

Health care waste management in public clinics in the iLembe
District: Situational analysis and intervention strategy.

BY

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DECLARATION

I, Sibusiso Derrick Gabela, the undersigned hereby declare that the content of this research study is my own original work. All other sources of reference have been acknowledged.

This project has not been submitted to any other university for a similar or any other examination.

Signature:  Date: 10 December 2007

DEDICATION

I dedicate this work to the Gabela family, my late father Mr GJ Gabela, my mother Mrs CN Gabela, my siblings Martin, Sipho, Jabulile, Dumisa, Sandile, Bongokuhle and my wonderful kids Thula, Linda and Kganya-Khanya.

Most of all, to the Almighty for the courage and energy to complete this project.

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GLOSSARY OF TERMS

APPA	Atmospheric Pollution Prevention Act
CHC	Community Healthcare Centre
DACEL	Department of Agriculture, Conservation, Environment and Land Affairs
DEAT	Department of Environment Affairs and Tourism
DWAF	Department of Water Affairs and Forestry
ECA	Environmental Conservation Act
EPA	Environment Protection Agency
HCW	Health Care Waste
HCGW	Health Care General Waste
HCRW	Health Care Risk Waste
KZNDoh	KwaZulu-Natal Department of Health
NEMA	National Environmental Management Act
NWA	National Water Act
OHSA	Occupational Health and Safety Act
PVC	Polyvinyl chloride
RDP	Reconstruction and Development Programme
SABS	South African Bureau of Standards
WHO	World Health Organization

ABSTRACT

INTRODUCTION

All waste generated at health care facilities in the past was regarded as hazardous and needed to be incinerated first before it was disposed.

The purpose of this study was to investigate health care waste (HCW) management practices employed in public health clinics in the iLembe District, with a view of developing a HCW management intervention strategy.

METHODOLOGY

The study design was observational, descriptive, and cross-sectional.

Data was collected using a structured individual questionnaire, which was administered to key informants from 31 rural and urban government fixed public clinics in the iLembe District Municipality.

RESULT

Thirty public clinics in iLembe district participated in the study. A total of 210 kg/day (0.06 kg/patient/day) of HCW was estimated to be generated in public clinics, 69% was health care general waste (HCGW) and 31% was health care risk waste (HCRW). The district's generation rate was 0.04 kg/patient/day and 0.018 kg/patient/day, for HCGW and HCRW, respectively.

The study found that HCW was improperly managed in the district.

DISCUSSION

The findings are different when compared to World Health Organisation norms and this was attributed to improper segregation of waste categories other than sharp waste, which was given special treatment.

Factors such as the number of patients, size of the clinic, types of health care services rendered, and socio-economics status of the patient played a pivotal role in the waste volume generated.

It is evident that no proper HCW management plan was being implemented in the district public clinics.

CONCLUSION

The management of health care risk waste is of great concern. There is a need for development of a health care waste management intervention strategy that must be implemented consistently and universally in the district.

RECOMMENDATIONS

It is recommended that a proper health care waste management intervention strategy be developed and implemented in the whole district. This strategy must incorporate training programmes and a waste management plan.

1 CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter provides a brief overview of the background of health care waste (HCW) problems. The background to the research, research purpose and objectives, operational definitions, and the layout of the dissertation are then presented.

1.2 Background to the research

Waste generated at health care facilities was regarded as hazardous and as such, it needed to be incinerated first before disposal. The incineration of HCW results in the emission of dangerous chemicals that threaten public health and the environment. This is a global concern, and the number of reports of improper management of HCW from health care facilities has increased. The Environment Protection Agency of the United States of America in 1994 identified that emissions from incinerators in health care facilities were responsible for high levels of chemicals such as dioxin and furan in the atmosphere (Malkan, 2005).

Dioxin is a known human carcinogen, which is also related to other endocrine and immune disorders. It is transported by water and in the atmosphere. Dioxin is a lipophilic and bio-accumulative toxin, which moves up the food chain easily from plants to animals, then to human beings. Health facility waste contains a large proportion of polyvinyl chloride (PVC) plastics. When PVC plastics are incinerated, they emit dioxin into the atmosphere (Malkan, 2005).

1.2.1 What is known so far?

Many activities at health care facilities generate HCW, and this waste has been related or linked to environmental damages as well as threats to public health when not properly managed. Muswema (2003) refers to data published by Hall (2000), which states that in South Africa there are approximately 27 000 sources of HCW. These sources include all facilities that provide different levels of health care service in both public and private institutions.

A number of policies have been developed with the sole purpose of preventing environmental damage arising from generation and disposal of HCW, and protecting public health.

Proper HCW management practice reduces the negative impact on the environment and public health.

1.2.2 What needs to be known?

According to Leonard's (unpublished) desktop study about 45% of health care waste generated in the Province of KwaZulu-Natal is not accounted for. In the iLembe health district, HCW volumes and composition are not known, which makes it difficult to plan and develop an appropriate intervention strategy in order to provide better HCW management.

1.2.3 Significance of the study

This study intends to bridge this information gap, as well as to provide relevant information that will inform the development of an appropriate intervention strategy. The study will also increase the level of understanding regarding how HCW is managed in the public health clinics in this district.

1.2.4 How will the study solve this?

The study will provide information regarding current HCW practices, identifying deficiencies and areas needing reinforcement. This information will then influence or shape the development of an intervention strategy.

1.3 Statement of the research problem

Health care waste is improperly managed in public clinics within the iLembe District Municipality.

1.4 Purpose of the research

The purpose of this study was to investigate health care waste management practices employed in public health clinics in the iLembe District, with a view to develop an integrated and sustainable HCW management system.

1.5 Objectives of the research

To achieve the above purpose, the following objectives were set:

- To describe the current HCW handling practices in public sector health clinics in the iLembe district in 2006;
- To measure the components and volumes of HCW generated by each clinic; and lastly,
- To determine clinic staff ability to handle HCW generated at public health clinics.

Findings are intended, firstly, to inform and facilitate the development of a HCW management strategy for the iLembe district, which will result in improving HCW management practices by HCW generators in public clinics. Secondly, they will influence or shape the design of HCW management policy by national and

provincial policymakers. Finally, the investigation seeks to enrich the knowledge base of HCW management in KwaZulu-Natal.

1.6 Assumptions underlying the study

The assumptions are that generally there is a lack of proper HCW management practices at health care facilities. In addition, staff at public clinics is not sufficiently equipped to handle HCW at public clinics.

1.7 Operational definitions

1.7.1 Definition of Health Care Waste

HCW is defined as the total waste generated in health care facilities, which includes waste generated from the blood banks, research facilities and laboratories irrespective of the volumes, characteristics and composition (Pruss, Giroult, Rushbrook, 1999). HCW is further sub-divided into health care general waste (HCGW) and health care risk waste (HCRW).

Terms that have been used in other literature are medical waste and clinical waste.

1.7.1.1 Health Care General Waste (HCGW)

This is the non-hazardous component of the HCW from the health facilities and is similar to household refuse. It is mainly generated during the administrative and housekeeping functions of the health care facilities as well as from patients and visitors. This may include a number of recyclable materials. Between 75% and 90% of the total waste generated by health facilities is general health care waste similar to that which is generally generated by the normal household. (Pruss, *et*

al., 1999). Numerous HCW audits conducted in different countries have revealed that total HCW waste is comprised of health care general waste (non-hazardous) and health care risk waste (hazardous).

