

**KNOWLEDGE AND PRACTICES OF HEALTH CARE WORKERS ON MEDICAL
WASTE DISPOSAL AT GEORGE MASEBE HOSPITAL, WATERBERG DISTRICT,
LIMPOPO PROVINCE, SOUTH AFRICA.**

By

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MINI-DISSERTATION

Submitted in partial fulfilment of the requirements for the degree of

MASTER OF PUBLIC HEALTH

in the

Faculty of Health Sciences

School of Health Care Sciences

Department of Public Health, At the

UNIVERSITY OF LIMPOPO

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DEDICATION

To family, friends and colleagues, thank you for your continuous support throughout this study.

“Special thanks to God who made it possible for me to complete this studies successfully through his guidance. For nothing will be impossible with God (Luke 1 verse 7).”

DECLARATION

I **Malebatja Samuel Mashao** declare that KNOWLEDGE AND PRACTICES OF HEALTH CARE WORKERS ON MEDICAL WASTE DISPOSAL AT GEORGE MASEBE HOSPITAL, WATERBERG DISTRICT, LIMPOPO PROVINCE, SOUTH AFRICA is my own work and that all the sources that have used or quoted have been indicated and acknowledged by means of complete references and that this work has not been submitted for any other degree at any institution.

Signature:

Date signed:

ACKNOWLEDGEMENTS

I would like to acknowledge the following people for their contributions in the study:

My supervisor Dr Ramalivhana NJ for his continuous mentorship, support and guidance throughout this study.

Professor Skaal L for consistent motivation and encouragement

Mr MP Kekana for his encouragement, coordination and support

Mr.Netshidzivhani NV for support in statistics and analysis

The management of George Masebe hospital for allowing me to conduct the study at the hospital.

My colleagues at George Masebe for their willingness to participate in the study

The Limpopo province Department of health for giving me permission to conduct the study

ABSTRACT

Introduction

The aim of the study was to determine the knowledge and practices of health care workers on medical waste disposal at George Masebe Hospital, Waterberg District, Limpopo Province, South Africa.

Method

A cross sectional study was conducted and simple random sampling was used to select participants. Data was collected using self-administered questionnaire which where total of 141 participants were sampled using the Slovin formula. Data were analyzed using the IBM SPSS Version 22 and both descriptive and inferential statistics were used to answer the study objectives.

Results

The study shows that 43% of the respondents had good knowledge on medical waste disposal, 13% were not sure and 44% had insufficient knowledge. Forty nine percent (49%) of the respondents practiced safe medical waste disposal, 4, 3% were moderate in practice and 46, 1% had insufficient practice in place. There was no statistical significant relationship between knowledge and practice of medical waste disposal control measures of health care workers.

Conclusion

The study concluded that knowledge of the respondents on medical waste disposal was insufficient, there were satisfactory medical waste practices and there was no relationship between knowledge and practice.

KEY CONCEPTS

Knowledge; Practices; Health care workers; Medical waste; Disposal.

DEFINITION OF KEY TERMS

Knowledge- described as information, skills and understanding that have been gained through learning or experience (Longman, 2006:845).

Practice- something done regarding regularly or habitually, repetition of something so as to gain skills (Holmes, 2003).

Health care workers - nurses and doctors providing care, treatment and rehabilitation to patients according to Health Professions Act no 56 of 1974 and Nursing ACT no 33 of 2005 as amended.

Medical waste- refers to discarded biological product such as blood or tissues removed from wards, laboratories, clinics, operating rooms and other medical facilities. Bandages, used hospital linen, syringes and other materials used in patient care are also regarded as medical waste (Mosby, 2009).

Biohazardous waste- a biological agent, such as an infectious microorganism, that constitutes a threat to humans or to the environment especially one produced in biological research or experimentation (Houghton, 2009).

Disposal- the action or process of getting rid of something (Mosby, 2009)

Incineration- is a waste treatment process that involves the combustion of organic substances contained in waste materials (Lewis, 2007).

Bioaccumulation- particles or deposits stored into the tissues of an organism instead of being broken down and dissipated (Tia, 2011)

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LIST OF ACRONYMS AND ABBREVIATIONS

DEAT- Department of Environmental Affairs and Tourism

DWAF- Department of Water Affairs and Forestry

SANS- South African National Standards

IWM- Institute of Waste Management

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CHAPTER 1

1.1 INTRODUCTION

Health care activities protect and restore the health of the population and medical waste is produced during these health activities. Medical waste is therefore referred to as any solid waste that is generated in the diagnosis, treatment or immunization of bugs or animals, in research pertaining thereto, or in the production of bio-liquids (Mosby, 2009). According to reports by the World Health Organization 80% of waste generated in the hospital is domestic waste and the remaining 20% is considered hazardous material that may be infectious, toxic and radioactive (WHO, 2005). Medical waste that is generated during health care activities is dangerous and poses threat to human and environmental health (Marthur *et al.*, 2012). Medical waste should be carefully monitored and controlled to prevent nosocomial infections associated with exposure to wastes (Nascimento *et al.*, 2009).

Several studies concerning medical waste suggest that improper management of medical waste is detrimental to the health of the patients, communities and cause the imbalance in the ecosystem as the food chain is affected. The study conducted in Nairobi Kenya by Kaseva and Mato 1999, report that waste generated during health care activities poses serious health risk, affecting various systems in the body such as respiratory, reproductive, central nervous system and others are carcinogenic in nature.

WHO report that the proportion of health care establishments that do not use proper waste disposal methods range from 18-64%, the direct re-use of contaminated injection equipment resulted in occupational hazards to health workers, waste handlers and scavengers. In situations where waste is dumped in a non-restricted area, children come into contact with used needles and syringes (WHO, 2002).

There are several legislations that regulate the management of medical waste with the main aim of protecting the individual, environment and the ecosystem (Leonard, 2001). There are multi-lateral agreements that relate to the management of hazardous waste around the world and these agreements are legal instructions that are conducted between a large numbers of states and are governed by international law. However, some studies report challenges in implementing policy between the central government and hospital (Nemathaga *et al.*, 2008; Johannesen *et al.*, 2000). There is no proper segregation of waste according to their classifications as required by the national government in most countries. The modern practice

of incinerators and landfills are not used according to minimum standards and incinerators are sometimes not environmentally friendly (Nemathaga *et al.*, 2008).

The effective implementation of proper waste management depends on the national regulations, occupational safety, internal policy and administration, qualifications and competence of the directors of waste management in the departments. Therefore sufficient training programs and protective measures should be provided by health care facilities to all relevant personnel and adequate financial support and effective administrative monitoring should be performed by local authorities (Zhang *et al.*, 2013). Medical waste management faces challenges in different countries ranging from lack of budgets, control measures and proper management. Problems faced by hospitals in the management of health care waste such as lack of rules and instructions on different aspects of collection and disposal of waste , failure to quantify waste in reliable records and no committees for waste management makes it difficult to achieve WHO standards(Abor,2007).

Global burden of medical waste

The study conducted by Hanhary *et al.*, 2009 reported that over half of the world population are at risk from medical waste either through impacts at work, in the environment or impacts on the public. Lack of awareness on medical waste management, absence of proper laws and policies, limited budgets and low levels of technology poses significant challenges to medical waste management in the Dhakar city (Hassan *et al.*, 2008). Lack of training posed a significant problem in the management of medical waste and inadequate level of training was found in Libya. Only 4 out of 14 hospitals investigated used personal protective equipment when handling medical waste and none at all used in 5 hospitals (Sawalem *et al.*, 2008). An outbreak of Hepatitis B in the Indian state of Gaujarat in 2009 was blamed on the doctors re-using syringes and trade in second hand syringes. It was evident that training on medical waste was needed (Solsberg, 2009).

The treatment of medical waste still a problem in many parts of the world and the preferred methods used are autoclaving and incineration. Autoclaving is a process of disinfecting materials by using the intense amount of heat and pressurized steam (Tia, 2011). The study conducted on the effectiveness of the incinerators in the management of medical waste in Eldoret municipality, Kenya reported that incinerators were maintained and operated in substandard condition. The ashes produced contained a list of toxic pollutants which included

high concentration of heavy metals of dioxins and furans that posed serious occupational and environmental hazards (Njoroge *et al.*, 2011). Harmful chemicals such as dioxins and furans cause serious effects to animals and birds and it can affect the reproductive health of animals. In Croatia the study conducted reported that even though the Croatian regulation define all the steps in waste management chain, implementation of the steps is one of the country greatest issues as improper practices was evident from the point of waste production to final disposal. Landfilling was predominantly practiced in Croatia which polluted the environment but it is believed that small number of incinerators would be the most economical solution (Natalija *et al.*, 2008).

In African countries the challenges to waste management were mostly from lack of knowledge, poor administration, poor infrastructure and technology to deal with medical waste. Medical waste disposed without proper treatment exposed rag pickers and children to health problems (Muluken, 2012). In Tanzania the study conducted reported that rubbish pit was used for the disposal of the discarded syringes and these pits were shallow that used syringes can be retrieved from them easily, the study suggested that health education was important to improve medical waste practices (Manyele, 2009). Lack of knowledge of the associated risks upon poor disposal practices of infectious and non-infectious waste contributed to poor waste management in North West Cameroon, variety of nosocomial infections were evident on waste handlers (Machongoung *et al.*, 2012). In Accra Ghana most of the laboratories were not aware of the segregation laws , only a few separate their waste before disposal and liquid waste was poured down the drain without treatment which pollute the water systems. No biohazardous signs on the vehicles for the transportation of medical waste and the drivers had no training (Williams, 2013)

Incineration for the treatment of medical waste in Kenya according to Njangi *et al.*, 2012 reported that two health care incinerators schemed combustion efficiency below 99% a national minimum limit and it was established that these incinerators tested released dioxins and furans which pollute the environment causing respiratory problems.

National burden

In South Africa according to the chairman of the Institute for Waste Management(IWM) Mr Stan Jewaskiewitz it is estimated that 45 000 tons of health care waste is produced annually and there is a perception that there is insufficient capacity to treat the amount of health care

waste resulting in illegal storage and dumping (IWM, 2013). Compliance and enforcement are the biggest challenges facing the health care industry in South Africa and it was further reported that tender irregularities and fraud also cause problems in the waste management chain. When conducting investigations it was found that storage facilities were found to be inadequate with poor compliance to current regulations and storage periods were also a problem in rural locations (IWM, 2013). The study conducted by Abor, 2009 at a South African hospital reported that lack of knowledge existed among health care workers and therefore suggested training for waste generators such as doctors and nurses because mixing medical waste with general waste caused large volumes of waste to require treatment (Abor, 2009).

The study conducted by Bodenstein and Du Toit, 2014, on the legal perspective on the disposal of medical waste, reported that illegal dumping of hazardous waste poses a danger to the environment when pollutants migrate into water sources ultimately cause widespread infections and toxicity , endangering the health of humans who might become exposed to infections and toxins. Reports of illegal disposal of waste suggest a general lack of awareness and training with regard to the safe disposal of medical waste.

Limpopo province

Knowledge on handling and disposal of medical waste was found to be insufficient in Limpopo and this is backed up by the study conducted by Nemathaga *et al*, 2011 where incinerator ash was openly dumped and waste buried on landfills instead of being covered with soil. While modern practices such as landfill and incineration are used, their daily operations were not carried out according to minimum standards and incinerators were also not environmentally friendly used old technology. The study further reported that there was no proper separation of waste according to their classification as demanded by national government.

Soil pollution in Limpopo province was evident on the study conducted by Adeniyi *et al.*, 2008 at Muledane open dump in Thohoyandou where open dump values of the phthalate esters and metals were higher in comparison to the control samples and it was revealed that discarding of metal waste on the open dump is dangerous and it's a threat to public health, plants and animals (Adeniyi *et al.*, 2008).

1.2 PROBLEM STATEMENT

The issue of medical waste management has received serious consideration due to rapid upsurge of HIV infections. Therefore, basic handling and disposal procedures need to be adhered to, in order to minimize the health risks associated with medical waste management. There is continuous mixing of medical waste materials observed by infection control officers during their inspection at George Masebe hospital units, this, despite the protocols and standards on medical waste management that exist within the hospital. This study was undertaken to investigate knowledge and practices of health care workers on medical waste disposal in George Masebe hospital.

