

**KNOWLEDGE AND PRACTICES OF HEALTH CARE WORKERS  
ON MEDICAL WASTE DISPOSAL IN MAPULANENG HOSPITAL  
IN THE EHLANZENI DISTRICT OF SOUTH AFRICA**

by

**RAMADIMETJA ROSINA MAKHURA**

MINI - DISSERTATION

Submitted in partial fulfilment of the requirements for the degree of

**MASTER OF PUBLIC HEALTH**

in the

**FACULTY OF HEALTH SCIENCES**

at the

**UNIVERSITY OF LIMPOPO**

**SUPERVISOR: Matlala S.F.**

**CO-SUPERVISOR: Kekana M.P.**

**2016**

## DECLARATION

I declare that **KNOWLEDGE AND PRACTICES OF HEALTH CARE WORKERS ON MEDICAL WASTE DISPOSAL IN MAPULANENG HOSPITAL IN THE EHLANZENI DISTRICT OF SOUTH AFRICA** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete reference and that this work has not been submitted before for any other degree at any other institution.

.....  
Ramadimetja Rosina Makhura

.....  
Date

## **ACKNOWLEDGEMENTS**

I thank the following people for their various contributions towards completion of this dissertation:

My sincere appreciation goes to the Almighty God who helped me and gave me courage to succeed in this project.

My supervisor Mr S.F. Matlala and Co-supervisor Mr M.P. Kekana, for your time, patience, sacrifice and providing guidance throughout all the stages of the research.

The university Statistician for assisting me with data analysis

Language Editor for editing the document

My family, for giving me support throughout my studies.

The Mpumalanga Department of Health, for giving me permission to conduct the study.

The staff of the Mapulaneng Hospital, for participating in the research. Without their participation this research would not have been a success. Special thanks to the Environmental Health Practitioner Ms M.M. Madumo for assistance in the research.

## **DEDICATION**

This dissertation is dedicated to:

My children Thabo, Karabo, and Tshepho for being there for me and understanding when I was concentrating more on my studies instead of being with them. This achievement is yours.

My best friend, who encouraged, supported and believed in my ability.

## CONTENTS

<b>DECLARATION.....</b>	<b>ii</b>
<b>ACKNOWLEDGEMENT.....</b>	<b>iii</b>
<b>DEDICATION.....</b>	<b>iv</b>
<b>DEFINITION OF CONCEPTS.....</b>	<b>x</b>
<b>ABBREVIATIONS.....</b>	<b>x</b>
<b>ABSTRACT.....</b>	<b>xiii</b>
<b>CHAPTER 1: INTRODUCTION AND BACKGROUND</b>	
1.1. INTRODUCTION AND BACKGROUND.....	1
1.2. RESEARCH PROBLEM.....	1
1.3. RESEARCH AIM.....	3
1.4. RESEARCH QUESTION.....	3
1.5. OBJECTIVES.....	3
1.6. LITERATURE REVIEW.....	4
1.7. RESEARCH METHODOLOGY.....	5
1.8. SIGNIFICANCE OF THE STUDY.....	5
1.9. CHAPTER OUTLINE.....	6
<b>CHAPTER 2: LITERATURE REVIEW</b>	
2.1. INTRODUCTION.....	7
2.2. TYPES OF MEDICAL WASTE.....	7
2.3. KNOWLEDGE WITH REGARD TO DISPOSAL OF MEDICAL WASTE.....	8
2.4. PRACTICES OF HEALTH CARE WORKERS WITH REGARD TO DISPOSAL OF MEDICAL WASTE.....	10

2.5. HEALTH IMPACT ON HEALTHCARE WORKERS AND THE ENVIRONMENT.....	15
2.6. LEGISLATIVE REQUIREMENTS AND GUIDELINES ON DISPOSAL OF MEDICAL WASTE.....	16

**CHAPTER 3: RESEARCH METHODOLOGY**

3.1. INTRODUCTION.....	18
3.2. RESEARCH DESIGN.....	18
3.3. STUDY SITE.....	18
3.4. STUDY POPULATION.....	19
3.5. SAMPLING.....	19
3.6. INCLUSION AND EXCLUSION CRITERIA .....	21
3.7. DATA COLLECTION.....	21
3.8. DATA ANALYSIS.....	21
3.9. VALIDITY.....	22
3.10. RELIABILITY.....	22
3.11. PILOT STUDY.....	22
3.12. BIAS.....	23
3.13. ETHICAL CONSIDERATION.....	23

**CHAPTER 4: RESULTS**

4.1. INTRODUCTION.....	26
4.2. SOCIO-DEMOGRAPHIC INFORMATION OF RESPONDENTS.....	26
4.3. KNOWLEDGE OF HEALTH CARE WORKERS.....	28
4.4. THE ASSOCIATION OF DEMOGRAPHIC FACTORS TO KNOWLEDGE AND PRACTICE.....	30

4.5. ASSOCIATION BETWEEN KNOWLEDGE AND PRACTICE REGARDING DISPOSAL OF MEDICAL WASTE.....	40
---	----

**CHAPTER 5: DISCUSSION OF THE FINDINGS, LIMITATIONS,  
CONCLUSION AND RECOMMENDATIONS.**

5.1. INTRODUCTION.....	42
5.2. SUMMARY AND INTERPRETATION OF THE FINDINGS.....	42
5.3. LIMITATIONS.....	48
5.4. CONCLUSION.....	48
5.5. RECOMMENDATIONS.....	49
<b>REFERENCES.....</b>	<b>49</b>

**APPENDICES**

Appendix A: Questionnaire.....	55
Appendix B: Informed consent.....	60
Appendix C: Budget.....	61
Appendix D: Time frame for the study.....	62
Appendix E: Ethical clearance.....	64
Appendix F: Permission letter from Department of Health.....	65
Appendix G: Permission letter from hospital management.....	66
Appendix H: Letter from Editor.....	67
Appendix I: Letter from Statistician.....	68

## LIST OF TABLES

Table 1.1 Number of needle pricks.....	2
Table 2.1 Summary of colour coding.....	10
Table 3.2 Total number of staff according to professional category.....	20
Table 4.1 Frequency distribution of males and females.....	26
Table 4.2 Frequency distribution of health care workers by professional category.....	27
Table 4.3 Frequency distribution of health care workers by knowledgeable, not sure and no knowledge .....	28
Table 4.4 Cross tabulation of gender and knowledge regarding disposal of medical waste.....	30
Table 4.5 Chi-square tests of gender and knowledge.....	30
Table 4.6 Cross tabulation of gender and practice regarding disposal of medical waste.....	31
Table 4.7 Chi-square tests of gender and practice.....	31
Table 4.8 Cross tabulation of age and knowledge.....	32
Table 4.9 Chi-square tests of age and knowledge.....	32
Table 4.10 Cross tabulation of age and practice.....	33
Table 4.12 Cross tabulation of professional category and knowledge.....	35
Table 4.13 Chi-square tests of professional category and knowledge.....	35
Table 4.14 Cross tabulation of professional category and practice.....	36
Table 4.15 Chi-square tests of professional category and practice.....	37
Table 4.16 Cross tabulation of years of experience and knowledge.....	37



Table 4.17 Chi-square tests of professional years of practice and knowledge.....	37
Table 4.18 Chi-square of years of experience and practice.....	39
Table 4.19 Cross tabulation of knowledge and practice.....	40
Table 4.20 Chi-square test of knowledge and practice.....	41

### **LIST OF FIGURES**

Figure 2.1 International infectious substance symbol.....	19
Figure 4.1 Percentage of health care workers by age group.....	27
Figure 4.2 Percentage of health care workers by years of experience.....	28
Figure 4.3 Percentage distributions of health care workers by practice.....	29

## DEFINITION OF CONCEPTS

**Knowledge:** Knowledge is the information, understanding and skills that one gains through education or experience (Oxford Advanced Learners Dictionary, 2010). In this study, knowledge refers to the awareness of guidelines for medical waste disposal.

**Practices:** Practice is the usual or expected way of doing something in a particular organization or situation (Oxford Advanced Learners Dictionary, 2010). In this study practice refers to application of rules and knowledge that leads to action in medical waste disposal

**Health care worker:** A health care worker is an individual who is engaged in the promotion, protection or improvement of the health of the population (Diallo, Zurn, Gupta & Dal Poz, 2003). In this study health care worker refers to nursing staff, medical staff, dental staff and allied health staff.

**Chemical waste:** Chemical waste refers to discarded solid, liquid, or gaseous chemicals used for diagnostic or experimental purposes or for general cleaning, housekeeping and disinfecting procedures. In this study, chemical waste refers to discarded chemicals which have been used for diagnostic or disinfecting procedures (Chartier, Emmanuel, Prüss, Rushbrook, Stringer, Townend, Wilburn & Zghondi, 2014).

**Medical waste:** Medical waste as any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals (World Health Organization, 2005). In this study medical waste includes sharps, human tissues, laboratory waste, soiled bandages and any other material which contain free-flowing or expressible blood.

**Waste disposal:** Waste disposal is the final placement of treated waste using environmentally acceptable method of final storage appropriate to the local conditions (World Health Organisation, 2005). In this study, it refers to the disposal of medical waste according to waste management policies and guidelines.

**Waste segregation:** Waste segregation refers to the separation of waste according to classification prior to storage (Health Professions Council of South Africa, 2008). In this study it refers to separation of waste in the wards when waste is generated, into non-infectious, infectious and sharps.

**Needle stick injury:** A needle stick injury is an accidental puncture of the skin by a needle during a medical intervention (World gastroenterology organisation, 2011). In this study needle stick injury refers to any prick with sharp instruments which were used on a patient.

## **ABBREVIATIONS**

AIDS: Acquired Immune Deficiency Syndrome

HIV: Human Immune Deficiency Virus

NEMA: National Environmental Management Waste Act

OHS: Occupational Health and Safety Act

PPE: Personal Protective Equipment

WHO: World Health Organization

## **ABSTRACT**

**Background:** Health care workers produce various types of waste in the course of rendering health care services. Each classification of waste must be disposed according to the prescribed guidelines. Improper disposal of waste may pose a danger to employees, patients and the environment. Health care workers must have adequate knowledge on disposal of medical waste. This study was therefore done to determine the knowledge and practices of health care workers on medical waste disposal.

**Objectives:** This study aims to determine the knowledge and practices of health care workers on medical waste disposal at a hospital in the Mpumalanga Province in South Africa.

**Methods:** A quantitative cross-sectional research approach was used at a regional hospital for the Mpumalanga Province in the Bushbuckridge Municipality under the Ehlanzeni District. The study respondents included professional nurses, enrolled nurses, enrolled nursing assistants, medical doctors, dental health and allied health staff. Data were collected through self-administered questionnaires analysed using International Business Management Statistical Package for Social Sciences 22 (IBM SPSS 22).

**Results:** The results show that a high percentage of health care workers did not have adequate knowledge regarding disposal of medical waste but disposed medical waste appropriately. The results further show that knowledge and practice of health care workers had no association with age, gender and years of experience. There is an association between professional category and knowledge and practice of healthcare workers.

**Conclusion:** Disposal of medical waste is the responsibility of all health care workers. There should be regular training of all categories of health care workers to improve their knowledge on disposal of medical waste and minimise the risks associated with improper waste management. This will further increase compliance with the guidelines of disposal of medical waste.

**Key words:** Health care workers, medical waste, knowledge, practice, disposal

## CHAPTER 1

### INTRODUCTION AND BACKGROUND

#### 1.1. INTRODUCTION AND BACKGROUND

Medical waste is waste that is generated by health care workers when carrying out health care activities in health institutions. Health care workers produce various types of waste in the course of rendering health care services. Hospital waste is classified into medical waste, chemical waste, radioactive waste, cytotoxic waste, pharmaceutical waste and general waste. Medical waste includes sharps, laboratory and associated waste, human tissue and carcasses used for research purposes. Each classification must be disposed according to the prescribed guidelines (Health Professions Council of South Africa, 2008).

Methods of disposal of waste are incineration, sterilization, chemical disinfection and secured landfill. Segregation of medical waste must be done at the point of generation. This should be done by discarding the medical waste in colour coded containers. Incineration, chemical disinfection and microwaving are methods of disposing sharps. Radioactive waste must be handled, stored and disposed in accordance with the prescribed legislature. Laboratory and associated waste directly involved in specimen processing can be disposed either through incineration or chemical disinfection. Human tissue must be disposed through incineration. Disposal of pharmaceutical waste depends on the composition of the materials. It must be stored in non-reactive containers and disposed through incineration (Chartier et al, 2014).

In order to prevent injuries to other employees, patients and to protect the environment from medical waste, health care workers must have adequate knowledge on disposal of medical waste. Hospitals have the responsibility to capacitate their employees with regard to medical waste disposal. The training should include occupational hazards, management of exposure to blood and body fluids, procedures to follow when disposing medical waste and prevention of injury and diseases, management of needle stick and blood and body substance exposure (South Africa, 2008). A study conducted in Karachi indicates that knowledge, attitude

and practice of personnel involved in health care facilities waste management are extremely poor and proper facilities for management of hospital waste are almost non-existent (Habibullah & Afsar, 2007). Another study which was conducted among health care workers in Agra on medical waste management indicates deficiency in information and awareness among hospital employees regarding legislation associated with medical waste management (Lakshmi & Kumar, 2012).

There has been an increase in the number of needle stick injuries among general assistants at the hospital which occurred during their daily activities according to the occupational health statistics of the institution. The general assistants in various wards are not working with health care instruments, like sharps, and it is not acceptable for them to have needle pricks. This study was therefore done to determine the knowledge and practices of health care workers on medical waste disposal.

