

**ASSESSMENT OF MANAGEMENT OF HEALTH-CARE
WASTES IN NON-GOVERNMENT HEALTH CARE
FACILITIES IN NAIROBI PROVINCE**

RESEARCH THESIS

**Thesis submitted as part fulfilment of the requirement for the degree of
Master of Public Health**

University of Nairobi

By: Dr. Washington Njogu Ngari, MD (Perugia)

Department of Community Health

University of Nairobi

University of NAIROBI Library

0537470 7

June 2009

**UNIVERSITY OF NAIROBI
MEDICAL LIBRARY**

**ASSESSMENT OF MANAGEMENT OF HEALTH-CARE
WASTES IN NON-GOVERNMENT HEALTH CARE
FACILITIES IN NAIROBI PROVINCE**

RESEARCH THESIS

**Thesis submitted as part fulfilment of the requirement for the degree of
Master of Public Health**

University of Nairobi

By: Dr. Washington Njogu Ngari, MD (Perugia)

Department of Community Health

University of Nairobi

University of NAIROBI Library

0537470 7

June 2009

**UNIVERSITY OF NAIROBI
MEDICAL LIBRARY**

DECLARATION

I, WASHINGTON NJOGU NGARI declare that the work contained herein is original idea and has not been presented at any other place to the best of my knowledge.


Signature: U J . V r A l K ^ . k l l l) .] ^ Date: U I v k i . t . . . L P

APPROVAL BY SUPERVISORS

This thesis has been submitted with our approval as university supervisors.

PROF. MUTUKU A. MWANTHI, BSc; MSEH; Ph.D.

Department of Community Health, University of Nairobi/

Signature..  Date.. ^.....

MRS. MARY KINOTI, BSc; MSc.

Department of Community Health, University of Nairobi / . . /

Signature.  D a t e . . . /

DR MICHAEL J. GATARI, Mphil; PhD.

Institute of Nuclear Science and Technology, University of Nairobi

Signature.... 'J?.....Date..

APPROVAL BY DEPARTMENT

This thesis has been submitted with the approval of:

THE DEPARTMENT OF COMMUNITY HEALTH, University of Nairobi

CHAIRMAN'S signature.1 (A1& . 0/9/09

DEDICATION

To my wife Joyce for her encouragement, support and for the long periods of my absence she endured while I was away conducting research and preparing this thesis. I also dedicate it to my dear mother Katherine Ngari.

I also dedicate it to Prof Guido Sacchi in whose memory I was able to pursue this course.

ACKNOWLEDGEMENT

I am greatly indebted the following without whose assistance this thesis would not have been realized:

My most heartfelt and profound gratitude to my supervisors; Prof. M. A. Mwanthi and Mrs. M. Kinoti; of the Department of Community Health, University of Nairobi, and Dr. M- J- Gatari; of the Institute of Nuclear Science and Technology, University of Nairobi for their invaluable assistance, guidance, patience, support and the time they devoted in the critical review of this thesis.

I would also like to appreciate the kind contribution from Dr. Gianfranco Morino of the World Friends organization for all the assistance accorded during this research.

I also appreciate the assistance accorded to me by Mr. Langat the former Chief Public Health Officer, Ministry ^Health.

I also appreciate the assistance accorded to me by Mr. Nyabola of the Department of Community Health, University of Nairobi

Finally, I would like to recognize my fellow postgraduate colleague; Dr. Christopher E. Ekuttan encouragement and support and in brain storming of ideas,

God bless you all.

TABLE OF CONTENTS

DECLARATION.....	i
APPROVAL BY SUPERVISORS.....	ii
APPROVAL BY DEPARTMENT.....	iii
DEDICATION.....	iv
ACKNOWLEDGEMENT.....	v
LIST OF FIGURES.....	ix
LIST OF TABLES.....	xi
ABBREVIATIONS.....	xi
ABSTRACT.....	1
CHAPTER 1.0: INTRODUCTION.....	3
1.1: CLASSIFICATION OF HEALTH-CARE WASTES.....	4
1.2: PRINCIPLES FOR THE SOUND MANAGEMENT OF HEALTH-CARE WASTES.....	5
1.2.1: Allocation of resources.....	6
1.2.2: Waste minimization and re-cycling.....	6
1.2.3: Waste segregation and colour coding.....	6
1.3.1: Safe transportation and storage of health care wastes.....	8
1.4: SAFE TREATMENT OF HEALTH CARE WASTES.....	9
1.4.1: Treatment options for waste.....	10
1.4.2: Chemical disinfection.....	10
1.4.3: Autoclaving (Wet thermal treatment).....	11
1.4.4: Microwave irradiation.....	11
1.4.5: Incineration.....	12
1.4.6: Encapsulation.....	13
1.5: SAFE DISPOSAL OF HEALTH CARE WASTES.....	13
CHAPTER 2.0: LITERATURE REVIEW.....	15
2.1: HEALTH CARE WASTE GENERATION.....	15
2.2: HEALTH RISKS ASSOCIATED WITH HEALTH CARE WASTE.....	15
2.3: HEALTH CARE WASTE MANAGEMENT.....	18
CHAPTER 3.0: PROBLEM STATEMENT.....	21
3.1: GENERAL OBJECTIVE.....	22
3.2: SPECIFIC OBJECTIVES.....	22
3.3: RESEARCH QUESTIONS.....	22
3.4: JUSTIFICATION.....	23

CHAPTER 4.0: METHODOLOGY.....	24
4.1: STUDY DESIGN.....	24
4.2: STUDY AREA.....	24
4.3: STUDY POPULATION.....	25
4.3.1: Inclusion and exclusion criteria.....	25
4.4: SAMPLING PROCEDURE.....	25
4.5: DATA COLLECTION.....	26
4.5.1: Questionnaire administration.....	26
4.5.2: Observation checklist.....	27
4.6: VALIDATION OF DATA COLLECTION TOOLS.....	28
4.7: CONTROL OF BIASES AND CONFOUNDERS.....	28
4.8: STUDY VARIABLES.....	28
4.8.1: Independent variables.....	28
4.8.2: Dependent variables.....	28
4.9: DATA MANAGEMENT AND ANALYSIS.....	28
4.10: ETHICAL CONSIDERATION.....	29
4.11: LIMITATIONS OF THE STUDY.....	29
CHAPTER 5.0: RESULTS.....	30
5.1: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS.....	30
5.2: RESULTS OF HEALTH CARE WORKERS.....	32
5.2.1: Knowledge of health care workers on HCWM.....	32
5.2.2: Attitudes of health care workers on HCWM.....	35
5.2.3: Practices of health care workers on HCWM.....	35
5.3: RESULTS OF THE WASTE HANDLERS.....	39
5.4: PERSONAL PROTECTIVE MEASURES EMPLOYED BY THE WASTE HANDLERS.....	40
5.5: RESULTS ON HCWM <i>IN</i> HEALTH CARE FACILITIES.....	41
5.5.1: Presence of a HCWM plan, waste management team, waste management officer and provision of personal protection equipment.....	42
5.5.2: Segregation of wastes.....	43
5.5.3: Waste colour coding.....	43
5.5.4: Safe transportation of wastes within the facility.....	44
5.5.5: Waste storage.....	44
5.5.6: Waste treatment and disposal.....	44
5.6: Financial resources allocated for HCWM.....	45

CHAPTER 6.0: DISCUSSION.....	46
CHAPTER 7.0: CONCLUSIONS AND RECOMMENDATIONS.....	50
7.1: CONCLUSIONS.....	50
7.2: RECOMMENDATIONS.....	51
REFERENCES.....	52

CHAPTER 6.0: DISCUSSION

CHAPTER 7.0: CONCLUSIONS AND RECOMMENDATIONS

7.1: CONCLUSIONS

7.2: RECOMMENDATIONS

REFERENCES

APPENDICES

Appendix 1. Institution consent form.....	55
Appendix 2. Individual consent form.....	56
Appendix 3. Questionnaire.....	57
Appendix 4. Observation checklist.....	61
Appendix 5. Ethical considerations.....	63

LIST OF FIGURES

Figure 1: The geographical location of Nairobi province.....	24
Figure 2: Percentage of the different categories of health workers interviewed.....	30
Figure 3: Distribution in percentage of the facility administrators according to their profession.....	31
Figure 4: Distribution in percentage of the waste handlers according to their training.....	32
Figure 5: Definition of health care wastes by the health workers.....	33
Figure 6: Health care workers' understanding of waste segregation.....	34
Figure 7: Knowledge of health workers on the meaning of waste colour coding.....	34
Figure 8: Number of categories of waste produced by institutions.....	43

LIST OF TABLES

Table 1: Classification of health care wastes.....	4
Table 2: Examples of typical items placed in separate waste containers.....	8
Table 3: Treatment methods suitable for different categories of health care wastes...	10
Table 4: Disposal methods suitable for the different health care wastes categories...	14
Table 5: Infections from exposure to hazardous health care wastes.....	17
Table 6: Categories of health care facilities selected.....	26
Table 7: Training on HCWM of the different cadres of health care workers.....	31
Table 9: Frequency of needle prick injuries in relation to the practice of re-capping used needles.....	36
Table 10: Categories of wastes produced by the health care workers.....	37
Table 11: Influence of HCWM training on the knowledge, attitude and practices of the health workers.....	38
Table 12: Relationship between HCWM training and the incidence of needle prick injuries among waste handlers.....	39
Table 13: Immunization status of the waste handlers.....	39
Table 14: Provision of personal protective equipment (PPE) by HCFs.....	40
Table 15: Usage personal protective equipment (PPE) by the waste handlers.....	41
Table 16: Services offered by the health care facilities selected.....	41
Table 17: Number of institutions and the elements of HCWM.....	42
Table 18: Types of colour codes in use by the practising facilities.....	43
Table 19: Waste treatment and disposal methods adopted by the facilities.....	45.

ABBREVIATIONS

AIDS	-	Acquired Immunodeficiency Syndrome
DNA	-	Deoxyribonucleic Acid
ESF	-	Environmentalists Sans Frontiers
HBV	-	Hepatitis B Virus
HCF	-	Health-Care Facility
HCV	-	Hepatitis C Virus
HCW	-	Health Care Waste
HCWM	-	Health Care Waste Management
HIV	-	Human Immunodeficiency Virus
HMIS	-	Health Management Information System
MOH *	-	Ministry of Health
MMIS	-	Making Medical Injections Safer project
NEMA	-	National Environmental Management Authority
PPE	-	Personal Protective Equipment
PVC	-	Polyvinyl chlorides
UNICEF	-	United Nations Children's Fund
UNCED	-	United Nations Conference on the Environment and Development
VCT	-	Voluntary counselling and testing centre
WHO		World Health Organization
WMO	-	Waste Management Officer
WMT	-	Waste Management Team
X²	-	Chi square

ABSTRACT

Poor management of health care wastes exposes health care workers, waste handlers and the community to infections, toxic effects and injuries. Despite this inherent hazardous nature of the health care wastes, their treatment and disposal remains neglected and unattended within the urban municipal waste systems in Kenya. The national healthcare waste management plan is yet to be implemented, consequently leaving the management of the health care facilities (HCFs) without a reference on how to manage their wastes.

The goal of this study was to provide data that can be used to improve HCWM by analyzing the existing practices currently adopted by the health care facilities. The general objective was to carry out a situation analysis on the management of health care wastes in non- government health care facilities. This was a descriptive cross-sectional study that assessed health care waste management (HCWM) in 24 non-governmental (12 mission and 12 private owned) HCFs in the Nairobi province. An observation checklist was used to document the various elements of HCWM practiced within the HCFs. It included the presence of a HCWM plan, a waste management team, provision of personal protective equipment for the waste handlers, waste segregation, waste colour coding, storage, safe transportation, treatment and disposal. Structured questionnaires were used to elicit information on the knowledge, attitudes and practices of the different cadres of health workers and waste handlers, and to determine the management's contribution towards safe HCWM. Sixty five health care workers, 24 waste handlers and 24 facility administrators were interviewed.

The study found that no facility had a HCWM plan and only 3 HCFs (12.5%) had a waste management team headed by a waste management officer. Waste segregation was found to be inadequate as no facility had a general waste category hence all the wastes produced within these facilities are considered hazardous and have to be treated prior to disposal. Waste storage facilities were not adequate as they are easily accessible and not secure. Waste was transported manually in 21 facilities (88%), putting the waste handlers at risk of injuries and infections. The only treatment method found to be in use within the facilities is incineration and only 13 facilities (54/o) were found to have functioning incinerators. The incinerators are the De M^ontfort type and there are no measures for emission control in place and can therefore be source of air pollution putting the community at risk of disease. Private collectors are used by two thirds of the facilities to dispose their wastes while the rest

dispose them within their premises by means of a landfill or open pit. There was no specific budget allocation for HCWM except in the cases where the services of private waste collectors were used.

The knowledge of the health workers on HCWM was found to be inadequate, but their attitude was found to be positive. Three quarters of the health workers re-cap used needles, they have low immunization rates against tetanus and hepatitis B virus and the rate of needle prick injuries was low at 6% in the previous one month. Twenty one facilities (88%) provide personal protection equipment (P.P.E.) for their waste handlers and the waste handlers had high levels of compliance in the usage of the P.P.E. Immunization status and needle prick injuries among the waste handlers were also low.

These findings show that there is need to implement the national policy on HCWM so as to improve and harmonize HCWM within the facilities.

Key words: health care wastes, health care waste management, health care facilities

CHAPTER 1.0: INTRODUCTION

Waste is something, which the owner no longer wants at a given place and time and which has no current or perceived market value (Suess and Huismans, 1983).

Health care waste (HCW) is defined as all the waste generated in the process of health care provision. This includes all the waste generated from health care facilities like hospitals, dispensaries, clinics, laboratories, research facilities and home based care. Between 75% to 90% of the total health care waste produced is general waste that is comparable to domestic waste and mostly comes from the administrative and housekeeping functions of the health care facilities. The remaining 10% to 25% are hazardous health care wastes which may cause a variety of health risks (Pruss and Townend, 1999).

Health care facilities generate and discharge a wide range of hazardous wastes into the environment. The preferred modes of waste disposal are incineration or landfill disposal. However not all types of wastes can be incinerated and not all health care facilities can maintain a sanitary landfill (Mwanthi and Mutua, 2002).