1.3 RESEARCH QUESTION

What is the knowledge and practices of health care workers on medical waste disposal at George Masebe Hospital, Waterberg District, Limpopo Province, South Africa?

1.4 AIM OF THE STUDY

To determine the knowledge and practices of health care workers on medical waste disposal at George Masebe Hospital, Waterberg district, Limpopo Province, South Africa within the duration of the study.

1.5 OBJECTIVES OF THE STUDY

- To describe the socio-demographic profiles of the participants of the study
- To determine if health workers at George Masebe Hospital, Waterberg district, Limpopo province, South Africa have sufficient knowledge with regard to medical waste disposal.
- To describe the medical waste disposal control practices by health care workers at George Masebe Hospital, Waterberg district, Limpopo province, South Africa.
- To determine the relationship between knowledge and practice of medical waste disposal control measures of health care workers at George Masebe Hospital, Waterberg district, Limpopo province, South Africa.

1.6 SUBSEQUENT CHAPTERS

A summary of subsequent chapters are discussed below:

Chapter two: Literature review

This chapter reviews the previous related studies in articles, journal and books on medical waste disposal in South Africa and elsewhere.

Chapter three: Research methodology

This chapter gives a brief explanation on the methods and approach used to conduct the study. The study was a descriptive cross sectional study with an analytic component on health care workers working at George Masebe hospital and data was collected using questionnaires. Data was analyzed using IBM SPSS version 22 with the help of the statistician, both descriptive and inferential statistics were used to answer the objectives, ethical considerations, bias and measures to ensure validity and reliability were addressed

Chapter four: Results

This chapter deals with the analysis of the results obtained in the study using tables and graphs and also checking if study objectives were met.

Chapter five: Discussion

The results obtained from the analysis of this study are compared with literature in order to address the aims and objectives of this study. The results are further discussed.

Chapter six: Conclusions and recommendations

The chapter deals with summarizing the research findings draw conclusions on the study and give recommendations for future plans and research in the proper disposal of medical waste.

1.7 CONCLUSION

The background information on medical waste disposal was provided, research questions, problem statement, aims of the study, objectives, significance of the study and summary of subsequent chapters were clearly defined in this chapter.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter is about literature review which is insightful analysis of written materials that contain information related to the current study. The review was based on literature from journals and studies conducted on knowledge and practice of health care workers on medical waste disposal, in order to identify information, methods and ideas relevant to the present study. Literature review was conducted to enable the researcher to gain insight into the research question, verify the significance of the research problem and to decide on the most appropriate research instrument (Burns and Grove, 2001)

Literature review in this study was categorized into the following subtopics:

- Detailed analysis of relevant policy regarding medical waste
- Comparison of literature looking at knowledge and practice
- Literature on the effects of improper medical waste management and the challenges

2.2 POLICIES REGARDING DISPOSAL OF MEDICAL WASTE

For better management of health care waste, health care waste management must be guided by appropriate policies and legislation. The legislation will be discussed with reference to the current legal framework for management of health care risk waste in South Africa displayed in figure 2.2.1

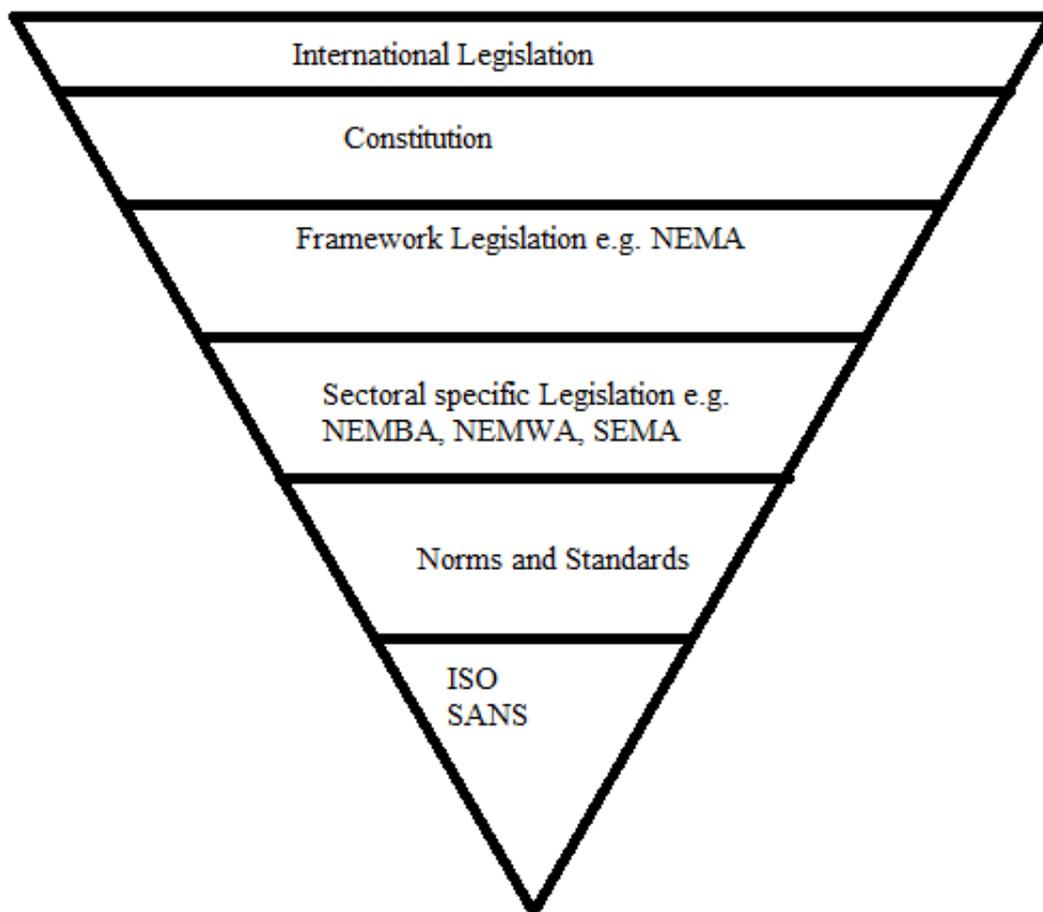


Figure2.2.1 The current legal framework for management of health care risk waste.

International legislation (Conventions)

In terms of environmental policy and practices related to South Africa as a trading partner, it became necessary to participate in international affairs pertaining to health care waste management and South Africa therefore takes cognizance of the international efforts to control hazardous waste.

The South African government on 3 August 1994 became signatory to the international legislations governing waste management. The Basel Convention on the control of trans-boundary movements of hazardous waste, The Stockholm conventions on Persistent organic pollutants, Kyoto protocol on climate change, The International register of potential toxic chemicals 1985 and the United Nations Environmental Code of Practice 1993 are some of the key regulations for better management of health care waste around the world with a view to achieve low standard of environmental pollution caused by bioharzadous waste. The South

African government therefore has an obligation to comply with international legislations and set standards to control health care waste within its borders.

Constitution (Act no 108 of 1996)

The practice of medical waste management in South Africa must also be guided by Act no 108 of 1996 in the Bill of Rights section where it is stipulated that each and every citizen has a right to an environment that is not harmful. The State must respect, protect, promote and fulfil the social, economic and environmental rights of everyone. Improper practice of medical waste that causes pollution to population violates this right and is therefore punishable by law.

Framework legislation (National Environmental Management Act 107 of 1998)

This Act provides for cooperative environmental governance by establishing principles for decision making on matters affecting the environment, institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state, to provide for certain aspects of administration and enforcement of other environmental management laws.

The application of appropriate environmental management tools must ensure the integrated environmental management activities. The principles of environmental management must be integrated into all decisions which may have a significant effect on environment. The Act provides for overall control of Environmental legislations and protects the environment from the effects of uncontrolled disposal of dangerous biomedical waste.

Sectoral specific legislations

Known by the abbreviation SEMAs, Specific Environmental Management Acts, all fall under the auspices of the overarching National Environmental Management Act (NEMA). To date five SEMAs have been promulgated the recent one being Waste Act in 2008. The full lists of SEMAs are explained below:

1. National Environmental Management: Protected Areas Act (57 of 2003) which is intended for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes, it classifies various types of protected

areas in order to conserve biodiversity and these protected areas are to fall on state owned land, privately owned land and communally owned land

2. National Environmental Management: Biodiversity Act (10 of 2004) - the focus of this legislation is on the preservation of species and ecosystem irrespective of whether or not they are situated in protected areas. The act also establishes both the South African National Biodiversity Institute (SANBI) through which the act is to a large extent implemented and the National Biodiversity Framework which is the strategic document for implementation of this act.

3. National Environmental Management: Air Quality Act (39 of 2004) - aims to protect the environment by providing reasonable measures for the protection and enhancement of air quality in the republic, the prevention of air pollution and environmental degradation. The Act also regulates the emission standards of incinerators that are used for treatment of medical waste to the atmosphere.

4. National Environmental Management: Integrated Coastal Management Act (24 of 2008)- this act applies to the coastal zones of South Africa and is intended to protect , preserve and to some extent enhance the coastal status of public property as being held in trust by the State

5. National Environmental Management: Waste Act (59 of 2008) - deals with different types of waste and also provides for the licensing process for specified waste activities with the result that a person may require authorization under both NEMA and NEMMWA for elements of the same activity.

Policies and Norms

Health care risk waste is also regulated by policies and Standards. The Department of Water affairs and Forestry 1998 drafted the Waste management policy which comprise of 3 series documents for the management of waste

Document 1: Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste

This policy set out the classification system into general and hazardous waste according to their inherent toxicological properties. The hazard wastes are checked according to the risk posed at disposal, the rating of 1-2 indicates extremely hazardous and 3-4 indicate moderate

to low hazards. The requirements for pre-treatment are set according to waste classification. Hazard waste, prevention and minimization are briefly addressed including transportation, handling and storage. This document basically categorize hazardous waste and prescribe how it should be disposed according to the level of toxicity

Document 2: Minimum requirements for waste disposal landfill

Landfill classification, design, investigation, operation and monitoring of landfills are governed by this document. A landfill is classified in terms of waste class, size of operation, all of which influence the risk it poses to the environment. It regulates the requirements where medical waste must be dumped.

Document 3: Minimum requirements for the Monitoring of Water Quality of Waste Management Facilities

This document addresses the monitoring of water quality at and around waste disposal facilities

South African National Standards (SANS)

Standards presents basic elements of the management of health care waste, certain issues are of utmost importance which include:

- 1.The need to deal with management aspects of health care risk waste in addition to the technical operation of health care waste disposal.
2. Need for a document suitable for audit process that can be administered over a broad range of health care facilities which may have greatly ranging resources
3. The need to control the potential for spread of infectious diseases that can place the public at risk especially waste collectors
4. The need for guidelines the waste cycle including waste minimization, point of use through internal and external transport to the final treatment and disposal

Below is the National Health Care Risk Waste Management Standards:

SANS 10248-1(2008) Management of health care risk waste from a health care facility

The standard regulates how health care risk waste should be managed in the health facility from generation, handling, storage until final disposal.

SANS 10248-(2009) Management of health care risk waste facilities and health care providers in rural and remote setting

SANS 10248-3(2011) Management of health care risk waste from minor generators-Registered health care professionals and non-health care professionals

Provinces such as Mpumalanga, Gauteng, North West and Limpopo came up with regulations in 2004 for the management of health care risk waste which was guided by national policy on waste management, regulations are as follows example being Limpopo:

1. Integrated Strategy and Action plans for sustainable health care risk waste management in Limpopo
2. Limpopo health care risk waste management regulations 2004
3. Integrated waste management policy 2006
4. Limpopo province air quality management plan 2009

Other legislations related to waste management that are interrelated to medical waste

Environmental Conservation Act (73 of 1989)

National health Act (61 of 2005)

Occupational Health and Safety Act (85 OF 1993)

Hazardous Substances Act (19 of 1973)

National Road Traffic Act (93 of 1996).