1.7.1.2 Health Care Risk Waste (HCRW)

HCRW is mainly hazardous, and has the potential to cause environmental, health, and safety risks. It includes infectious waste (containing pathogenic micro-organisms), pathological waste, sharps (used needles, blades and scalpels) and pharmaceutical waste (discarded drugs and medicines). This definition excludes radioactive waste, as it is covered by the National Nuclear Regulation Act 1999 (Act 47 of 1999). HCRW includes materials considered to be potential health hazards, or that require special handling, treatment and disposal and this is usually governed by specific legislation, regulations, and guidelines (Lee, Ellenbecker, Moure-Ersaso, 2004).

The second component, which is about 10 to 25 percent, is the hazardous component of the HCW, which requires a cautious and sensitive handling (Pruss, *et al.*, 1999; Carvalho, Silva, 2002).

1.7.1.3 Public clinic

This is a public building where government funded primary health care services are rendered. This definition includes community health care centres, but excludes mobile clinics.

1.7.1.4 Health care waste management

This is a process that ensures a proper hygienic, and safe means of disposing of HCW, thereby ensuring the protection of health care workers and the public.

1.8 Scope of the study

The study entailed an audit of HCW generated in all 31 public clinics in the iLembe Municipal District as well as the establishment of a HCW management system to be employed in these clinics.

1.9 Organisation of the report

This report is presented as follows: Chapter one covers the introduction of the study, provides background, and describes the aim and objectives of the study. The second chapter reviews available literature on health care waste, both locally and international, as well as the principles of proper health care waste management, and concludes by describing an ideal model for proper health care waste management.

The third chapter presents the methodology employed in conducting this investigation and looks at procedures and processes employed when the investigation was conducted.

The fourth chapter presents the results of the investigation. This chapter begins to interrogate the findings that were unearthed during data collection and analysis.

The fifth chapter provides discussion of findings, highlights gaps and points out areas for future investigation. Here, current findings are compared with previous studies.

The final chapter presents a brief synopsis of major findings and provide recommendations based on the findings of the investigation.

1.10 Summary

It is evident that in the past, HCW has done much damage to the environment and to public health. This damage has been seen to be local, and yet has had far-reaching consequences. As a result, the international community began to address issues of environmental damage at a global level. It is encouraging to note that many countries of the world are beginning to synergistically address these issues. This investigation also contributes towards the resolution of HCW management problems.

2 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of relevant literature, in order to establish the context within which the framework for this study on health care waste management in clinics in KwaZulu-Natal was developed. It highlights the growing pressure generated by the international community to ensure that all health care facilities adhere to environmentally sound HCW management practices.

Currently, in South Africa, there exists very little evidence-based scientific information available on HCW. In particular, scientific investigation is required of the HCW management process, public health and other environmental issues. Despite the lack of reliable scientific information, there is an array of laws, policies, and guidelines regulating HCW, but these have been poorly enforced.

From the literature review, it is evident that some countries were already conducting scientific investigations of HCW issues as far back as 1982. In South Africa, research into this matter was only started around 2000.

This chapter begins by outlining the purpose of the literature review, and then moves on to look at the contributions that different scientific papers have made in shaping HCW management policies and practice. It also reviews South African legislation, policy documents, and guidelines for HCW management.

This chapter also focuses on the HCW management process as outlined in different existing or proposed policies, legislation, and HCW management theories. Finally, a HCW management model is presented, against which the findings of this study will be measured.

2.2 Purpose of literature review

The importance of doing a wide and comprehensive literature review has been emphasised by Bless and Higson-Smith (2000) and the following core areas needing to be covered in a literature review were identified:

- ❖ To become familiar with the latest developments in the area of research;
- ❖ To identify the gaps in knowledge and weaknesses in previous studies;
- ❖ To discover similarities and contradictions in different studies;
- ❖ To understand different definitions used in previous works; and
- ❖ To identify the strengths and weaknesses in research methods used in other investigations.

A researcher must embark on a literature review for two reasons; firstly, to find out what other work has been done in the field of interest (content area), and secondly, to critically examine different research methodologies employed in various studies (Katzenellenbogen, Joubert, Karim, 1997). In addition, a literature review is conducted in order to establish consistency in past investigations, as well as to identify flaws in existing research (Babbie, 1995).

2.3 Scope of literature review

In the literature review, all available and accessible studies on HCW are content analysed by looking at different conceptual definitions of HCW, components that make up the HCW, volumes, and waste management practices employed.

Furthermore, the literature review entailed looking at the strengths and weaknesses of different methodologies used in the different studies in the field of HCW.

2.3.1 Conceptual framework

The study is guided by the understanding that health care waste is waste that is generated at health care facilities. HCW is managed according to existing legislation, policies and guidelines. The process of handling waste from where it is generated to its final point of disposal, as stipulated in the legislation, should be done flawlessly in order to safeguard public health as well as the environment. HCW management is an integral part of health care activities. Any compromises taken may result in placing the public's health at risk, and may reduce the overall benefits gained during health care provision.

2.3.2 Empirical literature sources

2.3.2.1 Primary sources

The indexes and abstracts of the relevant subject matter from the university library formed an integral part of the initial source of the literature reviewed. Most of the information was found in professional journals. The literature search was done with the assistance of the subject librarian. Articles identified at this stage were reviewed, and the references in these articles created a snowball effect and helped in identifying other relevant articles.

2.3.2.2 Secondary sources

A secondary list of relevant documents and scientific articles were accessed from the Internet. This expanded the search for articles to be reviewed.

2.4 Literature reviewed

For a long time, health care service has been rendered without taking into consideration the impact the waste it produces has, on either the environment or on public health. The biomedical model of disease management and treatment produces an ever-increasing volume of HCW. This has led to the depletion of natural resources and the degradation of the natural environment, and has caused harm to human health. HCW management must then guarantee that assimilation of HCW by land, water or air take place, without any major environmental damage. Consequently, the lack of proper health care waste management leaves the environment vulnerable and unprotected (WHO, 2005c).

The recent past has seen pressure put on the health system to dispose of HCW in such a way as to avoid unnecessarily high levels of environmental damage. Health care facilities worldwide are beginning to enhance the fulfilment of societal goals for a cleaner and safer environment (WHO, 2005b).

The above developments should be understood within the context that health care facilities seek either to improve or better quality of life by using the best available resources. This must be done within a regulated framework, which seeks to ensure both public health and environmental protection. Health care providers should consider all stages of the medical product's life cycle, by looking at the medical product's up-stream¹ and down-stream activities (Kaiser, Eagan, Shaner, 2001).

¹ This concerns the product development stage, where issues such as raw materials and processes used in the production of a particular product are involved. Down-stream refers to the product life after use in terms of its effects on the environment when disposed of.

2.4.1 Quality health care provision and environmental protection

Health care providers have to perform a difficult balancing act between quality health care provision and environmental protection. In the past, medical ethics focused on the issues which benefit patients, without considering the negative effects which HCW had on the environment, not realising that human health requires a healthy global ecosystem. It is now understood that the health care industry is in a rapid state of flux, with a multitude of internal and external factors driving these changes. Factors such as population growth, consumption patterns, and technology have perpetuated the crisis in the health care industry, as well as caused environment degradation (Nyambe, 2001).

The underlying assumption is that health care facilities are predominantly motivated by the need to make sure that patients are provided with the best medical care possible. Current developments dictate that health care facilities must be responsible for the HCW they generate. This has developed as a result of a sharp increase in both environmental awareness and environmentally sensitive legislation, which followed after the realization that the environmental crisis has reached unprecedented levels (WHO, 2005c).