Although the management of health care wastes is a serious concern, few African governments have provided guidelines on their effective management. In Kenya only a few individuals among the management staff of the health care facilities are familiar with sound waste management policies. In many instances waste handling is left to the least educated and lowest cadre of workers, who normally operate without any training, guidance or supervision (ESF 2005). Also the practice of indiscriminate open dumping of waste is rampant and this worsens the situation (Mwanthi and Mutua, 2002).

The Government owned health care facilities in Kenya do not have a health care waste management plan, although most of them have a public health officer who is well trained in the handling of health care wastes (ESF, 2005).

Proper health care waste management has many advantages that include control of nosocomial infections and reduction of community exposure to multi drug resistant bacteria. It also addresses the safety of health care workers by reducing the risks of

needle prick injuries, HIV/AIDS, sepsis and hepatitis transmission from needles and other medical items that are not properly disposed (WHO, 2003).

1.1: CLASSIFICATION OF HEALTH-CARE WASTES

Health care wastes are classified into ten main categories by WHO (1999) as shown in Table 1.

Table 1: Classification of health care wastes

Waste category	Characteristics	Source	Potential health effects
General wastes	Domestic type waste and packing materials.	Administration, kitchen and wards.	No hazard to human health or the environment.
Infectious wastes	Suspected to contain pathogens (bacteria, viruses, parasites, or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts. Includes; dressings, gloves, disposable items contaminated by excreta and I.V. tubing.	Cultures and stocks from laboratory and nursing care.	Infection of humans by the pathogens. Contamination of underground and superficial waters.
Pathological waste	Consists of tissues, organs, body parts, human foetuses, animal carcasses, blood, plasma and body fluids.	Waste from surgical theatres, maternity wards autopsies, and laboratory.	Similar to infectious wastes.
Sharps	Includes needles, scalpels, knives, I.V. cannulas, broken glass and nails.	Waste from, surgery, autopsies, laboratory, nursing care and general maintenance.	Can inflict cut wounds and introduce infections.
Pharmaceutical waste	Includes expired, unused and contaminated pharmaceutical products, drugs, vaccines and sera that are no longer required.	Pharmacy, nursing care and stores.	Corrosive, flammable, Mutagenic, and carcinogenic.
Genotoxic wastes	Wastes containing cytotoxic drugs and genotoxic chemicals,	Specialized HCFs that administer cancer therapy.	Mutagenic, carcinogenic and teratogenic effects.
Chemical waste	Discarded solid, liquid and gaseous chemicals from diagnostic, experimental work, housekeeping and disinfecting procedures.	Pharmacy, laboratory, nursing care and stores.	Corrosive, flammable, reactive and explosive.
Wastes with a high content of heavy metals	Batteries, dental amalgams that contain mercury, broken thermometers and blood pressure machines.	Pharmacy, dental units, nursing care and stores.	Deposits in the fatty tissues along the food chain.
Pressurized containers	Aerosol cans, cartridges and gas cylinders.	Pharmacy, nursing care and stores.	May explode if incinerated or punctured.
Kadio -active waste	Solid, liquid and gaseous materials contaminated with radio nucleotides.	Specialized HCFs that use radio nucleotides for diagnostic and therapeutic purposes.	Mutagenic, carcinogenic and teratogenic effects.

Source: WHO, (1999)

1.2: PRINCIPLES FOR THE SOUND MANAGEMENT OF HEALTH-CARE WASTES

Health care waste management (HCWM) is a process that ensures proper hospital hygiene and the safety of health care workers and communities. It includes planning, procurement, construction, staff training, proper use of tools, machines and pharmaceuticals, proper disposal methods inside and outside the hospital, and process evaluation (WHO, 2003).

The United Nations Conference on the Environment and Development (UNCED) in 1992 led to the adoption of Agenda 21. The Agenda 21 recommends a set of measures for waste management which aim to:

- Prevent and minimize waste production.
- Re-use or re-cycle waste as much as possible.
- Treat waste by safe and environmentally sound methods.
- Dispose of the final residues by landfill in confined and carefully designed sites.

It also stresses that any waste producer is responsible for the treatment and final disposal of his own waste and where possible, each community should dispose of its wastes within its own boundaries (UNCED, 1992).

The human element is more important than technology. Health care waste management (HCWM) requires diligence and care from a chain of people, starting with the nurses or doctors who use the equipment and supplies that become waste, through to the porter who provides clean sacks or containers and carries away the waste, on to the technicians who keep the equipment in good condition. At the end of the chain we have the person responsible for ensuring that wastes are treated and disposed of in the correct manner. If any of these is careless in their work, or allows scavengers to access the waste, the chain is broken and danger follows (Coad, 1992).

Each health care facility should have a waste management team (WMT) headed by a waste management officer (WMO). The mandate of the waste management team is to formulate guidelines for a health care waste management plan within the facility. This includes allocation of funds, staff training, waste minimization and re-cycling, waste segregation and colour coding, safe collection and storage, waste treatment and disposal (Government of Nigeria, 2006).

1.2.1: Allocation of resources

Good HCWM is not free of charge, but when all is included it represents only a minor part of the total running costs of the facility, around 0.1 to 0.2%. Therefore savings on this process account for an insignificant proportion of the total expenditure (Coad, 1992).

The waste management officer should ensure that all waste handlers should be provided with personal protective equipment (PPE). These should include safety spectacles, facial masks, uniforms, aprons, heavy duty gloves and industrial boots (Government of Nigeria, 2006).

1.2.2: Waste minimization and re-cycling

Waste minimization includes any source reduction or re-cycling activity by a generator that results in reducing either the quantity or the toxicity of the hazardous wastes, consistent with the goal of minimizing present and future threats to health and the environment (City of Los Angeles, 1995).

Medical equipment used in health care facilities can be reused, provided that they are designed to withstand the sterilization process. Reusable items may include certain sharps, such as scalpels, glass bottles and containers. After use, these should be collected separately from non-reusable items, carefully washed and then sterilized using thermal or chemical sterilization. Pressurized gas containers can be sent to specialized centres to be refilled. Containers that once held detergent or other liquids may be reused as containers for sharp wastes provided that they are puncture-proof and are clearly marked on all sides (Pruss *et al* 1999).

1.2.3: Waste segregation and colour coding

Waste segregation involves separating the waste into different waste streams at the point of generation, based on the hazardous properties of the wastes, treatment and disposal methods to be applied. Segregation is one of the most important steps in HCWM. Given that only 10-25% of all HCW are hazardous (Pruss and Townend, 1999), (WHO, 2005), proper segregation reduces the costs of waste treatment and disposal and the associated health risks (Government of Eritrea, 2003).

In a study on health care waste management and re-cycling in 4 major cities (Bogota, Hanoi, Karachi and Manila), the hazardous component of the wastes was estimated to be 30-70% of the total and this was attributed to the poor segregation of wastes at the point of generation thus resulting in the hazardous component being much higher (Pescod and Saw, 1998).

Unfortunately this stage involves the largest number of personnel and unless they have been well trained, most hospital staff probably knows little about the waste management process. This means that they do not appreciate what happens to the waste when it is taken from the ward or surgery and rarely thinks about the hazards that are posed by the material that they discard. The safety and well being of the waste handlers and the scavengers picking through the waste depends on the training, motivation and supervision of the health workers who generate the waste. Waste segregation is of great importance, because it allows special attention to be given to the relatively small quantities of waste that need it (Coad, 1992).

WHO recommends that all health care facilities should separate their wastes into a minimum of least three categories, namely; general, sharps and infectious wastes that does not contain sharps (WHO, 2005). For each of these categories there should be a clearly marked container and all staff should be able to identify the container for each particular type of waste. It is important to use colour codes for each type of waste. Each country has its own colour-coding scheme for HCW. In the UK black plastic bags are used for the general non-hazardous wastes, yellow plastic bags for the infectious wastes not containing sharps and yellow rigid puncture proof containers for sharps (Table 2) (Rushbrook *et al*, 2000).

The WHO recommends a black plastic bag for general wastes, yellow for infectious wastes not containing sharps, yellow rigid container for sharps and brown for the chemical and pharmaceutical wastes (Pruss and Townend, 1999).

To reinforce the importance of separating waste in medical departments, the yellow and black waste bags should be located in separate places. They should be located ^{a w a y} patient areas usually at the nurses' station and in the treatment room. Sharps containers should also be placed in the same locations and not in the patients' areas where they could be interfered with (Rushbrook *et al*, 2000).

Table 2: Examples of typical items placed in separate waste containers

General wastes container	Potentially infectious wastes container	Sharps wastes container
Waste materials not contaminated with body fluids (black plastic bags)	Waste materials contaminated or possibly contaminated with body fluids (yellow plastic bags)	Used sharp containers (yellow rigid container)
Packages, boxes, wrappings, newspapers, magazines, disposable plates, cups and utensils, food, food packaging, tissues, paper towels and flowers	Gloves, gowns, masks, gauzes, dressings, swabs, spatulas, urine bags, blood bags, suction canisters, disposable bowls and containers used for medical purposes, haemodialysis tubing, intravenous lines, catheters, sanitary napkins, incontinence pads, pre-treated highly infectious waste from medical laboratories and isolation patients, nappies, diapers, human and animal tissue, placentas and body parts.	Needles, syringes, lancets, blades, I.V. cannulas, scissors, sutures, broken glass, ampoules, glass slides and cover slips.

Source: WHO, (2000)

1.3.1: Safe transportation and storage of health care wastes

It the benefits of segregation are to be realised then there must be a secure internal and external collection and transportation system for waste (BAN, 1999).

Collected wastes must be transferred from the point of generation to storage areas for treatment and appropriate disposal. The wastes should be placed in rigid or semi-rigid and leak-proof containers. The health care waste management plan should include Procedures to be used if liquid wastes are spilled, plastic bags ruptured or equipment fails (City of L.A., 1995).

Within the health care facility wastes can be transported by means of trolleys or hand carts and they should not be used for any other purposes. These should be easily cleanable and designed to prevent leakage (Government of Nigeria, 2006).

Waste bags and containers should be sealed and carried to a waste storage room twice a day. However this should be done more often in operating theatres and intensive care rooms where they should be placed in separate piles according to the colour of the sacks. Porters carrying the waste should use personal protective equipment (P.P.E.) for hygienic reasons and to prevent skin puncture (Coad, 1992), besides other hazardous risks.

A waste storage area should be designated within the health care facility premises and should be sized according to the quantity of wastes generated and the frequency of collection. The storage area should not be situated near food stores or food preparation areas and its access should be limited only to authorized personnel. This limits exposure of people trying to access the site who are not aware of the related risks. Waste storage areas should be impermeable, have good drainage, be constructed with easy to clean surfaces, have a sufficient water supply, be secure and lockable, have good lighting and ventilation and be proofed against rodents, insects and birds (WHO, 2005).

1.4: SAFE TREATMENT OF HEALTH CARE WASTES

Waste treatment refers to any chemical, thermal or mechanical process that significantly reduces or eliminates the hazardous characteristics, or reduces the bulk volume of waste (Texas A& M University, 2004). Treatment is required to disinfect or sterilize the waste so that it ceases to be a source of pathogenic organisms, to render pathological waste unrecognizable, and to make re-cyclable items un-usable (e-g- syringes are cut into pieces so that they cannot be re-used) (Coad, 1992).

The choice of the treatment method depends on the quantities of waste generated, technologies available in the market, related costs, availability of qualified personnel, space available within the hospital premises, environmental considerations and the options available for the final disposal. (Pruss and Townend, 1999).

Table 3: Treatment methods suitable for different categories of health care wastes

Treatment method	Infectious wastes	Pathological wastes	Sharps	Pharmaceutical wastes	Genotoxic wastes	Chemical wastes	Radioactive wastes
Rotary kiln	Yes	Yes	Yes	Yes	Yes	Yes	Low level
Pyrolytic incinerator	Yes	Yes	Yes	Small quantities	No	Small quantities	Low level
Single chamber incinerator	Yes	Yes	Yes	No	No	No	Low level
Drum or brick incinerator	Yes	Yes	Yes	No	No	No	No
Chemical disinfection	Yes	No	Yes	No	No	No	No
Autoclaving (Wet thermal treatment)	Yes	No	Yes	No	No	No	No
Microwave irradiation	Yes	No	Yes	No	No	No	No
Encapsulation	No	No	Yes	Yes	Small quantities	Small quantities	No

Source: WHO, (1999)

1.4.1: Treatment options for waste

Health care wastes should be treated before being disposed of by incineration, chemical disinfection, microwave irradiation, encapsulation or autoclaving (Table 3), (Pruss *et al*, 1999).

If the treatment is reliable, most hazardous HCWs can be handled as normal municipal wastes after being disinfected. Sharps and other items that have a re-sale value should still be kept separate and disposed of with great care to prevent access by scavengers or the general public (Coad, 1992).

1.4.2: Chemical disinfection

Chemical disinfection is done by adding chemicals (mainly aldehydes, chlorine compounds, ammonium salts and phenolic compounds), to the waste to kill or deactivate the pathogens. If chemical disinfectants are cheap and readily available in local market, it can be the cheapest method for treating HCW. This treatment is

most suitable for treating liquid wastes such as blood, urine, stools or hospital sewage. Solid wastes can also be chemically disinfected, but they should be shredded beforehand (Johannessen *et al* 2000).

One disadvantage of chemical disinfection is that it may be ineffective against strains of pathogens that are resistant to the selected chemical. It is therefore recommended that HCWs which have been chemically disinfected should continue to be treated as hazardous, unless careful bacteriological and virological testing has proven that the disinfection is complete (Coad, 1992).

1.4.3: Autoclaving (Wet thermal treatment)

At a temperature of 160° C, waste is subjected to steam in a sealed, pressurized chamber. This process is widely used for sterilizing surgical equipment and requires qualified operators to operate and maintain the equipment (Coad, 1992). Steam sterilization is limited in the types of health care wastes it can treat, but is appropriate for laboratory cultures and substances contaminated with infectious organisms (City of L.A., 1995). For the sterilization to be complete the steam should penetrate every part of the waste and maintain the temperature of around 160° C for a sufficient length of time (Coad, 1992). The liquid that may form is drained off to the sewer or sent for processing. The unit is then reopened after a vapour release to the atmosphere, and the solid waste is taken out for further processing or disposal. One advantage of steam sterilization is that it has been used for many years in hospitals to sterilize instruments and containers and to treat small quantities of waste. Since autoclaving does not change the appearance of the waste it is not suitable for body parts as there could be a problem in gaining acceptance of the waste for land filling (City of L.A., 1995).