Environmental Conservation Act 73 of 1989

In terms of Section 20 of the Environmental Conservation Act 73 of 1989 waste can only be disposed of at a waste disposal facility that has a permit issued by the Minister of Water Affairs and Forestry, such a facility must be sited, designed and maintained strictly in accordance with the permit conditions. The following principles are therefore encourage to ensure better management of health care risk waste

Waste prevention- this principle aim to prevent and avoid the production of certain hazardous waste

Waste minimization- the economic reduction of the volume of waste during production, by means of different processes or clean technology

Resource recovery- it entails the recovery of energy through incineration or biodegradation

Treatment- this is the treatment to reduce volume of waste or the hazardousness

Disposal –safe disposal of waste in a way that it will not pollute the environment

National Health Act 61 of 2005

This Act has regulation GNR 363 of 2013 that deals with the management of human remains and how it should be handled, stored, disposal and final treatment.

Occupational Health and Safety Act 85 of 1993

This Act enforces the provision of personal protective clothing to the handlers of waste. Goggles, boots, gloves, aprons and other protective materials must be provided to prevent transmission of infections and diseases. The Act also serves to eliminate or minimize possible dangers handling, storage and treatment of medical waste can cause.

Hazardous Substances Act 19 of 1973

This Act regulates the handling and disposal of hazardous substances capable of causing harm to the individual and environment. The GNR 1382 of 1994 deals with the group 2 hazardous substances and how they should be handled and disposed due to the nature of danger they are capable of causing.

National Road Traffic Act 93 of 1996

The Act regulates the transportation and handling of waste on the roads, the type of vehicles that should be used and the temperature regulations. The driver of medical waste must have proper documentation with the details of the type of waste on the vehicle and the nature of toxicity.

2.3 COMPARISON OF LITERATURE LOOKING AT KNOWLEDGE AND PRACTICE OF MEDICAL WASTE

There are several studies on the knowledge and practices of medical waste. The study conducted in the Mazandaran province in Iran reported that lack of knowledge and low understanding of universal precautions on health care workers was the contributing factors to poor waste management (Khalilian *et al.*, 2006). According to the study conducted in India lack of knowledge contributed to poor waste management practices and it was suggested that there was a need to develop waste management protocol for health and to develop waste management audits after realizing that waste management was generally poor (Mostafa *et al.*, 2009)

The survey on attitudes and knowledge of pharmacists on medical waste at an educational campaign for proper medication disposal reported that brief educational intervention was effective in changing the attitude and practices of pharmacists , pharmacists received the education on proper disposal are likely to improve than those who did not receive education(Sullivan, 2009). Rhadar, (2012), in India on the study to assess the existing knowledge , attitude and practice regarding biomedical waste management amongst health care workers in tertiary care rural hospital supported that adequate knowledge was the first step towards developing favorable attitudes to practice waste management effectively. Health workers with adequate knowledge were better in terms of practice than those with less knowledge

In a study conducted at North West Cameroon by Mochungong *et al.*, 2010, reported that due to infectious nature of some clinical waste, poor disposal practices have sparked concerns regarding the impact on public health. The study further suggested that lack of sufficient knowledge of the associated risk may be a strong factor contributing to the inadequate disposal practices. According to Mochungong *et al.*, (2010) 47, 5% of HCWs lacked sufficient awareness of any policy national or international on safe disposal of medical waste (Mochungong *et al.*, 2010). The survey conducted in Tanzania between 2003 and 2005 to study the existing medical waste management systems which were aimed at enabling health workers to establish medical waste management in the health care facilities found that

knowledge levels on medical waste management amongst health care workers were low and training on waste management was needed.

The analysis of waste management practices showed that the increased population and the poor medical waste management system as well as the expanded use of disposables were the main reasons for the increased medical waste in hospitals; many had low incineration capacity with few of them having bricks (Manyele and Anecitus, 2006). A study that was conducted in the urban area of Karachi on health care personnel reported that general waste and infectious waste was collected together and disposed of in landfills where liquid waste was disposed without treatment and it was therefore concluded that knowledge, attitude and practices of health care workers was extremely poor and proper facilities for management of hospital waste was almost non-existent in Karachi (Sultana and Salahuddin, 2007)

The study conducted by Ashwini, 2013 reported that nurses were educated about safe handling and disposal of waste, had a fairly satisfactory practices about health care waste management but the degree of understanding and practices was not uniform amongst them. Ferreira and Teixeira 2012 in Algarve hospitals, Portugal reported that there was lack of training in hospitals due to lack of resources , but nurses showed higher knowledge on medical waste separation than doctors and the medical staff showed a low perception of risk associated with infectious waste. Needle stick injuries according to the study were attributed to poor segregation and containerization of waste materials. Sarma *et al.*, 2005 attributed poor waste management on medical professionals towards lack of commitment and accountability in ward management because nurses had better understanding and more responsible in implementation. Due to insufficient knowledge on correct method of medical waste disposal in Kanchipuram town India, there was a need to develop programs that not only give knowledge to doctors but also to motivate them to actively practice proper biomedical waste management (Kumar, 2010).

The survey conducted in the northern part of Jordan showed health care facilities in Irbid city have less appropriate practices when it comes to handling, storage and disposal of waste generated in comparison to developed countries (Bdour *et al.*,2007). Knowledge and training on medical waste management was describe as inadequate in Bangladeshi where only 23 of Bangladeshi waste workers have received the most basic information from non-governmental organizations than their employers.

The challenge in good medical waste management was also found in Palestinian hospital in the West Bank where there was insufficient separation between infectious and non-infectious waste, an absence of necessary rules and regulations for the collection of waste from the hospital wards and the on-site transportation to a temporary storage location inside and outside the hospital, inadequate waste treatment and disposal of medical waste along with municipal garbage was evident. The study reported that training of personnel was lacking and protective equipment for staffs were not available (Al Khatib and Khatib, 2006). Waste management was of the crucial concern for public health in developing countries. In Uganda one of the problems connected to public health is poor management of waste. There was a need for society to take responsibility of the population by improving infrastructure and long sustenance being to eradicate poverty and corruption around waste management issues (Bergqvist *et al.*, 2006).

According to the study that was conducted in Gondor Town, North west of Ethiopia on factors associated with the risk perception of health care workers towards health care waste management reported that health care waste in developing countries including Ethiopia are treated equally like any other general waste, no health care facilities had health care waste management guidelines only small quantities of health care workers had health care waste management guidelines. The study recommended that training on health care waste should be offered to improve the perception of health care workers and facilities should have waste management plans and guidelines (Muluken *et al.*, 2012).

A number of studies on health care waste management reported that health and environmental risk posed by health care waste can be reduced by having careful, proper guidelines and full participation by health care workers (Silva *et al.*, 2004). The study conducted by Saini 2005 showed that knowledge was a detrimental tool to good practices, in comparison of knowledge with attitude and practice the people with high education such as the consultants, residents and scientists had very good knowledge but relatively low percentage of this category of people have the same kind of attitude and practice.

A study conducted by Hossain *et al.*, 2012 reported that management of clinical solid waste remains a major challenge in most health care facilities of the developing world. Poor conduct and inappropriate disposal methods executed during handling and disposal of clinical solid waste increased significant health hazards and environmental pollution to due to infectious nature of the waste.

The study suggested that the main reasons for the mismanagement of clinical solid waste was due to lack of appropriate legislation, lack specialized clinical staff, lack of awareness and effective control. Most health centres of the developing world have faced financial difficulties therefore they are looking for cost effective methods of managing clinical waste(Hossain *et al.*,2011). Fischer *et al.*, 2003 conducted an audit on waste management at Gauteng province South Africa which suggested that excessive and incorrect manual handling of health care waste, unsafe utilization of equipments and the excessive emission of pollutants from health care risk waste treatment plants were identified to cause problems in the health care waste management (Fischer *et al.*, 2003).

According to the study that was conducted in Abuja Nigeria to evaluate waste disposal technique employed in the management of solid waste, reported that health workers and patients are at risk of acquiring infections from sharps and contamination of environment with multidrug resistant organisms if medical wastes they are exposed to are not properly disposed. The results showed that the average waste per bed was 2,78kg of solid waste and 26, 5% of the waste was hazardous in nature, hospital incinerated waste in a locally built brick incinerator and waste disposed in the municipal landsides. The study concluded that waste management officers do not have formal training in waste management technique and hospital administrators pay very little attention to appropriate management of medical waste. The study also recommended that waste generators must be educated to manage their waste so that their patients and environment are protected. The study argued that health care institutions are service orientated establishments that provide medical care facilities comprising of observational, diagnostic, research, therapeutic and rehabilitative services with less emphasis to medical waste as a by-product (Bassey *et al.*, 2006).

Phengxay *et al.*, 2005, conducted a study to investigate health care waste management at each level of health care facility of the two selected sites in Lao Democratic Republic focusing on the health care waste generated particularly segregation. A highly improper segregation of medical waste was found at each level of health care facility and a high proportion of medical waste was found from the inpatient department and the primary health care which suggested that health care waste management of Primary health care needed more attention and should be better understood. Glenda *et al.*, 2008 reported that an audit waste practices of the ten general dental surgeries identified problems that have occurred due to the lack of specific dental guidelines or codes of practice in this area.

Improper practice of medical waste was evident on the study conducted by Gupta *et al.*, 2013 amongst dental practitioners in Tricity (Mohali, Panchkula and Chandira) where 14% of the practitioners were not aware of the types of waste generated at their practice and 32% of dentists did not dispose their medical waste properly. The study conducted by Tanaka *et al* 2006 supported that health workers are responsible for the correct disposal of waste, their intensive knowledge in the management of health care waste was more important leading to proper practices.

2.4 THE EFFECTS OF IMPROPER MEDICAL WASTE MANAGEMENT AND THE CHALLENGES

Health care waste produced in the course of health care activities carries a higher potential than any other type of waste therefore inadequate and inappropriate handling has serious consequences and negative impact on the environment (Marthur, 2011). The study conducted by Rhadar 2012 reported that medical waste from medical activities can be hazardous, toxic and even lethal because of their high potential for disease transmission. Medical wastes pose significant health hazards affecting the respiratory, reproductive, central nervous system and they are also carcinogenic if not handled properly.

According to Kaseva and Mato, 1999 Dar-es Salaam in Tanzania it was reported that hospital and industrial owners were not taking responsibility on how waste were disposed leading to environmental pollution. The mismanagement of health care risk waste may also cause growth and multiplication of insects, rodents and worms; this may lead to transmission of diseases like typhoid, cholera, hepatitis and Aids (Gupta *et al.*, 2009). The study conducted by Saini *et al.*, 2005 in India reported that the safe disposal and subsequent destruction of medical waste was the key step to the reduction of illness or injuries through contact with potential hazardous material and in the prevention of environmental contamination, transmission of blood borne viruses and soft tissue infections through improper medical waste disposal was not well described (Saini *et al.*, 2005).

The environmental effects caused by the incorrect disposal of medical waste are the contributory factor to some of the public health problems experienced by the population. The medical waste generated and dumped illegally caused air pollution and soil contamination that resulted in poor agricultural production because of the toxicity of the waste material. Tia 2011 reported that when burned, medical waste emitted several air pollutants including

dioxins, acids and dangerous metals like mercury. These pollutants fall to the land and waters and cause damage to a lot of wildlife exposed to it. When fish ingests mercury, it turned into the form of methyl mercury which bioaccumulated, meaning it was stored into the tissues of an organism instead of being broken down and dissipated. Many of the hospital waste are considered infectious and possibly dangerous which lead hospitals to believe that it was better to burn them instead of filling in landfills (Tia, 2011).

The pilot study conducted by in Kenya on the Dandora municipal dumping site has linked environmental pollution to public health. Soil samples analyzed from adjacent locations and within the dumpsite show high level of metals emanating from the site in particular lead, mercury, copper and cadmium. The medical evaluation of children living and schooling near the dumpsites indicated a high incidence of diseases associated with high exposure levels to these metal pollutants. About 50% of children schooling and living near the dumpsites had respiratory ailments and blood lead levels equals to or exceeding internationally accepted toxic levels 10ug/dl of blood while 30% had size and staining abnormalities of their red blood cells, confirming high exposure to metals. The study reported that some of the waste ended up into the river thus extending environmental and health risk to the communities living within the same vicinity as well as those living downstream who could be using the water for domestic and agricultural processes like irrigation (Njoroge, 2012).