## 1.2. RESEARCH PROBLEM

Waste management inspections conducted at the Mapulaneng Hospital in the Ehlanzeni District in the year 2013 by the hospital waste management team indicated that there was non-compliance with waste management policies and guidelines. The remarks centred on improper segregation of waste which posed health risks to health care workers in the institution. The number of needle stick injuries among health workers and general assistants was also increasing according to the occupational health statistics of the institution. The number increased from 7 to 11. The information is summarised in Table 1.1.

**Table 1.1: Number of needle pricks**

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Number of needle pricks (2012)	1	0	0	0	1	0	0	0	4	1	0	0	7
Number of needle pricks (2013)	0	2	3	0	1	1	1	1	0	1	0	1	11

The annual rate of increase from the year 2012 to 2013 was 57%. It seemed the hospital management was not aware of the reasons behind this non-compliance and hospital workers were also not aware of the consequences of not implementing proper waste management procedures. The researcher was therefore interested in determining knowledge and practices of health care workers on medical waste disposal.

### **1.3. RESEARCH AIM**

The aim of the study was to determine the knowledge and practices of health care workers on medical waste disposal in Mapulaneng Hospital at the Ehlanzeni District in South Africa.

### **1.4. RESEARCH QUESTION**

What are the knowledge and practices of health care workers on medical waste disposal in Mapulaneng Hospital at Ehlanzeni District in South Africa?

### **1.5. OBJECTIVES**

- To determine the socio-demographic profile of health care workers at the Mapulaneng Hospital.
- To determine the knowledge of healthcare workers on medical waste disposal at the Mapulaneng Hospital.
- To determine how medical waste is disposed by health care workers at the Mapulaneng Hospital.
- To determine the association of demographic factors to knowledge and practice of medical waste disposal at the Mapulaneng Hospital.
- To determine the association between knowledge and practice of health care workers on medical waste disposal at the Mapulaneng Hospital.



## **1.6. LITERATURE REVIEW**

Literature review is a critical summary of research on a topic of interest, often prepared to put a research problem in context or to summarise existing evidence (Polit & Beck, 2008). A literature review will be fully outlined in chapter 2. The review of the literature assisted the researcher to identify what other researchers have done and reported on the research problem.

Literature on types of medical waste, knowledge, practices, environmental and health impact of practices has been reviewed. Medical waste is categorised into different types, namely: infectious waste, pathological waste, sharps, pharmaceutical waste, chemical waste, radioactive waste, cytotoxic agents and human or anatomical waste (Health Professions Council of South Africa, 2008).

Knowledge of health care workers with regard to medical waste disposal management also plays a role in its improvement. A study conducted among hospitals of Allahabad City in India on knowledge about medical waste revealed that doctors, nurses and laboratory technicians had better knowledge than general assistants regarding medical waste management (Mathur, Dwivedi, Hassan & Misra, 2011).

Proper waste segregation must be done at the point of generation. This can be achieved by providing education and training programs for all personnel who generate waste, providing material safety data sheets for identification of material composition, establishing identifiable colour coding, labelling and containment, using methods that ensure easy, safe and proper segregation of medical wastes at the point of generation and providing a suitable storage area at point of generation (Chartier et al., 2014). The results of a study conducted in the hospitals of Istanbul in Turkey indicated that training programs on waste management in the health institutions has a significant effect in increasing the information level of health care workers (Ozder, Teker, Eker, Altindis, Kocaakran & Karabay, 2013).

Some types of medical waste represent a higher risk to health. Disposal of these types of waste must be done in accordance with prescribed policies and guidelines to prevent harm to the health care workers, waste handlers and pollution of the environment (WHO, 2005).

## **1.7. RESEARCH METHODOLOGY**

A quantitative research approach was used to determine the knowledge and practices of health care workers on medical waste disposal in the Mapulaneng Hospital at the Ehlanzeni District in South Africa. Quantitative research is defined as a formal, objective and systematic process in which numerical data are used to obtain information about the world (Burns & Grove, 2009). A cross-sectional research design was used. This research design provides a snapshot of an outcome and the characteristics associated with it (Lavrakas, 2008). The design helped the researcher to obtain more information in a short time than would have been possible otherwise, as it takes little time to conduct.

This study was conducted at the Mapulaneng Hospital which is a regional hospital for the Mpumalanga Province in the Bushbuckridge Municipality under the Ehlanzeni District. The study population consisted of 319 health care workers which included 269 nursing staff, 17 medical staff, 5 dental staff and 28 allied health staff employed at the Mapulaneng Hospital. The research methodology will be outlined fully in chapter 3.

## **1.8. SIGNIFICANCE OF THE STUDY**

The study may assist hospital management in identifying factors contributing to non-compliance with waste management at the hospital. The study indicates that a high percentage of health care workers did not have adequate knowledge regarding disposal of medical waste. This information may be used to develop improvement plans for correcting identified gaps. The study may influence the development of institutional guidelines for handling waste which may lead to reduction in audit

queries, needle stick injuries and cost which may be aggravated by improper segregation of waste. The results of the study were made available to the Mpumalanga Department of Health as a basis upon which further research can be made.

## **1.9. CHAPTER OUTLINE**

### Chapter 1

This chapter provides a background to the study and research framework.

### Chapter 2

The chapter discusses reviewed literature and other studies on knowledge and practice of health care workers on medical waste disposal.

### Chapter 3

The chapter outlines the methodology of the study, which includes, research design, study site, sampling, inclusion and exclusion criteria, data collection, data analysis, validity, reliability, and bias.

### Chapter 4

The chapter outlines the results of the study.

### Chapter 5

The chapter focuses on the discussion of the findings, limitations, conclusion, and recommendations.

## **CONCLUSION**

This chapter outlined the introduction and background of the study, research aim, research question, research objectives, summary of literature review and research methodology. Chapter 2 will discuss literature review in full.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1. INTRODUCTION**

Literature review is a critical summary of research on a topic of interest, often prepared to put a research problem in context or to summarise existing evidence (Polit & Beck, 2008). A review of the literature assisted the researcher to identify what other researchers have done and reported on the research problem. Its main goals are to place the current study within the body of literature and to provide context for the particular reader. Literature review substantiates the research, shows that a problem exists and establishes the need for the present study. The researcher used the literature review process to develop a comprehensive understanding of the topic. The literature review process helped the researcher to identify gaps in current knowledge and begin to establish the conceptual or theoretical frame work to be used in the study (Norwood, 2010). It identified findings and views from previous studies in order to provide intellectual context for positioning the study in relation to other studies. The literature reviewed was on types of medical waste, knowledge, practices, environmental and health impact of practices. A review of international and local sources from peer reviewed sources and from expert organizations in health and environmental issues was done.

#### **2.2. TYPES OF MEDICAL WASTE**

Medical waste is categorised into different types, namely: infectious waste, pathological waste, sharps, pharmaceutical waste, chemical waste, radioactive waste, cytotoxic agents and human or anatomical waste. Infectious waste is any waste contaminated with viable micro-organisms capable of transmitting a disease. Pathological waste includes body fluids, secretions and surgical specimens. Sharps are any objects capable of inflicting a penetrating injury, which may or may not be contaminated with blood and or body substances. This includes needles and any other sharp objects or instruments designed to perform penetrating procedures. Pharmaceutical waste includes pharmaceutical products such as drugs and medicinal chemicals that are no longer usable in patient treatment and have been

returned from patient care areas, have expired or have been contaminated. Chemical waste comprises of discarded solid, liquid and gaseous chemicals. Examples may be from diagnostic or experiential work, or from cleaning, housekeeping or disinfecting procedures. Chemical waste may be hazardous or non-hazardous (Health Professions Council of South Africa, 2008). Radioactive waste is material contaminated with radioactive substances which arises from medical or research use of radionuclides (Chartier, Emmanuel, Prüss, Rushbrook, Stringer, Townend, Wilburn & Zghondi, 2014).

Cytotoxic agents are substances that have a deleterious effect upon cells, commonly used in the treatment of cancer, for example chemotherapy agents. Pressurised containers consist of aerosol cans or disposable compressed gas containers that may explode if incinerated or accidentally punctured. Human or anatomical waste is waste consisting of tissues, organs, body parts, products of conception and animal carcasses (Health Professions Council of South Africa, 2008).

### **2.3. KNOWLEDGE WITH REGARD TO DISPOSAL OF MEDICAL WASTE**

Knowledge of health care workers with regard to disposal of medical waste plays a role in its improvement. Assessment of knowledge gaps should be made and addressed with required training. A study conducted among hospitals of Allahabad City in India on knowledge about medical waste revealed that doctors, nurses and laboratory technicians had better knowledge than general assistants regarding disposal of medical waste (Mathur, Dwivedi, Hassan & Misra, 2010). A study conducted in Gondar Town, North West Ethiopia in 2012, on medical waste disposal practices among health care workers indicated that the majority of health care workers had a low level of knowledge on the existence of manuals on medical waste, types of medical waste, colour coding of containers for waste and the importance of waste segregation (Yenesew, Moges, Woldeyohannes, 2012).

The level of knowledge varies among health care workers. A study by Suwarna and Ramesh (2012) in Bangalore indicates that doctors and nurses have got a higher level of knowledge than other health care workers. A study conducted at Bagepalli Taluk in India in 2013 to assess the knowledge and practice on medical waste

disposal among the health care workers revealed that the majority of health care workers did not have any in-service education regarding disposal of medical waste (Nagaraju, Padmavathi, Puranik, Shantharaj & Sampulatha, 2013). Similar results were also found in a study conducted in the Souss-Massa Drâa region in Morocco on medical waste disposal, which revealed that knowledge of health care workers related to medical waste separation is low (Mbarki, Kabbachi, Ezaidi & Benssaou, 2013).

It is important that health care workers access and have knowledge of policies and guidelines for medical waste disposal to enable them to practice safe disposal methods. Lakshmi and Kumar (2012) conducted an analysis among health care workers on medical waste disposal in Agra. The study indicated deficiency in knowledge of health care workers regarding legislation associated with medical waste disposal.

A study which was conducted at Johannesburg hospital in South Africa in 2008 on knowledge and practices of doctors and nurses about management of medical waste revealed that there was a significant association between knowledge and access to documents. Health care workers who had access to documents related to medical waste were reported to have good medical waste practices (Ramokate & Basu, 2009).

Proper waste segregation must be done at the point of generation. This can be achieved by providing education and training programs for all health care workers who generate waste, providing material safety data sheets for the identification of material composition, establishing identifiable colour coding labelling and containment, using methods that ensure easy, safe and proper segregation of medical wastes at the point of generation and providing a suitable storage area at point of generation (Chartier et al., 2014). The results of a study conducted in the hospitals of Istanbul in Turkey indicated that training programs on medical waste disposal in the hospitals had a significant effect on increasing the information level of health care workers. The most important problem in disposal of medical waste was

identified as lack of sufficient training and supervision (Ozder, Teker, Eker, Altindis, Kocaakran & Karabay, 2013). A study which was conducted at a hospital in Cape Town, South Africa, on medical waste disposal practices, in 2007 indicated that there was no training conducted for staff members on waste management and this resulted in medical waste not being properly disposed (Abor & Bouwer, 2008).

**Table 2.1 Summary of colour coding**

Type of medical waste	Colour of container and markings
Infectious non-anatomical waste	Yellow
Human / animal anatomical waste	Red
Sharps	Yellow, marked "SHARPS", with biohazard symbol
Chemical and pharmaceutical waste	Black, dark green, or recognised coding Cytotoxic hazard symbol
Radioactive waste	Labelled with radiation symbol
General medical waste	Black

(Chartier et al, 2014).

Table 2.1 shows the summary of colour coding. Each type of medical waste must be disposed in the correct container. Colour coding enables health care workers to dispose medical waste into the correct containers. It also provides a visual indication of the potential risk posed by the medical waste in that container. Medical waste bags and containers should be labelled with the date, type of waste and point of generation to allow easy tracking (Chartier et al, 2014).

#### **2.4. PRACTICES OF HEALTH CARE WORKERS WITH REGARD TO DISPOSAL OF MEDICAL WASTE**

Each hospital has the responsibility to ensure that waste generated is disposed safely to prevent harm to the people and the environment. Hospitals must appoint waste officers and have an approved designated waste storage area. All health care workers are expected to follow the policies and guidelines for waste disposal. Each hospital must develop a waste management strategy to ensure that all relevant

regulatory requirements are met. Waste management plans should also be developed as part of the overall strategy. A designated waste officer or committee must ensure that the waste management plan is implemented (South Africa 2008).

Generic waste management guidelines have been developed by some countries. For example, guidelines for the management of medical waste have been developed by the Health Professions Council of South Africa in 2008. Hospitals must provide storage areas with adequate lighting, ventilation and provision for containment of spills within the storage area. Waste security and restriction of access to authorised persons must be ensured. Storage areas should be designed in such a way that routine cleanliness, maintenance of hygienic standards and post-spill decontamination are all easy to undertake. Health care facilities may be held responsible for small medical and related waste spill that may occur both on-site and during transportation. They must develop a spill management plan and train personnel on it (Health Professions Council of South Africa, 2008).

There are a number of the common procedures followed at the hospitals in managing medical waste which include the following: sharps should all be collected together, regardless of whether or not they are contaminated. Sharps containers should be puncture-proof and are usually made of metal or high-density plastics. Sharps containers should be tamperproof and fitted with covers that do not allow access to the sharps contained within. The containers should be rigid and impermeable so that they safely retain not only the sharps but also residual liquids from syringes.





(Chartier et al, 2014).

**Figure 2.1: International infectious substance symbol**

Bags for infectious waste should be red and marked with the international infectious substance symbol as shown in Figure 2.1. Bags and containers should be removed when they are not more than three quarters full to enhance their safe handling. Some bags can be closed by tying the neck of the bag while heavier gauge bags may require plastic sealing ties of the self-locking type (Chartier, Emmanuel, Prüss, Rushbrook, Stringer, Townend, Wilburn & Zghondi, 2014).