Autoclaving is less reliable than incineration in terms of disinfection, but it is cheaper and less polluting, except that autoclaves do produce odours. On the other hand the residues from incinerators are much less in volume and not recognizable (Coad, 1992).

1-4.4: Microwave irradiation

In

microwave irradiation the waste is shredded and humidified for homogeneous heating then exposed to microwaves at a frequency of about 2450MHz and a wavelength of 12.24 cm. The microwaves rapidly heat the water within the waste and

the pathogens are destroyed by the heat conduction. After disinfection the waste is compacted and sent to the municipal waste for land filling. Microwave irradiation is suitable for most infectious wastes, but is not suitable for pathological wastes, sharps, pharmaceutical, genotoxic, chemical and radioactive wastes (Table 3). The efficiency of microwave disinfection should be checked routinely through bacteriological and virological tests. (Pruss and Townend, 1999).

1.4.5: Incineration

Incineration is a high-temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter. Incineration reduces the weight and volume of the waste by as much as 95% (TelMedPak, 2000).

Incinerators can produce toxic emissions such as carbon monoxide (CO), dioxins (Polychlorinated dibenzo-para-dioxins or PCDDs), and furans (polychlorinated dibenzofurans or PCDFs). Carbon monoxide is produced by poor and incomplete combustion. Dioxin and furan emissions occur through burning of chlorine-containing wastes, e.g., polyvinyl chlorides (PVC) and other plastics. Emissions can be minimized by high-temperatures and strict waste segregation practices to eliminate PVCs from the waste to be sent for incineration (WHO, 2004 a).

Governments should put into place legislation to minimize emissions, and decrease exposure and risks to the workers and the community. These should include the use of approved incinerator designs that can achieve appropriate combustion conditions (e.g., minimum temperature of 800° C, minimum chimney heights), appropriate site setting (e.g., away from populated areas or where food is grown), adequate operator training, appropriate waste segregation, storage, ash disposal facilities, adequate equipment maintenance, supervision and sufficient budgeting (Batterman, 2004).

In developing countries UNICEF has been promoting controlled air incineration using low cost incinerators built on-site. These two-chamber brick incinerators designed by Professor Jim Picken, at the De Montfort University, have been introduced in several countries including Kenya. When properly maintained they can achieve temperatures of about 800° C destroying the waste and reducing the production and emission of dioxins and furans in gases and ash. An ash pit, where residual ash, glass, metallic parts, deluding needles, are safely deposited after incineration should be constructed next to the incinerator (WHO, 2004 a).

Incineration is the preferred method of treatment because it has the highest volume and weight reduction, requires no prior processing of the waste and renders most of the waste un-recognizable. It can be used to treat different waste categories and can also be a source of energy. The major disadvantages of incinerators are that they are expensive to maintain, require skilled operators, are prone to frequent breakdowns and can cause pollution if the emissions are not controlled (Manyele, 2004).

1.4.6: Encapsulation

This is the treatment of sharp wastes using materials such as Plaster of Paris, plastic foam, bituminous sand, cement mortar or clay material which when fully reacted, will encase the waste in a solid protective matrix. The encapsulating agent must completely fill the container. When dry, the containers are sealed and land filled to restrict access. (Pruss *et al*, 1999).

1.5: SAFE DISPOSAL OF HEALTH CARE WASTES

Waste disposal is the intentional burial, dumping, discharge, placing or release of any waste material into the air, land or water (Government of Nigeria, 2006).

Table 4 illustrates the different disposal options for the different categories of health care wastes.

Table 4: Disposal methods suitable for the different health care wastes categories

Disposal method	Infectious wastes	Pathological wastes	Sharps	Pharmaceutical wastes	Genotoxic wastes	Chemical wastes	Radioactive wastes
Landfill within hospital premises	Yes	Yes	Yes	Small quantities	No	Small quantities	No
Municipal landfill	Yes	No	No	Small quantities	No	No	No
Discharge to sewer	No	No	No	Small quantities	No	No	Low level liquid waste
Other methods				Return expired drugs to supplier	Return expired drugs to supplier	Return unused chemicals to supplier	Decay storage

Source: WHO, (1999)

A sanitary landfill is a controlled and organized deposit of wastes which are then covered regularly with inert material (WHO, 2005).

Disposing of the health care wastes by landfill within the premises of the health care facility is preferred because it allows close supervision of the disposal area by people who understand the seriousness of the hazards. This is only possible if the facility's premises are big enough (Coad, 1992), (Pruss and Townend, 1999).

2.1: HEALTH CARE WASTE GENERATION

Globally approximately 30 billion syringes are used each year (Safe Injection Global Network, 2004). Waste generation depends on numerous factors such as established waste management methods, the type of health care facility, health care facility specializations, proportion of reusable items utilized in the provision of health care, and proportion of patients treated on a day-care basis (Coad, 1992).

Health care waste is a small fraction of urban municipal waste. Estimates of the generation rate can be calculated from the number of beds in any city and the average amount of waste produced per bed. The estimates for developing countries range from 1 to 4.5 kg per bed per day (BAN, 1999).

India generates about 0.33 million tonnes of HCW each year. The generation rate is between 0.5 - 2.0 kg per bed per day (Patil and Shekdar, 2001), while in Iran it is about 4.45 kg per bed per day (Mehrdad *et al*, 2004).

In the republic of Tanzania it is estimated that a total of around 12 to 14 tonnes of health care waste is generated every day. Health centres and dispensaries generate around 0.03kg/patient/day, while institutions with in-patient facilities generate around 0.41 kg/bed/day (WHO, 2005).

In Kenya a study by ESF (2005) estimated that the Kenyatta National hospital produces an average of 923kg/day of HCW, a Provincial Hospital produces 242kg/day of HCW, district hospital 64.2kg/day of HCW, health centre 12kg/day of HCW and a dispensary produces around 8.2kg/day of HCW.

2.2: HEALTH RISKS ASSOCIATED WITH HEALTH CARE WASTE

Poor HCWM practices pose great health risks for the health workers, patients, waste handlers, scavengers and the community. Only 10-25% of the HCW is hazardous (WHO, 2005) and may create a variety of health risks, while the majority of the waste is non-hazardous general waste (Johannessen *et al*, 2000).

Hazardous HCW may contain infectious agents, genotoxic properties, hazardous chemicals or pharmaceuticals, radioactive substances and sharps. Hazardous properties of chemicals can be classified as being toxic, corrosive, inflammable, reactive, explosive, and genotoxic. Sharps not only cause cuts and punctures, but also infect the wounds by agents that previously contaminated them. Genotoxic is the property of a substance or its metabolite that is capable of interacting directly with deoxyribonucleic acid (DNA), leading to DNA damage. It may include carcinogenic, mutagenic and teratogenic substances. There is no reliable epidemiological data from developing countries on the health impacts of health care waste, unlike from the developed countries (Pruss *et al.*, 1999).

Pathogens may infect the human body by absorption through a cut in the skin, absorption through mucous membranes, inhalation and ingestion. Infections are transmitted by contact with the patient's excretions or body fluids contained in the wastes (Table 5). Rodents and insects that come into contact with wastes that are not stored safely may also transmit pathogens. Little data exists on the number of infections caused by exposure to infectious wastes (Pruss and Townend, 1999).

Table 5: Infections from exposure to hazardous health care wastes

Pathology	Examples of associated Pathogens	Infected body fluids
Gastro-enteric infections	Enterobacteria, e.g. <i>Salmonella</i> , <i>Shigella spp.</i> <i>Vibrio cholerae</i> , Helminths	Faeces and vomitus
Respiratory infections	<i>Mycobacter. tubercul</i> , Measles virus. <i>Strept. pneumoniae</i>	Airway secretions, saliva
Ocular infection	Herpes virus	Eye secretions
Genital infections	<i>Neisseria gonorrhoeae</i>	Genital secretions
Skin infections	<i>Streptococcus spp.</i>	Pus
Anthrax	<i>Bacillus anthracis</i>	Skin secretions
Meningitis	<i>Neisseria meningitidis</i>	Cerebral spinal fluid
AIDS	Human immunodeficiency virus (HIV)	Blood, sexual secretions
Haemorrhagic fevers	Junin, Lassa, Ebola and Marburg viruses	Blood and secretions
Septicaemia	<i>Staphylococcus spp.</i>	Blood
Bacteraemia	Coagulase-negative <i>Staphylococci</i> , <i>Staphylococcus aureus</i> , <i>Enterobacter</i> , <i>Enterococcus</i>	Blood
Hepatitis A	Hepatitis A virus	Faeces

Source: WHO, (1999)

WHO estimated that, in the year 2000, injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infections (32% of all new infections), 2 million hepatitis C virus (HCV) infections (40% of all new infections) and 260,000 HIV infections (5% of all new infections) (WHO, 2004 b).

Epidemiological studies indicate that a person who experiences one needle-prick injury from a needle used on an infected patient has a risk of 30%, 1.8% and 0.3% of becoming infected with HBV, HCV and HIV respectively (WHO, 2004 b).

2.3: HEALTH CARE WASTE MANAGEMENT

In 2002, the results of a WHO assessment conducted in 22 developing countries showed that the proportion of health-care facilities that do not use proper waste disposal methods ranges from 18% to 64% (WHO, 2004 b).

In a study on HCWM in the four cities (Bogota, Hanoi, Karachi and Manila), it was found that there was poor waste segregation and waste storage was not well managed thereby allowing easy access to scavengers. There was lack of concern for the handling, treatment and disposal of hazardous health care wastes among the administrators, doctors, nurses, cleaners, waste handlers and recyclers. High disease infection rates and ignorance regarding protection was common among waste handlers (Pescod and Saw, 1998).

A study in Dhaka found that the majority of the health care facilities do not have a HCWM plan and they do not treat their hazardous wastes prior to disposing them in the municipal waste stream. These factors pose a serious threat to the community and environment (Habibur and Mansoor, 2000).

An evaluation of HCWM carried out in seven African countries found that there was no HCWM plan in most of the health care facilities. It was also noted that waste segregation was inadequate. Up to 60% of the health workers had suffered needle prick injuries due to the practice of recapping of used needles, which was found to be widely practised. Where incinerators had been installed, they were poorly maintained and lacked adequately trained staff to run them leading to their inadequate performance. Most of these incinerators are currently not in use (Lloyd, 2003).

In Nigeria over 60% of all HCFs do not separate sharps from the rest of the wastes at the generation point, putting the waste handlers at risk of injury and infection. Most HCFs dispose of their wastes in the municipal dumpsite thereby endangering scavengers and the community (Government of Nigeria, 2006).

In Zambia there is no legislation to regulate health care waste management in the various health care facilities. The resources for HCWM are scarce and this has led to a deficiency in trained personnel and lack of supervision of the waste handlers. All this leads to a serious risk for the community and the environment (Mwango, 2005).

A study done in Kenya on HCWM in government owned facilities found that most facilities practiced poor waste segregation, except Kenyatta National Hospital. In these facilities only sharps are segregated from the other types of wastes. Half of the respondents in the study were not aware of any legislation regarding HCWM. Less than a third of the institutions have a waste management plan and most of them (95%) provided personal protective equipment for the waste handlers (ESF, 2005).

In Kenya the practice of indiscriminate dumping, burning and burying are prevalent in a significant number of health facilities. Incinerators are few and where available, they are not utilized properly. The situation is worsened by lack of an adequate health policy addressing the safe use of injections (GOK, 2004).

An assessment of incinerator performance in HCFs in Kenya by Taylor (2003) found that the design standards were not consistent, quality control was inadequate during installation and the operators were not properly trained and lacked motivation. It demonstrated lack of HCWM plans in the facilities and no budget allocation for HCWM.

The ESF (2005) study revealed that scavenging occurs in almost all dumpsites except at the Kenyatta National Hospital where all the wastes are incinerated. At a Kisumu dumpsite it was found that scavengers feed on the kitchen wastes and use the expired medicine and this was blamed for 8 deaths 1997. The kitchen wastes are also sold to pig keepers. In Nyeri, Machakos and Kisumu it was observed that the empty bottles that were scavenged were sold to herbalists (ESF, 2005).

Kenya lacks a comprehensive management plan for the handling and disposal of domestic, agricultural, industrial and health care wastes. While the rest of the wastes are handled in an unplanned manner by the local authorities and the private sector, HCWs pose serious challenges due to the associated health risks. The Ministry of Health with the assistance of John Snow Incorporated and the Centre for Disease Control has for the last two years been training health care workers in waste management under the project making medical injections safer (MMIS). The project provides sharp waste containers in selected HCFs in Kiambu, Bondo Kisumu and Kakamega (ESF, 2005).

A study done in Kenya on HCWM in government owned facilities found that most facilities practiced poor waste segregation, except Kenyatta National Hospital. In these facilities only sharps are segregated from the other types of wastes. Half of the respondents in the study were not aware of any legislation regarding HCWM. Less than a third of the institutions have a waste management plan and most of them (95%) provided personal protective equipment for the waste handlers (ESF, 2005).

In Kenya the practice of indiscriminate dumping, burning and burying are prevalent in a significant number of health facilities. Incinerators are few and where available, they are not utilized properly. The situation is worsened by lack of an adequate health policy addressing the safe use of injections (GOK, 2004).

An assessment of incinerator performance in HCFs in Kenya by Taylor (2003) found that the design standards were not consistent, quality control was inadequate during installation and the operators were not properly trained and lacked motivation. It demonstrated lack of HCWM plans in the facilities and no budget allocation for HCWM.

The ESF (2005) study revealed that scavenging occurs in almost all dumpsites except at the Kenyatta National Hospital where all the wastes are incinerated. At a Kisumu dumpsite it was found that scavengers feed on the kitchen wastes and use the expired medicine and this was blamed for 8 deaths 1997. The kitchen wastes are also sold to pig keepers. In Nyeri, Machakos and Kisumu it was observed that the empty bottles that were scavenged were sold to herbalists (ESF, 2005).