Bhuyian *et al.*, 2003, reported that environmental degradation due to unplanned waste disposal and improper waste management was not a pure concern in developing countries like Bangladeshi. The study revealed that uncollected waste are dumped in open spaces and block the drainage system of water causing serious environmental degradation and health risks in the city. According to Matsumoto 2000 suggests that since the law requires hospitals to take responsibility for discharging medical waste, hospitals must adopt a prudent policy for waste management. It was the most crucial issue for hospitals because medical waste was the subject of spot inspection and also the subject of border transgression prohibition between countries.

The study conducted in Port Harcourt Metropolis Nigeria, to assess hospital waste management practice enquired into waste generation rates and various waste disposal options by different categories of the hospital .It was evident that the problems in waste management are not peculiar to Port Harcourt Metropolis alone. Solid waste disposal methods indicated that site was most preferred while incineration was non-existent in hospitals and clinic. It was

further noted that other hospitals do not segregates wastes into marked into color coded containers for the different waste streams neither do they keep records of waste generated and disposed.

It was also noted that hospital waste was treated like any other type of waste with less caution and no proper clothing. One of the disadvantages was that like any other growing city in developing countries Port Harcourt lacked infrastructure as well as institution capacity necessary to effectively manage medical waste as part of the effort to enhance protection of human life and the environment from health hazards arising from improper management of solid waste. It was found that the open dumpsites are not even engineered or treated thus exposing the general public to danger. The study concluded that except for the oil company clinics such as the SPDC, all other hospitals sampled do not have any unit or department responsible for waste management. Knowledge, attitude and practices towards environmental issues are relatively low among the various actors in hospital waste management (Ogbonna, 2011).

Mostafa, 2009 reported that waste management in most countries is faced with many challenges and the study suggests that good health care waste management in a hospital depends on a dedicated waste management team, good administration, careful planning, sound organization, adequate financing and full participation by trained staff. In Saudi Arabia there was poor training of health workers, lack of legal enforcement and penalties on bad practice of waste management firms but there was evidence that Saudi Arabia was beginning to tackle the challenges posed by medical waste seriously even if the effort failed to replicate the ideal system of those in industrialized countries. Health workers are required to abide by regulations in the proper handling and storage of medical waste and private medical waste firms must be licensed and abide by regulations related to treatment, transport and disposal. The study however reported that there was lack of penalties and charges to those who do not comply (Ahzahrani, 2011).

The study conducted in Yemen by Al Emad 2011 reported that waste workers were collecting infectious and non-infectious waste together without proper protection equipment. This was attributed to lack of training and no budget allocated for waste resulting in lack of resources and other study conducted in Portugal reported that mixing medical waste with general waste was not cost-effective because it requires the whole waste generated to require treatment which was expensive.

In a study that was conducted to assess the status of health care waste in South Africa, Mozambique and Swaziland, the government of Mozambique was given to arrange a reliable method of waste management quickly and in Swaziland the challenge was that there were no uniform standards for source separation and collection equipments in the hospitals and clinics studied (Leonard, 2001). There was no clarification of responsibilities and cooperation between the different operating entities within the hospitals, with hospitals managing their waste by using their old substandard incinerators. It seems problems arised in small rural and hospitals which were unable to give the required care on medical waste due to lack of resources, resources that are lacking includes sharp containers and color coded bags (Leonard , 2001).

According to Omar *et al.*, 2012 on the study conducted in district hospitals of Tumpat, Pahat and Taiping to determine the variations and similarities in medical waste management results showed similarity in many areas, confirming that similarity takes place within hospitals and variations in other areas confirming that many factors both internal and external affect the clinical waste management and other activities within the hospitals. The study revealed most deficiencies especially in the management mostly weakness in segregation processes.

The study that investigated waste management practiced in Oregon, Washington and Idaho reported that hospitals were provided with definition of medical waste but they were queried about how they define infectious waste. The results implied that there was no consensus about which agencies definition of infectious waste should be used in their program, confusion around the definition of medical waste may have contributed to the finding that almost half of the hospitals are not segregating hospital waste from infectious waste. The study reported that hospitals in Idaho still operated incinerators in the absence of state regulators (Hangsin and Harding, 2011).

In order to execute standard waste management, an understudy of health care establishment with regard to standard waste management practices in or outside the country may be the first practical step to take. The study concluded that a waste management team should be constituted which will prepare waste management plan, policy documents and technical guidelines and in addition supervise waste management activities(Ngiwuluka *et al.*, 2001).. In South Africa the challenges of health care risk waste management in Limpopo were identified on two hospitals were there was a major policy implementation gap between the central government and the hospitals. There was no proper segregation of waste according to

their classifications as required by the national government as laid down in the decreasing order general waste(60,74%) ,medical waste (30,32%), sharps(8,94%). The modern practice of incinerators and landfills were not used according to minimum standards and incinerators were not environmentally friendly. Incinerator ash is openly dumped and waste dumped on landfills instead of being covered with soil (Nemathaga *et al.*, 2008).

In a study conducted by Gabela, 2007 on selected public health clinics in Ihembe district Kwazulu Natal suggested that public health clinics does not have proper health care waste management system in place and health care waste volumes and composition in the Ihembe district are not known and this makes it difficult to plan and develop an appropriate intervention strategy in order to provide better health care waste management. A study on waste management practices in Southern African hospital revealed that segregation of infectious and non-infectious waste were not done according to definite rules and standards, hospitals did not quantify medical waste correctly. There was no policy in place for managing medical waste and a number of problems were identified with respect to medical waste management (Abor and Bouwer, 2008).

CONCLUSION

The chapter describes the literature related to the study and the effects caused by the incorrect medical waste disposal which have potential to cause damage to the respiratory, reproductive and nervous system and also cause harm to the environment and the ecosystem. It was also highlighted how incinerators as the used method for treatment of medical waste materials can release harmful pollutants in the atmosphere such as dioxins and furans. In the previous studies on medical waste management lack of knowledge was a contributory factor to incorrect handling and disposal of medical waste.

CHAPTER 3

RESEARCH METHODOLOGY

3. INTRODUCTION

This chapter describes the methodology used in the study which includes the research design, study site, sampling, data analysis and other techniques used in the study.

3.1 Research Design

A research design is the overall plan for gathering data in a research study (Brink, Van der Walt & Van Rensburg, 2012). This study used a quantitative approach, and a cross-sectional study design was used. Cross-sectional study design was appropriate for this study as the purpose was to determine the knowledge and practice of health care workers and to determine the relationship between knowledge and practice of medical waste disposal control measures of health care workers on medical waste disposal at George Masebe Hospital, Waterberg District, Limpopo Province, South Africa.

3.2 Study setting

The study was conducted at George Masebe Hospital west of Mokopane, Waterberg district, Limpopo province, South Africa. The hospital is situated between Marulaneng and Mabula village in the Mogalakwena municipality, Waterberg district. The Rebone local area with the population of around 70575 and the Bakenberg local area with the population of 59615 falls within the demarcation of the hospital and the majority of the population are black people. The hospital serves 15 clinics with the nearest clinic being 10km and the furthest being 101km according to the George Masebe catchment map.

3.3 Study population

Burns and Grove (2011), describes population as all people or elements who are the focus of the research. In this study, the research population was comprised of 236 health care workers working at George Masebe hospital.

3.4 Sampling

The general population (236) of health care workers working at different stations within the hospital was included to participate in the study. Simple random sampling was used and a total of 141 respondents was sampled to participate in the study which included 131 nurses and 10 doctors, confirm by Slovin formula of determine the sample size because the sample size was reduced looking at this phenomenon from 196 nurses to 131. Following is the Slovin formula

N_n = represents nurses

$N_n = 196$

$$\begin{aligned} &= N = \frac{N}{1+ne^2} \\ &= \frac{196}{1+(196)(0.05)^2} \\ &= 131 \end{aligned}$$

3.5 Inclusion criteria

The study focused on only health workers who handle and dispose medical waste on daily basis at George Masebe hospital.

3.6 Exclusion criteria

All other employees such as clerks, mortuary attendants, pharmacy personnel and the management were excluded to participate in the study. Session doctors were also excluded to participate in the study because they are only available on weekends and not all of them at once. Students in the nursing school, laboratory personnel and polyclinic staff were also excluded to participate.

3.7 Data collection

3.7.1 Data collection tool

Data was collected using a self-constructed questionnaire and data was collected during the last two weeks of April. The questionnaire after construction was piloted and corrections were made on it based on the comments and later submitted to the university statistician for reliability.

3.7.2 Data collection technique

The questionnaires were distributed to the respondents after their morning report taking routine and each questionnaire was designed with clear instructions to the respondents for answering questions and respondents were allocated a secured box to insert in after completion.

3.7.3 Characteristics or structuring of the data collection tool

- Section A- Personal and Demographic data
- Section B- Designed to check the knowledge of health care workers on medical waste disposal
- Section C- Designed to describe the medical waste control practices by health care workers and to check the relationship between knowledge and practice

3.8 Pre-test

The questionnaires were pre-tested on other staff members who did not participate in the study. The pre-test assisted to find out if the questions answered the research question. The results of the pre-test helped to validate and restructure the questionnaires. The respondents that took part in the pre-test were not included in the main study. The study used 21 respondents for pre-test from the nursing school, Polyclinic and the laboratory which was approximately 10% of the study population.

3.9 Data analysis

Data was loaded, quoted and validated in consultation with the statistician and analysed using IBM SPSS Version 22. Descriptive and Inferential statistics were used to answer the study objectives. Descriptive statistics was presented with the tables and graphs and inferential statistics was shown using the Chi squared test.

3.10 Reliability, Validity and Objectivity.

Chronbach Alpha was used to check for the reliability of the study because it measures the internal consistency that shows how closely related a set of items are as a group, where $\alpha = 1$ or close, was considered reliable. Reliability of the study was further checked when the questionnaire was pre-tested on 10% respondents who were not part of the major study. Validity was ensured by submitting the questionnaires to the supervisor and peers who are HCWs dealing with waste management in hospitals. The research assistants were trained in filling the data to minimize errors, reduce misinterpretation and misclassification in order to address the study objectives. Objectivity in the study was checked by ensuring that the questionnaires are in line with the study objectives and focused on the sampled population as verified by supervisor.

3.11. ETHICAL CONSIDERATION

3.11.1 Permission to conduct the study

The ethical clearance was obtained from the Medunsa Research and Ethics Committee and the permission to conduct the study was obtained from, Department of Health and Social Development, Limpopo Province the Chief Executive Officer of George Masebe Hospital and the study participants were also requested to dedicate time to participate.

3.11.2 Confidentiality and Anonymity

The research did not link any individual to the research results and confidentiality of the research participants was protected. Names and identity of the participants did not appear anywhere in the study and there were only numbers to represent sections and individuals thus ensuring anonymity.

3.11.3 Informed consent

The details of the study were distributed amongst participants including the risks and benefits to ensure that they understand the study contents. Participants were assured that the

participation is voluntary and no penalties were imposed to participants who wished to withdraw from the study at any time. Consent from participants was obtained in writing.

3.11.4 Principle of Justice

The study ensured the implementation of this principle by selecting the appropriate research population and not any available person and fair treatment applied across all participants.

3.11.5 Principle of Beneficence

The researcher explained all the benefits and possible harm that the study might cause to enable fair participation. The research promoted good by giving participants knowledge on medical waste disposal and avoiding any type of physical and psychological harm to the participants. The researcher explained that no financial benefits will be rewarded to the respondents after the study.

3.11.6 Generalizability of the study

The study was only done only on health care workers at George Masebe hospital and therefore the results cannot be generalized to other institutions

3.12 SIGNIFICANCE OF THE STUDY

- The findings of the study will be made available to the management of George Masebe Hospital and the Limpopo province, Department of Health and Social Development.
- The findings of the study might help in planning and development of policies related to medical waste management and to strengthen the proper culture of medical waste disposal.
- The results of the study might benefit the management as a reference source to improve issues related to medical waste management.
- The findings of the study might add to the existing body of knowledge on medical waste management.