A study which was conducted in Ghana on disposal of medical waste revealed that both public and private hospitals have got waste management policies and teams. They have got internal storage facilities for storing the waste before it is finally disposed of, which is in line with the waste management guidelines (Abor, 2013). On the other hand there are some countries whose practice regarding medical waste are poor, like in a study conducted in Brazil in 2014, on the reality of waste management in primary health care units. The results of this study reveal that waste containers are filled beyond the recommended limits, temporary storage of waste takes place in makeshift areas, usually in more isolated places of the facility and waste left exposed to potential environmental, human and animal actions (Alves, Souza, Tipple, Rezende, Resende, Rodrigues & Pereira, 2014).

Segregation of medical waste must be done at the point of generation and disposed according to the relevant classifications. The practice regarding medical waste disposal in Korea as per the study conducted on medical waste management in

2006, support the statement. The study reveals that medical waste is segregated at the point of generation by the majority of health care facilities. Human tissues are placed in a red container, pathological waste and discarded sharps are stored in a yellow container and all other wastes are placed in an orange container (Jang, Lee, Yoon and Kim, 2006).

Best segregation practices are also implemented in some countries. A study conducted in Ghana also reveals that both public and private hospitals segregated their waste into different categories, by first identifying the waste type and then separating non-infectious or general waste from general waste (Abor, 2012).

Most countries and institutions are faced with challenges of disposing medical waste, this is evident in the studies which were conducted in various areas. A survey of medical waste disposal which was conducted in Lagos Nigeria in 2012, indicated that waste was collected in a mixed form, transported and disposed along with municipal solid waste. Most hospitals in the area lacked appropriate systems for medical waste management for some reasons e.g. inadequate funding, little or no priority for medical waste management as well as a lack of competent waste managers (Longe, 2012). Another study conducted in the hospitals of Gondar Town in Ethiopia on factors associated with risk perception of health care workers towards medical waste disposal in the hospitals, reveals that segregation of medical waste is not done. None of the hospitals have got coloured coded containers and medical waste management guidelines (Muluken, Haimanot, Mesafint, 2013).

A study conducted on medical waste disposal at Yenagoa, South Nigeria in 2011 reveals that standard practice is not followed in the disposal of medical waste. About 2,000,000 kg of medical waste is generated annually with infectious wastes and sharp items constituting nearly 19%. These wastes are disposed in public waste bins along streets and often dumped in open and unlined landfills (Chima, Ezekwe & Digha, 2011).

Some countries have hospitals which comply with medical waste disposal regulations as guidelines for practice. Tertiary and secondary hospitals in Gansu province of China generally comply with national regulations, provide better occupational safety measures to all related personnel, formulate an internal plan, organise a medical waste management team and have got a reasonable composition of waste management directors (Zhang, Whang, Yang, 2013). In Allahabad City in India, the majority of hospitals including government and private hospitals, as well as nursing homes, use a common private provider for the collection, management, and disposal of medical waste and at times training regarding medical waste disposal to the health care workers is arranged by the same common provider (Mathur, Dwivedi, Hassan, Misar, 2011).

Improper practices in medical waste disposal are also experienced in South Africa. In a study which was conducted at a hospital in Cape Town, South Africa, the results revealed that segregation of waste was not conducted according to the prescribed rules and standards. There was no policy and plan in place for disposing medical waste. Users of sharps left used sharps like needles on the patients' bed which may pose a danger of needle pricks (Abor & Bouwer 2007). Policies and guidelines serve as a source of reference for staff and implementation thereof will improve their practice. A study conducted at Tygerberg Hospital in Western Cape, South Africa in 2006 on medical waste disposal indicates that the institution does not have a policy or plan for purchasing the necessary equipment and for providing facilities for correct disposal of medical waste. Colour coding is not implemented, only one colour is used for all types of waste. Medical waste disposal is not implemented according to the World Health Organisation recommended standards (Abor, 2007).

Other factors which may affect waste management practices include supervision deficiency and the intensity of the work. In a study conducted in 2007 at Ankara Ataturk Training Research Hospital in Turkey the reason given by the respondents regarding the problems they encounter on the matter of medical waste was intensity of the work and supervision deficiency (Hascuhadar, Kaya, Serbetcioglu, Arsian & Altinkaya, 2007). Findings from literature in third world countries highlights financial

problems and lack of specialised medical waste staff, as contributing to poor disposal of medical waste (Babanyara, Ibrahim, Garba, Bogoro, Abubakar, 2013).

## **2.5. HEALTH IMPACT ON HEALTH CARE WORKERS AND THE ENVIRONMENT**

Some types of medical waste represent a higher risk to health than others. These include infectious waste (15% to 25% of medical waste) among which are sharps waste (1%) and body part waste (1%). Disposal of these types of waste must be done in accordance with prescribed policies and guidelines to prevent harm to the health care workers and waste handlers and the pollution of the environment. The WHO (2005) estimated that in the year 2000, needles with contaminated syringes caused 21 million Hepatitis B virus infections (32% of all new infections), two million Hepatitis C virus infections (40% of all new infections) and 260,000 HIV infections (5% of all new infections). During the handling of waste, injuries occur when needles or other sharps have not been collected in rigid puncture proof containers. Inappropriate design or overflow of existing sharp containers increase risk exposure of the health care workers to needle stick injuries (WHO, 2005).

In addition to health risks derived from direct contact, medical waste can adversely impact human health by contaminating water bodies during waste treatment and by polluting the air through emissions of highly toxic gases during incineration. When medical waste is disposed in a pit which is not lined or too close to water sources, the water bodies may become contaminated. If medical waste is burned openly or in an incinerator with no emission control, dioxins and furans and other toxics air pollutants may be produced, causing serious illness in people who inhale this air (Health Professions Council of South Africa, 2008).

In South Africa, every employer must provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees. The employer therefore is responsible for ensuring that all types of waste generated in the health care facility are properly managed. The employees must take reasonable care for their health and safety and that of other persons who may be affected by their acts or omissions (South Africa, 1993). One study shows that 45% of medical waste generated in the KwaZulu-Natal province in South Africa

alone could not be accounted for, suggesting that it may have been illegally dumped, buried or burnt somewhere, thus affecting the health of people and the environment (Leonard, 2004). A study which was done in Zimbabwe in 2008 on solid medical waste management reveals that sharps are disposed in plastic bags, and this endangers the health of workers as they are exposed to pricks and cuts. Storage of waste is not secure and it is revealed that some waste such as placentas and fetuses were found strewn near the bins (Mangizvo & Chinamaza, 2008).

## **2.6. LEGISLATIVE REQUIREMENTS AND GUIDELINES ON DISPOSAL OF MEDICAL WASTE**

Medical waste management is governed by legislation to ensure that environmentally achievable standards are met. Health care workers must familiarise themselves with all legislation regarding waste management. The constitution is the supreme source of law in South Africa, and provides the mandate for waste management regulation (Hall, 2006). The Environment Conservation Act 73 of 1989 regulates the disposal of medical waste. The act advises that no person shall dispose waste in any manner except at the disposal site for which permission has been obtained. The Water Act 54 of 1956 advises on the prevention of pollution by effluent, storm water control, location of waste sites, offences and penalties, policies and strategies. The Health Act 63 of 1977 advises on prevention of pollution of water for human consumption, regulations regarding communicable disease and relating to rubbish, night soil, nuisances, offences and penalties.

The Atmospheric Pollution Prevention Act of 1965 advises on the prevention of burning, smoke control, smoke and dust. The Occupational Health and Safety Act 85 of 1993, with particular reference to hazardous chemical substances stipulate that they must be disposed only on sites designated for the purpose. Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees. The National Environmental Management Waste Act 59 of 2008 provides for norms and standards of regulating the disposal of waste by all spheres of government, specific waste management measures, licensing and control of waste management activities, remediation of contaminated land, national waste information system, compliance

and enforcement. The act stipulates that waste must be disposed in an environmentally sound manner (Council for Scientific and Industrial Research in South Africa, 2009).

Some countries have legislation which regulates medical waste disposal and others do not. A study conducted in Brazil reveals that there is no legislation that regulates medical waste disposal and as a result medical waste is not properly disposed (Alves, Souza, Tipple, Resende, Rodrigues & Pereira, 2014). A study conducted at a primary health care facility located in Sao Paulo found that most of the legal requirements were still unknown to the managers and health care workers. There were no medical waste disposal policies, plans and protocols (Moreira & Gunther, 2012).

## **CONCLUSION**

Literature on knowledge and practice of health care workers on medical waste disposal has been reviewed to provide insight to this study. The literature review has revealed that most hospitals are facing challenges with regard to medical waste disposal. Improper practices on medical waste disposal includes mixing of different types of waste, improper disposal of sharps and the colour coding of waste disposal containers not followed. Lack of knowledge on waste management among health care workers in some institutions leads to poor medical waste disposal. There is also non-compliance to waste disposal policies and guidelines in some institutions. The literature review has provided the researcher with information regarding the different methodologies used to research the topic. The next chapter outlines the research methodology used in this research.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1. INTRODUCTION**

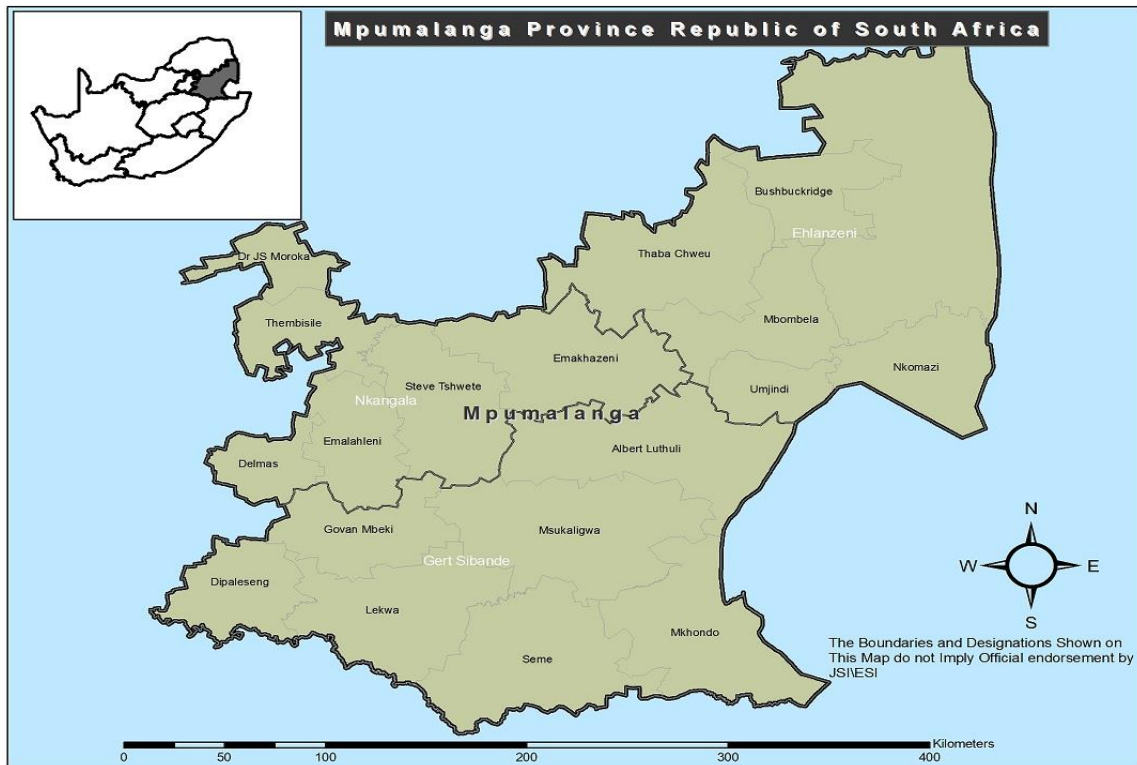
This chapter focuses on research methodology which encompasses research design, study site, study population, sampling, data collection, data analysis, validity, reliability, inclusion and exclusion criteria, and ethical consideration.

#### **3.2. RESEARCH DESIGN**

A quantitative research approach was used to determine the knowledge and practices of health care workers on medical waste disposal in the Mapulaneng Hospital at the Ehlanzeni District in South Africa. Quantitative research is defined as a formal, objective and systematic process in which numerical data are used to obtain information about the world (Burns & Grove, 2009). A cross-sectional research design was used. This research design provides a snapshot of an outcome and the characteristics associated with it (Lavrakas, 2008). The design helped the researcher to obtain more information in a short time as it took little time to conduct.

#### **3.3. STUDY SITE**

This study was conducted at the Mapulaneng Hospital, which is a regional hospital for the Mpumalanga Province in the Bushbuckridge Municipality under the Ehlanzeni District. A map showing Ehlanzeni District is available as Figure 6.1. The hospital is situated on the Northern part of the Ehlanzeni District towards the Limpopo province about 70km from Hoedspruit and 100km from Nelspruit. The Mapulaneng Hospital renders level 1 and 2 health care services with 319 health care workers. The package of services includes 8 basic specialities and general health care services. The hospital has two medical wards, one surgical ward, one orthopaedic ward, a tuberculosis ward, three wards under obstetrics and gynaecology, a casualty, outpatient department, an intensive care unit, a paediatric ward, a neonatology unit, a dental unit, a pharmacy and allied health sections.



<http://localhost/Open/image/data/Eastern Cape/>

**Figure 6.1. Map for the Mpumalanga Province of South Africa showing Ehlanzeni District**

### **3.4. STUDY POPULATION**

A population is defined as any group of individuals who have one or more characteristics in common, that are of interest to the researcher (Brink, 2006). The study population consisted of 319 health care workers which included 269 nursing staff, 17 medical staff, 5 dental staff and 28 allied health staff employed at Mapulaneng hospital.