Kenya lacks a comprehensive management plan for the handling and disposal of domestic, agricultural, industrial and health care wastes. While the rest of the wastes are handled in an unplanned manner by the local authorities and the private sector, HCWs pose serious challenges due to the associated health risks. The Ministry of Health with the assistance of John Snow Incorporated and the Centre for Disease Control has for the last two years been training health care workers in waste management under the project making medical injections safer (MMIS). The project provides sharp waste containers in selected HCFs in Kiambu, Bondo Kisumu and Kakamega (ESF, 2005).

An injection is safe if it is given by a qualified and experienced health worker using the right medication, respecting aseptic techniques and if given with a disposable syringe and needle that is sterile and which is disposed of without being recapped, in a designated safety box or a rigid sharps container after the injection is completed (SIGN, 2004).

The Kenya National Injection Safety and Health Care Waste Management policy sets out strategies to ensure that health workers, communities and the environment are protected from risks associated with unnecessary and unsafe injections, as well as improper disposal and destruction of injection materials and other health care wastes. The development of this policy was prompted by the desire to promote rationality in the use of injections within the HCFs. This decision followed the rise in excessive use of injections, improper disposal of the generated waste, the resultant injuries to health workers and the negative community and environmental impacts (GOK, 2004).

Health care waste management (HCWM) in developing countries lacks funding, adequate management structures, trained personnel, adequate equipment and awareness among the staff of the health facilities. This leads to improper HCWM practices thereby exposing health care workers, waste handlers and the community to risk of infections, toxic effects, accidents and injuries (Akter, 2003).

Between 10% - 25% of all health care waste is regarded as hazardous and may create a variety of health risks (Pruss and Townend, 1999). The existence in the health care facilities of bacteria resistant to antibiotics and clinical disinfectants contributes to the hazards created by poorly managed wastes (ESF, 2005). Health care waste is considered the second most hazardous waste after radioactive wastes (BAN, 1999).

Poor HCWM creates opportunities for the collection of disposable health care devices (particularly syringes) by scavengers, their re-sale and potential re-use without sterilisation, which increases the spread of diseases worldwide (WHO, 2000).

In Kenya, there is no comprehensive management plan for handling and disposing of the different types of wastes. Lack of guidelines has left the management of health care facilities without any reference on how to manage their wastes. This has led to the risk of having unscrupulous individuals dispose potentially hazardous wastes indiscriminately (ESF, 2005).

In Nairobi almost three quarters of the HCFs are non-government and the categories range from the small private clinics to the large HCFs (MOH, 2005a). It is for this reason that this study has chosen to assess the management of HCW in the non-government health care facilities in Nairobi province. These HCFs play an important role in the provision of health care in Nairobi.

3.1: GENERAL OBJECTIVE

The general objective was to carry out a situation analysis on the management of health care wastes in non- government health care facilities in Nairobi province.

3.2: SPECIFIC OBJECTIVES

- (i) To determine the socio-demographic characteristics of the respondents;
- (ii) To determine the knowledge, attitude and practices of the health-care workers on sound health care waste management based on the World Health Organization standards;
- (iii) To investigate the protective measures employed by the health care waste handlers;
- (iv) To establish the extent to which health care facilities adhere to the sound practices of health care waste management based on the World Health Organization (WHO) standards;
- (v) To determine the existing health care waste management practices in the non-government health care facilities in Nairobi province;
- (vi) To determine whether the financial resources allocated for the management of health care wastes are adequate.

3.3: RESEARCH QUESTIONS

1. Are the health care workers adequately knowledgeable on HCWM?
2. Are the waste handlers using adequate personal protective equipment?
3. Do the health care waste management practices in the non government health care facilities in Nairobi conform to the WHO standards?

4.4: JUSTIFICATION

health care waste management (HCWM) is of public health concern. If not properly managed, health care wastes have great potential of becoming an environmental and a health hazard. The knowledge of HCWM in the non-government HCFs will help us understand the situation on the ground. This study will help raise awareness among the policy makers and offer recommendations on how to plan and regulate HCWM. The recommendations of the study if effectively implemented can improve HCWM.

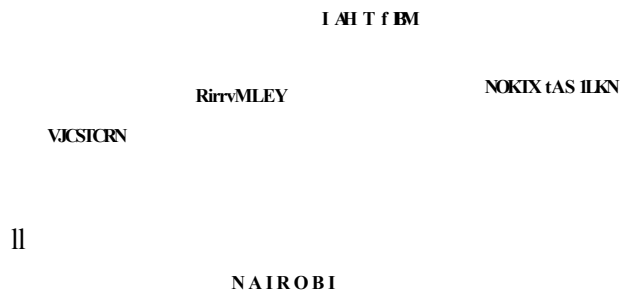
In Kenya a major study was done by ESF (2005) on the status of health care waste management in the government owned health care facilities. In this context it becomes necessary to assess the status in the non-government facilities and see if there are similarities.

CHAPTER 4.0: METHODOLOGY

4.1: STUDY DESIGN

This was a descriptive cross-sectional study that determined the status of health care waste management in non-government health care facilities in Nairobi province. A questionnaire and an observation checklist were used for data collection.

4.2: STUDY AREA



SOURCE: WHO; Country Health System Fact Sheet 2006 Kenya

Figure 1: The geographical location of Nairobi province

The study was carried out in non-government health-care facilities in Nairobi province. The province covers an area of about 684 square kilometres and it is divided into three districts. It borders Kajiado district to the south (Rift Valley province) and west, Kiambu and Thika districts to the north (Central province) and Machakos to the east (Eastern province). As of 31st August 1999 the population of Nairobi was at 2.137 million inhabitants (Central Bureau of Statistics, 2002). With an annual population growth rate of 4.8% it was projected that by 31st August 2007 the population of Nairobi will be 3.138 million inhabitants. Nairobi has 409 registered health care facilities of which 281 are non-government health care facilities. Out of these 216 are private and 55 are mission facilities (MoH, 2005a).

4.3: STUDY POPULATION

The study population comprised of non-government health care facilities in Nairobi province. The administrators, the different cadres of health care workers (Doctors, clinical officers, nurses, laboratory technicians and counsellors working in the outpatient departments) and the waste handlers in these facilities were interviewed. The outpatient department was chosen because most facilities do not have an inpatient department and the waste produced from all outpatient departments is similar.

4.3.1: Inclusion and exclusion criteria

The study included the non-government health care facilities in Nairobi province and their employees and excluded all public health care facilities and their employees.

4.4: SAMPLING PROCEDURE

Multi-stage sampling was used. A sampling frame of all the registered non-government health-care facilities was made using the list provided by the health management information systems (H.M.I.S). The 281 non-government health-care facilities were classified according to categories namely: VCT clinic, clinic, health centre, dispensary, nursing home and hospital. A further sub classification was done according to ownership: private and mission (MoH, 2005a). Each sub classification became a sampling frame and each health care facility a sampling unit allocated with a number from 1 to 'N' (N being the sample size). Then using the table of random numbers two health care facilities were selected from each group. The number of institutions was selected using the WHO HCWM rapid assessment tool, which suggests that one or two health care facilities in each category be selected randomly for HCWM studies (Pruss *et al.* 2001). This is so as to ensure that a sufficient number of each category of HCFs is well captured. For each category 2 mission and 2 private institutions were selected. Using this method a sample size of twenty-four health care facilities were selected for the study (Table 6). In each facility an administrator, the different cadres of health care workers in the outpatient department (a doctor, a clinical officer, a nurse, a laboratory technician and/or a counsellor) and a waste handler were interviewed.

Table 6: Categories of health care facilities selected (n=24)

Category of health care facility (N)	Number of health care facilities selected
Private VCT Centre (29)	2
Mission VCT Centre (7)	2
Private Clinic (101)	2
Mission Clinic (20)	2
Private Dispensary (57)	2
Mission Dispensary (18)	2
Private Health Centre (3)	2
Mission Health Centre (2)	2
Private Nursing Home (25)	2
Mission Nursing Home (2)	2
Private Hospital (11)	2
Mission Hospital (6)	2

4.5: DATA COLLECTION

A set of three different questionnaires and an observation checklist were used as data collection tools.

4.5.1: Questionnaire administration

The field work was carried out by the researcher personally. This was due to the fact that prodding of responses surfaced during the pre-testing runs.

Three types of questionnaires were used. One for the administrator, another one for the different cadres of health care workers in the outpatient department (doctor, nurse, clinical officer, laboratory technician and/or counsellor) and the third one to a waste handler in each health care facility (Appendix 4). The questionnaire assessed the

knowledge, attitudes and practices of the respondents. It also obtained data on the health risks that the health care workers are exposed to when handling health care wastes. Data on the management's contribution to health care waste management was also obtained.

The different cadres of health care workers were asked about their understanding of health care wastes, health care waste management, waste segregation and colour coding of wastes.

Overall knowledge of the health workers on HCWM was assessed by scoring the different aspects of knowledge. A score of 3 out of a maximum of 4 was considered adequate knowledge.

The respondents were asked if they had a role to play in HCWM, if they believed that health care wastes should be treated separately from other types of wastes and if they thought training on HCWM was important for them. Attitudes of the health workers on HCWM were assessed by scoring the different aspects of attitude. A score of 5 out of a maximum of 6 was considered a positive attitude.

Their practices were assessed by enquiring if they had been immunized against hepatitis B and tetanus and if they practice needle re-capping.

The respondents were asked if they had suffered a needle prick injury in the previous one month to assess the risk of injury related with HCWM

4.5.2: Observation checklist

A pre-designed observation checklist based on the WHO guidelines on HCWM was used to document the status of HCWM within the HCFs. The checklist captured information such as the type of HCW storage receptacles in use, availability of personal protective equipment for the waste handlers, colour coding, waste segregation, waste treatment and waste disposal methods (Appendix 5).

The observation checklist was compiled after all the questionnaires had been answered in each health care facility.

4.6: VALIDATION OF DATA COLLECTION TOOLS

A pre-test of the questionnaires and the observation checklist was carried out at a mission dispensary, but due to ethical considerations the name of the participating dispensary cannot be indicated. Following the pre-test, the necessary corrections of the questionnaires and the observation checklist were made.

4.7: CONTROL OF BIASES AND CONFOUNDERS

Assuring the management and the workers of the confidentiality of their responses helped control bias. The questionnaires were pre-tested and the health care facilities were selected randomly to reduce bias. An observation checklist was used to document the status of health care waste management within the health care facilities and the information gathered was used to triangulate the questionnaire findings. Recall questions were limited to the past one month to reduce recall bias.

4.8: STUDY VARIABLES

4.8.1: Independent variables

These include training of the staff on health care waste management, funds allocated for HCWM, presence of a HCWM plan and staff supervision.

4.8.2: Dependent variables

The occurrence of injuries to the staff related to HCWM, adequacy of knowledge, attitudes and practices on HCWM.

4.9: DATA MANAGEMENT AND ANALYSIS

Data from the questionnaires and the observation checklist were analysed using Statistical Package for Social Sciences (SPSS version 11.5) software. The results were presented in descriptive statistics in the form of frequency tables, histograms and bar charts. Chi-square test and Fisher's exact test were used to test for association between the variables. The level of significance for both was fixed at 0.05.

4.10: 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, the Ministry of Science and Technology and the Ministry of Health (Appendix 5). The administrator of each of the health care facilities selected for the study signed a consent form allowing the researcher to carry out the study. The different cadres of workers identified signed an individual consent form prior to being issued with the questionnaire (Appendices 1 & 2).

4.11: LIMITATIONS OF THE STUDY

Due to resource constraints it was not possible to assess how the private waste collectors manage the wastes collected from the facilities and the emissions produced from the incinerators.

CHAPTER 5.0: RESULTS

In this study 24 non-government health care facilities within Nairobi province were visited, of whom twelve (50%) were mission owned and the rest were private owned. The facilities comprised of 4 V.C.T. centres, 4 clinics, 4 dispensaries, 4 health centres, 4 nursing homes and 4 hospitals. The total number of health care workers working in the various facilities ranged from 3 to 38.

5.1: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

A total of 113 questionnaires were administered to elicit information from 65 health care workers, 24 facility administrators and 24 waste handlers.

Thirty three (51%) health care workers interviewed were male and 32 were female (49%). Their ages ranged from 23 to 62 years. There were 15 doctors (23%), 11 clinical officers (17%), 19 nurses (29%), 18 laboratory technicians (28%) and two counsellors (3%) (Figure 2).

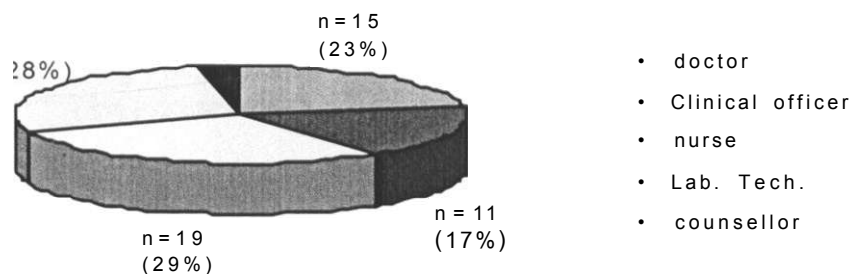


Figure 2: Percentage of the different categories of health workers interviewed (n=65)

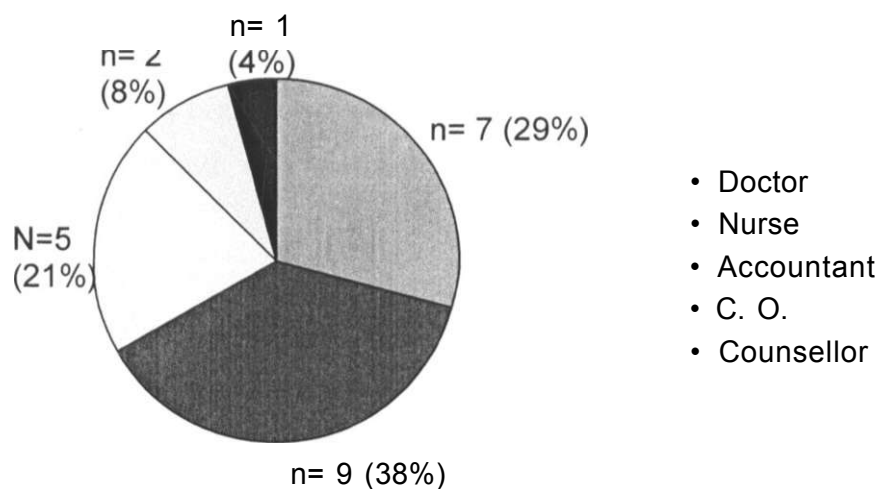
Among the 65 health care workers interviewed only 22 (33.9%) have been trained in health care waste management, while 43 (66.1%) had no training in HCWM. Doctors were the least trained in HCWM with only 26.7% of them having been trained in HCWM (Table 7).