Mounting pressure, advocating change arising from scientific and technical experts relating the effects of HCW in causing environmental damage, has become more apparent. The result has been that health care facilities have had to change the way they deal with HCW. Pressure also came from the media, pressure groups, cultural expectations, political influences, and improvement of administration systems. These forms of pressure have assumed a bottom-up approach, which has seen communities raising their voices on issues such as the illegal dumping of HCW in residential areas. Top-down pressure has been exerted by the international community in the form of international treaties and conventions, forcing countries to change their careless attitude in managing HCW (WHO, 2005b).

2.4.2 Definition of health care waste

In the previous chapter, a World Health Organisation (WHO) definition and classification system of health care waste was provided (Pruss, *et al.*, 1999). HCW is defined as the total waste stream that is generated from health care establishments, health related research facilities, laboratories, and emergency relief donations (Yimer, 2005). About 75% to 90% of HCW is made up of Health Care General Waste (HCGW), which is non-contaminated and poses no risk of infection. The balance of it is Health Care Risk Waste (HCRW), which is considered infectious, toxic, or radioactive.

The Department of Water Affairs and Forestry (DWAF) (1998) defines HCW as the waste generated by hospitals, clinics, doctors' rooms, and health research facilities. The definition the DWAF uses is similar to the one utilized by Yimer (2005), who defined HCW as the total waste stream that is generated from health care facilities, including hospitals, clinics, health related research institutions, laboratories, and emergency medical relief. Both DWAF and Yimer are using a source-based definition of HCW. In South Africa, there is no statutory definition of HCW (Muswame, 2003).

A research project conducted on HCW in Saudi Arabia pointed out that the lack of a universally agreed upon definition of infectious waste led to an over-disposal of infectious waste (Almuneef, Memish, 2003; Hagel, Al-Humaidi, Blake, 2001). The fear of contracting diseases such as HIV and hepatitis led hospitals to treat most HCW as potentially infectious waste (Leonard, unpublished).

A study comparing infectious waste management in European hospitals discovered that infectious waste definitions differed widely in different hospitals. As such, the volume generated differed significantly as a result of a lack of a universally acceptable definition of infectious waste (Muhlich, Scherrer, Daschner, 2003). They also observed that some health care facilities classified

HCW based on the source of waste and/or activities that produced the waste, while others classified waste based on material contamination with defined pathogens.

Health care facilities can reduce total treatment and disposal cost of HCW by improving the definition and classification of HCW. Revised regulations that provide clear and precise definitions of infectious waste are essential in the implementation of a proper HCW management plan (Miyazaki, Une, 2005).

This view was also shared by Lee, Ellenbecker, and Moure-Ersaso (2003), who confirmed that hospitals employed different classifications of waste because of the lack of a single acceptable definition of HCW.

2.4.3 Factors contributing to volumes of HCW generated

There are a number of factors contributing to the volume of HCW generated by health care facilities. Waste management policy, the level of economic development of a country, the size of the health care facility, and the type of medical specialties practised are some of the factors that contribute to the amount of HCW generated in a particular country (Yimer, 2005). The amount of HCW generated in a health care facility also depends on other factors, such as the number of beds (or patients), types of health care services provided or medical activities, the economic, social and cultural status of patients, and the general conditions of the area where the health care facility is situated (Jang, Lee, Yoon, 2006; Askarian, Vikili, Kabir, 2004).

2.4.4 Reducing volumes

An intervention based on a commonly accepted definition of HCW implemented between 1991 and 1999, recorded a significant reduction in volumes of infectious waste (from 2.8 kg per patient per day to 0.85 kg per patient per day) (Hagel, Al-

Humaidi, Blake, 2001). They also observed that although the educational program was difficult, it did yield positive results. It was associated with a 21% reduction in the first month (Almuneef, Memish, 2003).

2.4.5 Audit of health care waste

Conducting an audit of HCW in order to understand types and quantities of HCW generated assists a great deal in formulating an appropriate HCW management policy (Chitnis, Vaidya, Chitnis, 2005). The idea of starting with a HCW audit before any intervention is decided upon was supported by other authors (Almuneef, Memish, 2003).

Conducting HCW audits will assist in overcoming the problem of the non-availability of information on HCW as this has been identified as a major stumbling block in dealing with HCW management (Askarian, Vakili, Karib, 2004). The lack of such information has been seen as the underlying cause of the failure to establish a health care waste management system, at both the macro and micro levels (Almuneef, Memish, 2003).

HCW management intervention is bound to fail if not informed by audit surveys conducted on the amounts of waste generated, the sources of waste generation, and the particular type of waste (Carvalho, Silva, 2002). The need to conduct studies prior to the development of a waste management strategy has also been supported by other authors (Pruss, *et al.*, 1999).

An audit of HCW in Gauteng identified three critical problems in the HCW management system, namely: environmental damage, occupational health, and public health. This critical problem arose as a result of an excessive and incorrect manual handling of HCRW, the unsafe utilization of equipment, and the excessive emission of pollutants from HCRW treatment plants (Fischer, Krisiansen, Nkosi, 2003).

2.4.6 HCW management in developing countries

HCW management in many developing countries is often poor and fraught with difficulty (Mohee, 2004). This view is common in developing countries, and it raises concerns about inappropriate HCW management methods employed in such states (Diaz, Savage, Eggerth, 2005). High on the list is the inappropriate treatment and final disposal of HCW, which leads to an adverse impact on public health, occupational health and safety, and the environment.

Formal HCW management services are not accessible for the majority of clinics on the African continent (Rogers, Brent, 2005). In a study conducted in 2002 in which 22 developing countries were included, it was found that 18% to 64% of health care facilities were not using proper waste disposal methods (WHO, 2005a).

HCW management is strongly influenced by the economic conditions of the country, and all economically developing countries have constraints in dealing with HCW adequately (Patil, Shekdar, 2001).

In South Africa, Gauteng was found to be handling HCW in a questionable and environmentally unstable manner, characterised by a lack of awareness amongst HCW handlers and the general public (Fischer, Kristiansen, Nkosi, 2003).

In Brazil, about 76% of towns were found to be disposing of domestic and medical waste together in municipal dumpsites, which created a health risk for municipal workers, the public, and the environment (Da Silva, Hoppe, Ravanello, *et al.*, 2004).

2.4.7 Health care waste in South Africa

“South Africa is emerging from a period of unsustainable and inequitable development, an outcome of which was environmental degradation. This has significant economic and social impacts. Part of the purpose of transformation is development that is economically, socially and environmentally sustainable in order to redefine the way pollution and waste will be managed in South Africa” (Rogers, Brent, 2006).

It is evident from the limited South African HCW literature that in terms of HCW waste management practise, South Africa has had two distinct phases, that is, that which existed prior to 1994, and that which has developed post-1994. The pre-1994 phase was characterised by insecure storage and incineration of HCW, uncontrolled transportation of HCW, the lack of protection for waste handlers, and HCW segregation (Fischer, Kristiansen, Nkosi, 2003).

Since 1994 the provincial governments throughout the country have begun to chart a responsible way forward by developing HCW management strategies. This clearly demonstrates a paradigm shift in South Africa, and a commitment to deal effectively with the management of HCW. This process has been facilitated and evidenced by the country becoming a signatory to international treaties on sustainable development.