### **3.5. SAMPLING**

Sampling refers to the process or procedure of selecting a smaller group called a sample from within a defined population to represent the population. A stratified



random sampling method was used to select the required categories of health professionals. A random sample is one in which every element in the population has an equal and independent chance of being selected from the sample (Crowther & Lancaster, 2009). The sample size was determined using the Slovin Formula where N was the population and E represented error of estimation. Calculation was as follows:

$$n = \frac{N}{1 + NE^2} = \frac{319}{1 + 319(0.05)^2} = \frac{319}{1.7975} = 177.46 \approx 178$$

The total number of the population was 319, which comprised of 269 nursing staff, 17 medical staff, 5 dental staff and 28 allied health staff. The sample size was calculated as 178 respondents who were further stratified as 150 nursing staff, 9 medical staff, 3 dental staff and 16 allied health staff as summarised in Table 3.2.

**Table 3.2: Total number of health care workers according to professional category**

	Nursing staff	Medical staff	Allied health staff	Dental staff	Total
Total number of staff	269	17	28	5	319
% of total group	84%	5%	9%	2%	100%
Sample size	150	9	16	3	178

The confidence level of 95% and a margin error of 0,05 were considered when calculating the sample size. The personnel and salary system (Persal) print out of all health care workers was used as a sample frame. A list of all health care workers was requested from the hospital's Human Resource section. Numbers were allocated to each category. Each number was written on a square piece of paper. The lottery or hat method was used where the numbered pieces of paper were placed in a container (Brink, 2009). The pieces of paper were mixed thoroughly followed by withdrawing numbered pieces of paper, until the desired sample size was reached. An additional 22 health care workers were added as suggested by the University Statistician to cater for spoilt questionnaires and distributed as 18 nursing staff, 1 medical staff, 2 allied health staff and 1 dental staff.

### **3.6. INCLUSION AND EXCLUSION CRITERIA**

The study included nursing staff, medical staff, dental staff and allied health staff in various sections. Exclusion criteria on the other hand refer to characteristics that eliminate elements from being included in a study sample (Norwood, 2010). All health care workers who are doing administrative work in the offices and those who were recently employed were excluded from the study.

### **3.7. DATA COLLECTION**

The data were collected through a self-administered questionnaire which has been developed with questions aimed at determining the knowledge and practices of health workers regarding disposal of medical waste. Pre-existing questions from a previous study (Al-Emad, 2011) have been adapted and modified. The questionnaire is attached as Appendix 1. The questionnaire was not translated into other languages spoken in the area as all respondents are proficient in English. Questionnaires with completion instructions were distributed by the researcher to the selected categories of health professionals individually. The questionnaires were collected by the researcher after one hour. The questionnaire had three sections. Section A had questions on demographic and socioeconomic information. Section B had questions on the knowledge of health professionals with regard to disposal of medical waste. Section C had questions on the practices of health care workers with regard to medical waste disposal.

### **3.8. DATA ANALYSIS**

Data analysis is a process of examining and interpreting data in order to get meaning and gain understanding (Grove, Burns & Gray, 2013). The data were analysed using the International Business Management Statistical Package for Social Sciences 22.0 (IBMSPSS 22.0) with the assistance of the university statistician. Scores were allocated and ranking of knowledge and practice was done as follows:

- Scores between 1-49 = Poor
- Scores between 50-74 = Good

- Scores between 75-100 = Excellent

Descriptive and inferential statistics were used. Descriptive statistics included frequencies for counts on single variables, cross tabs for determining the relationship between two or more categorical variables, descriptive for computing univariate statistics and explore for producing summary statistics and graphical display either for all categories or separately. Inferential statistics tests included the chi-squared test, which measures whether there is a significant relationship between two categorical variables (Leech, 2005).

### **3.9. VALIDITY**

Validity refers to the extent to which the study's findings accurately depict the phenomenon being studied (Norwood, 2010). Content validity was ensured by making sure that the aim and objectives of the study are clearly defined and presenting the proposal to the supervisor and peers. The questions on the questionnaire were phrased appropriately to ensure that the questionnaire measures what it is intended to measure.

### **3.10. RELIABILITY**

Reliability occurs when an instrument measures the same thing more than once and results in the same outcome. Reliability refers to the degree of consistency with which an instrument measures whatever it is measuring (Norwood, 2010). Reliability was ensured by testing the questionnaire on 10% of the population. The questionnaire was given to the participants to give comments on the clarity of the questions and no corrections were found to be necessary on the questionnaire. A Cronbach Alpha test was done on knowledge questions, to ensure that the questions are reliable.

### **3.11. PILOT STUDY**

The questionnaire was tested on 10% of the population which comprised of senior nurses at Mapulaneng hospital. The questionnaire was given to the participants to

give comments on the clarity of the questions and no corrections were made on the questionnaire. The population used for the pilot study were not used for the main study.

### **3.12. BIAS**

Sampling bias refers to the systematic over-representation or under-representation of some segment of the population in terms of characteristics that could affect the dependant variables (Norwood, 2010). Sampling bias was prevented by affording every member in the population an equal opportunity to be selected, through stratified random sampling. Respondents were afforded an opportunity to complete the questionnaires independently without the researcher's influence. No responses were altered by the researcher.

### **3.13. ETHICAL CONSIDERATIONS**

#### **3.13.1. Protecting the rights of participants**

- **Principle of respect for persons**

The respondents were treated with dignity and their autonomy was recognised. The respondents were informed about the process of the research, the research problem, the purpose and the objectives of the study and the benefits thereof. Informed consent (Appendix D) was obtained from all respondents to allow them to take part in the study voluntarily. The respondents were given freedom to choose to participate or opt out of the survey at any time of the study. Confidentiality of all the information obtained from the respondents was maintained. Anonymity of the respondents was ensured by not using the respondents' names on the questionnaires. Respondents were informed on how confidentiality and anonymity will be ensured. The right to privacy for the respondents was maintained by asking only questions which are relevant to the aim and study (Polit & Beck, 2008).

- **The principle of beneficence**

The principle of beneficence refers to a duty to minimise harm and maximise benefits (Polit & Beck, 2008). Respondents were informed about the harms and benefits of the study, being improved medical waste management in the institution. The benefits of participating in this study were improved medical waste management in the institution. There were no anticipated harms in the study (Polit & Beck, 2008).

- **The principle of justice**

The principle of justice refers to fairness and equity which relates to the respondents' rights to fair treatment and their rights to privacy (Polit & Beck, 2008). All respondents meeting the criteria were afforded a chance to participate and to benefit from participating.

### **3.13.2. Protecting the rights of the institution**

The rights of the institution were protected by obtaining permission from the head of the institution (Appendix C) before conducting the study. Information pertaining to the institution was kept confidential by keeping the questionnaires in a locked cupboard to prevent unauthorised access. Respondents were instructed not to write the name of the institution when completing the questionnaires.

### **3.13.3. Scientific integrity of the researcher**

Researchers have an obligation to the discipline of science in the way they conduct and report research (de Vos, Strydom, Delport, and Fouche 2005). The proposal has been given ethical clearance by Medunsa Research Ethics Committee (MREC) before commencing with data collection. After MREC has issued the clearance certificate, permission from the Mpumalanga Provincial Department of Health (Appendix C) to conduct the study was requested. The approvals were then submitted to the hospital Chief Executive Officer to request permission to access

respondents. Guidelines for conducting quantitative research design from both the University of Limpopo and the supervisor were followed

## **CONCLUSION**

This chapter focused on the research methodology used for the study of knowledge and practices of health care workers on disposal of medical waste. The study was conducted at the Mapulaneng Hospital in the Ehlanzeni District of South Africa. A quantitative research approach was used in the study. The population comprised of health care workers. Sampling, inclusion and exclusion criteria were described. The procedure used to collect data was explained. Data analysis methods used were outlined. Measures to ensure validity and reliability were described. Ethical considerations were described. The next chapter deals with data analysis.

## CHAPTER 4

### RESULTS

#### 4.1. INTRODUCTION

The previous chapter focused on research methodology which encompassed research design, study site, study population, sampling, data collection, data analysis, validity, reliability, inclusion and exclusion criteria, and ethical consideration. This chapter outlines the data analysis based on the responses in the completed questionnaires on knowledge and practice of health care workers at the Mapulaneng Hospital on disposal of medical waste. Data analysis was done using IBM SPSS statistics 2. The results are presented as frequencies and percentages in tables, charts and graphs. Chi-square tests were done to determine associations between variables.

#### 4.2. SOCIO-DEMOGRAPHIC INFORMATION OF RESPONDENTS

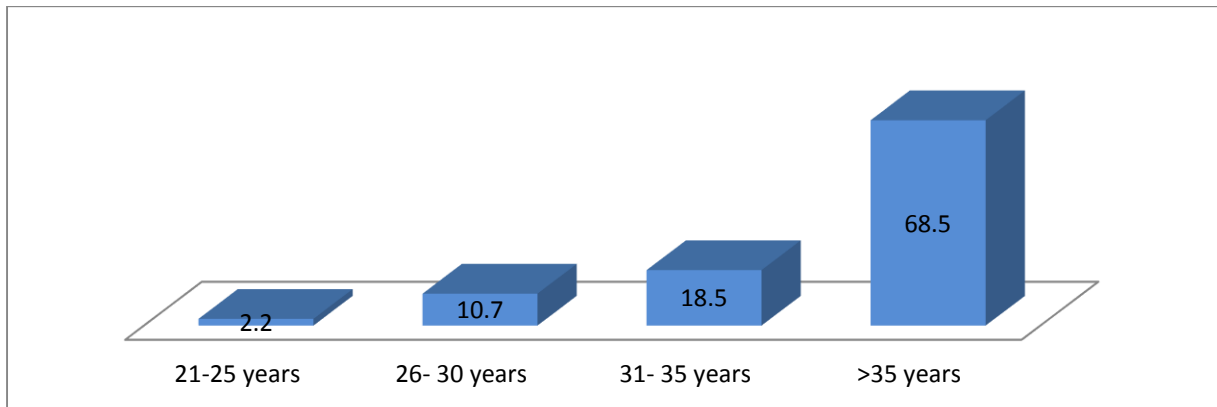
##### 4.2.1. Gender

**Table 4.1: Frequency distribution of males and females**

Gender	Frequency	Percentage
Male	34	19.1
Female	144	80.9
Total	178	100.0

Table 4.1 shows the frequency distribution of respondents according to gender. A total of 34 (19.1%) males and 144 (80.9%) females participated in the study. The percentage of females is much higher than that of males.

#### 4.2.2. Age



**Figure 4.1: percentage of health care workers by age group**

Figure 4.1 Shows the percentage of health care workers by age. Only 2.2 % of the participants are between 21-25 years, 10.7 % between 26-30 years, 18.5 % between 31-35 years, and 68.5 % older than 35 years.

#### 4.2.3. Health care workers by professional category

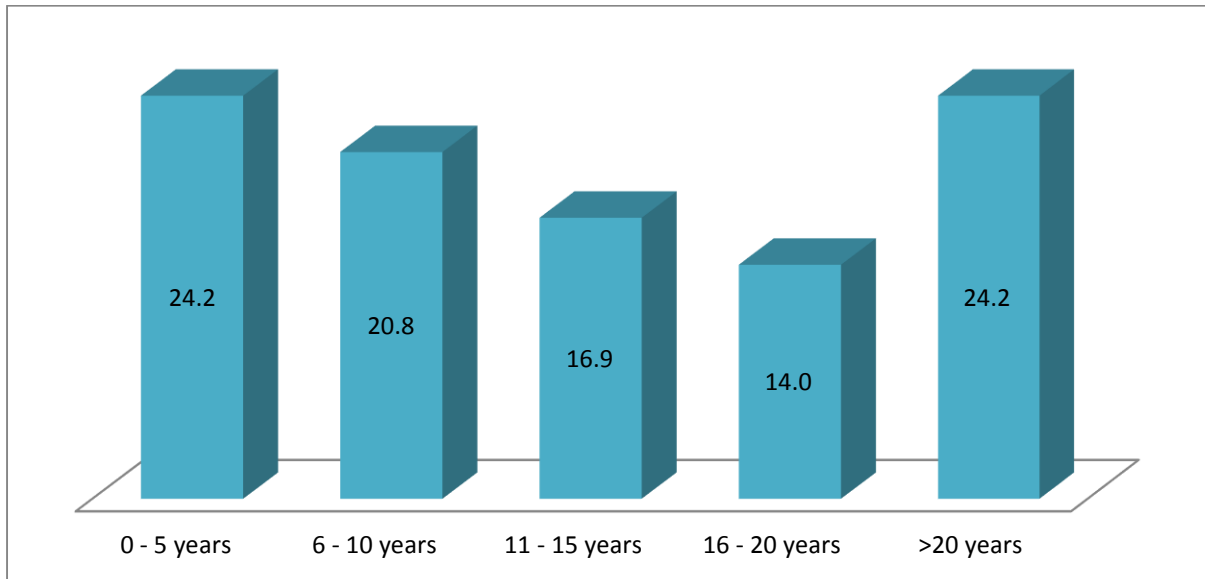
**Table 4.2: Frequency distribution of health care workers by professional category**

Professional category	Frequency	Percentage
Doctor	9	5.1
Dentist	3	1.7
Nurse	150	84.3
Allied Health	16	9.0
Total	178	100.0

Table 4.2 indicates the frequency distribution of health care workers by profession. Doctors form 5.1 % of the population, dentists 1.7 %, nurses 84.3 %, and allied health staff 9.0 %. A total of 178 respondents participated in the study



#### 4.2.4. Health care workers by years of experience



**Figure 4.2: Percentage of health care workers by years of experience**

Figure 4.2 shows percentage of health care workers by years of experience. Participants with 0-5 years of experience are 24.2 %, those with 6-10 years are 20.8 %, 11-15 years are 16.9 %, 16-20 years are 14.0 % and those above 20 years are 24.2 %. Health care workers with 0-5 years of experience and those with more than 20 years have got the highest percentage. Health care workers with 16-20 years of experience have the lowest percentage.