3.13. Conclusion

This chapter outlined the methods and techniques used to conduct the study. The study was conducted at George Masebe hospital, Limpopo province, Waterberg district, South Africa and it is a quantitative cross sectional study conducted on health care workers using questionnaires as a data collection tool. The ethical considerations, measures to ensure validity and reliability and the significance of the study were highlighted.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

In this chapter the results of the research study conducted are presented with figures and tables to provide better understanding.

4.2 Interpretation of results

4.2.1 Section A: *Socio-demographic profile of the respondents*

4.2.1.1 Position

It was important for the researcher to ask the position of work of the respondents in order to understand which occupation has large number of respondents. Figure 4.2.1.1 below indicates the position of work on the respondents

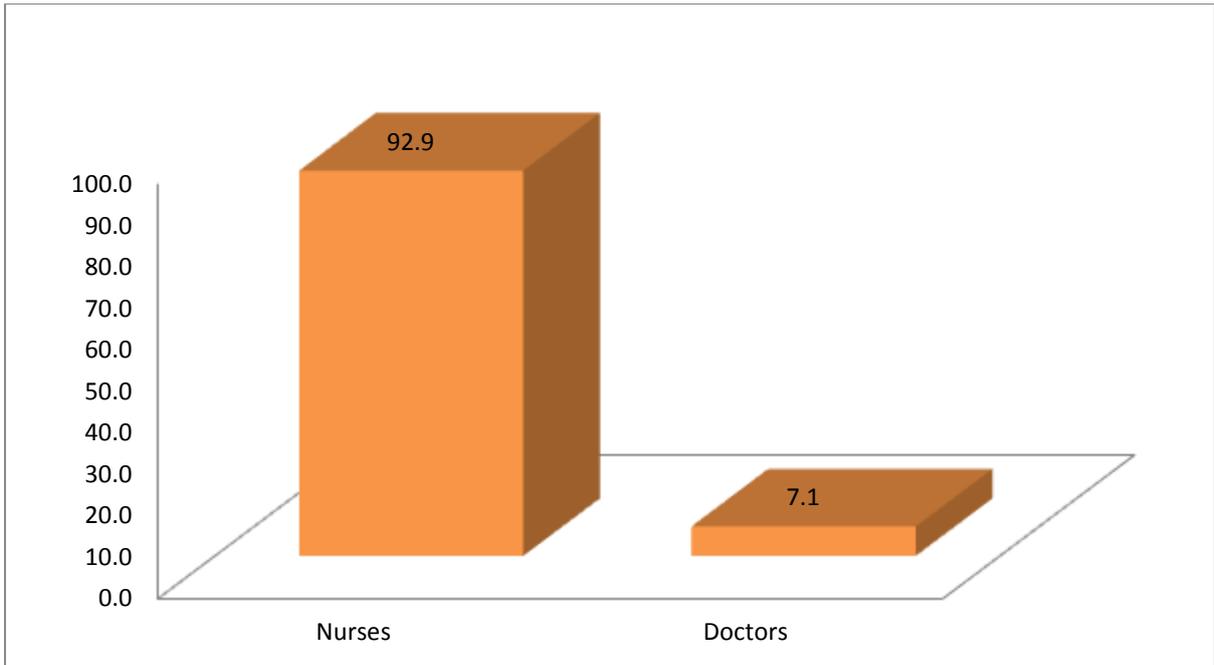


Figure 4.2.1.1 Position of the respondents.

Figure 4.2.1.1 above shows the position of work of the respondents within the study. The results shows that 92, 9% were nurses and 7, 1% were doctors.

4.2.1.2 Gender

The researcher also found it important to check the gender of the respondents in order to determine which gender was the most participants. Figure 4.2.1.2 below shows the gender of the respondents

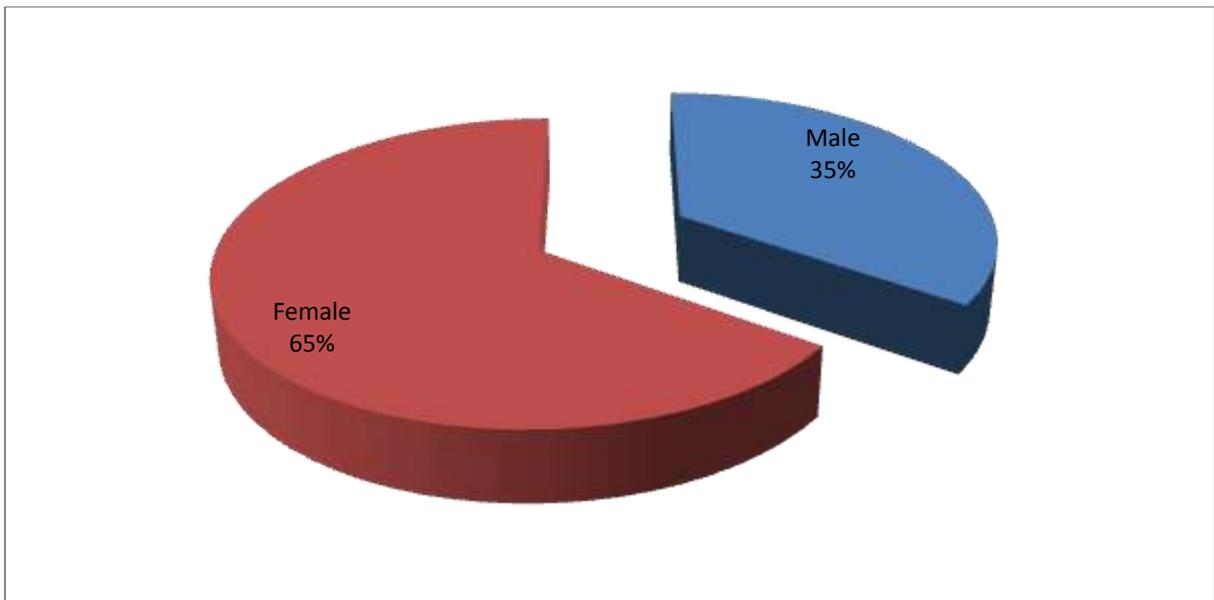


Figure 4.2.1.2 Gender of the respondents

Figure 4.2.1.2 above shows the gender of the respondents in the study. The results shows that females were the larger group with the frequency distribution of 92 (65%) and males were less with the frequency distribution of 49 (53%)

4.2.1.3 Age

It was important for the researcher to ask the age of the respondents so that the researcher can find out about the age. Figure 4.2.1.3 below shows the age of the respondents

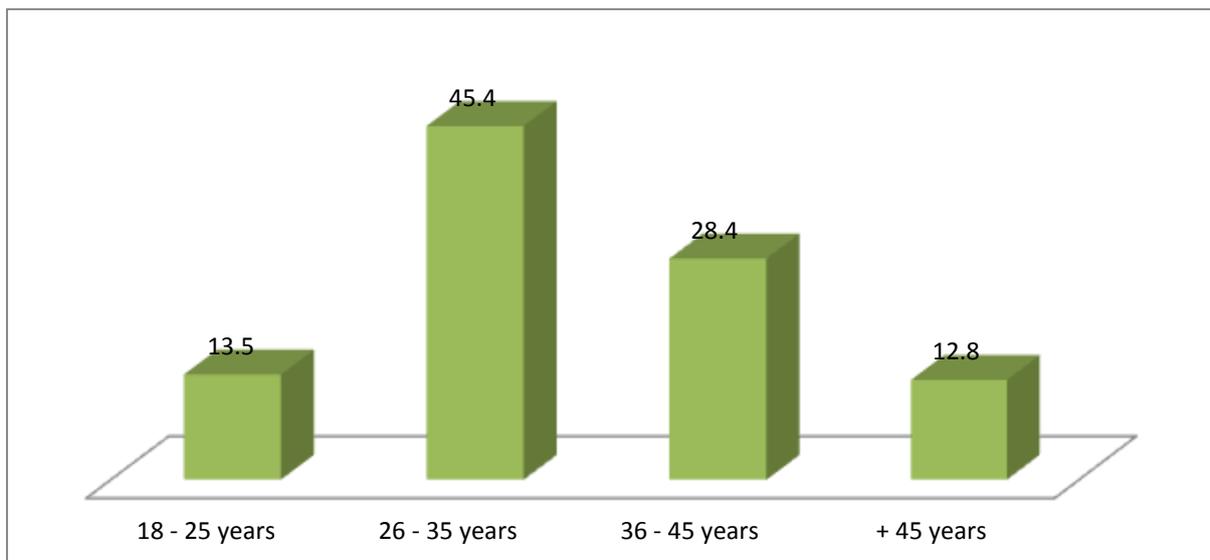


Figure 4.2.1.3 Age of the respondents

Figure 4.2.1.3 shows the age of the respondents in the study. The results shows that the largest group was between 26-35 years at the frequency distribution of 64 (45,4%), between the age of 36-45 years was at the frequency distribution of 40 (28,4%), followed by the respondents at 18-25 years at the frequency distribution of 19 (13,5%) and lastly the respondents at +45 years at the frequency distribution of 18 (12,8%).

4.2.1.4 Ethnicity

The researcher asked the ethnic group of the respondents to understand their ethnic background. Figure 4.2.1.4 below depicts the ethnicity of the respondents

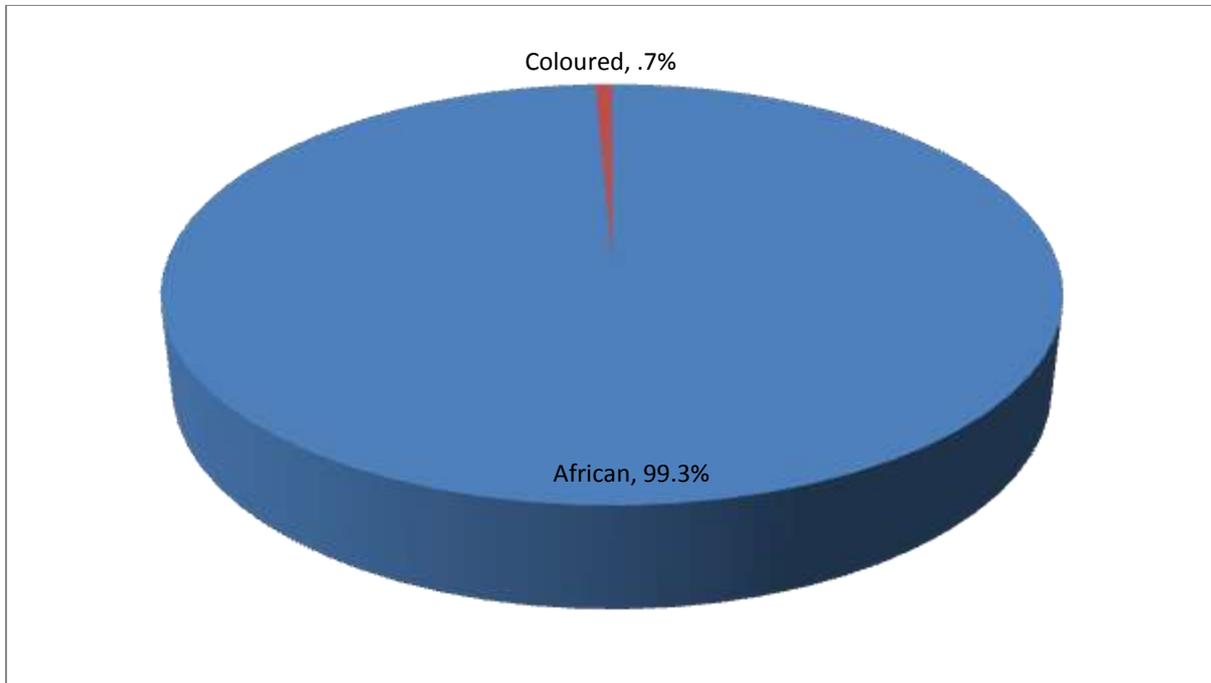


Figure 4.2.1.4 Ethnicity of the respondents

Figure 4.2.1.4 above shows the ethnicity of the respondents. The results shows that majority of the respondents were Africans at the frequency distribution of 140 (99, 3%) and less number of respondent was Coloured with the frequency of 1 (0, 7%).