South Africa became signatories to the Basel Convention on the 5th of May 1994 (stated on Basel Convention website <http://www.basel.int/ratif/convention.htm>). This means that South Africa has had to upgrade its HCW management practices to internationally acceptable standards. Consequently, the National Department of Environmental Affairs and Tourism conducted investigations on HCW management. This resulted in the production of new standards for health care waste management, in the form of SABS Code 10248:2004. This code has influenced the development of two regulations promulgated by the Gauteng

Provincial Government. The two regulations are, firstly, HCW management Regulation 2004 and, secondly, Waste Information Regulation 2004. The code has also played a pivotal role in informing the development of a Western Cape Provincial Bill on the Management of Health Waste, and is likely to influence the HCW policy of KwaZulu-Natal.

The following two incidents clearly reflect a need for South Africa to develop a comprehensive and well informed HCW management policy that is based on existing legislation in order to ensure protection of the environment and public health from HCRW.

“Tygerberg Hospital treated 48 children with AZT after some were pricked with needles and others ingested potentially lethal pills they found in a field in Elsie’s River” (Cape Argus, September 1999). The following year The Star newspaper carried a story that: “..... 80 tons of medical waste was removed from a house in Johannesburg....” (The Star, August 2000).

Similar occurrences are probable in the future if no system is in place that will ensure proper audit trail documentation of the type and volume of all HCRW generated by health care facilities. In the absence of a proper audit trail, contractors are likely to carry on within appropriate disposal of HCW (McLear, *et al.*, 2006).

Both aforementioned incidents happened in urban areas. This raises questions about the situation of HCW management in rural areas, where both scant capacity and resources are a real problem.

Incidents of the indiscriminate dumping of HCW in open areas and poorly managed municipal landfill sites have raised concern about public health and environmental protection internationally. The improper disposal of HCW could be

attributed to a lack of awareness and information about the risk HCW poses or could also be attributed to a mere disregard for the law.

2.4.8 Local issues in HCW management

A desktop study revealed that about 45% of health care waste generated in the Province of KwaZulu-Natal could not be accounted for (Leonard, unpublished). This suggests the possibility of illegal dumping in open fields, mixing HCW with domestic waste and then disposing of it in municipal landfill sites (Da Silva, *et al.*, 2004), burning, incinerating, or burying it, thereby creating a risk to public health as well as causing environmental damage. This finding by Leonard, in as much as it was a desktop exercise, does justify the need for a thorough investigation of HCW management.

Within the iLembe district, there has not been any investigation of HCW. The amount produced, its composition and quantities and the disposal methods thereof, are unknown. The reality that there is an even distribution of public clinics in this district means the findings of this investigation will be fairly representative. For the proper management of HCW quantities, both composition and disposal methods must be known in order to develop an informed HCW management plan.

2.4.9 Legislative framework for health care waste in South Africa

This section looks at legislation, policies and guidelines that have been developed in order to establish proper HCW management that seeks to provide protection to both the environment and public health.

2.4.9.1 Review of waste management legislation

The following legislation is referred to:

- ❖ Atmospheric Pollution Prevention Act (Act No. 45 of 1993)
- ❖ Constitution of the Republic of South Africa (Act No. 108 of 1996)
- ❖ Environmental Conservation Act (Act No. 73) of 1989)
- ❖ National Environmental Management Act (Act No. 107 of 1998)
- ❖ National Environmental Management: Air Quality Act (Act No. 39 of 2004)
- ❖ National Water Act (Act 36 of 1998)
- ❖ Occupational Health and Safety Act (Act No. 58 of 1993).

The point of departure is the supreme law of the country, the Constitution of the Republic of South Africa (1996). Environmental rights are enshrined in the constitution under the Bill of Rights (Chapter 2, Section 24), which states that: “Everyone has the right:

- a. to an environment that is not harmful to their health or well-being; and
- b. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that
 - i. prevent pollution and ecological degradation;
 - ii. promote conservation; and,
 - iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. “

In South Africa waste management practices are regulated by the Environmental Conservation Act (ECA) of 1989 (Act 73 of 1989), of which section 20 which states that “no person may establish, provide or operate a waste disposal site without a permit issued by the Minister of Water Affairs and Forestry.” It further states that “no person may discard waste anywhere but at a waste disposal site or other facility approved by the Minister.” This piece of legislation seeks to give protection to the environment, and also to eliminate environmental pollution. The

ECA also recognises that the establishment of landfill and other operations such as incinerators can have a detrimental effect on the environment, as sections 21, 22 and 26 controls the establishment of both landfills and scheduled processes.

While the ECA provides protection for the environment and the public at large, the Occupational Health and Safety Act (OHSA) of 1993 (Act 85 of 1993) seeks to guarantee the protection of workers at their places of work. In terms of section 8 of the OHSA, the employer is duty bound to provide a safe working environment. At public clinics, employers are also responsible for the provision of HCW management procedures which are easily accessible to workers, in order to ensure the protection of workers, patients, the public, and the environment. It is therefore the prerogative of employers to protect HCW handlers from injuries and infections while handling HCW.

The National Environmental Management Act (NEMA) of 1998 (Act 107 of 1998) emphasises the importance of sustainability and responsibility in waste management, based on two fundamental principles: “duty of care” and “polluter pays”.

The National Environmental Management: Air Quality Act (Act No. 39 of 2004) deals with the protection of the environment by preventing pollution and ecological degradation, with emphasises on the protection and enhancement of the quality of air in the country. There is no specific mention of the HCW and HCW management in this legislation. The act compels HCW generators to seek safer methods of disposing their HCW in such a manner that it does not degrade the environment.

The other legislation that deals with the protection of public health and the environment in the treatment and disposal of HCW is the Atmospheric Pollution and Prevention Act (APPA) of 1993 (Act 45 of 1993). The APPA lists all the scheduled processes required by an Environmental Impact Assessment, such as

an incinerator found in a health care facility. It deals with the prevention of atmospheric pollution, such as the burning of HCW in the open, or the use of inefficient incinerators.

The National Water Act (NWA) of 1998 (Act 36 of 1998) addresses the question of the prevention of possible water pollution as a result of waste that is suspended, dissolved or transported in water, and any act that can lead to the pollution of water resources.

2.4.9.2 Review of waste management policies

The Reconstruction and Development Program (RDP) promoted equitable access to natural resources by making provision for a safe and healthy living and working environment. It also encouraged community participation in the decision making process around environmental issues in order to empower communities in managing their natural environment in a sustainable way. Much South African legislation and policy has been influenced and/or shaped by the RDP. A healthy society needs a healthy environment and a healthy economy (Nyambe, 2001). Therefore, sustainable development is of paramount importance to all.

The integrated waste management approach is contained in the White Paper on Integrated Pollution and Waste Management for South Africa (DEAT, 2000). The white paper encompasses a vision of a society in harmony with its environment. This policy seeks to provide a holistic approach to waste management, which takes into consideration issues of waste from “cradle to grave”, i.e, from its generation, through storage, collection, transportation and treatment to final disposal. The white paper recognises the generation of HCW and its possible risks to the environment if not properly managed. Some of the objectives of the white paper are to regulate and monitor waste production, enforcement of waste control measures, and co-ordination and administration of integrated pollution

and waste management through a single government department. The white paper promotes a clean, healthy environment and a strong, stable economy.