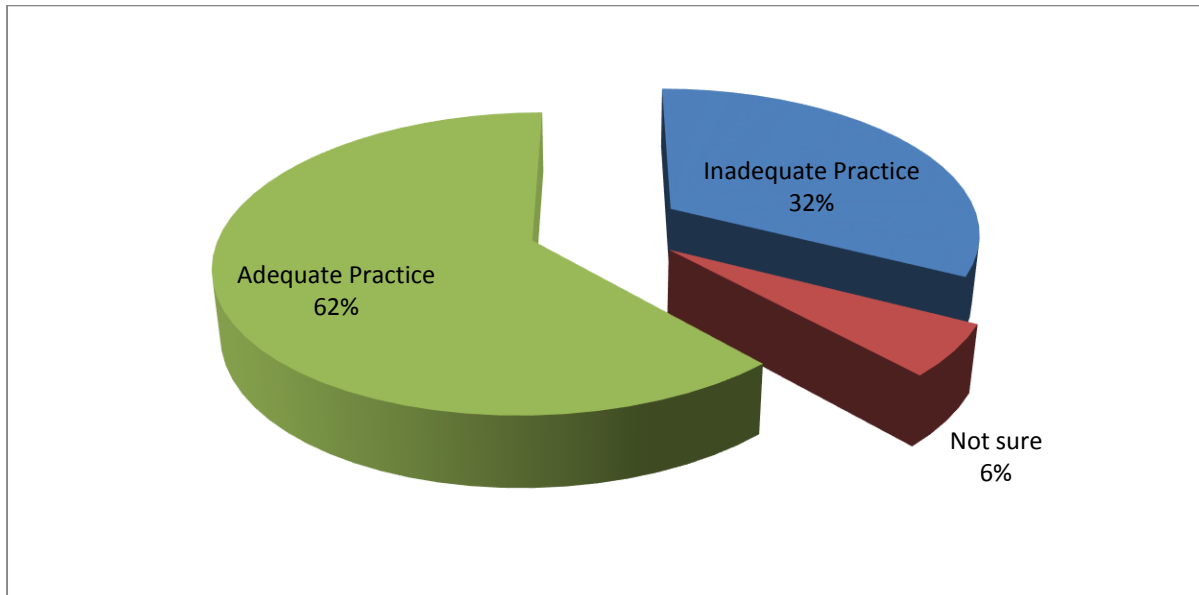
#### 4.3. KNOWLEDGE OF HEALTH CARE WORKERS

**Table 4.3: Frequency distribution of health care workers by knowledgeable, not sure and no knowledge**

Knowledge	Frequency	Percentage
No knowledge	80	44.9
Not sure	14	7.9
Knowledgeable	84	47.2
Total	178	100.0

Table 4.3 shows the frequency distribution of health care workers according to knowledge. A total of 44.9 % of health care workers have got no knowledge on disposal of medical waste, 47.2 % are knowledgeable and 7.9 % are not sure.

### 4.2.3. Health care workers by practice



**Figure 4.3 percentage distribution of health care workers by practice**

Figure 4.3 indicates percentage distribution of health care workers by practice. About 32 % had inadequate practices, 62 % practiced adequately and 6 % were not sure.

#### 4.4. THE ASSOCIATION OF DEMOGRAPHIC FACTORS TO KNOWLEDGE AND PRACTICE

##### 4.4.1. Gender and knowledge regarding disposal of medical waste

**Table 4.4: Cross tabulation of gender and knowledge regarding disposal of medical waste**

			Knowledge			Total
			No knowledge	Not sure	Knowledgeable	
Gender	Male	Count	15	5	14	34
		% of Total	8.4 %	2.8 %	7.9 %	19.1 %
	Female	Count	65	9	70	144
		% of Total	36.5 %	5.1 %	39.3 %	80.9 %
Total		Count	80	14	84	178
		% of Total	44.9 %	7.9 %	47.2 %	100.0 %

Table 4.4 shows that, 8.4 % are male and do not have knowledge, 7.9 % have knowledge, and 2.8 % are not sure. Some 39.3 % are female and have knowledge, 36.5 % have no knowledge and 5.1 % were not sure. A greater percentage of males does not have knowledge on disposal of medical waste disposal than the percentage of those, who do. Among females a greater percentage have knowledge than the percentage of those who do not.

**Table 4.5. Chi-square tests of gender and knowledge**

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.829 <sup>a</sup>	2	.243
Likelihood Ratio	2.460	2	.292
Linear-by-Linear Association	.122	1	.727
N of Valid Cases	178		

Using chi-square  $P=0.243$  which is greater than the required P Value of 0.05. This implies that gender does not have association with knowledge.

#### 4.4.2. Gender and practice regarding disposal of medical waste

**Table 4.6: Cross tabulation of gender and practice regarding disposal of medical waste**

			Practice			Total
			Inadequate Practice	Not sure	Adequate Practice	
Gender	Male	Count	10	2	22	34
		% of Total	5.6 %	1.1 %	12.4 %	19.1%
	Female	Count	48	8	88	144
		% of Total	27.0 %	4.5 %	49.4 %	80.9%
Total		Count	58	10	110	178
		% of Total	32.6 %	5.6 %	61.8 %	100.0%

Table 4.6 shows cross tabulation of gender and practice. Some 5.6 % are male and practice inadequate disposal of medical waste, 12.4 % have got adequate practice and 1.1 % are not sure. A total of 27.0 % are female and have got inadequate practice, 49.4 % have adequate practice and 4.5 % are not sure. A greater percentage of both males (12.4 % vs. 5.6 %) and females (49.4 % vs. 27.0 %) practiced disposal of medical waste adequately.

**Table 4.7: Chi-square tests of gender and practice**

#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.193 <sup>a</sup>	2	.908
Likelihood Ratio	.195	2	.907
Linear-by-Linear Association	.180	1	.671
N of Valid Cases	178		

Table 4.7 indicates the results of Chi-square test.  $P = 0.908$  which is greater than the required P Value of 0.05.

#### 4.4.3. Age and Knowledge

**Table 4.8: Cross tabulation of age and knowledge**

			Knowledge			Total
			No knowledge	Not sure	Knowledgeable	
Age	21-25 years	Count	4	0	0	4
		% of Total	2.2 %	0.0 %	0.0 %	2.2 %
	26- 30 years	Count	8	3	8	19
		% of Total	4.5 %	1.7 %	4.5 %	10.7 %
	31- 35 years	Count	15	0	18	33
		% of Total	8.4 %	0.0 %	10.1 %	18.5 %
	>35 years	Count	53	11	58	122
		% of Total	29.8 %	6.2 %	32.6 %	68.5 %
Total		Count	80	14	84	178
		% of Total	44.9 %	7.9 %	47.2 %	100.0 %

Table 4.8 shows cross tabulation of age and knowledge. A total of 44.9 % of the participants do not have knowledge and are constituted as follows, 2.2 % are between 21-25 years, 4.5 % between 26-30 years, 8.4% between 31-35 years and 29.8 % older than 35 years. A total of 47.2 % of participants are knowledgeable and are aggregated as follows: 0.0 % between 21-25 years, 4.5 % between 26-30 years, 10.1 % between 31-35 years and 32.6 % longer than 35 years. Some 7.9 % of the participants are not sure and are constituted as follows: 1.7 % between 26-30 years, and 6.2 % older than 35 years.

**Table 4.9: Chi-square tests of age and knowledge**

#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.801 <sup>a</sup>	6	.133
Likelihood Ratio	13.525	6	.035
Linear-by-Linear Association	1.199	1	.273
N of Valid Cases	178		

Table 4.9 shows the results of Chi-square tests. P= 0.133 which is greater than the required P value of 0.05.

#### 4.4.4. Age and Practice

**Table 4.10: Cross tabulation of age and practice**

			Practice			Total
			Inadequate Practice	Not sure	Adequate Practice	
Age	21-25 years	Count	4	0	0	4
		% of Total	2.2 %	0.0 %	0.0 %	2.2 %
	26- 30 years	Count	8	1	10	19
		% of Total	4.5 %	0.6 %	5.6 %	10.7 %
	31- 35 years	Count	10	2	21	33
		% of Total	5.6 %	1.1 %	11.8 %	18.5 %
	>35 years	Count	36	7	79	122
		% of Total	20.2 %	3.9 %	44.4 %	68.5 %
Total		Count	58	10	110	178
		% of Total	32.6 %	5.6 %	61.8 %	100.0 %

Table 4.10 shows cross tabulation of age and practice. A total of 2.2 % of the participants are between the age of 21-25 years and practice disposal of medical waste inadequately. Some 4.5 % are aged between 26-35 years have got inadequate practice. And 5.6 % are between 31-35 years and have inadequate practice. A total of 20.2 % are those who are aged above 35 years and have inadequate practice. The highest percentage of those having inadequate practice is among those who are aged above 35 years.

Adequate practice of disposal of medical waste was different among the age groups. No participants between the ages of 21-25 years have got adequate practice. Some 5.6 % are aged between 26-35 years and have adequate practice. A total of 11.8 % are aged between 31-35 years have adequate practice. A total of 40.4 % are those aged above 35 years having inadequate practice. The age group with the highest percentage of participants with adequate practice is that of above 35 years.

**Table 4.11: Chi-square of age and practice**

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.679 <sup>a</sup>	6	.139
Likelihood Ratio	10.353	6	.111
Linear-by-Linear Association	4.919	1	.027
N of Valid Cases	178		

Table 4.7 indicates the results of Chi-square test. Using chi-square  $P = 0.139$  which is greater than the required  $P$  value of 0.05. This implies that age does not have association with practice.

#### 4.4.5 Professional category and knowledge regarding disposal of medical waste

**Table 4.12: Cross tabulation of professional category and knowledge**

			Knowledge			Total
			No knowledge	Not sure	Knowledgeable	
Professional category	Doctor	Count	7	0	2	9
		% of Total	3.9 %	0.0 %	1.1 %	5.1 %
	Dentist	Count	2	1	0	3
		% of Total	1.1 %	0.6 %	0.0 %	1.7 %
	Nurse	Count	58	12	80	150
		% of Total	32.6 %	6.7 %	44.9 %	84.3 %
	Allied Health	Count	13	1	2	16
		% of Total	7.3 %	0.6 %	1.1 %	9.0 %
Total	Count	80	14	84	178	
	% of Total	44.9 %	7.9 %	47.2 %	100.0 %	

Table 4.11 shows that 44.9 % of participants have got no knowledge and were rated according to professional category was as follows: 3.9 % doctors, 1.1 % dentists, 32.6 % nurses and 7.3 % allied health staff. A total of 47.2 % have knowledge, and they are constituted as follows: 1.1 % doctors, 0.0 % dentists, 44.9 % nurses and 1.1 % allied health staff. 7.9 % of the participants were not sure.

**Table 4.13: Chi-square tests of professional category and knowledge**  
**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.604 <sup>a</sup>	6	.003
Likelihood Ratio	21.287	6	.002
Linear-by-Linear Association	.024	1	.876
N of Valid Cases	178		

Table 4.13 indicates the results of Chi-square test. P= 0.003 which is less than the required P value of 0.05.



#### 4.4.6. Professional category and Practice regarding disposal of medical waste

**Table 4.14: Cross tabulation of professional category and practice**

			Practice			Total
			Inadequate Practice	Not sure	Adequate Practice	
Professional category	Doctor	Count	5	0	4	9
		% of Total	2.8 %	0.0 %	2.2 %	5.1 %
	Dentist	Count	1	1	1	3
		% of Total	0.6 %	0.6 %	0.6 %	1.7 %
	Nurse	Count	40	9	101	150
		% of Total	22.5 %	5.1 %	56.7 %	84.3 %
	Allied Health	Count	12	0	4	16
		% of Total	6.7 %	0.0 %	2.2 %	9.0 %
Total		Count	58	10	110	178
		% of Total	32.6 %	5.6 %	61.8 %	100.0 %

Table 4.14 shows cross tabulation of professional category and practice. A total of 32.6 % of the participants practice disposal of medical waste inadequately and they are constituted as follows: 2.8 % are doctors, 0.6 % dentists, 22.5 % nurses and 6.7 % allied health staff. The majority of 61.8% of the participants practice medical waste adequately and are aggregated as follows: 2.2 % are doctors, 0.6 % dentists, 56 % nurses and 2.2 % allied health staff. Some 5.6 % of the participants were not sure and were aggregated as follows: 0.6% are dentist and 5.1 % nurses.

**Table 4.15: Chi-square tests of professional category and practice**

<b>Chi-Square Tests</b>			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.531 <sup>a</sup>	6	.001
Likelihood Ratio	20.319	6	.002
Linear-by-Linear Association	.435	1	.510
N of Valid Cases	178		

Table 4.15 indicates the results of Chi-square test. P= 0,001 is less than the required P value of 0.05.