4.2.1.5 Employment status

The researcher asked the respondents on the employment status in order to find out about their employment standing Figure 4.2.1.5 below depicts the employment status of the respondents.

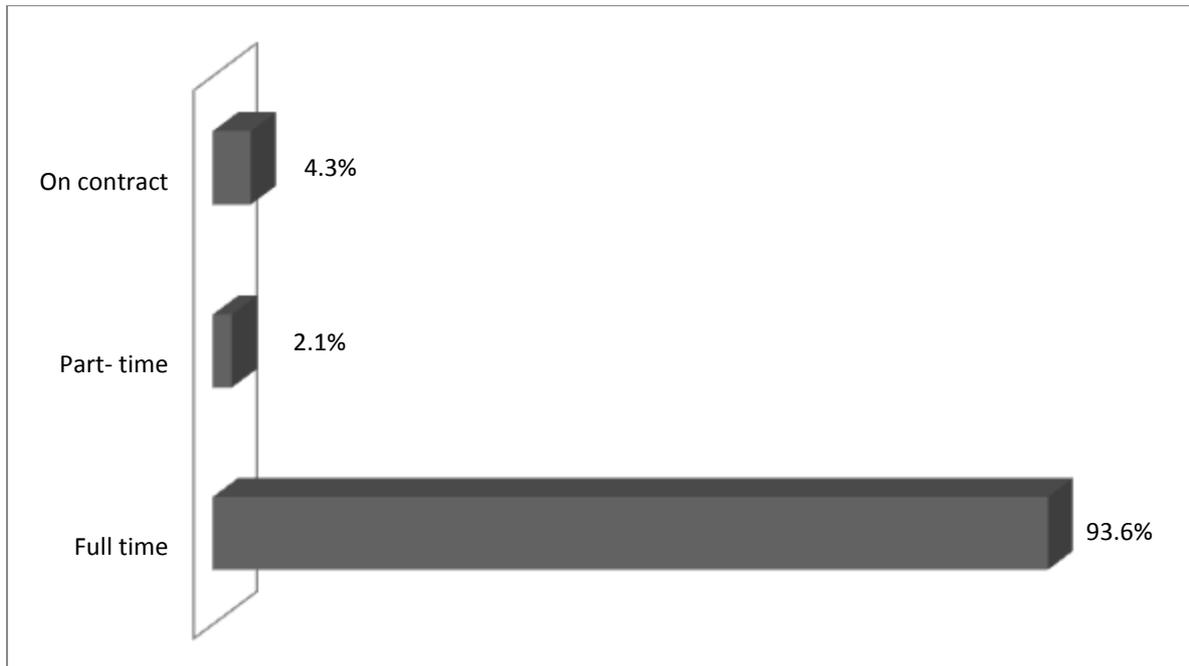


Figure 4.2.1.5 Employment status of the respondents

Figure 4.2.1.5 above shows the employment status of the respondents. The results shows that majority of the respondents were on full time employment at the frequency distribution of 132 (93, 6%), followed by the respondents on contract at frequency of 6 (4, 3%) and lastly the respondents on part-time employment at frequency of 3 (2, 1%).

4.2.1.6 Duration of working hours

The researcher found it important to ask the duration of working hours of the respondents in order to determine the length of working hours of employment. Figure 4.2.1.6 below shows the duration of the working hours of the respondents.

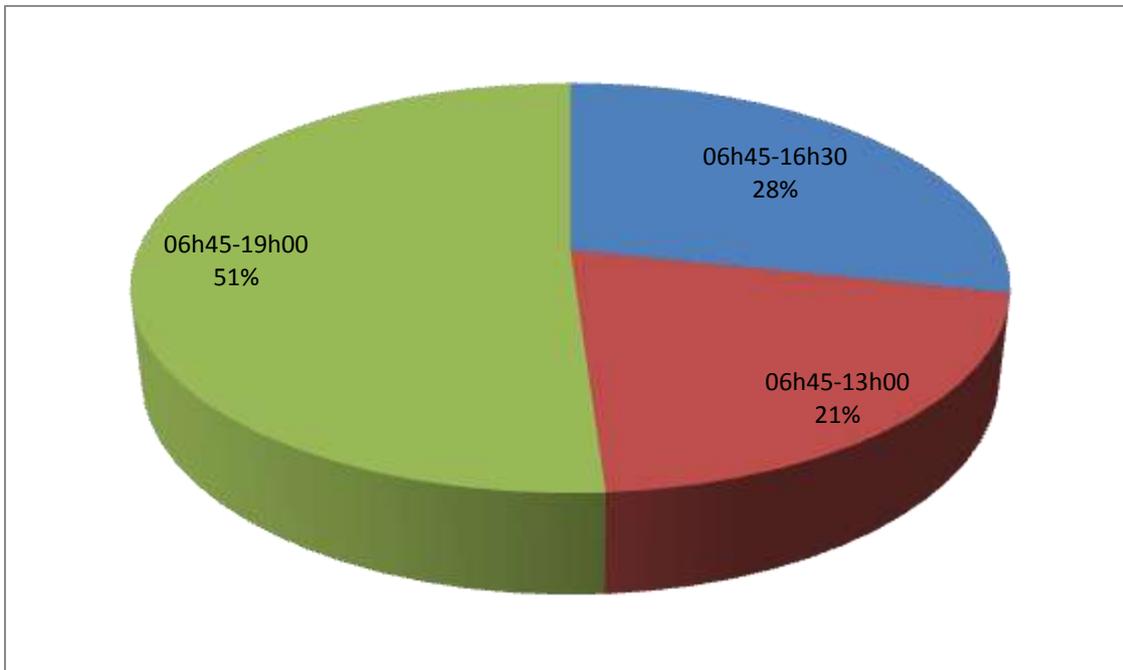


Figure 4.2.1.6 Duration of working hours of the respondents

Figure 4.2.1.6 above shows the duration of working hours of the respondents. The results of the study shows that the majority of the respondents worked between 06h45-19h00 at frequency distribution of 72 (51%), followed by the respondents worked between 06h45-16h30 at 40 (28,4%) and lastly the respondents working between 06h45-13h00 at the frequency of 29 (20,6%).

4.2.1.7 Duration of employment

It was important for the researcher to ask the duration of employment of the respondents in order to understand the length of employment in the hospital. Figure 4.2.1.7 below depicts the duration of employments of the respondents.

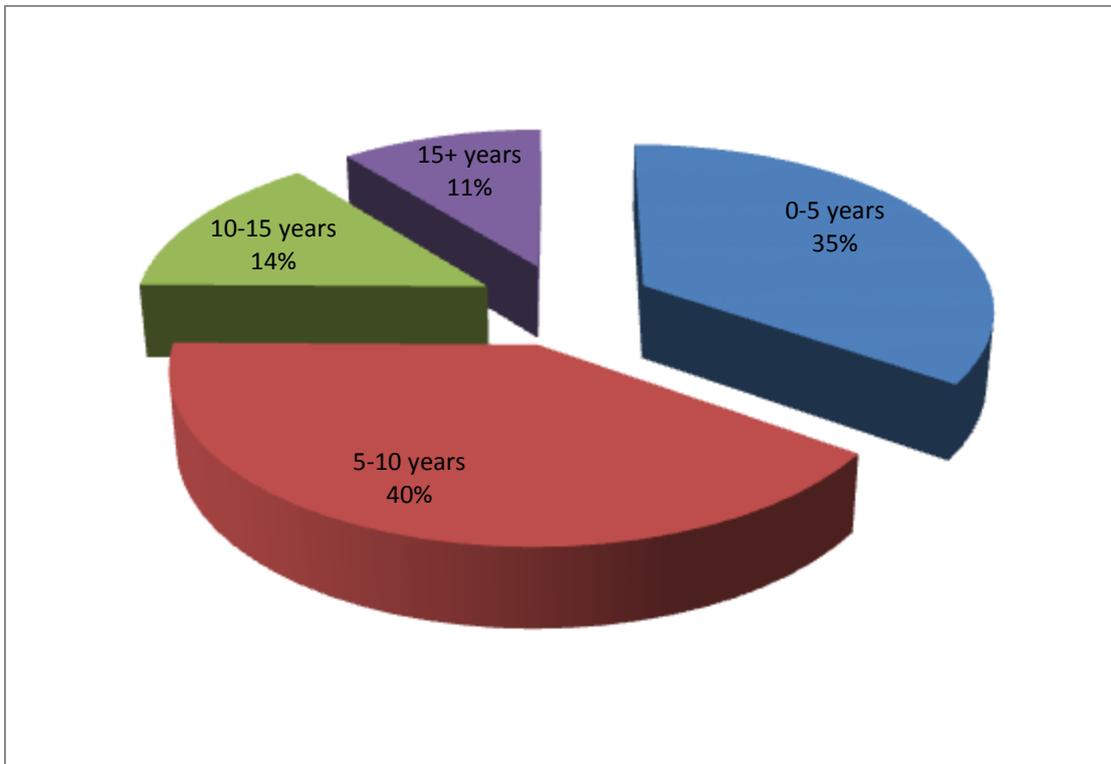


Figure 4.2.1.7 Duration of employment of the respondents

Figure 4.2.1.7 shows the duration of employment of the respondents. The results of the study shows that employees respondents who worked between 5-10 years were at frequency distribution of 57 (40%), respondents on 0-5 years at frequency of 49 (35%), followed by the respondents on 10-15 years at frequency distribution of 20(14%) and lastly respondents at 15+ years at frequency of 15 (10,6%)

4.3 Section B: To determine if health care workers at George Masebe Hospital, Waterberg district, Limpopo province, South Africa have sufficient knowledge with regard to medical waste disposal.

It was important for the researcher to check if health care workers have sufficient knowledge with regard to medical waste disposal. Figure 4.3.1 below shows the level of knowledge of the respondents

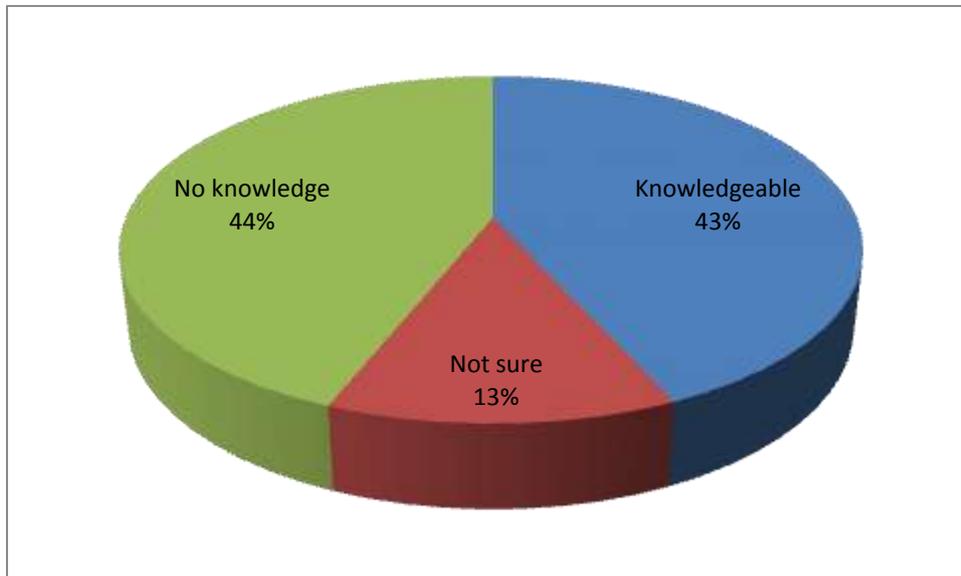


Figure 4.3.1 Response on knowledge with regard to medical waste disposal.