In South Africa, more than one department had control over the issue of waste in the past. A change is noticeable in the sense that the new National Health Act (Act 61) of 2003 is silent on issues of waste except in declaring that section 91 (1) (n) mandates the Minister of Health to make regulations regarding health nuisance and medical waste after consultation with the National Health Council.

2.4.9.3 Waste management guidelines

The South African Bureau of Standards (SABS) Code 0228 deals with the classification of waste into nine categories, or classes. Category 6 deals with hazardous waste, and furthermore, category 6.2 makes reference to infectious waste. SABS Code 0248:1993 was subsequently developed to address specifically the handling and disposal of waste material from health care facilities.

The South African Bureau of Standards (SABS, 2004) has developed the new SABS Code 10248:2004, entitled the Management of Health Care Waste, which provides guidelines for the management of health care waste from its generation to disposal. These guidelines have influenced the development of the two regulations promulgated in 2004 by the Gauteng provincial government as well as the Western Cape Health Care Waste Management Bill. It is expected to influence the development of both national and other provincial waste management guidelines. The KwaZulu-Natal Department of Health (KZNDoh, 2001) states that any provincial HCW intervention strategy must be backed by a national policy and guidelines on HCW management and must be supervised at a local government level. KZNDoh (2001) acknowledges that the worst problem in KwaZulu-Natal is found in rural hospitals and clinics, as they are unable to give

the required special care in handling HCW, because a constraint in terms of resources exists.

SABS code 10248 of 2004 spells out the following:

- ❖ Types of HCW (infectious, pharmaceutical and radioactive) and determines the classes of disposal sites for these classes of waste.
- ❖ Marking and labelling of HCW for transportation purposes.
- ❖ Management's responsibilities (formulation of HCW management policy, waste management plan, assigning responsibilities, training, supervision, and workplace hygiene).
- ❖ Storage of hazardous health care waste.
- ❖ Segregation and packaging of waste prior to removal.
- ❖ Guidelines in the case of spillages of hazardous HCW.
- ❖ Treatment and disposal methods.
- ❖ Disposal by small scale generators.
- ❖ Minimal guidelines for remote rural health care facilities where legal requirements cannot be met.

The Institute of Waste management of Southern Africa also developed a policy on HCW management, which is based on five fundamental principles that inform a sound HCW management policy:

- ❖ The principle of green procurement: firstly, avoiding hazardous waste and there after using products which are environmentally sensitive.
- ❖ A duty of care: requires that any entity that generates, transports, treats, or disposes of waste must ensure that there is no unauthorised transfer or escape of waste from its control until proper disposal is achieved.
- ❖ The polluter pays principle: authorities in charge of the facilities where HCW is generated are responsible for the cost of disposing of their HCW and, should any environmental damage occur, the polluter must pay the remediation costs.

- ❖ The precautionary principle: an assumption is made that all waste has the potential to cause harm to public health and the environment, until proven otherwise.
- ❖ The principle of segregation at the source, where waste is generated and is separated into categories at the point of generation, in order to ensure that all waste is subjected to its relevant treatment and disposal.

The Institute of Waste management is a professional association based in South Africa, with voluntary membership and the majority of its members are from the public and private sectors. The role of the association is to advice and recommend on policies and issues that revolves around the management of waste. The institute promote environmentally acceptable and professional waste management practices (this information was obtained on the institute website <http://www.iwmsa.co.za>).

Public health safety, and environmental protection, can only be achieved by enforcing a code of practice or guidelines for all aspects of handling, storage, transportation, and disposal of HCW (Bdour, *et al.*, 2006).

The following problems in proper HCW management have been identified: lack of waste segregation, absence of necessary rules and regulations applicable to HCW collection, temporary storage locations, and improper disposal, the insufficient training of personnel, and insufficient personal protective equipment (Askarian, *et al.*, 2004b).

It is important to conclude this section on the legislative framework of HCW by stating that any HCW management intervention strategy developed must ensure that responsible actions are taken to improve HCW management and instil a sense of responsibility, in order to ensure public health safety, and environmental protection and sustainability.

2.4.10 Generation rate

It is difficult to compare the generation rates from different countries as different generation rates are employed such as kg/patient/day, as opposed to kg/bed/day. The other compounding factor is the use of different definitions of health care risk waste, as different classifications of waste are employed (Lee, Ellenbecker, Moure-Ersaso, 2004).

Gauteng's Department of Agriculture, Conservation, Environment and Land affairs (DACEL) (2000) commissioned a feasibility study regarding the regionalisation of HCR waste disposal. In their report, they stated that public clinics in Gauteng are producing HCRW at a rate of 0.002kg/patient/day to 0.5 kg/patient/day, while private clinics were producing 0.06kg/patient/day to 0.48 kg/patient/day.

In the United States of America hospitals generated a total HCW with a median of 6.93 kg/patient/day, and HCRW was 15% of the total HCW generated (Rutala, Odette, Samsa, 1989). Saudi Arabia's hospitals generated 1.13 kg/bed/day (mean) with primary health centres and clinics accounting for 0.08 kg/patient/day (mean) (Al-Zahrani, Fakhri, Shanshour, *et al.*, 2000).

In Kuwait, large hospitals have a range of 4.89 to 5.4 kg/patient/day, which corresponded to a range of 3.65 to 3.97 kg/bed/day (Hamoda, El-Tomi, Bahman, 2005). In a study conducted in Jordan, generation rates at public hospitals were 6.10 kg/patient/day (3.49 kg/bed/day); at maternity hospitals it was 5.62 kg/patient/day (3.14 kg/bed/day); and private hospitals generated 4.02 kg/patient/day (1.88 kg/bed/day) (Bdour, Altrabsheh, Hadadin, *et al.*, 2006).

An average of 0.179 kg/bed/day of HCRW was generated at private clinics which was higher than that generated at public hospitals, i.e, 0.072 kg/bed/day (Mohee, 2005).

In Dar es Salaam, Tanzania it was ascertained that hospitals generated about 200kg/day (0.2 ton/ day), while the average waste generation was 0.55 kg/patient/day or 2.43 kg/bed/day. These generation rates are comparable with both those in the United States of America and the United Kingdom (Mato, Kassenga, 1997).

In Iran, the HCW generation rate is 4.45 kg/bed/day, and 71.44% of the total waste generated was HCGW while the remaining 28.56% was HCRW (Askarian, Vikili, Kabir, 2004a).

The HCRW generation rate in Korea ranged from 0.14 kg/bed/day to 0.49 kg/bed/day (Jang, Lee, Yoon, *et al.*, 2006). While in Jordan's Irbid City it was recorded that public hospitals were producing 6.10 kg/patient/day (3.49 kg/bed/day) and private hospitals were generating 4.02 kg/patient/day (1.88kg/bed/day) of HCW (Bdour, *et al.*, 2006).

2.4.11 Risks associated with health care waste disposal

Exposure to HCW risk can occur in three ways: through accidental exposure due to contact with waste; the exposure to toxic chemicals or biological contaminants in water; and the exposure to toxic residues such as mercury, dioxins, and furans from the atmosphere through the incineration of HCW.

Certain categories of HCW are hazardous, and it is HCWRW which poses a potential danger to the community (Bdour, *et al.*, 2006). The complexity of HCW is inexorably accelerating and, as a result, the risk of the transmission of diseases through both unsafe handling and improper disposal practices is increasing.

There are a number of people who are at risk from an improperly managed HCW. However, at greater risk are health care waste handlers, such as health workers, municipal workers and rag-pickers. The general public is also exposed to this risk although only at a secondary level, when such HCW is not disposed of properly.