**4.4.7. Years of experience and knowledge about disposal of medical waste**

**Table 4.16: Cross tabulation of years of experience and knowledge**

			Knowledge			Total
			No knowledge	Not sure	Knowledgeable	
Years of experience	0 - 5 years	Count % of Total	23 12.9 %	3 1.7 %	17 9.6 %	43 24.2 %
	6 - 10 years	Count % of Total	14 7.9 %	3 1.7 %	20 11.2 %	37 20.8 %
	11 - 15 years	Count % of Total	12 6.7 %	0 0.0 %	18 10.1 %	30 16.9 %
	16 - 20 years	Count % of Total	11 6.2 %	3 1.7 %	11 6.2 %	25 14.0 %
	>20 years	Count % of Total	20 11.2 %	5 2.8 %	18 10.1 %	43 24.2 %
Total		Count % of Total	80 44.9 %	14 7.9 %	84 47.2 %	178 100.0 %

Table 4.16 shows cross tabulation of years of experience and knowledge. A total of 44.9 % of the participants have got no knowledge on disposal of medical waste and can be rated according to years of experience as follows: 12.9 % between 0-5 years, 7.9 % between 6-10, 6.7 % between 11-15 years, 6.2 % between 16-20 years and 11.2 % more than 20 years. Some 47.2 % of the participants have got knowledge on disposal of medical waste and according to years of experience they are aggregated as follows: 9.6 % between 0-5 years, 11.2 % between 6-10, 10.1 % between 11-15 years, 6.2 % between 16-20 years and 10.1 % more than 20 years. And finally some 7.9 % are not sure and they can be described as follows: 1.7 % between 0-5 years, 1.7 % between 6-10, 1.7 % between 16-20 years and 2.8 % more than 20 years.

**Table 4.17: Chi-square tests of professional years of practice and knowledge**

<b>Chi-Square Tests</b>			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.288 <sup>a</sup>	8	.506
Likelihood Ratio	9.405	8	.309
Linear-by-Linear Association	.014	1	.907
N of Valid Cases	178		

Table 4.17 indicates the results of Chi-square test. P= 0,506 which is greater than the required P value of 0.05.

#### 4.4.8. Years of experience and practice regarding disposal of medical waste

**Table 4.18: Cross tabulation of years of experience and practice**

**Crosstab**

			Practice			Total
			Inadequate Practice	Not sure	Adequate Practice	
Years of experience	0 - 5 years	Count	16	1	26	43
		% of Total	9.0 %	0.6 %	14.6 %	24.2 %
	6 - 10 years	Count	11	1	25	37
		% of Total	6.2 %	0.6 %	14.0 %	20.8 %
	11 - 15 years	Count	9	3	18	30
		% of Total	5.1 %	1.7 %	10.1 %	16.9 %
	16 - 20 years	Count	7	2	16	25
		% of Total	3.9 %	1.1 %	9.0 %	14.0 %
	>20 years	Count	15	3	25	43
		% of Total	8.4 %	1.7 %	14.0 %	24.2 %
Total	Count		58	10	110	178
	% of Total		32.6 %	5.6 %	61.8 %	100.0 %

Table 4.18 shows that 32.6 % of the participants practice disposal of medical waste inadequately, and broken down according to years of experience they are 9.0 % between 0-5 years, 6.2 % between 6-10, 5.1 % between 11-15 years, 3.9 % between 16-20 years and 8.4 % with more than 20 years. A total of 61.8 % of the participants practice disposal of medical waste adequately can be rated according to years of experience as follows: 14.6 % between 0-5 years, 14.0 % between 6-10, 10.1 % between 11-15 years, 9.0 % between 16-20 years and 14.1 % more than 20 years. Finally, some 5.6 % are not sure and they are aggregated as follows 0.6 % between the age of 0-5 years, 0.6 % between 6-10 years, 1.7 % between 11 and 15 years, 1.1 % between 16-20 years and 1.7 % more than 20 years.

**Table 4.18: Chi-square tests of years of experience and practice**

<b>Chi-Square Tests</b>			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.816 <sup>a</sup>	8	.873
Likelihood Ratio	3.948	8	.862
Linear-by-Linear Association	.006	1	.936
N of Valid Cases	178		

Table 4.18 indicates the results of Chi-square test. P = 0.873 which is greater than the required P value of 0.05.

#### **4.5. ASSOCIATION BETWEEN KNOWLEDGE AND PRACTICE REGARDING DISPOSAL OF MEDICAL WASTE**

**Table 4.19: Cross tabulation of knowledge and practice**

			Practice			Total
			Inadequate Practice	Not sure	Adequate Practice	
Knowledge	No knowledge	Count	40	5	35	80
		% of Total	22.5 %	2.8 %	19.7 %	44.9 %
	Not sure	Count	2	1	11	14
		% of Total	1.1 %	0.6 %	6.2 %	7.9 %
	Knowledgeable	Count	16	4	64	84
		% of Total	9.0 %	2.2 %	36.0 %	47.2 %
Total	Count	58	10	110	178	
	% of Total	32.6 %	5.6 %	61.8 %	100.0 %	

Table 4.19 shows cross tabulation of knowledge and practice. A total of 22.5 % of participants has got inadequate practice and does not have knowledge, while 19.7 % do not have knowledge but have got adequate practice. A higher percentage (22.5%) of those who do not have knowledge have an inadequate practice of adequate practice. Nine percent of the participants have inadequate practice in spite of being knowledgeable and 36% do have knowledge and have adequate practice. A higher percentage are those who have the knowledge and also have adequate practice (36.0%) while a lower percentage (9%) does have inadequate practice.

**Table 4.20 Chi-square test of knowledge and practice**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.503a	4	.000
Likelihood Ratio	21.907	4	.000
Linear-by-Linear Association	18.985	1	.000
N of Valid Cases	178		

Table 4.20 indicates the results of Chi- square test. P = 0.000 which is less than the required P value of 0.05.

## **CONCLUSION**

This chapter has described the results of the study of knowledge and practice of health care worker on disposal of medical waste at the Mapulaneng Hospital in the Ehlanzeni District. The results focused on the socio-demographic profile of health care workers, knowledge, practice, association of demographic factors to knowledge and practice and association between knowledge and practice. Discussion of results will follow in chapter 5.

## CHAPTER 5

### DISCUSSION OF THE FINDINGS, LIMITATIONS, CONCLUSION AND RECOMMENDATIONS.

#### 5.1. INTRODUCTION

This chapter presents the summary and discussion of the findings from the study of knowledge and practice of health care workers with regard to disposal of medical waste at the Mapulaneng Hospital. The limitations of the study and recommendations are also outlined. The findings for this study have been outlined in the previous chapter. The objectives of the study were:

- To determine socio-demographic profile of health care workers at the Mapulaneng Hospital.
- To determine the knowledge of health care workers on medical waste disposal at the Mapulaneng Hospital.
- To determine how medical waste is disposed by health care workers at the Mapulaneng Hospital.
- To determine the association of demographic factors to knowledge and practice of medical waste disposal at the Mapulaneng Hospital.
- To determine the association between knowledge and practice at the Mapulaneng hospital.

#### 5.2. SUMMARY AND INTERPRETATION OF THE FINDINGS

The interpretation of the findings is outlined according to objectives in this section.

##### 5.2.1 Socio-demographic profile of health care workers

A total of 178 respondents participated in the study. The percentage of females (80.9 %) was higher than that of males (19.1 %). Health care workers with the years of experience between 0-5 years and those greater than 20 years had the highest percentage of 24.2 %. Those with years of experience between 16-20 had the lowest percentage of 14. According to the World Health Organisation (WHO) statistics for 2015, the majority of health care workers are women comprising over 75% of the

health sector work force in many countries. The analysis of the socio-demographic characteristics of the health care workers in England shows that a few years ago the health care workers were predominantly females, and the age profile of the work force ranged between 25 and 54 (Yar, Dix & Bajekal, 2001).

### **5. 2.2. Knowledge of health care workers on medical waste disposal**

Table 4.3 of the results shows that 44.9 % of health care workers had no knowledge on disposal of medical waste. 47.2 % were knowledgeable and 7.9 % were not sure. The results of this study are similar to a study which was conducted in 2013 to assess the knowledge and practice on biomedical waste management among the health care workers working in Bagepalli Taluk. The study revealed the lack of knowledge and awareness of medical waste disposal among health workers (Nagaraju, Padmavathi, Puranik, Shantharaj & Sampulatha, 2013). The percentage of health care workers who had knowledge of medical waste disposal is higher than the one for those who were not knowledgeable. The results of this study are in contrast with the study which was conducted in 2007 on waste disposal of government hospitals in urban area of Karachi. The study showed that the knowledge of health care workers involved in hospital medical waste disposal were extremely poor (Habibullah & Afsar 2007).

The results show that 7.9 % of health care workers were not sure of their knowledge meanwhile they practice disposal of medical waste in their day to day activities and they were also taught as part of their education and training. They should be able identify their own gaps in knowledge of disposal of medical waste in order to develop plans to close these gaps. The difference in percentage between those who were knowledgeable is not much, only 2.3 % without considering those who are not sure. It is expected that staff members should possess the necessary knowledge for them to dispose medical waste according to the guidelines (South Africa, 2008).



### **5.2.3. HOW MEDICAL WASTE IS DISPOSED BY HEALTH CARE WORKERS**

About 32 % of health care workers had improper practices while 62 % practiced properly and 6 % were not sure of required practices for disposal of medical waste as per waste management guidelines. A higher percentage of healthcare workers practiced disposal of medical waste adequately than the percentage of those who did not. The results are similar to those of a study which was conducted at the Johannesburg Hospital in 2008 on knowledge and practices of doctors and nurses about management of health care waste. The results showed that doctors and nurses engaged in good practices for disposal of medical waste (Ramokate, 2008). The findings of a study which was conducted in hospitals in Addis Ababa on health care waste generation and management practice in government health centres were different from this study as they showed that disposal of medical waste was poor (Debere , Gelaye , Alando & Trifa, 2011).

Improper disposal of medical waste exposes health care workers, waste handlers, patients and the community to infection, toxic effects, injuries and risks polluting the environment. It is essential that all medical waste is segregated at the point of generation, appropriately treated and properly disposed (WHO, 2011). Health care workers have the responsibility to protect the community and other staff members through implementation of waste management policies.

### **5.2.4. THE ASSOCIATION OF DEMOGRAPHIC FACTORS OF HEALTH CARE**

#### **WORKERS TO KNOWLEDGE AND PRACTICE OF MEDICAL WASTE**

#### **DISPOSAL**

#### **Gender and knowledge of health care workers on medical waste disposal**

A substantial percentage were males (44.1 %) who did not have knowledge on disposal of medical waste. The females who had knowledge formed a greater percentage (48.6 %) than those who did not. Using chi-square, the p value was 0.243 which is greater than the acceptable value of 0.05 and this implies that gender does not have association with knowledge. A study which was conducted at

Bagepalli Taluk in 2013 to assess knowledge and practice on medical waste disposal among health care workers working in primary health care centres also showed that there was no statistical relationship between knowledge and gender (Nagaraju et al., 2013).

### **Gender and practice of medical waste disposal**

A greater percentage of both males (12.4 %) and females (49.4 %) practiced disposal of medical waste correctly. Using chi-square the p value was 0.908 which is greater than the acceptable value of 0.05 and this implies that gender does not have association with practice. This finding is similar with the results of a study which was conducted at Bagepalli Taluk in 2013 to assess knowledge and practice on medical waste disposal among health care workers working in primary health care centres which showed that there was no significant association between gender and practice (Nagaraju et al, 2013).

### **Age and knowledge of medical waste disposal**

Table 4.8 shows that age does not have an impact on knowledge because participants in all age groups had knowledge irrespective of their ages. A total of 47.2 % of the participants were knowledgeable while 44.9 % did not have knowledge. Using chi-square, the p value was 0.133 which is greater than the acceptable value of 0.05 and this implies that age does not have an impact on knowledge. A study conducted in 2013 to assess knowledge and practice on medical waste management among health care workers working in primary health care centres of Bagepalli Taluk also revealed that there was no significant association between age and knowledge (Nagaraju, Padmavathi, Puranik, Shantharaj & Sampulatha, 2013). Another study conducted in 2014 on medical waste disposal in a tertiary care hospital of India also showed that there was no significant association between age and knowledge (Shivalli & Sanklapur, 2014).

### **Age and practice of medical waste disposal**

Proper practice of disposal of medical waste was different among the age groups. No participants between the ages of 21-25 practiced proper disposal of medical waste. The age group with the highest percentage of participants with proper practice was those above 35 years. Using chi-square the p value was 0.139 which is

greater than the acceptable value of 0.05 and this implies that age does not have association with practice. These results are in contrast with the results of a study which was conducted in 2011 on medical waste disposal at the Norfolk and Norwich University Hospital, which showed that the age group seemed to have some effect on segregation practice as part of the procedure of disposal of medical waste (Pudussery, 2011).

### **Professional category and knowledge regarding disposal of medical waste**

The results on Table 4.12 show that there is association between professional category and knowledge. The p value was 0.003 which is less than the acceptable value of 0.05. Nurses had the highest percentage, higher than the other categories. A study which was conducted in 2011 at Allahabad City, on knowledge, attitude and practices about biomedical waste management among health care workers indicated that nurses had better knowledge than other health care categories (Mathur, Dwivedi, Hassan & Misra, 2011). The results were also similar to a study which was conducted in Johannesburg Hospital in 2008 on medical waste disposal at an academic hospital, looking at the knowledge and practices of doctors and nurses. The result of the study show that knowledge of nursing staff was significantly higher than that of the doctors (Ramokate, 2008).

### **Professional category and practice regarding disposal of medical waste**

Professional category has association with practice according to the results in table 4.13. The category which had the highest percentage of proper medical waste disposal was that of nurses. Using chi-square, the p value was 0.001 which is less than the acceptable value of 0.05 and this implies that professional category has association with practice. This is in contrast with the study which was conducted in 2013 to assess knowledge and practice on medical waste disposal among health care workers working in primary health care centres of Bagepalli Taluk which showed that there was no significant association between professional category and practice (Nagaraju, Padmavathi, Puranik, Shantharaj & Sampulatha, 2013).