Table 7: Training on HCWM of the different cadres of health care workers (n=65)

Cadre of health care worker	Training on HCWM	
	Trained	Not trained
	n (%)	n (%)
Doctors	4 (26.7)	11 (73.3)
Clinical Officer	4(36)	7(64)
Nurses	7(37)	12(63)
Lab Tech	6(33)	12(67)
Counsellor	1(50)	1(50)
Total	22 (33.9)	43 (66.1)

There was no statistically significant difference in the training on HCWM among the different cadres of health workers, $X^2 = 0.688$, $p = 0.95$.

Twenty-four facility administrators were interviewed in this study, 12 (50%) of whom were females. Their ages ranged from 29 years to 77 years. Professionally they were 7 (29%) doctors, 9 (38%) nurses, 5 (21%) accountants, 2 clinical officers (8%) and one counsellor (4%) (Figure 3). Eight administrators (33.3%) have been trained in HCWM, while 16 (66.7%) had not been trained.



NB: C.O. = Clinical officer

Figure 3: Distribution in percentage of the facility administrators according to their profession (n=24)

A total of 24 waste handlers were interviewed, 17 of whom were male (70.8%) and 7 were female (29.2%). Their ages ranged from 21 to 47 years. Twenty one waste handlers had only secondary school education, 2 were nurse aides and one was a trained counsellor (Figure 4). Seven waste handlers (29.2%) have been trained on HCWM while 17 (70.8%) had not been trained.

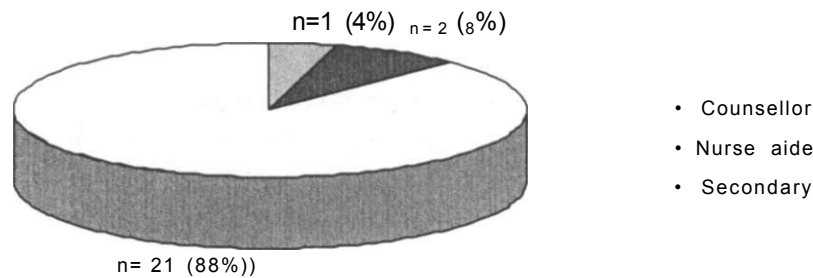


Figure 4: Distribution in percentage of the waste handlers according to their training (n=24)

5.2: RESULTS OF HEALTH CARE WORKERS

5.2.1: Knowledge of health care workers on HCWM

The different cadres of health care workers were asked about their understanding of health care wastes, health care waste management, waste segregation and colour coding of wastes.

Thirty seven health workers (57%) correctly defined health care wastes as all types of wastes produced in health care provision. This varied from 82% of clinical officers down to 33% of the laboratory technicians who answered correctly. Twenty eight health workers (43%) erroneously responded that HCW are wastes produced **while** handling patients (Figure 5). This difference among the health workers **was** statistically significant ($X^2 = 13.34$, $df=3$, $p\text{-value} = 0.01$).

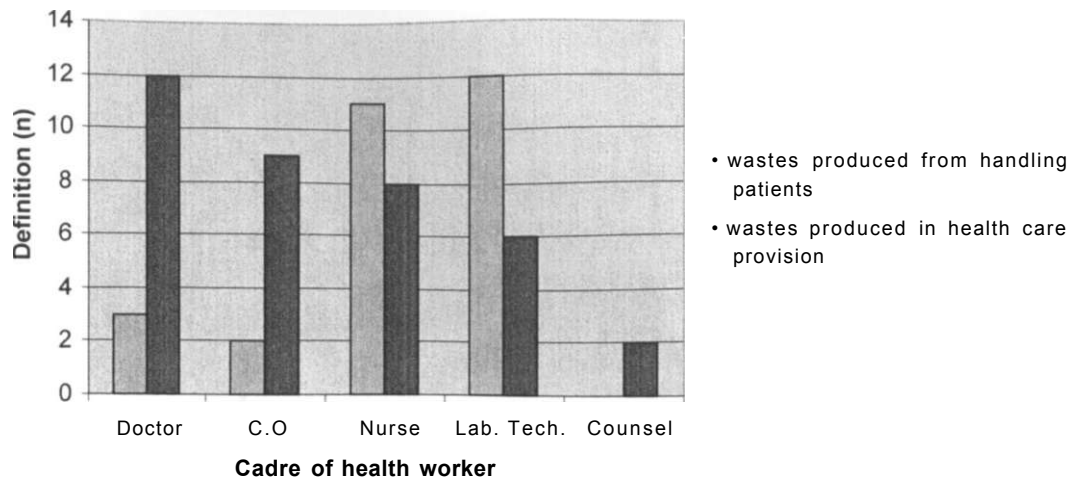


Figure 5: Definition of health care wastes by the health workers (n=65)

Twenty nine health workers (44.6%) correctly defined HCWM as the proper handling and disposal of health care wastes, while 36 (55.4%) erroneously responded that it means proper waste disposal, but there was no statistically significant difference among the different cadres of health workers, in respect to their understanding of HCW ($X^2 = 1.7$, $df=3$, p -value = 0.19).

In this study 44 health workers (68%) correctly defined waste segregation as the separation of wastes into different categories at the point of generation. Across the different cadres of health workers, 13 (20%) of them erroneously responded that waste segregation meant separating sharps from other wastes. Nurses had the least percentage (48%) that correctly defined waste segregation, but laboratory technicians had the highest percentage (22%) of the ones who had no idea of what was the meaning of waste segregation (Figure 6). There was no statistically significant difference among the different cadres of health workers, in respect to their understanding of waste segregation ($X^2 = 8.52$, $df=3$, $p = 0.38$).

14
12
c* 10
9
8
7
6
5
4
3
2
1
0

- No idea
- separating sharps from other wastes
- separation of HCW in different categories

Doctor C.O Nurse Lab Tech Counsel

Cadre of health worker

Figure 6: Health care workers' understanding of waste segregation (n=65)

Twenty seven health workers (42.5%) correctly defined colour coding of wastes. Thirty eight (57.5%) health workers had no idea. Nine doctors (60%), 4 clinical officers (36.4%), 5 nurses (35.7%), 7 laboratory technicians (39%) and the 2 counsellors interviewed defined colour coding correctly (Figure 7). There was no statistically significant difference among the different cadres of health workers, in respect to their understanding of colour coding ($\chi^2 = 8.56$, $df=3$ $p = 0.07$).

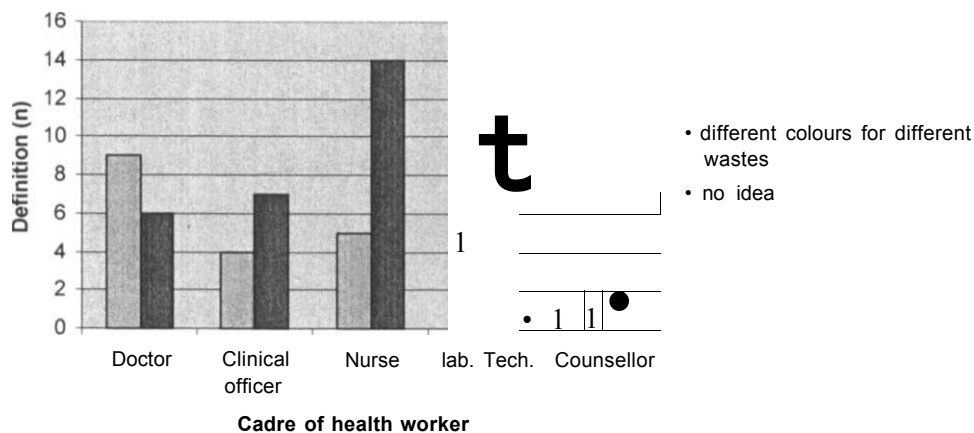


Figure 7: Knowledge of health workers on the meaning of waste colour coding (n=65)

Overall knowledge of the health workers on HCWM was assessed by scoring the different aspects of knowledge. A score of 3 out of a maximum of 4 was considered adequate knowledge. Thirty five (54%) of the 65 health care workers had inadequate knowledge on HCWM.

5.2.2: Attitudes of health care workers on HCWM

The respondents were asked if they have a role in HCWM, if they believed that health care wastes should be treated separately from other wastes and if they thought training on HCWM was important to them.

All the health workers interviewed believed that they have a role to play in health care waste management. Only 2 health workers believed that health care wastes should not be treated differently from other types of wastes. Two clinical officers responded that health care waste management training is only important for the waste handlers, while the rest of the health workers believed that the training was important for both waste handlers and health workers.

Attitudes of the health workers on HCWM were assessed by scoring the different aspects of attitude. A score of 5 out of a maximum of 6 was considered a positive attitude. Sixty two (95.4%) of the 65 health care workers were found to have a positive attitude on HCWM.

5.2.3: Practices of health care workers on HCWM

Forty one health workers (65%) had been immunized against Tetanus and 31 (47%) against Hepatitis B. Twenty nine health workers (45%) had been immunized against both Hepatitis B and tetanus, while 20 (31%) had not been immunized against both diseases, this was statistically significant.

Currently the re-capping of used needles by health workers is being discouraged so as to minimize the risk of needle prick injuries and the transmission of HIV/AIDS. The health workers were asked if they normally re-cap used needles and their responses were correlated to their training in HCWM. Sixteen health workers (25%) re-cap used needles while 49 (75%) do not re-cap used needles (Table 8).

Table 8: Impact of HCWM training on the practice of recapping of used needles by the health care workers (n=65)

		Training health care waste management?		Total	
		Trained	Not trained	n	%
Do you re-cap needles after use?	Yes	5 (23%)	11 (26%)	16	25
	No	17(77%)	32 (74%)	49	75
Total		22 (34%)	43(66%)	65	100

Twenty three percent of the health workers who had been trained in HCWM re-cap used needles compared to 26% who have no training in HCWM (Table 8). Training in HCWM does not influence the practice of re-capping needles, OR = 0.855, 95% C.I. (0.255-2.87). Five trained workers re-cap used needles compared to 11 who are not trained, but this difference was not statistically significant ($p = 0.53$).

This study found that 4 health care workers (6.1%) suffered a needle prick injury in the previous one month and all of them did not practice re-capping of used needles, while none of the ones who re-cap needles suffered a needle prick injury (Table 9). Although the 4 who had needle prick injuries had not practiced re-capping, there was no statistically significant relationship between the practice of re-capping needles and the risk of needle prick injuries, ($p = 0.31$).

Table 9: Frequency of needle prick injuries in relation to the practice of re-capping used needles (n=65)

Practice of needle re-capping	Have you had a needle prick injury in the last one month?		Total	
	Yes	No	n	%
Yes	0	16	16	25
No	4	45	49	75
Total	4(6.1%)	61 (93.9%)	65	100

The health care workers were asked to catalogue the different categories of wastes that they produce in their daily duties. Only 3 health workers (5%) produce at least 4 different categories of wastes. The majority 42 (65%) produce only two categories (sharps and other wastes). The remaining 20 (31%), produce at least 3 different categories of wastes, (Table 10). Although two thirds of the health workers produce only 2 waste categories, there was no statistically significant difference among the different cadres of health workers, ($X^2 = 9.07$, $df = 3$ $p = 0.34$).

Table 10: Categories of wastes produced by the health care workers (n=65)

Categories of wastes produced according to the health worker	Cadre of health care worker					Total	
	Dr	Clinical Officer	Nurse	Lab. Tech.	Counsel	n	%
Sharps, other wastes	7 (47%)	6 (55%)	16 (84%)	12 (67%)	1 (50%)	42	64.6
Sharps, infectious, other wastes	6 (40%)	4(36%)	3 (17%)	6 (33%)	1 (50%)	20	30.8
Sharps, infectious, pharmaceutical, other wastes	2 (13%)	1(9%)	0	0	0	3	4.6
Total	15	11	19	18	2	65	100

Table 11 illustrates the influence HCWM training imparts on the knowledge, attitudes and practices of the health workers.

Table 11: Influence of HCWM training on the knowledge, attitude and practices of the health workers (n=65)

		Training on HCWM (n)		Chi square	p-value	Odds Ratio	95% CI	Remark
		Trained	Not trained					
Workers knowledge on HCWM	Adequate	12	18	3.478	0.06	1.667	0.592-4.69	
	Not adequate	10	25					
Workers attitude on HCWM	Positive	22	40	-	0.283	-	-	Fisher's exact
	Negative	0	3					
No. of categories of wastes produced by health worker	2	17	25	2.54	0.28	-	-	
	3	4	16					
	4	1	2					
Needle prick injuries among health workers		2	2	-	0.42	2	0.3-15.6	Fisher's exact
		20	41					

Twelve of the 22 health workers who had been trained on HCWM had adequate knowledge on HCWM, while 18 of those 43 with no training on HCWM had adequate knowledge. The difference was not statistically significant (p= 0.06).

Three of the 43 health workers who had not been trained on HCWM had a negative attitude on HCWM, compared to none among the 22 trained ones. The difference was not statistically significant (p=0.283).

Seventeen of the 22 trained health workers produce 2 waste categories, compared to 25 of the 43 not trained. There was no statistically significant difference between the trained and untrained health workers, ($X^2 = 2.54$, $df= 1$ $p= 0.28$).

Four health workers suffered needle prick injuries in the previous one month, two were trained and two were not trained. There was no statistically significant relationship between needle prick injuries and training, (p= 0.42) (Table 11).

5.3: RESULTS OF THE WASTE HANDLERS

Twenty four waste handlers were interviewed in this study. Waste handlers are subordinate staff employed by the HCF and their duty is to handle wastes within the facility i.e. collection of the waste from the generation point and taking it to the storage area for collection by the private collectors or for later treatment.

Only one waste handler had suffered a needle prick injury in the previous one month and is trained on HCWM. None of the waste handlers who had not been trained suffered any needle prick injury. There was no statistically significant relationship between needle prick injury and training on HCWM ($p= 0.29$) (Table 12).

