety, five aspects were assessed (PPE provision & use, Hep. B vaccination, PPE use by WH at facility level and presence of facility IPC committees instituted). Four of the aspects were scored as good compliance and only presence of IPC Committee aspect scored poor compliance. Generally, overall compliance was fair at 65.02%.

Based on the findings of this study, the health facilities grapple with shortage of PPEs. Increasing investment in PPEs can help in bridging gaps observed. There were still some health workers, 14.2% (40/281) who were not provided with PPEs while handling of healthcare waste and 14% (39/279) of health workers who did not use PPE although it had been provided.

This study illustrated that medical specialists are characterized with commendable use of PPEs but 20% (5/25) of the clinical officers underutilized PPEs. There is a need to increase PPE use awareness among the health workers.

Failure in addressing occupational hazards and safety matters is against MoH (2012) guidelines on HCWM. The analysis of the findings obtained in relation to these variables indicate that there is a need for the County Government of Machakos to invest more resources in ensuring health workers' and waste handlers' safety while handling health care waste.

From the study, it was also evident that health workers and waste handlers were at risk and face occupational hazards if the ministry's standards are not implemented.

The lack of functioning IPC committees in any of the health facilities also implies that it is hard to monitor and audit HCWM in the health facilities. There is need to advocate for this committees to be functionalized to ensure proper HCWM is done including conducting periodic risk assessment in all health facilities.

An average of 85.8% (240/279) of health workers were provided with PPEs & 86% (217/277) utilized PPEs, in 75% of the health facilities waste handlers were observed as utilizing relevant PPEs, this was a good practice comparing to the MoH assessment of 2012 results that showed only 37% of health facilities provided a variety of relevant PPE's. There is need to strive more in having this right practice adopted in all health facilities in Machakos County.

5.5 Financial aspect in Healthcare Waste Management

On Financial aspects on HCWM at facility level the compliance level was rated as poor with none of the health facilities having estimated annual HCWM cost or having factored HCWM in their annual budget. Despite having the general understanding that some finances must have been utilized in HCWM having this allocation missing in the budget can be translated as low financial commitment towards this very key part of service delivery.

This concurs with the study done in Uganda in 2020 that identified low/no budgetary allocation as one of the factors causing inappropriate HCWM in developing countries, Kenya included. The need for a specific HCWM vote line factored in the health facility budget must be emphasized in Machakos County.

The findings obtained in this study underlined the correlation between financial constraints in the county directed to HCWM and poor compliance to guidelines on healthcare waste management.

While Level 2 health facilities in Machakos sub- county use open burning level 3, 4 and 5 hospitals practice incineration. This illustrates how the Level 2 health facility in the sub-county have access to limited resources. This also indicates that the County government and relevant stakeholders may be concentrating less on Level 2 health facilities.

Another observation made in the study was that while Level 3 and 4 hospitals in the sub-county had incinerators, both were not in good working conditions. This needs to be improved, of course requires financing.

Final disposal in all categories was done through simple pits. The lack of job aids and M/E

tools in all categories also indicates that there is a need for more investment in HCWM.

Considering that in all health facilities where the study was conducted lacked evidence to show the annual cost of healthcare waste management, it becomes clear that planning functions are hampered, HCWM needs to be picked up as a key priority in healthcare service delivery for Machakos County and the same be portrayed in the health facilities' operational plans and budgets.

Generally, the overall performance was poor with an aggregate score of 35.7% computed from the 17 indicators specified under the 5 specific objectives (Table 9).

The score was better compared to the assessment done by MOH in 2013 (HCWM Plan 2016 – 2020) which showed overall aggregate score on compliance of health facilities to HCWM guidelines of 14.24%. Both scores fall under poor compliance as given in the pre-determined criteria by MoH 2013. The need for improvement must be emphasized if we are to uphold the Kenyan Constitution on every citizen having a right to safe and clean environment.

Chapter 6: CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The Kenya National HCWM guideline of 2008 stated that all health workers including the support staff should be capacity built on HCWM principles and its significance for both individual and entire community's benefit.

This study assessed 5 specific objectives; capacity building on HCWM had an average score of 37.1%, knowledge of health workers on HCWM scored 50.7%, practices of HCWM processes from transportation to final disposal 25.8%, occupational health & safety scored 65.0% and financing aspects linked to HCWM scored 0% (Table 9).

The aggregate performance score was 35.7% rated as poor (0 – 49%) in the pre-determined criteria on HCWM given by MoH in 2013, indicating that the health facilities did not comply with the set out MOH guidelines

6.2 RECOMMENDATIONS

6.2.1 More research to explore factors hindering appropriate HCWM

There is need for more investment to be done in research on exploring the implementation gaps that need to be breached at both National and County level. This will inform both policy makers and implementers intervention levels aimed at improving the MOH HCWM indicators.

6.2.2 The harmonization and operationalization of existing legal framework

National government in conjunction with the County Government to customize existing legislation frameworks by creating operational linkages among different stakeholders enforcing HCWM. This will consolidate all efforts into ensuring a safe environment and a healthy public.

6.2.3 Enhanced training opportunities by the National Government

National government should create more post-employment training opportunities targeting all workers working in a health facility both technical and support staff. This in close liaison with the County Government will have health staff well equipped, ensuring continuous upgrading on HCWM guidelines for all cadres.