### **Years of experience and knowledge about disposal of medical waste**

In terms of years of experience and knowledge, a total of 44.9 % of participants had no knowledge on disposal of medical waste. Using chi-square the p value was 0.506

which is greater than the acceptable value of 0.05 and this implies that years of experience do not have association with knowledge. This is in contrast with the results of a study which was conducted in 2013 on knowledge, attitude and practices regarding medical waste disposal among nursing staff in private hospitals in Udupi City, India which showed that with an increase in experience there is significant increases in knowledge regarding medical waste (Asadullah, Karhtic, & Dharmappa, 2013).

### **Years of experience and practice regarding disposal of medical waste**

The results of this study show that years of experience do not have association with practice of disposal of medical waste. The p value was 0.873 which is greater than the acceptable value of 0.05 and this implies that years of experience do not have association with practice. The results of this study are in agreement with a study which was conducted in 2014 on knowledge, attitude and practices of health care workers towards medical waste disposal at the Ain Shams University Hospitals, Cairo. The results showed that work experience did not have significant relationship with practice (Hakim, Monsen and Bakr, 2014). The results of this study are in contrast with that of a study which was conducted at Bagepalli Taluk in 2013 to assess knowledge and practice on medical waste disposal among health care workers working in primary health care centres. The results showed that there was a significant association between practice and total years of experience. These findings indicated that the practices of healthcare workers were dependant on the years of experience (Nagaraju et al, 2013).

### **5.2.5. THE ASSOCIATION BETWEEN KNOWLEDGE AND PRACTICE REGARDING DISPOSAL OF MEDICAL WASTE**

Participants with improper practice of medical waste disposal who did not have knowledge formed a higher percentage (22.5 %) than those with proper practice who did not have knowledge. This shows that lack of knowledge had an influence on both proper and improper practice. Nine percent of the participants had improper practice although they were knowledgeable and 36% of them had knowledge and proper practice. Using chi-square the p value was 0.000 which is less than the acceptable value of 0.05 and this implies that knowledge has association with practice. This

finding is similar to the results of a study which was conducted in 2013 at Bagepalli Taluk to assess knowledge and practice on medical waste disposal among health care workers working in primary health care centres, which showed that there was a positive correlation between knowledge and practice. The results of another study which was conducted in the hospitals of Gondar Town in 2013 on medical waste disposal practices among health care workers also shows that knowledge on medical waste types, diseases transmitted through contact with infectious waste, training and availability of guidelines was significantly associated with health care waste management practice (Muluken, Haimanot & Mesafinit, 2013).

### **5.3.3. LIMITATIONS OF THE STUDY**

The study used a self-administered questionnaire to assess the practice of health care workers on disposal of medical waste and there is a possibility that the responses given may not provide a true picture as it was self-reporting; this would have been different if they had been observed while practicing. There were a number of neutral responses and these may have affected the scores either negatively or positively.

### **5.4. CONCLUSION**

The results show that there is insufficient knowledge of disposal of medical waste by health care workers. Only 47.2 % of health care workers had sufficient knowledge regarding disposal of medical waste. There is proper medical waste disposal practiced by 61.8 % of health care workers. The highest percentage of those with proper practice was among the nurses. This implies that there is a need to train other professional categories in order to ensure proper disposal of medical waste. The findings showed that knowledge and practice of health care workers had no association with age, gender, and years of experience. There is association between professional category and knowledge and practice of health care workers. The results also show that there is association between practice and knowledge. Disposal of medical waste is a responsibility of all healthcare workers, and they are required to have knowledge of, and implement waste management guidelines. There is a need to improve the knowledge of health care workers with more

emphasis on doctors, allied health staff and dentists as their practice scores were lower. This will further increase compliance to disposal of medical waste. The researcher hopes that the study will provide a baseline of knowledge and practice of health care workers with regard to disposal of medical waste. This baseline may be used by the hospital management to develop an improvement plan to address the identified gaps. A future study which could be conducted could focus on the effect of lack of knowledge for disposal of medical waste among health care workers in the institution.

## **5.6. RECOMMENDATIONS**

Proper disposal of medical waste is of great importance to protect the employees, the environment and the public against health risks. It is recommended that there should be regular training of all categories of workers on disposal of medical waste in order to improve their knowledge on disposal of medical waste. The results of the study show that some staff members are not sure with either knowledge or practice. This also indicates that measures must be taken to improve their knowledge. Supervision must be strengthened to identify and address the gaps regarding disposal of medical waste. Waste management inspections to be done regularly by the waste management committee to identify areas which needs intervention regarding disposal of medical waste.

## REFERENCES

- Abor, PA & Bouwer, A. 2007. Medical waste management practices in a Southern African hospital. *International Journal of Health Care Quality Assurance* 21 (4): 356-364.
- Abor, PA. 2007. Medical waste management at Tygerberg Hospital in the Western Cape, South Africa. Master of Technology (Environmental Health) Dissertation. Cape Peninsula University. Cape Town.
- Abor, PA. 2012. Managing health care waste in Ghana: A comparative study of public and private hospitals. *International Journal of Health Care Quality Assurance* 26 (4): 375-386.
- Al-Emad, AA. 2011. Assessment of medical waste management in the main hospitals in Yemen. *Eastern Mediterranean Health Journal* 17 (10): 739-737.
- Asadullah, MD, Karhtic GK & Dharmappa B. 2013. A study of knowledge, attitude and practices regarding biomedical waste management among nursing staff in private hospitals in Udupi City, Karnataka, India. *International Journal of Geology, Earth and Environmental Sciences* 3 (1) 118- 123.
- Alves, SB, Souza, A.C.S, Tipple, AFV, Rezende, KC, de Resende, FR, Rodrigues, EG & Perreira M.S. 2014. The reality of waste management in primary health care units in Brazil. *Waste Management & Research* 32(9).
- Babanyara, YY, Ibrahim, DB, Garba T, Bagoro, AG & Abubakar, MY. 2013. Poor medical waste management (MWM) practices and its risks to Human Health and the environment: A literature review. *International Journal of Environmental, Earth Science and Engineering* 7(11).
- Brink, H. 2009. *Fundamentals of Research Methodology for Health Care Professionals*. 2<sup>nd</sup> edition. Cape Town: Juta and Co (Pty) Ltd.
- Burns, N & Grove, SK. 2009. *The Practice of Nursing Research*. 4<sup>th</sup> edition. Philadelphia: WB Saunders.

- Chartier, G, Emmanuel, J, Pieper, U, Prüss, A, Rushbrook, P, Stringer, R, Townend W, Wilburn, S & Zghondi, R. 2014. *Safe management of wastes from health-care activities*. 2<sup>nd</sup> edition. World Health Organization. Geneva
- Chima, GN, Ezekwe, IC & Digha NO. 2011. An assessment of medical waste management in health institutions in Yenagoa, South-South, Nigeria. *World Review of Science, Technology and Sustainable Development* 8 (2/3/4): 224-233.
- Council for Scientific and Industrial Research in South Africa. 2009. *Guidelines for human settlement planning and design*.
- Collis, J & Hussey, R. 2009. *Business Research: A practical guide for undergraduate and postgraduate students*. 3rd edition. Hampshire, U.K.: Palgrave Macmillan.
- Crowther, D & Lancaster, G. 2009. *Research Methods. A concise introduction to research in management and business consultancy*. Butterworth. Heinemann.
- De Vos, AS, Strydom, H, Delport, CSL, Fouche, CB. 2005. *Research at Grassroots*. 2<sup>nd</sup> edition. Pretoria: Van Schaik Publishers.
- Debere, MK, Gelaye KA, Alando AG & Trifa ZM. 2011. Assessment of the health care waste generation rates and its management system in hospitals of Addis Ababa, Ethiopia. *BMC Public Health* 2013 13:28.
- Diallo, K, Zurn P, Gupta N & Dal Poz, M. 2003 Monitoring and evaluation of Human resources for health and international perspective. *Human Resource for Health*, 2003 1:3
- Grove SK, Gray J & Burns N. 2013. *The Practice of Nursing Research. Appraisal, Synthesis and Generation of Evidence* 7<sup>th</sup> edition. Canada: Saunders.
- Habibullah, S & Afsar, S. 2007. Waste Disposal of Government Health-Care Facilities in Urban Area of Karachi - A KAP Survey. *Pakistan Journal of Medical Research* 46(1).
- Hakim, SA, Monsen A & Bakr I. 2014. Knowledge, attitudes and practices of healthcare personnel towards waste disposal management at Ain Shams University Hospitals, Cairo. *Eastern Mediterranean Health Journal* 20(5):1-6.
- Hascuadar M, Kaya, Z, Serbetcioglu, Arsian, T & Altinkaya, S. 2007. The awareness level among the employees working in Ankara Ataturk Training Research Hospital about medical wastes. *Turkish Journal of Medical Science* 1: 138-144.



Hall, J. 2006. National waste management strategy implementation project. South Africa – an assessment of the need and options for law reform. (DEAT report number 12/9/6)

HPCSA. 2008. *Guidelines for the management of health care waste*. Pretoria: HPCSA.

Jang, Y, Lee, C, Yoon, O, Kim, H. 2006. Medical waste management in Korea. *Journal of Environmental Management* 80: 107–115.

Lakshmi, BS & Kumar P. 2012. Awareness about bio-medical waste management among healthcare personnel of some important medical centers in Agra. *International Journal of Engineering Research and Technology* 1 (7): 1-5.

Lavrakas, PJ. 2008. *Encyclopaedia of survey research methods*. Sage publications

Leech, N. 2005. *SPSS for Intermediate Statistics Use and Interpretation*. Mhawah, New Jersey: Lawrence Erlbaum Associates

Leonard, L. 2004. “Health care waste in Southern Africa: a civil society perspective”, Proceedings of the International Health Care Waste Management Conference and Exhibition, Johannesburg, South Africa.

Longe, EO. 2012. Health care waste management status in Lagos state, Nigeria: a case study from selected health care facilities in Ikorodu and Lagos Metropolis. *Waste Management Research* 30(6):562- 571.

Mbarki, A, Kabbachi, B, Ezaidi, A & Benssaou M. 2013. Medical Waste Management: A Case Study of the Souss-Massa-Drâa Region, Morocco. *Journal of Environmental Protection*: (4), 914-919.

Mangizvo, RV & Chinamasa, R. 2008. Solid medical waste management: the case of Kwekwe City in Midlands’s province, Zimbabwe. *Journal of Sustainable Development in Africa* 10(3): 188-200

Mathur, V, Dwivedi S, Hassan MA & Misra RP. 2011. Knowledge, attitude, and practices about biomedical waste management among health care personnel: A cross- sectional study. *Indian Journal of Community Medicine* 36:143-145.

Moreira AMM & Gunther WMR. 2012. Assessment of medical waste management at Primary health care centre in Sao Paulo Brazil. *Waste Management* 33(2013):162-167.

Muluken, A, Haimanot, G & Mesafint, M. 2013. Healthcare waste management practices among healthcare workers in healthcare facilities of Gondar Town, Northwest Ethiopia. *Health Science Journal*: 7 (3): 315-326.

Nagaraju, B, Padmavathi, GV, Puranik, DS, Shantharaj, MP & Sampulatha, SP. 2013. A study to assess the knowledge and practice on biomedical waste management among the health care providers working in PHCs of Bagepalli Taluk with the view to prepare informational booklet. *International Journal of Medicine and Biomedical Research*, 2(1):28-35

National Health and Medical Research Council. 1999. *National guidelines on waste management in the health industry*. Commonwealth of Australia: ONHMRC.

Norwood, SL. 2010. *Research Essentials Foundation for Evidence Based Practice*. Pearson Prentice Hall, United States of America.

Polit, DF & Beck, CT. 2008. Nursing Research. *Generating and assessing evidence for nursing practice*. 9<sup>th</sup> edition. Philadelphia: Lippincott, Williams and Wilkins.

Ozder A, Teker B, Eker HH, Altindis S, Kocaakran M, Karabay O. 2013. Medical waste management training for health care managers – a necessity. *Journal of Environmental Health Science and Engineering* 1.23

*Oxford Advanced Learners Dictionary*. 2010. 8<sup>th</sup> edition. UK: Oxford University press

Pudussery, KP. 2011. A study on the medical waste management at the Norfolk and Norwich University Hospital. Norwich. United Kingdom.

Ramokate, T & Basu D. 2008. Health care waste management at an academic hospital: knowledge and practices of doctors and nurses. *South African Medical Journal* 99 (6): 444- 445.

Suwarna, M & Ramesh, G. 2012. Study about awareness and practice about healthcare waste management among staff in a medical college hospital, Bangalore. *International Journal of Basic Medical Science* 3 (1):7-11.

Shivalli, S & Sanklapur, V. 2014. Healthcare waste management: Qualitative and Quantitative appraisal of nurses in a tertiary care hospital of India. *The Scientific World Journal*.

South Africa. 2008. National Environmental Management Waste Act 59 2008, Cape Town: Government printer.

South Africa. Department of Environmental Affairs and Tourism. 2006. National waste management strategy implementation project, South Africa

South Africa. 1993. Occupational Health and Safety Act 85, 1993, Pretoria: Government printer

World Health Organisation. 2005. Management of solid health-care waste at primary health-care centres: a decision-making guide. WHO document publication, Geneva.

World Gastroenterology organization. 2011. Practice guideline - Needle Stick Injury and Accidental Exposure to Blood. WGO publication cooperation.

Yar, M, Dix, D & Bajekal M. 2001. Socio-demographic characteristics of the health care work force in England and Wales – results from the 2001 census. Office of National statistics.