Table 12: Relationship between HCWM training and the incidence of needle prick injuries among waste handlers (n=24)

		Training of waste handlers on HCWM		Total	
		Trained	Not trained	n	%
Needle prick injury	Yes	1(4%)	0 (0%)	1	4
	No	6 (25%)	17(71%)	23	96
Total		7 (29%)	17(71%)	24	100%

Three waste handlers (12.5%) had been immunized against both hepatitis B and tetanus, while 17 (71%) had not been immunized against the two diseases. The low immunization rates were statistically significant, ($p =0.042$) (Table 13).

Table 13: Immunization status of the waste handlers (n=24)

Tetanus vaccination	Hepatitis B vaccination		Total	
	Yes	No	n	%
Yes	3	2	5	21
No	2	17	19	79
Total	5(21%)	19 (79%)	24	100%

5.4: PERSONAL PROTECTIVE MEASURES EMPLOYED BY THE WASTE HANDLERS

The HCF management was asked what type of personal protection equipment (P.P.E.) they provide for their waste handlers and a checklist was used to confirm their availability and use by the waste handlers.

A total 21 health care facilities (88%) were found to provide various types of personal protection equipment (P.P.E.) for their waste handlers.

Safety spectacles are provided for in only 3 facilities, while facial masks were the most commonly available as they are provided for in 16 facilities, followed by heavy duty gloves in 15 facilities. Industrial aprons were provided for in 11 facilities, uniforms in 11 facilities and boots in 9 facilities (Table 14).

Table 14: Provision of personal protective equipment (PPE) by HCFs (n=24)

Type of PPE	PPE provided by HCF according to management	
	No. of HCFs that provide PPE	% of HCF that provide PPE
Safety spectacles	3	12.5
Facial mask	16	66.7
Heavy duty gloves	15	62.5
Industrial apron	13	54.2
Uniform	11	45.8
Industrial boots	9	37.5

Waste handlers compliance in using the P.P.E. provided for varied, with safety spectacles and heavy duty gloves having 100% compliance among the waste handlers. Compliance for facial masks was 87.5%, industrial aprons 92% and uniforms at 82%. In 9 facilities the management claimed to provide industrial boots for the waste handlers, but it was noted that 11 of them were using the boots, compliance was 122% (Table 15). Apparently some managers did not know which P.P.E. was provided for in their institutions.

Table 15: Usage personal protective equipment (PPE) by the waste handlers

Type of PPE	PPE usage by handlers	
	No. of waste handlers using PPE	% of waste handlers using PPE provided for by the HCF
Safety spectacles n=3	3	100
Facial mask n=16	14	87.5
Heavy duty gloves n=15	15	100
Industrial apron n=13	12	92
Uniform n=11	9	82
Industrial boots n=9	11	122

All the waste handlers were aware that the major risks of handling HCW were cut wounds and infections.

5.5: RESULTS ON HCWM IN HEALTH CARE FACILITIES

Twenty four health care facilities were visited in the course of this study. Twenty three health care facilities offer out-patient services. Only 1 facility offered V.C.T. services exclusively, but a total of 16 facilities offered V.C.T. among other services. Three quarters of the facilities offered laboratory services, while 7 facilities offered in-patient, radiology and theatre services. Six facilities offered maternity services while 11 facilities offered mother and child health services (Table 16).

Table 16: Services offered by the health care facilities selected (n=24)

Service offered	Number of institutions	%
Out-patient services	23	96
V.C.T.	16	67
Laboratory	18	75
In-patient services	7	29
Radiology	7	29
Theatre	7	29
M.C.H. services	11	46
Maternity	6	25

A pre-designed observation checklist was used to document the status of HCWM within the HCFs and determine the extent to which they adhere to WHO guidelines. Fisher's exact test was used to determine if the presence of a waste management team determined the implementation of the various elements of HCWM by the HCFs. No statistically significant difference was found (Table 17).

Table 17: Number of institutions and the elements of HCWM (n=24)

Element of HCWM	Institutions practising	Percent	P value (Fisher's exact)
HCWM plan	0	0	0.99
Waste management team (WMT)	3	12.5	0.99
Waste management officer(WMO)	3	12.5	0.99
P.P.E.	21	87.5	0.99
Segregation	24	100	0.99
Colour coding	3	12.5	0.99
Safe transportation	3	12.5	0.99
Waste treatment	13	54.2	0.99
Waste disposal			
1) Private collectors	16	66.7	0.99
2) Landfill	4	16.7	0.6
3) Pit	4	16.7	0.837

According to the WHO guidelines on HCWM each HCF should have a HCWM plan and a waste management team (WMT) headed by a waste management officer (WMO). Waste segregation, colour coding and safe waste transportation should be practiced, Waste treatment and final disposal using a landfill within the premises should be implemented. Personal protective equipment (P.P.E.) should be provided for the waste handlers.

5.5.1: Presence of a HCWM plan, waste management team, waste management officer and provision of personal protection equipment.

In this study no facility was found to have a HCWM plan. Only 3 HCFs (12.5%) were found to have a WMT with a WMO. Personal protective equipment was provided for in 21 facilities (87.5%).

Two waste management officers were laboratory technicians and the third one was a waste handler with secondary level of education.

5.5.2: Segregation of wastes

Segregation of wastes is practiced in all the 24 facilities. The degree of segregation varied from a minimum of two to a maximum of four waste categories. It was found that 16 facilities (66.7%) segregate wastes into two categories; sharps and other wastes, while 7 facilities (29.2%) segregate into three categories; sharps, infectious and other wastes and only 1 facility (4.2%) segregates its wastes into 4 categories; sharps, infectious, chemical and other wastes (Figure 8). No facility was found to have general, genotoxic, pathological, pharmaceutical, pressurized containers, heavy metals and radiological waste containers.

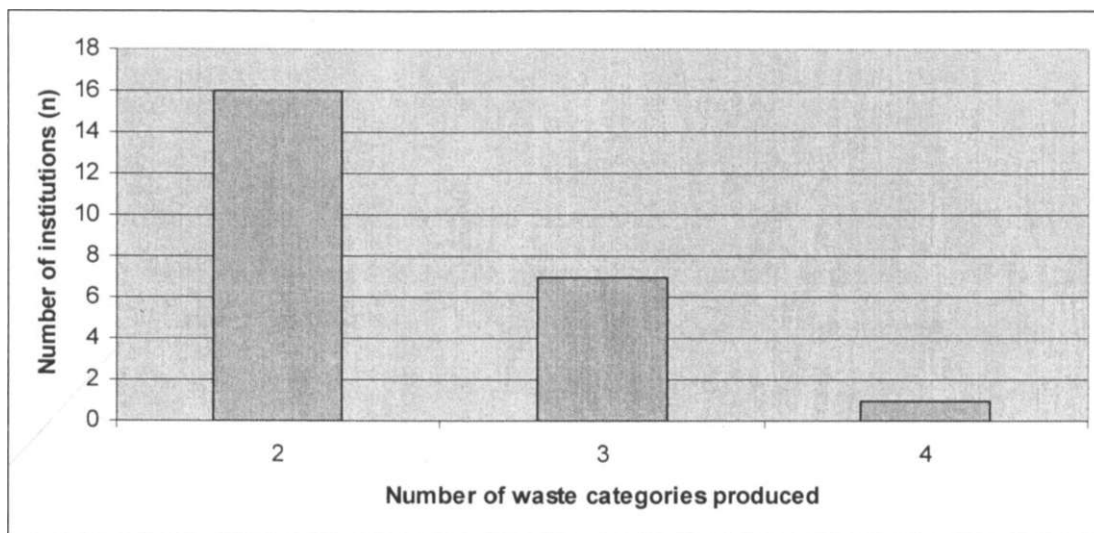


Figure 8: Number of categories of waste produced by institutions (n=24)

5.5.3: Waste colour coding

Colour coding of wastes was practised in only 3 facilities (Table 17). All the three facilities used yellow paper bags for sharps, for infectious wastes however two used black bags while one used a white bag. Two facilities used blue bags for the other wastes category one used a transparent bag (Table 18). There was lack of harmony in the allocation of colour codes for the different waste categories.

Table 18: Types of colour codes in use by the practising facilities (n=3)

		Colour code				
		Yellow	Black	Blue	White	Transparent
Waste category	Sharps	3	-	-	-	-
	Infectious	-	2	-	1	-
	Other wastes	-	-	2	-	1

According to the WHO guidelines sharps and infectious wastes should be coded yellow. None of the facilities that practise colour coding used yellow as the colour code for infectious wastes (Table 18).

5.5.4: Safe transportation of wastes within the facility

Safe transportation of wastes is an important element of HCWM. Only 3 facilities (12.5%) provided the waste handlers with wheelbarrows to transport wastes while the other 21 facilities (87.5%) had their wastes transported manually putting the waste handlers at great risk of injury. The wheelbarrows were in a poor state and the waste bags were piled up on each other, thereby posing risk of tipping over and spillage if the bag is punctured.

5.5.5: Waste storage

Safe storage of wastes is an important element of HCWM. All the 24 facilities were found to store their wastes in sluice rooms which are left unlocked until the waste handlers come to collect them. In the facilities that had incinerators within their premises, it was observed that the wastes prior to their incineration were normally stored just next to the incinerator. All the facilities were found to use rigid waste containers.

5.5.6: Waste treatment and disposal

Fourteen facilities have incinerators within their premises, but one institution was denied use of the incinerator by the National Environmental Management Authority (NEMA) due to its proximity to residential areas and potential to air pollution. Thirteen of the 24 health care facilities (54.2%) treat their wastes prior to disposal and incineration was the only waste treatment method in use. The other 11 facilities have their wastes collected by private collectors without any treatment (Table 19).

Table 19: Waste treatment and disposal methods adopted by the facilities (n=24)

		Waste treatment within the facility (incineration)		Total
		Yes	No	
Waste disposal site	Disposal within facility	8	0	8
	Collection of wastes by private collectors	5	11	16
Total		13	11	24

Among the 13 facilities with functioning incinerators, 8 dispose of their wastes after incineration within their premises, while the remaining 5 use private collectors. Land filling was practised in 4 facilities while the other 4 disposed them into an open pit. In total 16 facilities use the services of private collectors to dispose of the wastes and ash outside the institutions' premises (Tables 17 & 19).

There was a statistically significant relationship between waste treatment and waste disposal within the facilities' premises ($p= 0.002$). All the facilities that dispose their wastes within their premises treat their wastes prior to disposal.

5.6: Financial resources allocated for HCWM

The administrators estimated the cost of HCWM to be between 1-3% of the facilities' total annual budget. The 16 (66.7%) facilities that use private collectors to dispose of their wastes spent between Ksh 10,000- 48,000 (125-600 USD) per month in the year 2006 as payment to the collectors.

CHAPTER 6.0: DISCUSSION

This study found that none of the 24 HCFs had a HCWM plan compared to the government facilities where about a third of them had a HCWM plan (ESF, 2005). This means that health care wastes are managed without planning, but on a need basis. A study in Iran reported similar findings (Mehrdad *et al* 2004). In some facilities it was noted that the management was not sure of the type of P.P.E. that they had provided their waste handlers with and there was no accurate budgetary allocation for HCWM.

Most health workers (54%) do not have adequate knowledge on HCWM, but no statistically significant association was found between knowledge and training in HCWM, $p=0.06$. Majority of them (95.4%) had a positive attitude for HCWM and there was no significant relationship between training and attitude, $p=0.283$. For their practices, these were dependent on the facility's management of wastes, because the health workers are predisposed to follow the practices within the institution.

The frequency of needle prick injuries among the health workers in this study was 6% for the health workers and 4% of waste handlers. These figures are low compared to a frequency of 58% among the health workers in government run HCFs (ESF, 2005). Majority of the health workers (75%) do not re-cap used needles. No statistically significant relationship was found between the practice of re-capping needles and the risk of needle prick injuries, even though all the four workers who had suffered needle prick injuries do not re-cap used needles, ($p=0.31$).

Majority of the waste handlers were educated up to form four level and only three of the facilities had a WMO, but no facility had a qualified public health officer and a HCWM plan. Consequently HCW handling and disposal within the health facilities is the preserve of the least educated cadres of employees and this is similar to the findings in Government run facilities (ESF, 2005). On the other hand most government run health care facilities have public health officers who are the waste management officers (ESF, 2005). This study found that 88% of the facilities provided PPE for their waste handlers, which is slightly less than the 95% in government facilities (ESF, 2005). In Eritrea most HCFs do not provide any type of P.P.E. for the waste handlers and even here they have low levels of formal education (Gov. of Eritrea, 2003).

According to WHO guidelines, health care facilities should have a minimum of at least three waste categories: general, infectious and sharps (Pruss and Townend, 1999). In this study only 8 facilities (33%) were found to adhere to the minimum number of waste categories. Sixty eight percent of the health workers correctly defined waste segregation, although 65% of them claimed to produce only two waste categories. The fact that 66.7% of the facilities segregate wastes into only two categories (sharps and other wastes) may have influenced their perception on the number of waste categories that they produce. In Nigeria only 30% of the HCFs segregate sharps from the other categories of wastes into a safety box. This poses great danger of injury and infection to the health workers, waste handlers and the community (Gov. of Nigeria, 2006).

It was also found out that 88% of the facilities do not practice colour coding and this seems to influence the health workers knowledge, as it was found that 57.5% of them had no idea of what waste colour coding was.

There was no harmony in the allocation of colour codes for the different wastes categories and this is similar to the findings in a study done in Lagos (Longe and Williams, 2006).

Incineration of all the wastes produced by the health care facilities does not reinforce the importance of waste segregation, as all the wastes eventually end up being incinerated. There was some element of re-cycling practiced within the facilities as it was noted that used-up rigid containers of detergent were used as sharp containers.

According to the WHO guidelines, waste storage areas should be confined, lockable and not easily accessible to unauthorized persons (WHO, 2005). However it was found that the waste storage areas were easily accessible by anyone who could access the facility. The wastes were stored in the sluice rooms which were left unlocked until the waste was collected by the waste handlers. In the facilities that had incinerators within their premises, it was observed that the wastes prior to their incineration were normally stored just next to the incinerator. Here the wastes are potentially accessible to the waste scavengers, rodents, insects and birds thereby posing a potential hazard. Similarly in Eritrea it was found that waste storage areas are not secure making the wastes easily accessible to scavengers (Gov. of Eritrea, 2003).