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Chapter 8: APPENDICES

8.1 Appendix 1: ERC LETTER



Yours sincerely


PROF. M.L. CHINDIA
SECRETARY, KNH/UON-ERC

c.c. Prof. A.N.Guantai, Chairperson, KNH/UoN-ERC
The Deputy Director CS, KNH
The Principal, College of Health Sciences, UoN
The Director, School of Public Health, UoN
AD/Health Information, KNH
Supervisors: Ms. Mary Kinoti, Dr.Richard Ayah, Dr. Dismas Ongore

"Protect to Discover"

8.2 Appendix 2: Request letter to the County Director Health

Appendix 7: Request letter to the Ministry of Health Director

12/1/2012
Noted, Approval letter by
Ethical Research Committee not
CofP ERMH-ERC/A/251.
Faculty Yc - Please account her
all her security archives.

JUDITH MUENI KIMUYU,
UNIVERSITY OF NAIROBI- CHS,
SCHOOL OF PUBLIC HEALTH,
P.O.BOX 30197-00100,
NAIROBI.



DATE 7/02/2014

TO
THE MACHAKOS COUNTY DIRECTOR OF HEALTH
P.O.BOX 19,
MACHAKOS.

Dear Sir,

REF: REQUEST TO CARRY OUT A RESEARCH AT HEALTH FACILITIES
IN MACHAKOS DISTRICT

I am Judith Mueni Kimuyu pursuing a Master's of Public Health degree in the University of Nairobi, School of Public Health. I am in part II currently and one of the requirements for the award of the degree is a research project. I have proposed to carry out a research on 'Evaluation of operationalization of the National Health Care Waste Management guidelines of 2008 in Machakos District Health facilities' with approval of the University of Nairobi/ Kenyatta National Hospital Ethical

Research Committee between September and November 2013. During the study, Athi River level 4 health facility will be used to conduct the pilot study and Machakos level 5, Bishop Kioko Catholic, Katumani level 3 and Mutituni level 2 HF's will be used for the actual data collection.

I will be using questionnaires to collect data from the HF's staff and observational checklists to assess the HF's compliance to Health Care Waste Management guidelines. I don't intend to interfere with the smooth running of the health institutions at any point and the data collected will be kept private and confidential to be used only for research and academic purposes. After completion of this study results obtained shall be submitted to your office for your future use to improve Health Care Waste Management in the institutions.

I look forward to your positive consideration. Thank you in advance.

Yours faithfully,



Judith M. Kimuyu

8.3 Appendix 3: Questionnaire

Questionnaire on the Assessment of Health Care Waste Management in Machakos Sub County

NAME OF HEALTH CARE FACILITY.....

SECTION A: Knowledge of Health Workers on HCWM

1. AGE.....

2. Sex M F

3. What is your Designation

Medical specialist

Medical officer

Clinical officer

Nurse

Laboratory technologist

4. Years of experience in clinical work.....

5. Have you received any post-basic medical training in the last 3.5 years?

Yes

No

6. If yes how many trainings have you received?

.....
.....

7. Give details on the type of training as shown in the table

Training	Sponsor (self or employer)	Duration	Certificate awarded (yes/no)

8. Was any of the trainings received on HCWM?

Yes

No

9. If yes how did it come about?

Self-initiative Health facility initiative

10. Can all health care waste be transported together?

Yes No

11. Should health care waste be stored before disposal?

Yes No

12. If yes how should it be stored?.....
.....
.....

13. How is health care waste treated in your health facility?

Incineration Autoclaving
Microwaving Shredding
Don't know

Any other (specify).....

14. How should all health care waste be finally disposed?

.....

15. Who participates in HCWM in your health facility

The HF administration Waste handler

All health workers Public health officer

Any other (specify)

B. Practices of Health Workers on HCWM

16. Have you been vaccinated against Hep. B?

Yes No

17. Are you provided with personal protective equipment daily

Yes No

18. Do you use the PPE provided daily?

Yes No

8.4 Appendix 4: Observation Checklist

Observation checklist for assessment of health care waste management in Machakos sub county

Name of Health Facility.....

1. How is waste transported from points of generation?.....

.....
.....

2. Is there a waste storage area?

Yes No

If yes describe the state of the storage area

.....
.....

3. How many categories is waste differentiated into?

.....

Category of waste noted

.....
.....

4. Is there any evidence of HCW treatment?

Yes No

What method(s) is/ are seen.....

5. Is there an incinerator within the health facility?

Yes No

DESCRIBE the state of the incinerator?.....

.....
.....
.....

6. What final disposal method is seen at use within the health facility's compound?

Open dump site

Crude burning site.

Sanitary landfill

Simple pit

7. Are waste handlers utilizing relevant PPEs?

Yes No

If yes what PPEs are they

utilizing.....

.....

8. Has the Health facility budget captured HCWM vote line?

YES NO.

If yes comment on proportion.....

9. Does the health facility have current annual estimate cost of HCWM?

Yes

No

10. Does the health facility have functional IPC Committees?

YES.

NO.

If yes check for evidence of meetings.....

11. Does the health facility have HCWM M/E tools?

YES.

NO.

Specify which tools.....

12. Does the health facility have HCWM SOPs and job aids displayed at strategic places?

YES.

NO.