Zhang, H, Zang, Y, Yang, Y, Yang, Y, Zang, J, Wang, Y & Wang, J. 2013. Investigation of medical waste management in Gansu Province, China. *Waste Management & Research* 31(6) 655-659

## APPENDIX A: Questionnaire

### QUESTIONNAIRE

Questionnaire on knowledge, and practices of health care workers on medical waste disposal in Mapulaneng hospital in the Ehlanzeni District of South Africa

Date of data collection: \_\_\_\_\_

Please answer the following questions by putting a cross (x) on the appropriate box or writing your answer in the space provided

#### Section A - Demographical Information

The information in this section will be used to compare the demographic data with knowledge and practice of health workers regarding medical waste disposal.

Mark with an x in the relevant box with a number

1. Gender

Male	1	Female	2
------	---	--------	---

2. Age

21-25yrs	1	26-30yrs	2	31-35yrs	3	>35yrs	4
----------	---	----------	---	----------	---	--------	---

3. Professional Category

Doctor	1	Dentist	2	Nurse	3	Allied Health (specify)	4
--------	---	---------	---	-------	---	-------------------------	---

4. Years of experience

0-5yrs	1	6-10yrs	2	11-15yrs	3	16-20yrs	4	>20yrs	5
--------	---	---------	---	----------	---	----------	---	--------	---

#### Section B - Knowledge

This section of the questionnaire seeks to ascertain the knowledge of health care workers on disposal of medical waste.

Mark with an x in the relevant box

	Statement	Disagree = 1	Agree = 2	Neutral = 0
5	I know from policy that personal protective equipment is to be used routinely when handling medical waste.	1	2	0
6	I am aware of the regulation that placing medical waste in wrong bin is a high risk.	1	2	0
7	I am aware that there are waste bins for disposal of wastes as regulated	1	2	0
8	I know of policy documents regarding adequate disposal procedures of human tissue remains	1	2	0
9	I read and understood that throwing human tissue remains in domestic waste is an adequate disposal procedure	1	2	0
10	I read and understood that throwing expired blood units in domestic waste is an adequate disposal procedure	1	2	0
11	I know from policy document that it is necessary to sort medical waste at point of generation	1	2	0
12	Our Policy document dictates that liquid waste must be disposed into the sewage without processing or treatment	1	2	0
13	I consider used dressings, cotton and plasters as medical waste according medical waste classification.	1	2	0
14	I know that used cartoons, paper and plastics are classified as medical waste	1	2	0

15	I am aware that improper waste disposal can lead to needle stick injuries	1	2	0
16	Our Policy document informs us that the colour code for disposal of human, biological and any object that has been in contact with body fluids is yellow as per guidelines for waste management	1	2	0
17	I know that colour code for microbiological waste is red as per guidelines for waste management.	1	2	0
18	I am aware that untreated medical waste can be stored for more than 48 hours in the temporary storage area as per regulation	1	2	0
19	I know from policy documents that any waste mixed with medical waste must be treated as medical waste	1	2	0
20	I read and understood that improper waste disposal may lead to transmission of diseases	1	2	0

### SECTION C– PRACTICE

This section of the questionnaire seeks to ascertain the practices of health care workers on disposal of medical waste.

Mark with an x in the relevant box

		Disagree = 1	Agree = 2	Neutral = 0
21	Gloves used when handling medical waste	1	2	0

22	Colour coding used for segregating medical waste	1	2	0
23	Medical waste separated from general waste	1	2	0
24	Medical waste segregated into infectious and non-infectious waste	1	2	0
25	Special plastic bags used once for collecting medical waste	1	2	0
26	Liquid waste disposed in bags that prevent leakage	1	2	0
27	Blood waste disposed in separate bags that prevent leakage	1	2	0
28	Human tissue remains disposed in separate bags that prevent leakage	1	2	0
29	Liquid wastes collected together with other wastes	1	2	0
30	Liquid waste disposed directly into sewage system without any processing (dilution and/or sterilization)	1	2	0
31	Liquid waste disposed into sewage system after processing	1	2	0
32	Used needles not recapped	1	2	0
33	Used needles discarded immediately after use	1	2	0
34	Used needles discarded in a designated sharp container	1	2	0
35	Sharp containers are replaced when they are $\frac{3}{4}$ full	1	2	0
36	Waste containers labelled with bio-hazard stickers	1	2	0

37	Needle stick injury reported to the Occupational Health Nurse	1	2	0
38	A temporary waste storage area available in the hospital	1	2	0
39	Personal protective equipment available	1	2	0
40	Waste monitoring inspections conducted on monthly basis.	1	2	0

Thank you for your cooperation in completing this questionnaire. Kindly return the questionnaire as specified in the cover letter.



APPENDIX B: Informed consent

**UNIVERSITY OF LIMPOPO(Turfloop Campus) ENGLISH CONSENT FORM**

**Statement concerning participation in a Research Project\*.**

Name of Study: Knowledge and practice of health care workers on medical waste disposal in Mapulaneng hospital in the Ehlanzeni District of South Africa.

I have read the information and heard the aims and objectives of the proposed study and was provided the opportunity to ask questions and given adequate time to rethink the issue. The aim and objectives of the study are sufficiently clear to me. I have not been pressurized to participate in any way.

I am aware that this material may be used in scientific publications which will be electronically available throughout the world. I consent to this provided that my name is not revealed.

I understand that participation in this Study is completely voluntary and that I may withdraw from it at any time and without supplying reasons. This will have no influence in my regular work.

I know that this Study has been approved by the Medunsa Research Ethics Committee (MREC), University of Limpopo (Medunsa Campus). I am fully aware that the results of this Study will be used for scientific purposes and may be published. I agree to this, provided my privacy is guaranteed.

I hereby give consent to participate in this Study.

.....  
Name of participant                      Signature of participant

.....  
Place                      Date                      Witness

**Statement by the Researcher**

I provided verbal information regarding this Study.  
I agree to answer any future questions concerning the Study as best as I am able.  
I will adhere to the approved protocol.

Ramadimetja Rosina Makhura

.....  
Name of Researcher                      Signature                      Date                      Place

\*Delete whatever is not applicable.

## APPENDIX C: Budget

### BUDGET

ITEM	COSTS
Registration	R3000
Purchasing Computer	R3500
Telephone cost	R500
Travelling	R5000
Accessing literature	R100
Language editing	R1 597-90
Photocopying: 200 copies at R1-00 each	R200
Printing: 4 copies at R180-00 each	R720
Binding:4 copies at R500-00 each	R 2000
Travelling	R4000
Total costs	R20,617-90

## APPENDIX D: Time frame for study

### TIME FRAME FOR THE STUDY

	2014						2015		
	March	April	May	June	July - November	December	January - March	April - August	September
Develop proposal	x								
Submit proposal to supervisor	x								
Presentation to Senior Degrees Committee				x					
Ethical clearance					x				
Seek Permission from Mpumalanga Ethics Committee				x					
Data collection and analysis						x			

Report writing							x	x	
Submit final document									x

## APPENDIX E: Ethical clearance

UNIVERSITY OF LIMPOPO  
Medunsa Campus



### MEDUNSA RESEARCH & ETHICS COMMITTEE

#### CLEARANCE CERTIFICATE

MEETING: 07/2014

PROJECT NUMBER: MREC/HS/277/2014: PG

#### PROJECT:

Title: Knowledge and practices of health care workers on medical waste disposal in Mapulaneng Hospital in the Ehlazeni district of South Africa

Researcher: Ms RR Makhura  
Supervisor: Mr SF Matlala  
Co-supervisor: Mr MP Kekana  
Hospital Superintendent: Ms DE Sekatane  
Department: Medical Science, Public Health & Health Promotion  
School: Health Sciences  
Degree: MPH

#### DECISION OF THE COMMITTEE:

MREC approved the project.

DATE: 04 September 2014

pp. 

PROF GA OGUNBANJO  
CHAIRPERSON MREC



The Medunsa Research Ethics Committee (MREC) for Health Research is registered with the US Department of Health and Human Services as an International Organization (IORG0004319), as an Institutional Review Board (IRB00005122), and functions under a Federal Wide Assurance (FWA00009415)  
Expiry date: 11 October 2016

#### Note:

- i) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.
- ii) The budget for the research will be considered separately from the protocol.  
**PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.**

*Finding Solutions for Africa*



## APPENDIX F: Permission letter from Department of Health

# MPUMALANGA PROVINCIAL GOVERNMENT

Building No.3  
No. 7 Government Boulevard  
Riverside Park Extension 2  
Nelspruit  
1200  
Republic of South Africa



Private Bag X 11285  
Nelspruit, 1200  
Tel: 013 766 3429  
int: +27 13 766 3429  
Fax: 013 766 3459  
int: +27 13 766 3459

## Department of Health

Litiko Letemphilo

Umnyango WezaMaphilo

Departement van Gesondheid

**Enquiries: Themba Mulungo (013) 766 3511**

**10 December 2014**

**Ms. Rosina Makhura  
P.O Box 1563  
Bushbuckridge  
1280**

**Dear Ms. Rosina Makhura**

**APPLICATION FOR RESEARCH & ETHICS APPROVAL: KNOWLEDGE AND PRACTICES OF HEALTH CARE WORKERS ON MEDICAL WASTE DISPOSAL IN MAPULANENG HOSPITAL IN THE EHLANZENI DISTRICT OF SOUTH AFRICA**

The Provincial Research and Ethics Committee has approved your research proposal in the latest format that you sent.

**PHREC REF: MP\_2014RP21\_182**

Kindly ensure that you provide us with the soft and hard copies of the report once your research project has been completed.

Kind regards

**MR. MOLEFE MACHABA  
RESEARCH AND EPIDEMIOLOGY**

10/12/2014  
DATE



## APPENDIX G: Permission letter from hospital management

**MPUMALANGA PROVINCIAL GOVERNMENT**

No.1 Masana Trust  
Graskop Road  
Bushbuckridge  
1280  
Republic of South Africa



Private Bag X 9305  
Bushbuckridge 1280  
Tel: 013 799 0214  
Int: +27 13 799 0214  
Fax: 013 799 0217/  
013 799 0339  
Int: +27 13 799 0217

**Department of Health**  
Mapulaneng Hospital

Litiko Lctemphilo                      Umyango Wezámaphilo                      Departemen van Gesondheid

Enquiries: Ms D.E. Sekatane  
Tel: 013-7990214

**DATE: 05 January 2015**

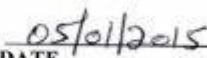
**To: Ms R.R. MAKHURA  
P.O. BOX 1563  
BUSHBUCKRIDGE  
1280**

**REQUEST FOR PERMISSION TO CONDUCT A RESEARCH AT MAPULANENG HOSPITAL**

1. The above matter refers
2. Permission is hereby granted for Ms Ramadimetja Rosina Makhura to conduct a research on Knowledge and practices of health care workers on medical waste disposal in Mapulaneng Hospital in the Ehlanzeni District of South Africa.

Thanks

  
Ms D.E. SEKATANE  
CHIEF EXECUTIVE OFFICER

  
DATE



## APPENDIX H: Letter from Editor

Revd. Dr. Lutz Ackermann  
(Independent Researcher)  
Mankweng, Zone A, Stand 506  
Tel: +27 72 3487010  
e-mail: DRLA4 @ directbox.com

27 Oct 2015


### TO WHOM IT MAY CONCERN

This is to confirm, that I, Dr Lutz Ackermann, have read the Research Thesis entitled

“KNOWLEDGE AND PRACTICES OF HEALTH CARE WORKERS  
ON MEDICAL WASTE DISPOSAL IN THE MAPULANENG HOSPITAL  
IN THE EHLANZENI DISTRICT OF SOUTH AFRICA”

by RAMADIMETJA ROSINA MAKHURA

(student number 201216930) and that I am satisfied with the quality of work she has produced in terms of structuring the document, in terms of style, grammar and spelling. Suggestions for suitable corrections and improvements have been made to the candidate.

  
(Rev. Dr. Lutz Ackermann, Mankweng)



## APPENDIX I: Letter from Statistician

**UNIVERSITY OF LIMPOPO**  
Turfloop Campus

**Research Development and Administration**



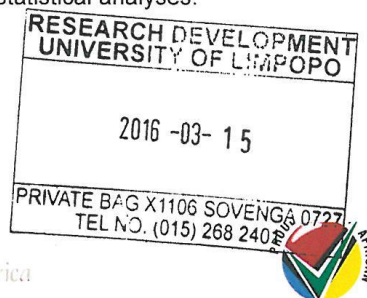
Private Bag X1106  
SOVENGA  
0727  
SOUTH AFRICA  
Tel.: (015) 268 2168  
Fax: (015) 268 2306  
Int. Tel.: +27 15 268 2168  
Int. Fax: +27 15 268 2306  
E-mail: [Mmbengeni.netshidzivhani@ul.ac.za](mailto:Mmbengeni.netshidzivhani@ul.ac.za)

**Ref No: Research and Statistical Support**  
**Date: 15 March 2016**  
**Subject: Data Management and Statistical Support for research titled the KNOWLEDGE AND PRACTICES OF HEALTH CARE WORKERS ON MEDICAL WASTE DISPOSAL IN MAPULANENG HOSPITAL IN THE EHLANZENI DISTRICT OF SOUTH AFRICA**

Dear Sir/Madam

1. The above matter refers.
2. I have studied the research protocol of Ms Ramadimetja Rosina Makhura student number 201216930. Titled **KNOWLEDGE AND PRACTICES OF HEALTH CARE WORKERS ON MEDICAL WASTE DISPOSAL IN MAPULANENG HOSPITAL IN THE EHLANZENI DISTRICT OF SOUTH AFRICA** and I agree to assist with data management and the statistical analyses.
3. Hope that you find this in order.

Yours sincerely,  
Netshidzivhani MV



*Finding Solutions for Africa*