Disposal of health care wastes by means of a landfill within a facility's premises is the preferred method as it restricts access to the wastes by scavengers (Coad, 1992). In this study, only a third of the facilities were found to dispose wastes within their premises, of which, half disposed by way of a landfill while the other half disposed in an open pit. On the contrary in Lagos, all facilities use private collectors for the disposal of their wastes (Longe and Williams, 2006). Most of the health facilities visited had limited space to be able to dispose of the wastes within their premises and had to depend on private collectors for their waste disposal. This was despite the fact that there were no private collectors that deal exclusively with HCW (ESF, 2005). Consequently there was no guarantee that these wastes do not end up in the municipal waste stream, thereby putting the community at risk of injury and infection.

The cost of HCWM according to the WHO is insignificant at between 0.1-0.2 percent of the total facility's budget (Coad, 1992). In this study the administrators estimated the cost to be between 1-3% of the total budget, which is about 10 times more. This could be due to the fact that waste segregation which is the most important part of HCWM is not strictly adhered to within the facilities. About 67% of the facilities segregated the wastes in only two categories and none of the 24 facilities had a general waste category. This makes all the wastes produced by the facilities to be considered hazardous and has to be treated. Thus increasing the costs of waste management. The relatively higher cost can also be explained by the fact that since there is no budget allocation for HCWM, the figures given are estimates and do not reflect the real cost.

In all the facilities there was no HCWM plan in place. Waste segregation was found to be inadequate, the HCW storage facilities were inadequate and the internal transport was found wanting, since it was manual in 88% of the facilities. The only wastes that were properly segregated in all the facilities were sharps. These were placed in rigid containers separate from all the other categories of wastes.

Incineration is the best treatment method for HCWs in third world countries because it has the highest volume and weight reduction, requires no prior processing, renders most of the waste un-recognizable, can be used to treat different waste categories and can also be a source of energy (Manyele, 2004). Private investors should be encouraged to invest in incineration facilities for HCWs. So that hospitals are left to do their core business which is patient management and get only involved in waste

do their core business which is patient management and get only involved in waste segregation. The waste is then collected by the private collectors to the incineration facilities.

CHAPTER 7.0: CONCLUSIONS AND RECOMMENDATIONS

7.1: CONCLUSIONS

This study found that most health workers are not trained on HCWM and they are not well knowledgeable on HCWM. The immunization levels among the health workers and waste handlers were low. The re-capping of used needles is not widely practised among the health workers.

Most HCFs provide P.P.E. for the waste handlers, but these are not sufficient. The most widely supplied P.P.E. were facial masks and heavy duty gloves. Compliance by the waste handlers in the use of P.P.E. was high and this shows that the waste handlers are aware of the risks associated with HCWs and understand the need to use P.P.E.

The findings of the study demonstrated that there is lack of harmony in HCWM across the different HCFs.

No facility was found to have a HCWM plan which is the basis for sound practices of waste management and only 3 facilities had a waste management team. The facilities were found not to adhere strictly to the WHO guidelines on HCWM.

Health care wastes in the non government health care facilities are not managed adequately. Waste segregation was found to be inadequate with sharps being the only wastes found to be well segregated in all the facilities. Waste transportation in most facilities is done manually putting the waste handlers at great risk. Waste storage areas are not secure and can be accessed by potential scavengers. Incineration is the only treatment method in use and no visible measures for emission control were seen. Waste disposal is not adequate given that most of the facilities use private collectors whose ability to manage HCWs is not well documented.

There is no budget allocation for HCWM and this is done on a need basis. This can be explained by the lack of a comprehensive HCWM plan.

The findings of the study demonstrate that there is some effort in HCWM in all the facilities, but it is not well planned.

7.2: RECOMMENDATIONS

1. There is need for the implementation of the national policy on injection safety and the health care waste management plan for the health sector in Kenya by the Ministry of Health in conjunction with NEMA.
2. The licensing of private health care waste collectors by NEMA and the Ministry of Health needs to be very stringent and there needs to be continuous monitoring of their activities.
3. Integration of health care waste management in the curriculum of studies for all cadres of health care workers in the Universities and other medical colleges.
4. There is need for continuous education for all facility administrators, health workers and waste handlers on HCWM. This should be enforced by the Ministry of Health.
5. Studies need to be done on the quantity of health care wastes produced within HCFs by the Ministry of Environment and Natural Resources together with NEMA. This should include studies on the treatment and disposal methods adopted by the private collectors so as to ascertain if they adhere to WHO guidelines on waste treatment and disposal.
6. Further studies need to be done on the emissions from the incinerators to establish the types of particulates and quantify the same in various parts of the country by NEMA.
7. Colour coding and labelling of HCW containers should be adopted by all the HCFs.
8. All heads of HCFs should allocate funds for HCWM in their annual budget.
9. All HCFs should institute a waste management team and a HCWM plan.

REFERENCES

1. Akter N., (2003). Appropriate management options for developing countries (the case of Bangladesh and Thailand). Doctoral Dissertation. Asian Institute of Technology, Thailand.
2. Basel Action Network (BAN), (1999). Health Care Without Harm. Clinical Waste in Developing Countries, an analysis with a case study of India, and a critique of the Basel-TWG guidelines, (www.ban.org).
3. Batterman S., (2004). Assessment of small scale incinerators for health care wastes. In World Health Organization (eds.), Geneva, Switzerland.
4. Central Bureau of Statistics, (2002). Kenya 1999 Population and Housing Census. Government printer, Nairobi, Kenya.
5. City of Los Angeles, (1995). Hazardous and Toxic Materials Office. Medical Waste Management, Fact sheet, (www.lacitysan.org).
6. Coad A., (1992). Managing medical wastes in developing countries. In World Health Organization (eds.), Geneva, (www.who.int).
7. Coker A.O., Sangodoyin A. Y., and Ogunlowo O.O., (1998). Managing Hospital Wastes in Nigeria, Islamabad. (Wedc.lboro.ac.uk).
8. Environmentalists Sans Frontiers (ESF), (2005). Status quo on training needs assessment and awareness creation on Health Care Waste Management in Kenya. National Health Care Waste Management plan 2006-2015.
9. Government of Eritrea, (2003). National health care waste management plan. (www.worldbank.org).
10. Government of Kenya, (1999). Environmental management and Co-ordination Act, Government Printer, Nairobi.
11. Government of Kenya, (2004). National policy on Injection Safety and Health Care Waste Management Kenya, Ministry of Health.
12. Government of Nigeria, (2006). National health care waste management plan. (www.worldbank.org).
13. Habibur R. and Mansoor A., (2000). Health Care Waste Management in Developing Countries, (en.scientificcommons.org).
14. Johannessen L.M., Dijkma M. AND Bartone C., (2000). Health care waste management guidance note. In the World Bank publications. Washington D.C. (www.worldbank.org).
15. Lloyd J., (2003). Safe disposal of syringes and needles in the context of Health Care Waste Management systems, (www.afro.who.int).

16. Longe E.O. and Williams A., (2006). A preliminary study of Medical waste management in Lagos metropolis, Nigeria. *Iran. J. Environ. Health. Sci. Eng.*, 2006, Vol.3, No.2, pp. 133-139.
17. Manyele V.S., (2004). Medical waste management in Tanzania: current situation and the way forward. *African J. Environ. Assess. Manage.*, 2004, Vol.8, No.1, pp.74-99.
18. Mehrdad A., Mahmood V. and Gholamhosein K., (2004). Results of a hospital waste survey in private hospital in Fars province, Iran. *Waste manag.*, 2004.
19. Ministry of Health, (2005 a). Health Management Information Systems.
20. Ministry of Health, (2005 b). Personal communication with the chief public health officer.
21. Mwango D., (2005). Experiences in Capacity Building in Health Care Waste Management - the case of Zambia, (www.basepretoria.org.za).
22. Mwanthi M.A. and Mutua G.N., (2002). Proposed procedures for management of waste generated by health care facilities, *African J. Environ. Assess. Manage.*, 2002, Vol.4, No.1, pp.39-45.
23. Patil A.D. and Shekdar A.V., (2001). Health care waste management in India. *Journ. Of Environ. Manage.* Vol., 63, No.2 (2001), pp 211-220.
24. Pescod M.B and Saw C.B., (1998). Health care waste management and recycling in four major cities, Gouda, Netherlands (www.waste.nl).
25. Pruss A and Townend W.K., (1999). Teachers Guide, Management of wastes from health -care activities. In World Health Organization (eds.), Geneva. (www.who.int).
26. Pruss A, Giroult E and Rushbrook P., (1999). Safe management of wastes from health-care activities. In World Health Organization (eds.), Geneva. (www.who.int).
27. Pruss A., Haltmeier and Bouvet F., (2001) Health Care Waste Management. Rapid Assessment tool for country level, (www.who.int).
28. Rushbrook P, Chandra and Gayton S., (2000). Starting health Care Waste Management in Medical Institutions. In World Health Organization (eds.), Copenhagen, (www.who.int).
29. Safe Injection Global Network (SIGN), (2004). Report of Global Infection Control and Injection Safety Meeting, Cape Town, South Africa. (www.who.int/injection_safety).

30. Suess M and Huisman J., (1983) Management of Hazardous Waste, Policy Guidelines and Code of Practice. In World Health Organization (eds.), Copenhagen, (www.who.int).
31. Taylor E., (2003). Rapid assessment of small-scale incinerators; Kenya. (www.who.int).
32. TelMedPak, (2000). Treatment and Disposal Technologies for Health-Care Waste, (www.telmedpak.com).
33. Texas A & M University Corpus Christ (2004). Environmental Health and Safety Department. Management and Disposal of Biological Waste. (<http://safety.tamucc.edu>).
34. United Nations Conference on Environment and Development (UNCED), (1992). A guide to agenda 21, pp 42-43, 87-88.
35. World Health Organization, (2000). Aide-Memoire for a National Strategy for Health-Care Management, Geneva, Switzerland, (www.who.int).
36. World Health Organization, (2003). Newsletter; Health Care Waste Management, Geneva, Switzerland, (www.who.int).
37. World Health Organization, (2004 a) Africa Region, Harare, Zimbabwe and IT Power India, PVT LTD. Managing Health Care Waste Disposal. (www.who.int).
38. World Health Organization (2004 b). Policy paper; Safe health care waste management, Geneva, Switzerland, (www.who.int).
39. World Health Organization, (2005). Preparation of National Health Care Waste Management Plans in Sub-Saharan Countries, (www.who.int).

Appendix 1. Institution consent form

ASSESSMENT OF HEALTH CARE WASTE MANAGEMENT IN NON GOVERNMENT HEALTH CARE FACILITIES IN NAIROBI PROVINCE

I am Dr. Washington N. Ngari, a postgraduate student pursuing a master in public health (MPH) at the Department of Community Health, University of Nairobi. As part of my postgraduate studies I am required to undertake a research project. I plan to do a study on the assessment of health care wastes management in non-Government health care facilities in Nairobi province.

I am conducting this study with the purpose of establishing the current health care waste management practices in the non-government health care facilities.

The study will be descriptive in design and the study tools will include a questionnaire to the members of staff and management of the selected facilities and an observation checklist of health care waste management practices.

The aim of the study is to generate information for health care workers, administrators and policy makers on the current practices of health care wastes management in non-Government health care facilities in Nairobi province. Secondly the study aims to offer recommendations on improvement of the health care waste management practices. This is intended to contribute towards occupational safety to the health care workers and a safer environment.

Your participation in the study will be highly appreciated and all the information offered will be treated with high confidentiality. A copy of the study will be presented to the Department of Community Health, University of Nairobi and copies will also be provided to the University of Nairobi library services for future references.

I.....in charge of-

do hereby give an informed and voluntary consent for the study to be undertaken in this health care facility.

Signature

Date.....—

Dr. Washington N. Ngari. Signature.....Date:

For any issues you may contact Dr Ngari on tel. no. 0727 072 490

Appendix 2. Individual consent form

I am Dr. Washington N. Ngari, a postgraduate student at the Department of Community Health, University of Nairobi. As part of my postgraduate studies I am required to undertake a research project. I plan to do a study on the assessment of health care wastes management in non-Government health care facilities in Nairobi province.

This will entail me asking you questions on health care waste management in your facility. I will also be taking photographs using a digital camera to document the practices of waste management within your institution.

Your rights will be respected and confidentiality maintained at all times. No names will be mentioned in the study document except serial numbers.

It is important that you understand, that participation in this study is absolutely voluntary and you can withdraw from the study without fear of anything. You are free to ask any questions relating to this study so as to get clarification on any issues that may not be clear to you. Thank you for your cooperation.

Dr. Washington N. Ngari has adequately explained to me the study he is undertaking and I voluntarily consent to participate in the study.

Signature:..... Date:

Number:

I have adequately explained to the interviewee all issues touching on this study and he/she has consented to participate in the study.

Dr. Washington N. Ngari. Signature.....Date:

For any issues you may contact Dr Ngari on tel. no. 0727 072 490

Appendix 3. Questionnaire

QUESTIONNAIRE ON THE ASSESSMENT OF MANAGEMENT OF HEALTH-CARE WASTES IN NON-GOVENMENTAL HEALTH CARE FACILITIES IN NAIROBI PROVINCE

A. HEALTH CARE FACILITY CHARACTERISTICS

1). NAME OF HEALTH CARE FACILITY.

2) CATEGORY OF HCF

1. PRIVATE HOSPITAL •
2. MISSION HOSPITAL •
3. PRIVATE NURSING HOME •
4. MISSION NURSING HOME •
5. PRIVATE HEALTH CENTRE •
6. MISSION HEALTH CENTRE •
7. PRIVATE DISPENSARY •
8. MISSION DISPENSARY •
9. PRIVATE CLINIC •
10. MISSION CLINIC •
11. PRIVATE VCT CENTRE
12. MISSION VCT CENTRE •
13. OTHER (SPECIFY)

3) SERVICES OFFERED BY YOUR FACILITY

1. IN-PATIENT •
2. OUT-PATIENT •
3. MATERNITY •
4. LABORATORY •
5. RADIOLOGY •
6. THEATRE
7. M.C.H •
8. V.C.T. •
9. OTHER (SPECIFY)

4) HOW MANY HEATH CARE WORKERS ARE IN THE FACILITY ?
(SPECIFY).