2.4.12 Ideal health care waste management model

This model is based on a number of policies and guidelines, but fundamental to the development of the model are issues raised in the World Health Organisation's Health Care Waste Management Guidelines, and the White Paper on Integration Pollution and Waste Management, which promote a paradigm shift from an end of the pipe solution to waste prevention and minimisation, identification, segregation, handling, treatment, and disposal. A well-formulated waste-management plan can be cost-effective as well as providing protection for the public and environment (Miyazaki, Une, 2005).

A HCW management team is a vital factor in terms of co-ordinating all the activities relating to HCW in a health care facility, and this is associated with the regular training of all staff involved in its generation and handling.

Proper HCW management starts with the proper packaging, labelling, and handling of waste.

2.4.12.1 *Waste prevention and minimisation*

The point of departure for health care facilities must be the prevention of waste. Should this fail, then minimisation must be the next option.

Health care facilities should seek to reduce the total amount of HCW generated. This can be achieved by using what Kaizer and associates (2001) referred to as “green purchasing.” The principle of green procurement encourages the purchasing of products able to withstand the sterilization process, and which are either reusable or recyclable. The selection of products that are environmentally sensitive must be taken into consideration on procurement (Kaizer *et al.*, 2001). Therefore, health care facilities must select products that are less wasteful or less hazardous to both the environment and public health, in order to prevent any unnecessary wastage of products.

2.4.12.2 *Waste segregation or separation*

Waste segregation is a process of removing particular waste segments with objectionable characteristics such as being hazardous or contaminated with harmful pathogens from uncontaminated waste. Proper waste segregation is critical for waste treatment and disposal. DoH KZN (2001) has raised the concern that very little “at the source waste segregation” occurs in the province.

Segregating waste at the source of generation is of paramount importance, as it is the key to waste reduction, reuse, and recycling (Chitnis, Vaidya, Chitnis, 2005).

Segregation of HCW allows for proper special treatment to be given to relevant quantities and categories of waste. Central to waste segregation is colour-coding.

Colour coding enhances proper HCW management when different colour containers for different HCW categories are employed (see plate 1 below). These containers must be easily accessible to health care workers in order to be filled with appropriate waste. The following guidelines have been provided by the WHO in the colour coding of health care waste containers: yellow for infectious

and pathological waste; red for sharps and infectious waste; brown for pharmaceutical; and black for general waste.



Plate 1: Different colour-coded waste containers for different waste categories.

Labelling of HCRW containers in terms identifying the type of waste, as well as the source of generation, plays a pivotal role in the management of this waste.

The principle of segregation at the source is applicable to this stage of HCW management.

It is imperative for health care facilities to use containers that are leak-proof, and for sharps, puncture proof containers must be utilised. For infectious waste, the international infectious substance symbol must be displayed on the plastic bag.

2.4.12.3 *Internal waste storage*

This is a temporary internal waste storage facility. HCRW must be stored in a secured area in order to prevent any unauthorised access. A waste storage area must have an impermeable floor, a water supply, and must be inaccessible to animals, insects, and birds.

2.4.12.4 *Waste handling*

This is the physical handling of waste when it is moved around the public clinic, until it gets to the internal waste storage area.

Every generator of HCW must ensure that any waste generated is handled properly, during both internal and external transportation, and that the treatment or disposal of waste must prevent any unauthorised transfer or escape of waste from its control. There must be an audit trail of all activities involved in the transportation of waste until its final disposal.

HCW handlers must be provided with adequate protection in order to avoid injury and infection during the handling of HCW.

2.4.12.5 *Waste collection*

Containers must be about three-quarters full and be tightly closed or sealed. Waste must not accumulate at the point of production. Collection must occur daily, and no bag must be removed without being labelled and its contents and point of production stated. Pathological and infectious waste must not be stored for more than 24 hours.

2.4.12.6 *Waste disposal*

Authorities in charge of public clinics where HCW is generated are responsible for the cost of disposing their HCW and, should any environmental damage occur, they must pay remedial costs.

2.4.12.7 *Waste transportation*

HCRW must be transported using a purpose built vehicle, which is able to secure the load during transit. This vehicle must be used for the sole purpose of transporting HCRW, and must be kept locked at all times, except during loading or off-loading.

2.5 Current understanding of the questions in HCW

This section examines what can be done to prevent improper HCW management. It also examine the how, when and who of HCW management.

2.5.1 What can be done to prevent improper HCW management?

A well-known saying has it that: “if you cannot measure it, you can not manage it.” It is against this background that all health care facilities develop a HCRW information collection tool, which will record all details regarding HCRW being generated, in order to be able to manage HCRW properly. This information must contain waste composition, weight or volume, generators, and disposal methods.

Thereafter, a HCW management plan must be developed, stating in detail all actions needed to be taken in order to ensure the proper disposal of the HCW. The plan must include waste segregation, storage, collection, transportation, and its final disposal.

The HCW management plan must also deal with issues such as the protection of waste handlers, the public and the environment.

Legislation forms a critical part of the HCW management plan, as it must both inform and influence the plan. Contained in this legislation must be the oversight role that is played by enforcement agents.

2.5.2 Where is HCW disposed of?

Environmental damage stems from a combination of population growth, consumption patterns, and inappropriate technology. Improper disposal of HCW contributes equally to environmental damage, as is the case with general household waste when not properly disposed of. But more care must be given to HCRW.

Indiscriminate waste disposal is a serious problem in both urban and rural areas. It can have a negative impact on the natural environment. Waste management is a major concern internationally, particularly when the prospects of imminent major environmental threats such as global warming and ozone layer depletion are taken into account.

Many products and substances utilized in health care facilities find their way into the waste stream as airborne residues from incineration, contaminants in sewer effluents, or as components of solid waste transported to landfill sites. Therefore, different categories of HCW are disposed of in different ways so as to prevent injury, infection, and damage to the environment.

2.5.3 How is HCW managed?

Many instances have been reported where health care waste has been illegally dumped in residential areas, thereby posing a serious hazard to both the community and the environment. Where such occurrences have taken place, it demonstrates that waste management practises are not up to required standards. Children have been found playing with health care waste illegally dumped in a soccer field. Consequently, some of them were hospitalised due to needle stick injuries, which emanated from such irresponsible conduct by health care waste handlers (de Waal, Rabie, Bester and Cotton, 2005).

From the literature reviewed, it is clear that proper management of HCW in health care facilities is a neglected aspect of health service delivery worldwide. This is reflected in studies conducted in countries such as Palestine (Massrouje, 2001), Saudi Arabia (Almuneef, Memish, 2003), India (Patil, Shekdar, 2000), Tanzania (Mato, Kassenga, 1997), Iran (Askarian, Vakili, Kabir, 2004), South Africa (Rogers, Brent, 2005), the United Kingdom (Diaz, 2005), Jordan (Oweis, Al-Widyan, Al-Limoon, 2005), the Czech Republic (Culikova, Polansky, Bencko, 1995) and Brazil (Carvalho, Silva, 2002).

It has been found that in 22 developing countries, health care facilities are not properly disposing of their HCRW (WHO, 2005a). Evidence suggests, however, that the majority of nations globally are steadily improving their HCW management practices. It is the reality that the desired state of proper health care waste management has not yet been realised.

HCW management, therefore, reflects three inter-connected spheres, namely nature, people, and economy. Firstly, there is a need to eliminate the use of harmful substances in order to protect and restore the natural environment. Secondly, there is the human need to meet basic health requirements, the human need to develop to full potential, and the need to enhance social capital.