The results of the study as shown in figure 4.3.1 shows that 61(43%) had sufficient knowledge with regard to medical waste disposal; 18(13%) of health care workers were not sure and 62(44%) did not have sufficient knowledge with regard to medical waste disposal. The results of the study therefore shows that most health workers at George Masebe Hospital, Waterberg District, Limpopo province, South Africa do not have sufficient knowledge with regard to medical waste disposal. The mean of all questions related to knowledge, health workers that were below the mean indicates that there was no sufficient knowledge, those that were not sure were at the normal mean and those that have sufficient knowledge were above the mean.

4.4 Section C: *To describe the medical waste disposal control measures practices by health care workers at George Masebe Hospital, Waterberg district, Limpopo province, South Africa.*

There was a need for the researcher to describe the medical waste disposal control practices of health care workers. Figure 4.4.1 below depicts the medical waste disposal practices.

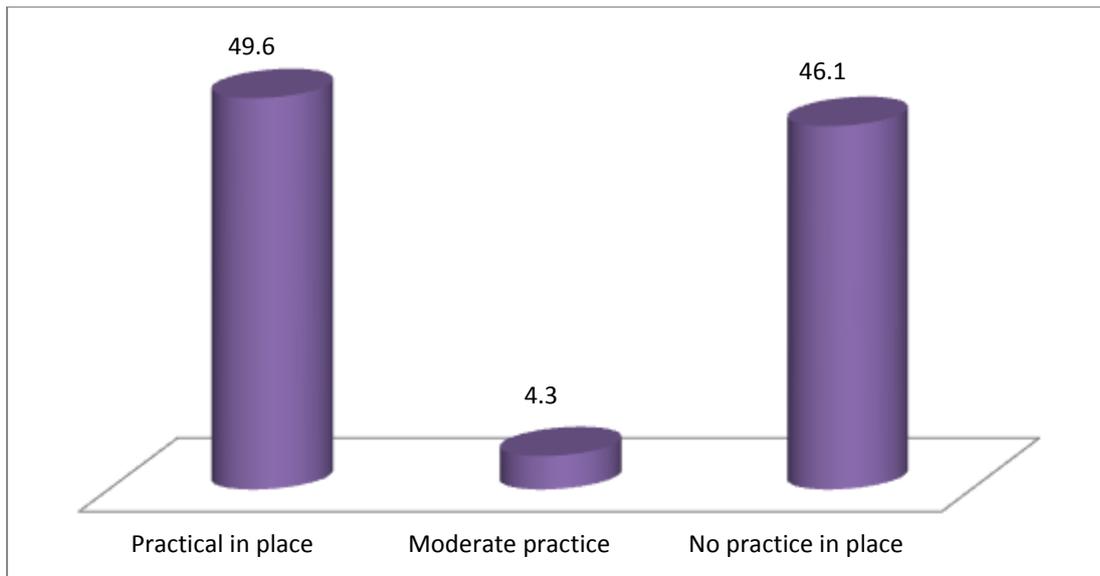


Figure 4.4.1 Medical waste disposal control practices of health care workers

The results of the study as shown in figure 4.4.1 shows that 70 (49, 6%) respondents had practice in place, 6(4, 3%) were not sure and 65(46, 1%) of the health care workers had no practice in place on medical waste disposal control measures practices. The results of the study shows that close to half of the respondents had practice in place.

4.5 Section D: *To determine the relationship between knowledge and practice of medical waste disposal control measures of health care workers at George Masebe Hospital, Waterberg district, Limpopo province, South Africa.*

It was important for the researcher to check if there was a relationship between knowledge of the respondents and their practices. Figure 4.5.1 and Table 4.1.1 below depicts to check if there was relationship between knowledge and practice

Table 4.1.1 Distribution of the scores of health care workers on the relationship between knowledge and practice.

Knowledge vs. Practice				
Knowledge	Practice			Total
	Practical in place	Moderate practice	No practice in place	
Knowledgeable	27	2	32	61
	44.3%	3.3%	52.5%	100.0%
Not sure	9	1	8	18
	50.0%	5.6%	44.4%	100.0%
No knowledge	34	3	25	62
	54.8%	4.8%	40.3%	100.0%
Total	70	6	65	141
	49.6%	4.3%	46.1%	100.0%

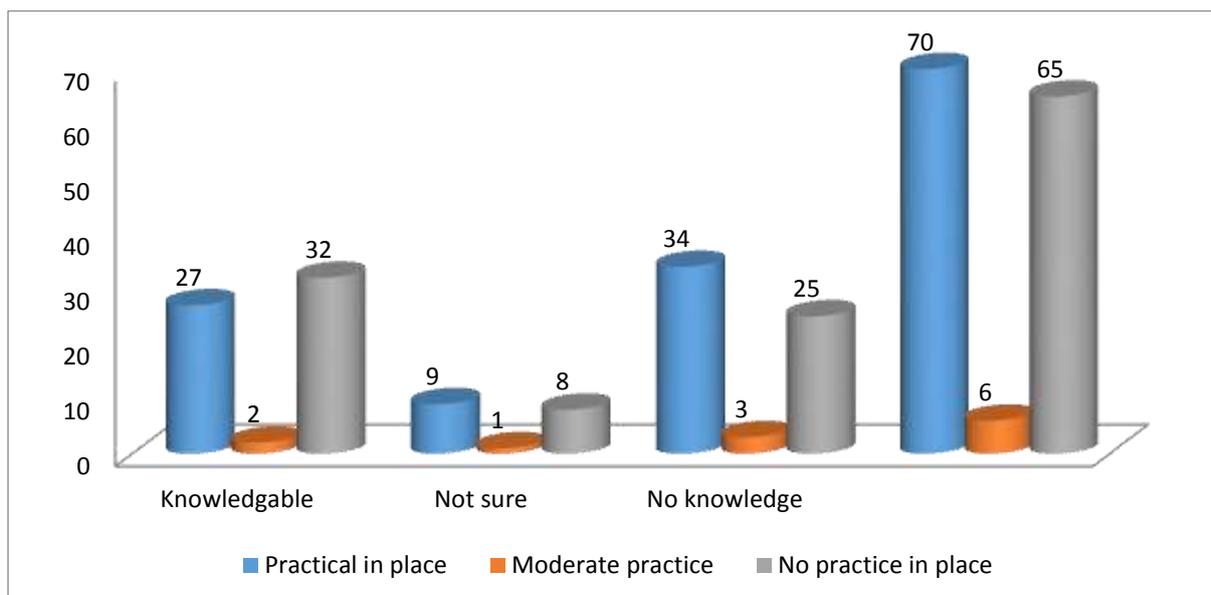


Figure 4.5.1 Relationship between knowledge and practice

Table 4.1.1 and Figure 4.5.1 shows that health care workers who had knowledge, 27 (44, 3%) had practice in place, 2 (3, 3%) were moderate in practice and 32 (52, 5%) had no practice in place. On the health care workers who were not sure 9 (50, 0%) had practice in place, 1 (5, 6%) moderate in practice and 8 (44.4%) had no practice in place. The results of the study further shows that on health care workers who had no knowledge 34 (54, 8%) had practice in place, those who were not sure 3 (4, 8%) and 25 (40, 3%) had no practice in place. Using the Chi-squared test P is equal to 0,746 which is greater than which is greater than the required P value of 0, 05. The results of the study concludes that there was no relationship between knowledge and practice of medical waste disposal control measures of health care workers at George Masebe hospital, Waterberg District, Limpopo province, South Africa. Table 4.1.2 below indicates the calculation of the P value:

Table 4.1.2 Calculation of the Value of P

Chi-Square Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.946 ^a	4	.746
Likelihood Ratio	1.949	4	.745
Linear-by-Linear Association	1.646	1	.199
N of Valid Cases	141		

4.6 Conclusion

The chapter mainly discussed the research results, tables and figures were also used as presentation of results.

CHAPTER 5

DISCUSSIONS

5.1 INTRODUCTION

The focus of this chapter is to discuss the results of the research study that was conducted to determine the knowledge and practice of health care workers on medical waste disposal at George Masebe hospital, Limpopo province, Waterberg district, South Africa.

5.2 Section A: Socio-demographic profile

The research sample included 141 health care workers at George Masebe hospital. The socio-demographic information required was position at work, age, gender, ethnic group, employment status, duration of working hours and duration of employment. The findings of this study reported that more nurses (92, 9%) participated in the study than doctors (7, 1%), this study can back up the study conducted by Ramokate and Basu 2009 at an academic hospital in Gauteng province where more nurses participated in the study than doctors. The study conducted by Nagaraju *et al.*, 2013 on health care providers in PHC of Bagepalli Taluk differ from the results of this study in that majority of the respondents were between 31-40 years at 26% and in this study majority of the respondents were between 26-35 years at 45, 4%. The results of this study shows difference in knowledge in males 46, 9% as compared to 41, 3% of females. The study conducted by Ehrampoush and Baghiani 2005 at Yazd University on medical sciences students showed similar results with this study in that there was a difference in knowledge in males and females 13,53% and 12,8%, the difference was significant ($P < 0,016$). The results of this study grouped the duration of employment of respondents into four those with more than 10 years' experience at 11% and 14% respectively which differs from the study conducted by Omaniti *et al.*, 2012 in Batu Pahat and Taiping where duration of services among respondents was grouped into three categories with respondents of more than ten years' experience at 39,8% from Batu Pahat. The results of the study conducted in Tertiary care Bagalkot city among health care workers on biomedical waste shows different results from this study in that more males 94(77,05%) than females participated in the study, similar to this study high number of participants were nurses 105(86,07%). (Mannapur *et al.*, 2014)

5.3 Section B: To check if health workers at George Masebe Hospital, Limpopo province, Waterberg district, South Africa have knowledge with regard to medical waste disposal.

The results of the study shows that knowledgeable respondents were at the frequency distribution of 61(43,3%), respondents who were not sure were at 18 (12,8%) and lastly the respondents who had no knowledge were at the frequency distribution of 62 (44,0%).The results of this shows similar results to the study conducted in Yemen by Al Emad,2011 where knowledge on medical waste amongst health care workers in private and public hospitals was insufficient,44% of health care workers in private hospitals could not understand the reason behind sorting medical waste. This study can back up the study conducted by Selvaraj *et al.*, 2013 on medical practitioners in Kanchipuram town India because in both studies knowledge about the correct method of biomedical waste management was insufficient. Similar results to this study was found in Lucknow, India where knowledge and practice on medical waste was insufficient, 16, 6% of health care workers felt that it was extra burden to their work (Gupta *et al.*,2012). The study conducted by Nagaraju *et al.*, 2013 also revealed that lack of knowledge and awareness of biomedical waste management among health care workers. The study conducted by Nath and Sigh, 2013 also shows similar results to the present study because it was found that knowledge regarding handling and safe disposal of biomedical waste among medical students 54(42,5%) was inadequate, majority was deficient in knowledge and awareness regarding the category of biomedical waste 73,2% and its disposal in colour bags 71,3%. Similar results from this study was found on the study conducted by Shrivastava *et al.*, 2015 among health care professionals of the surgery ward of the Tertiary hospital in India were only 56, 4% identified biomedical waste colours correctly and only 53, 6% knows about the biomedical waste categories, it was concluded that knowledge regarding biomedical waste and its management was not adequate. Hospitals are lacking proper biomedical waste protocols and health care personnel are not practicing the biomedical rules properly. Different results to this study was observed in the study conducted among nurses and nursing students of Rajendra Institute of Medical Sciences where it was reported that knowledge regarding biomedical waste was assessed (with scores 0-8), it was found that knowledge was better in students nurses than staff nurses (6-8 correct answers) as students scored good in more than half of the questions (65%) whereas staff nurses scored good only in 33, 33% questions. The study conducted by Pullishery *et al.*, 2013 differ from this study in that knowledge regarding biomedical waste was better in doctors and nurses than the sanitary

staff and knowledge regarding color coding and waste segregation was found to be better among nurses and laboratory staff as compared to doctors

5.4 Section C: To describe the medical waste disposal control measures practices by health care workers at George Masebe Hospital, Limpopo province, Waterberg district, South Africa.