B. KNOWLEDGE OF THE CLINICIAN (doctor/co /nurse/ Lab tech.) ON HCWM

1)1) AGE

2) SEX; M • F •

3) WHAT IS YOUR JOB DESCRIPTION?

1. DOCTOR •
- " 2. CLINICAL OFFICER •
3. REGISTERED NURSE •

- 4. ENROLLED NURSE •
- 5. LABORATORY TECH. •
- 6. OTHER (SPECIFY)

4) HAVE YOU BEEN TRAINED ON HEALTH CARE WASTE MANAGEMENT?

- 1. YES • 2.NO •

5) WHAT DO YOU UNDERSTAND BY HEALTH CARE WASTE?

6) WHAT IS YOUR UNDERSTANDING OF HEALTH CARE WASTE MANAGEMENT?

7) WHAT DO YOU UNDERSTAND BY WASTE SEGREGATION?

8) WHAT DO YOU UNDERSTAND BY COLOUR CODING OF WASTES?

C. ATTITUDES AND PRACTICES OF THE CLINICIAN (Doctor/ Co /Nurse/ Lab tech.) ON HCWM

1) IS HCWM PART OF PROVIDING HEALTH CARE?

- 1.YES • 2.NO •

2) SHOULD A HCF HAVE A WASTE MANAGEMENT PLAN?

- 1.YES D2.NO •

3) IS HCWM TRAINING IMPORTANT FOR CLINICIANS OR WASTE HANDLERS?

- 1.CLINICIANS • 2.WASTE HANDLERS • 3. BOTH •

4) ARE WASTE HANDLERS THE ONES RESPONSIBLE FOR HCWM?

- 1 .YESD2.NO •

5) SHOULD HEALTH CARE WASTES BE TREATED DIFFERENTLY FROM WASTES OF OTHER SOURCES?

- 1.YES D2.N0 •

6) IN YOUR CURRENT POSITION DO YOU THINK THAT YOU HAVE A ROLE TO PLAY IN HCWM?

- 1.YES D2.N0 •

- 7) HOW MANY CATEGORIES OF WASTES DO YOU PRODUCE IN YOUR DAILY DUTIES? (SPECIFY)
- 8) LIST DOWN THE DIFFERENT CATEGORIES OF WASTE THAT YOU PRODUCE. 1.
2.
3.
4.
- 9) DO YOU RE CAP NEEDLES AFTER USE?
1.YES • 2.NO •
- 10) HAVE YOU HAD A NEEDLE PRICK INJURY IN THE LAST ONE MONTH?
1.YES D2.NO •
- 12) HAVE YOU BEEN VACCINATED AGAINST HEPATITIS B?
1.YES D2.NO •
- 13) HAVE YOU BEEN VACCINATED AGAINST TETANUS?
1 .YESD2.NO •

D. QUESTIONNAIRE FOR THE WASTE HANDLER

- 1) AGE
- 2) SEX; M • F •
- 3) WHAT IS YOUR BASIC TRAINING? (SPECIFY)
- 4) HAVE YOU BEEN TRAINED ON HEALTH CARE WASTE MANAGEMENT?
1.YES • 2.NO •
- 5) DO YOU USE PERSONAL PROTECTIVE EQUIPMENT (P.P.E.)?
1 .YESD2.NO D
6. IF YES WHICH ONES?
- | | | |
|----------------------|---------|-------|
| 1) SAFETY SPECTACLES | 1.YES D | 2.NOD |
| 2) MASK | 1.YESD | 2.NOD |
| 3) HEAVY DUTY GLOVES | 1.YES D | 2.NOD |
| 4) INDUSTRIAL APRON | 1.YESD | 2.NOD |
| 5) UNIFORMS | 1.YESD | 2.N0D |
| 6) INDUSTRIAL BOOTS | 1.YESD | 2.NOD |
7. a) ARE YOU AWARE OF RISKS OF HANDLING HCW?
1.YES D 2. NOD

b) IF YES, WHAT RISKS?

8. HAVE YOU HAD A NEEDLE STICK INJURY IN LAST ONE MONTH?

1.YES • 2.NOD

9. HAVE YOU BEEN VACCINATED AGAINST HEPATITIS B?

1.YES • 2.NOD

10. HAVE YOU BEEN VACCINATED AGAINST TETANUS?

1.YES • 2.NOD

E. QUESTIONNAIRE FOR THE MANAGEMENT

1) AGE

2) SEX; M • F •

3) WHAT IS YOUR BASIC TRAINING? (SPECIFY)

4) HAVE YOU BEEN TRAINED ON HEALTH CARE WASTE MANAGEMENT?

1.YES • 2.NO •

5. DOES THE HCF HAVE A WASTE MANAGEMENT TEAM (WMT)?

1.YES • 2.NOD

6. DOES THE WMT HAVE A WASTE MANAGEMENT OFFICER?

1.YES • 2.NOD

7. IF YES WHAT ARE HIS/HER QUALIFICATIONS?

(SPECIFY).

8. DOES THE HCF ALLOCATE ANY FUNDS FOR HCWM?

1.YES • 2.NOD 3.DON'T KNOW •

10. IN 2006 MUCH DID THE HCF SPEND ON HCWMON PRIVATE COLLECTORS?

11 .WHAT PERCENTAGE OF YOUR ANNUAL BUDGET IS USED ON HCWM PER YEAR?_____ % (SPECIFY)

12. DO YOU PROVIDE PERSONAL PROTECTIVE EQUIPMENT (P.P.E.)

1.YES • 2.NOD

13. IF YES WHAT DO YOU PROVIDE?

1) SAFETY SPECTACLES 1.YES • 2.NOD

2) MASK 1.YES • 2.NOD

3) HEAVY DUTY GLOVES 1.YES • 2.NOD

4) INDUSTRIAL APRON 1.YES • 2. NOG

5) UNIFORMS 1.YES • 2. NOD

6) INDUSTRIAL BOOTS 1.YES • 2.NOD

7) OTHER (SPECIFY)

Appendix 4. Observation checklist

OBSERVATION /CHECKLIST FOR ASSESSMENT OF THE MANAGEMENT OF SOLID HEALTH-CARE WASTES IN NON- GOVERNMENT HEALTH CARE FACILITIES IN NAIROBI PROVINCE (1 CHECKLIST PER HCF)

NAME OF HEALTH CARE FACILITY _____

1. IS WASTE SEGREGATION PRACTICED WITHIN THE HEALTH CARE FACILITY?

1.YES • 2.NOD

2. IF YES INTO HOW MANY CATEGORIES?
(SPECIFY NUMBER)

3. INTO WHICH CATEGORIES IS THE WASTE SEPARATED?

- a.
- b.
- c.
- d.
- e.

4. IS COLOUR CODING OF WASTE PRACTICED IN THE FACILITY?

5. IF YES WHAT COLOUR CODES ARE USED FOR THE DIFFERENT TYPES OF WASTES (SPECIFY)?

- a.
- b.
- c.
- d.
- e.

6. TYPE OF WASTE STORAGE RECEPTACLES USED FOR STORAGE OF WASTES AT GENERATION POINT _____

7. TYPE / DESIGN OF VEHICLE USED FOR THE COLLECTION AND TRANSPORTATION OF WASTES FROM SOURCE (SPECIFY) _____

8. IS PERSONAL PROTECTIVE EQUIPMENT PROVIDED FOR THE WASTE HANDLERS?

9. IF YES WHAT TYPE OF PERSONAL PROTECTIVE EQUIPMENT IS PROVIDED _____

- 1) SAFETY SPECTACLES 1.YES • 2.NOD
- 2) MASK 1.YES • 2.NOD

- 3) HEAVY DUTY GLOVES 1.YESD 2.NOD
- 4) INDUSTRIAL APRON 1.YESD 2.NOD
- 5) UNIFORM 1.YESD 2. NOD
- 6) INDUSTRIAL BOOTS 1.YESD 2.NOD

10. ARE WASTES TREATED PRIOR TO DISPOSAL?
1.YESD 2.NOD

11. IF YES WHAT TREATMENT METHODS

- 1) INCINERATION D
- 2) AUTOCLAVING
- 3) CHEMICAL DISINFECTION D
- 4) ENCAPSULATION
- 5) MICROWAVE IRRADIATION D
- 6) OTHER (SPECIFY)

12. IS THERE AN INCINERATOR WITHIN THE HEALTH FACILITY COMPOUND?

13. VISIBLE WASTE DISPOSAL OPTION WITHIN THE HEALTH FACILITY COMPOUND

- 1) OPEN DUMPING D
- 2) CRUDE BURNING SITE D
- 3) SANITARY LANDFILL D
- 4) SIMPLE PIT D
- 5) NONE (PRIVATE COLLECTORS)

THIS IS TO CERTIFY THAT:

Prof./Dr., "Mr/Mrs
NGAR!

o ^ S ^ ^.....

COLLEGE OF HEALTH SCIENCES

O : B 0 r ' ' f f l 6 B f ^ P S m a ' w v ^ c r r ^ A R T
has been permitted to conduct rese^^.n.---.*..

NAIROBI .Province,

on the topic ASSESSMENT OF MANAGEMENT

0! HEALTH CARE WASTES iti SOS -
GOVERNMENT HEALTH CARE FACILITIES
IN NATROBI PROVIKCE

for a period ending 30TH APRIL > 20 07

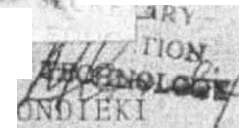
Research Permit No^{M9}.ST.

Date of issue...².f

Fee received .?HS_v500,,00



1



Applicant jt
Signa:ur<;

FOR: Permanent Secretary
Ministry of
Science and Technology

CONDITIONS

- 1 You must report to the District Commissioner and the District Education Officer of the area before embarking on your research. Failure to do that may lctul to the cancellation of your permit
 - 2 Government Officers will not be interviewed without prior appointment.
 - 3 No questionnaire \s»ll be used unless it has been approved
 - 4 Excavation, filming and collection of biological specimen* are subject to further permission from the relevant Government Ministries.
 - 5 You are required to submit at least two(2)/foun'4) bound copies of your final report for Kenyans and non-Kenyans respectively.
- (* The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice



REPUBLIC OF KENYA

RESEARCH CLEARANCE
PERMIT

MINISTRY OF SCIENCE at TECHNOLOGY

rcrlgram.v SCII NCI I E< Nairobi

No.
telephone: 3JS5S1
VN hen repl> inn please quote



jo<;oo hoi si
H \U.\MHCE W E M |
P O. Bo* WH-IMMO
NMROBI
KL.N\ A

MOST 13/001/37C 93/2

1st March 2007

Dr Washington Ngari
University of Nairobi
College of Health Sciences
P O Bex 3C<97
NAIROBI

Dear S.r

RE RESEARCH AUTHORIZATION

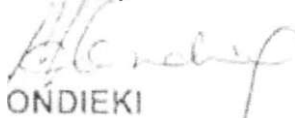
FcHowmg :your application for authority to carry out research
*Assessment of the Management of Health Care Wastes in
Government Health Care Facilities in Nairobi Province*

I am pleased to inform you that you have been authorized to carry out
research in Nairobi for a period ending 30 April 2007

It is noted that the research is a requirement in part fulfilment of the award
of VIPH Certificate of the University of Nairobi

On completion of your research you are expected to submit two copies of
your research report to this office

Yours faithfully


M. O. ONDIEKI
FOR: PERMANENT SECRETARY
Copy to

The Provincial Commissioner
Nairobi

The Provincial **Director** of Fisheries -
Nairobi

The Provincial **Director** of Health Services -
Nairobi

MINISTRY OF HEALTH

Telephone "MINHELTH", Nairobi
Telephone: Nairobi 717077 Fax: 715239
When replying please quote



OFFICE OF THE DIRECTOR OF
MEDICAL SERVICES
AFYA HOUSE
CATHEDRAL ROAD
PO. Box 30016
NAIROBI

R/10/1/1 Vol.XII

Ref. No.

23rd February, 2007

Date:

Dr. Washington N. Ngari
P.O. Box 53901-00200
NAIROBI

RH: **REQUEST TO CONDUCT A RESEARCH ON THE ASSESSMENT
HEALTH CARE WASTE MANAGEMENT IN THE NON-
GOVERNMENT HEALTH CARE FACILITIES IN NAIROBI
PROVINCE**

This refers to your letter dated 21^M February. 2007 on the above subject.

Permission is hereby granted for you to carry out a research on the assessment of health care wastes management in non-government health care facilities in Nairobi province.

A handwritten signature in black ink, appearing to be 'S. K. Sharif', written in a cursive style.

DR. S. K. SHARIF, oow. MBChB. M.Med D1.STMH.MSC
For: DIRECTOR OF MEDICAL SERVICES



KENYATTA NATIONAL HOSPITAL

Hospital Rd. along, Ngong Rd

P.O. Box 20723, Nairobi.

Tel: 726300-9

Fax: 725272

Telegrams: MEDSUP", Nairobi.

Email: KNHplan@Ken.Healthnet.org

14th December 2007

Ref: KNH-ERC/ 01/ 4998

Dr. Washington N. Ngari
Dept. of Community Health
School of Medicine
University of Nairobi

Dear Dr. Ngari

RESEARCH PROPOSAL: "ASSESSMENT OF MANAGEMENT OF HEALTH-CARE WASTES IN NON-GOVERNMENT HEALTH CARE FACILITIES IN NAIROBI PROVINCE" (P37/03/2007)

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and approved your above revised research proposal for the period 14th December 2007 - 13th December 2008.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimen must also be obtained from KNH-ERC for each batch.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely


PROF AN GUANTAI
SECRETARY, KNH-ERC

UNIVERSITY OF NAIROBI
MEDICAL LIBRARY

c.c. Prof. K.M. Bhatt, Chairperson, KNH-ERC
The Deputy Director CS, KNH
The Dean, School of Medicine, UON
The Chairman, Dept. of Community Health, UON
Supervisors: **Prof. Mutuku A. Mwanthi, Dept. of Community Health, UON**
Mrs. M. Kinoti. Dept. of Community Health, UON
Dr. Michael J. Gatari, Institute of Nuclear Sciences, UON