Finally, there is a need to ensure efficient and effective utilization of resources and financial stability (Anonymous, undated).

2.5.4 When is HCW a threat to public health and environment?

People impact on the environment through exploitation of natural resources and in the process, waste is generated which needs to be disposed of. Waste disposal then affects the three waste-receiving media such as; air, land, and water. When waste is burnt, it emits various gases and vapours that are harmful to both the environment and public health.

In 1994, the Environmental Protection Agency (EPA) of the United States of America identified HCW incineration as the leading source of dioxin, furan, and the other high persistent harmful pollutants found in the atmosphere (HCWH, 2005). These pollutants are associated with asthma; mercury poisoning, a neurotoxin; and dioxin. Dioxin is a known human carcinogen associated with birth defects and learning disabilities. Health Care Without Harm (HCWH) issued a warning that there is no minimal amount of dioxin exposure that is safe for human beings. HIV, Hepatitis B and C, and other pathogens have been reported to be transmitted during HCW management (HCWH, 2005).

2.5.5 Who is responsible for the HCW management?

Improper management of HCW poses serious implications for the environment and public health (WHO, 2002). HCW management begins with a commitment from heads of health care institutions and senior managers, and it must filter down to the general workers. All health care establishments must apply the “duty of care” principle in order to protect the environment and public health by taking full responsibility for the waste they generate (Pruss, *et al.*, 1999).

HCW management, particularly in the developing countries, is usually delegated to poorly educated and untrained workers. They are expected to render this high-risk function without any proper guidance or sufficient protection (Bdour, *et al.*, 2006; Diaz, Savage, Eggerth, 2005). Cleaners and nursing assistants are responsible for the collection, storage, and transportation of the HCW, and they do not usually wear sufficient protective gear during waste handling (Da Silva, Hoppe, Ravanello, *et al.*, 2004).

All health care waste handlers must have clearly defined responsibilities in order to ensure correct handling, treatment, and disposal of HCW without placing themselves, their colleagues, and the others at risk, and they must also ensure the promotion of environmental protection (Blenkharn, 1995).

2.6 Research findings already in use

Research has shown that not all HCW generated at health care facilities is risk waste. Out of the five categories of HCW only four categories require special attention, viz; infectious, sharps, pathological, and pharmaceutical. General health care waste can be disposed of as is normal household refuse, that is, in municipal landfill sites.

Health care facilities are encouraged to use correct and proper waste management practices, to avoid any negative impact to the environment and public health.

Around 1992, the EPA initiated an investigation on the incineration of HCW in the United States of America, and their findings influenced the government of the United States of America to put a stop to the use of incinerators in burning HCW. This was as a result of the negative impact of gasses and vapours that they have on the environment and public health. The International Agency for Research on

Cancer documented that dioxin is a human carcinogen, and traces of it have been found in breast milk (WHO, 2005a).

Research conducted in the field of HCW has created awareness about the magnitude of the problem of poor HCW management in health care facilities, and has generated a systematic control effort in HCW (Askaria, *et al.*, 2004).

Gauteng Provincial Government promulgated two provincial regulations dealing with HCRW management following intensive investigation on HCW in the Gauteng province.

2.7 Follow on the literature review

Research is required to establish a database, containing information and statistics of HCW sources, generation, collection, transportation, treatment, and disposal. Therefore, both actual measurements and proper recording are required, where components, composition, and quantities need to be kept. This forms the basis for planning, designing technology, development, and implementation of HCW management facilities.

In the literature review it has been stressed that information on HCW is of paramount importance in developing a HCW management intervention strategy. It is against this background that this investigation (auditing HCW in the public clinics in the iLembe district) was planned.

2.8 Strengths or weakness of other studies

An infectious waste survey conducted in a Saudi Arabian hospital called Dhahran Health Centre, demonstrated that the lack of a universally acceptable definition of infectious waste hampers progress intended by the intervention strategy (Hagen, Al-Humaidi, Blake, 2001).

In a study conducted in Gauteng to determine the composition and generation of HCW in public and private health care facilities, the following limitations were identified: a) both public and private health care facilities investigated were found in affluent, urban, and cosmopolitan areas, and b) the study refers to the limited number of international studies conducted on the subject of HCW, and yet there is a vast amount of literature available which include studies conducted in number of African states.

A health care waste management investigation conducted in five hospitals in five European countries and their results cannot be generalised, as the sample size was too small, and secondly, the study was based on rural hospitals (Muhlich, *et al.*, 2003).

A cross-sectional study of all 35 university hospitals in the province of Fars in Iran was conducted by Askarian and associates (2004a) and the following informants were interviewed: managers responsible for environmental health care and collection and disposal of hospital waste, chairmen of the central infection control committee, and personnel involved in the collection and disposal of hospital waste. It is evident that the aforementioned study was conducted in a comprehensive manner, with a view to provide an in-depth understanding of all issues pertaining to HCW in the targeted hospitals.

A preliminary risk analysis technique conducted to evaluate practices in the handling of infectious health care waste was done by looking at thirty six procedures related to segregation, containment, internal collection, and storage operations (Carvalho, *et al.*, 2002). The strength of this investigation relied on the fact that it concentrated on evaluating practices employed in handling infectious HCW in health care facilities that had introduced a HCW management program.

An investigation conducted by Sharma, Bansal, Sharma (1994) in ten hospitals in two states in India showed that not all categories of hospitals were included. Their sample was not representative, and there is no generalisability of the result to the total population. On the positive side was that where the investigation was done, all levels involved in HCW were interviewed, as well as substantive, on-the-spot observation of practices where HCW was generated until disposed of.

The strength of a cross-sectional study conducted in all private hospitals in the province of Fars in Iran was that it gave a detail account about HCW management practices and quantities generated. As such, recommendations emanating from the study were relevant, and reflected on the existing situation and possible interventions for private hospitals in terms of HCW management (Askrian, *et al.*, 2004b).

2.9 Areas of future research

The HIV and AIDS pandemic has resulted in an unprecedented increase in home-based care and medical waste that is generated in these instances needs to be researched. General practitioners have a responsibility to create a safe environment, but in their research they discovered that only seven percent of general practitioners had a written infection control policy, and only 14 percent provided training for their personnel on proper HCW management practices (Sneddon, *et al.*, 1997). Therefore, there is a need to do an investigation on HCW management practices at private sector institutions in the district.

In conclusion it is relevant to note that HCW offers numerous challenges to waste managers through out the world, as HCW needs to be managed appropriately in order to minimise or eliminate its deleterious effects on environment and public health (Diaz, 2005).

2.10 Summary

HCW was defined in this literature review, and all waste categories were listed. These categories included pathological, infectious, sharps, and pharmaceutical and general waste. It is important that HCW is treated with the respect it deserves, as it has the potential to spread diseases such as Hepatitis and HIV. There was also a review of international trends in HCW management, and the South African perspective was also examined. This was followed by a critical look at the country's legislative framework. The issue of the definition was also interrogated, as it is important in looking at waste volumes and the cost of HCW disposal.

Principles of sound HCW management were also presented. They have been included in the ideal HCW management model that has been presented. Included in the model are issues such as waste minimisation and prevention, waste segregation, waste collection, and waste disposal. This model will be used in evaluating HCW management practices employed in the iLembe District.