The results of the show that health care workers with practice in place were at the frequency distribution of 70 (49, 6%), followed by health care workers with no practice in place at frequency of 65 (46, 1%) and lastly those with moderate practice at frequency distribution of 6 (4, 3%). The results shows that majority of health care workers have practice in place. Similar results to this study was found on the study conducted on the management of medical waste in a Southern African Hospital where practice of medical waste was done to a satisfactory extent, segregation of medical waste into infectious and non-infectious was not done according to rules and standards, wheeled trolleys were used for onsite transportation of waste from points of production to the temporary storage site and there was no overall plan on the management of medical waste (Abor,2007).This study can also be backed up by the study conducted by Patan and Marthur, 2015 in government hospitals of Ajmar city where separation of medical waste and general waste was practised to a satisfactory extent. The study conducted on health care personnel at Ain Shims University hospital in Cairo also reported that satisfactory practices were found amongst nurses at 84%. The results of the study conducted by Abdullah *et al.*, 2007 on medical waste management in Northern Jordan differ from this study in that segregation of various types of medical waste in the hospital was not conducted properly and a case study on waste management in Nigeria also revealed that the level of health care waste was found to be at 0 (that is unsustainable), the study highlighted the pitfalls of health care waste management in Nigeria a developing country where resources are limited (Abah and Ohaiman, 2011). The results of this study differ from the study conducted by Ubajaka *et al.*, 2010 among health care workers in a Nigerian General hospital where all the doctors, nurses and 35% of the pharmacists and laboratory attendants were aware of the hazardous consequences of improper medical waste handling, however the real practice of medical waste management was poor among the respondents and majority of them had not received training on the subject. The results of this study differ from the study conducted in India by Singh *et al.*, 2014 where 83,5% of medical and dental doctors had knowledge about waste management plan and its authorization, majority of medical doctors

and paramedics had knowledge about place of disposal. On practice level, most health care personnel were using autoclave and lesser number using dry heat sterilization, the study concluded that health care personnel were observed to be good in theoretical knowledge as well as practice. The study conducted in northern parts of Jordan reported different results from this study in that types of medical waste was not segregated correctly (Abdulla and Atalla, 2008)

5.5 Section D: To check if there is a relationship between knowledge and practice of medical waste control measures of health care workers at George Masebe Hospital, Limpopo province, Waterberg district, South Africa.

The results of the study using the Chi-squared test show that there is no relationship between knowledge and practice of medical waste disposal control measures of health care workers at George Masebe hospital. The study conducted by Sood A 2011, on dentists' shows similar results to this study because there was no relationship between knowledge, attitude and practices. The study conducted by Godzinka *et al.*, 2002 shows different results from this study because there was a correlation between the levels of student's knowledge, their activities existed regarding waste management, Wait *et al.*, 2005 also reported that there was significant association between knowledge and practice with correlation coefficient of 0,003 for waste management. The results of the study conducted by Sengodan, 2014 on biomedical waste in South India revealed similar results to this study in that there was no relationship between knowledge and practice because it indicates that knowledge was not uniform amongst the individual groups and there was significant variation in practice (Sengodan and Armuith, 2014)The study to understand the integral link between human health and environmental health revealed that revealed that the existing knowledge did not correlate with the current practices and there it was concluded that no relationship was found (Njagi *et al.*, 2012). The study on the impact of educational intervention on the knowledge of biomedical waste management among health care workers in Bagalkot city reported that there was an increase in knowledge after training in all aspects of segregation, storage and disposal which differ from the results of this study in that there is no relationship between knowledge and practice on medical waste disposal control measures (Mannapur *et al.*, 2014). The study conducted among nurses on health care waste management in India shows similar results from this study in that no study variable displayed significant association($p>0,05$) with knowledge. The study further suggests that nurses knowledge and

health care waste management practices were not satisfactory, there was a need for training in optimum intervals to ensure sustainability and further improvement (Shivalli *et al.*, 2014). The study conducted by Naava and Rhema, 2005 on waste management in Mityana Town Council, Mubende District, Uganda reported that majority of the workers had adequate knowledge regarding medical waste management but it was not reflected in their practices. Lack of segregation of infectious waste, absence of necessary records, lack proper waste treatment and insufficient supervision of personnel were the main findings. The study concluded that no relationship between the knowledge of the workers and their practices existed (Naava and Rhema, 2005). The study conducted in an Institutional trauma center II in India shows similar results to this study because there was no significant correlation on the students' knowledge on biomedical waste and their practices (Singh and Nath, 2013)

5.6 Limitations of the study

The study was conducted in only one hospital in the Mogalakwena municipality therefore the results cannot be generalized. The study mainly focused on doctors and nurses all other allied structures were excluded and only questionnaires were used to collect information from the respondents.

5.7 Conclusion

The chapter was main the discussion of the research results with previous studies of the related topic.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

This chapter provides an outline of the researcher's findings and comments that are made to assist in future research. The chapter further provides an overview of the findings and measures of corrections in areas of concern to the researcher. The summary, conclusions and recommendations are presented.

6.2 Summary and conclusions

The study was conducted to determine the knowledge and practices of health care workers on medical waste disposal at George Masebe hospital, Waterberg district, Limpopo province, South Africa.

It is concluded that health workers at George Masebe hospital, Waterberg district, Limpopo province, South Africa does not have sufficient knowledge with regarded to medical disposal. 44% did not have sufficient knowledge which was the largest number of respondents. To describe the medical waste disposal control practices by health care workers, 49.6% had practice in place and it was concluded that health care workers at George Masebe hospital, Waterberg district, Limpopo province, South Africa had practice in place

To check if there was relationship between knowledge and practice of medical waste disposal control measures of health care workers at George Masebe hospital, Waterberg district, Limpopo province, South Africa. It was concluded that there was no relationship between knowledge and practice of medical waste disposal control measures of health care workers at George Masebe hospital, Waterberg district, Limpopo province, South Africa.

6.3 Recommendations

Based on the results and conclusion drawn from the study the following recommendations were made:

- Apply measures to strengthen health education and in-service training to increase the level of existing knowledge on health care workers.
- To ensure continuous monitoring and evaluation of medical waste disposal control measures practices for further improvement.

6.4 Future research

Future research should be conducted on compliance to waste management practices in the around Mogalakwena municipality and also on the effects of improper disposal of medical waste to the communities.

6.5 Conclusion

This chapter outlined the recommendations made by the researcher and the summary of the study.

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APPENDIX 1

Information to participants

University of Limpopo

Turfloop campus

School of Health Sciences

MPH Student

Malebatja S.M

Cell: 0787001759/ 0154236189

Dear Participant

Your participation is required in a research study that aims to determine the knowledge and practices of health care workers on medical waste disposal. Participation in the study is voluntary and participants have a right to withdraw at any time in the study without penalty.

No names and identity will be divulged to ensure anonymity of the research participants and participants can contact the researcher at the telephone numbers given should they have query concerning the study.

The research questionnaires will take at least 15-30 minutes of your time.

Your response is of utmost importance to me.

Yours sincerely

Mr Malebatja SM
(RESEARCHER)

Dr Ramalivhana N.J
(SUPERVISOR)

APPENDIX B

Q01

QUESTIONNAIRE

This questionnaire consists of three compulsory sections A, B and C, answer with a tick(X) next to each possible answer.

Section A. Personal and Demographic Details

1. Gender

Male	
Female	

2. Age

18 -25	
25-35	
35-45	
45+	

3. Ethnicity

African	English	Coloured	Indian
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4. Employment status

Full time	Part-time	On contract
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5. Duration of working hours

06h45-16h30	06h45-13h00	06h45-19h00
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6. How long have you been employed in this hospital?

0-5 years	5-10 years	10-15 years	15+ years
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Section B. Knowledge

Attend to B by marking with a tick (X) next to each possible answer below

The following abbreviations will be used in answering the questions

SA= Strongly agree

A= Agree

N= Neutral

D= Disagree

SD= Strongly disagree

	SA	A	N	D	SD
7. There are different types of waste generated by health					

care institutions.					
8. Waste management is one of the core standards of health care					
9. Municipal waste and clinical waste are different					
10. Any discarded biological products such as tissues and blood from wards and laboratories can be regarded as medical waste.					
11. Less than 50% of waste generated by health care institutions is medical waste					
12. Medical waste is highly hazardous than municipal waste and therefore requires separate treatment					
13. Red pedal bins can be used to collect all kinds of waste materials					
14. Colour-coded bins is part of waste management strategy to separate waste					
15. Equipments for proper waste management are not enough to address waste management practices					
16. To achieve good standards of patient care waste management must be addressed					
17. Exposure to medical waste poses a threat to human health					
18. Medical waste disposal practices that are recommended by law should be the responsibility of every health care worker					
19. Poor handling and disposal of medical waste poses threat to environmental health and cause ecosystem					

imbalance					
20. Segregation, collection, storage, handling, transport, treatment and disposal are 7 key steps in waste management					
21. Medical waste disposal is a long standing issue difficult to solve in majority of the sections in the hospital					
22. Proper health education and in -service training can improve medical waste management					
23. Health care institutions generate more medical waste than domestic waste.					
24. Pharmaceutical waste is usually disposed in green containers					
25. Information on guidelines and protocols of medical waste disposal is not accessible					
26. Policies on waste management are not clear enough and easy to comply with					

SECTION C

This section includes the description of medical waste disposal control measures and determining the relationship between knowledge and practice of medical waste disposal control measures. To answer questions in this section Never, Rarely, Sometimes, Often and Always will be used

Please attend to questions in Section C with a tick (X) next to each possible answer below

	Never	Rarely	Sometimes	Often	Always
27. Handling and disposal of medical waste is part of my daily duties.					

28. Sharps and vials containers are sealed when $\frac{3}{4}$ full					
29. Wearing of gloves is a common practice when handling medical waste					
30. Personal protective clothing is sufficient to deal with medical waste e.g. gloves, gowns and goggles					
31. Are you comfortable with the colour-coding system of the waste bins?					
32. How often do you think you put waste in the wrong bins?					
33. Health workers are strictly ensuring that waste is collected on time					
34. Have you ever attended a lecturer or seminar on medical waste management?					
35. Colour-coded plastics are always available in the unit					
36. Bins for medical waste are located inappropriately in the unit					
37. Medical waste bins are safe and well secured during storage					
38. Storage of human tissues is always done under required temperatures					
39. Medical waste disposal is not a compulsory activity in the hospital					
40. There are rewards or compliments					

on good waste management practices					
41. Disposal procedures are clearly presented on the walls					
42. Access to areas where medical waste is temporarily stored is controlled					
43. Patients are consistently advised about the dangers of medical waste in the units					
44. Very busy clinical units makes health care workers to dispose waste in the wrong containers					
45. Sharps are enclosed when a container is more than $\frac{3}{4}$ full					
46. Support services such as laundry are also at during waste handling and transportation					



MEDUNSA RESEARCH & ETHICS COMMITTEE

CLEARANCE CERTIFICATE

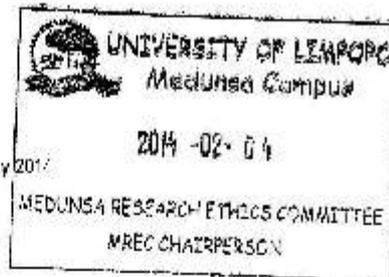
MEETING: 01/2014
PROJECT NUMBER: MREC/HS/09/2014: PG
PROJECT:
Title: Knowledge and practices of health care workers on medical waste disposal at George Masebe hospital, Waterberg district, Limpopo province, South Africa.
Researcher: Mr SM Malebatja
Supervisor: Dr VJ Ramalkhama
Department: Medical Sciences, Public Health & Health Promotion
School: Health Sciences
Degree: MPhil

DECISION OF THE COMMITTEE:

MREC approved the project.

DATE: 01 February 2014

PROF GA/DGUNBANJO
CHAIRPERSON-MREC



The Medunsa Research Ethics Committee (MREC) for Health Research is registered with the JS Department of Health and Human Services as an International Organisation (ICRO0004319), as an Institutional Review Board (IRB00005122), and functions under a Federal Fide Assurance (FWA00008418)
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.