The following chapter discusses the study methodology employed in dealing with HCW in the iLembe District, with focus on issues such as study population, sampling, questionnaire design, data collection, and data analysis.

3 CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses research design, study population, sample, measuring instrument, and data collection procedures. A structured individual interview based on a questionnaire was used to collect data from 31 clinics in the iLembe District Municipality.

Data collected included average number of patients visiting each public clinic per month, as well as HCW composition, quantities, and waste processes up to the point when it is taken for disposal. The questionnaire was tested in a pilot survey.

3.2 Type of research

This is health systems research. The information obtained is to inform policy and an intervention strategy within the municipality.

3.3 Study design

The study design was observational, descriptive, and cross-sectional. This was used in order to provide insight into existing health care waste management practises utilized in public clinics in the iLembe District.

3.4 Study population

The reference population was all primary health care clinics in KwaZulu-Natal. The study population consisted of all government fixed clinics in the iLembe District. This district was selected because of its easy access to the researcher.

ILembe District municipality is situated outside the northern boundary of the eThekweni Metropolitan, south of the uThungulu District municipality and on the west it shares its boundary with uMgungundlovu District municipality. ILembe District municipality is made up of four local municipality namely, KwaDukuza, eNdongakusuka, Maphumulo and Ndwedwe, and has a total population of 560 377. Agriculture and manufacturing sectors both employ 41% of the total number of employed people in the district. Only 10 610 people in the district have acquired tertiary qualification. This information was obtained from Statistics South Africa census 2001 (Statistics South Africa website <http://www.statssa.gov.za>).

There are 31 clinics in the district, of which 29 are day clinics and two offer a 24-hour clinic service (known as Community Healthcare Centre (CHC)). The study population comprises both urban and rural public sector clinics.

This investigation excluded hospitals, mobile clinics, private health care providers, and veterinary service providers, as well as any other HCW generators in the district.

3.4.1 Sampling and sample size

A census of all 31 public clinics in iLembe district was used in order to give a comprehensive picture of HCW management in the district (see attached map for public health clinic points, annexure G). This study provided baseline information on HCW management in the district.

All clinics were included because the sample size was manageable and as a census there was a need to get the picture of what is actually happening in the public clinics in the district of concern.

3.5 Data sources

Trained research assistants administered a standardised, semi-structured questionnaire (annexure A). Data was sourced from the person-in-charge of the health facilities, using interviewing technique, as well as observing the practice of how health care waste is dealt with in the clinics.

3.5.1 Measuring instrument

The questionnaire used was adapted from a questionnaire developed for a study that was conducted on behalf of the Gauteng Department of Agriculture, Conservation, Environment and Land Affairs in 2001 to assess the HCW management practices in Gauteng health care facilities. The only section of the questionnaire that was excluded was the one that dealt with the incinerators as all clinics in the district were not utilizing incinerators.

Data was collected on a semi-structured questionnaire, which included closed and open-ended questions. Questions measured variables such as waste volumes, components and that constitute the HCW generated, and recorded all observed practises in managing the HCW at the health facilities. This system was used to ensure all data fields in the questionnaire were completed. Interviewers were trained to effectively deal with complicated issues, and were able to make relevant observations.

3.5.2 Variables

The following variables were observed and recorded during data collection:

- ❖ Total number of patients
- ❖ Type of clinic

- ❖ Areas where HCW is generated
- ❖ Separation of HCW
- ❖ HCW handling methods
- ❖ Transportation of HCW to central storage points
- ❖ Conditions at central HCW storage point
- ❖ Handlers of HCW
- ❖ Training of staff on HCW handling
- ❖ Use of protective equipment
- ❖ Needle stick injuries
- ❖ Storage and collection of sharps
- ❖ Storage and collection of non-sharps
- ❖ Disposal costs of HCW per month
- ❖ Knowledge of legislation applicable to HCW management
- ❖ Manual, policy, or guidelines for HCW management
- ❖ Waste management team
- ❖ Defined procedure for HCW handling
- ❖ HCW management inclusion in the job description of the person in charge

3.5.3 Reliability

To ensure the reliability of the data collected, a measuring instrument that had already been used and validated in a previous study was used. The measuring instrument was standardized, and research assistants were used as observers. These assistants² were trained in standard observation and interview techniques during intensive three day training session from the 13th of June 2007 to the 15th of June 2007. Two follow up sessions were conducted on the 22nd June 2007

² The research assistants were second and third year students doing a Diploma in Environmental Health at Mangosuthu Technikon, and they were paid out of funding from the Health Systems Trust.

and the 25th of June 2007 after piloting the study outside the district of investigation.

The training sessions were all held at the Mangosuthu Technikon in uMlazi. Research Assistants were provided with the schedule that was sourced from the WHO guidelines on HCW which listed different categories of HCW. Each Research Assistant working alone. During the training emphasis was made on the importance of safety as such they were provided with muffs and gloves to protect themselves when they were handling HCW.

The training centred around questionnaire completion and on interviewing skills, as well as observational skills. On a daily basis, research assistants handed completed questionnaires to the supervisor, whose task was to ensure that all elements of the questionnaire were completed accurately. The supervisor also attended to daily queries experienced during data collection.

3.5.4 Validity

3.5.4.1 Internal validity and reduction of bias

3.5.4.1.1 Internal validity

Content validity: The instrument was designed to measure all components of the variables in question to ensure high content validity.

Construct validity: All questions were logically related to variables measured, and to the overall study aims.

3.5.4.1.2 *Reduction of bias*

Interview bias was reduced by using a standardized and validated measuring instrument. The researcher used an existing instrument that had already been tested in other studies. To avoid information response bias, the researcher also used trained research assistants under close and continuous supervision.

Selection bias was avoided by including all the public health clinics in the district.

3.5.4.2 *Threats to external validity / generalisability*

The study population is likely to represent all similar clinics in KwaZulu-Natal, and possibly in other mixed rural / urban provinces in South Africa.

- a) The study was representative, as all public clinics in the district were part of the investigation.
- b) Interviews were conducted in the natural setting of the participants.

3.5.5 Pilot study

A peer review of the questionnaire formed part of the initial stage of testing the validity and reliability of the measuring instrument. This stage was followed by a pilot study that was conducted at six public health clinics outside the iLembe District. These clinics were selected based on easy access to the research assistants. No major difficulties were experienced by the participants. The questionnaires were completed with relative ease, and the responses were within what was expected as normal answers. These public clinics were not included in the sample population and data analysis.

The research assistants visited each health facility for a day, recording details of volumes of waste generated, and the waste handling practices observed and reported from the point when waste was generated to the point when waste was stored or disposed.

3.5.6 Data collection

Data collection was started on 26 June 2006 and the last clinic was visited on the 10 July 2006. This was done after receiving letters of approval from both the KwaZulu-Natal Department of Health and the District Health Office. All selected public clinics were visited in the district without warning.

Each research assistant was dropped at a particular clinics on the day of observation before the clinic opened for business, where she were to introduce herself and explain the purpose of the investigation to the person-in-charge at the clinic, with an intention to establish rapport as well as gain co-operation and support. Then the research assistant would then request that all waste generated on the day of the investigation be kept separate, but where it was not possible the weighing of that kind of waste was then done in the morning before the start of business as well as at the end of business and the difference between the two measurement was regarded as the waste generated on the day.

After the weighing of the waste interviews were conducted followed by the waste storage facilities inspections. In the case where waste was not separated research assistants would then separate waste into categories and then weigh it. The weighing times were consistent throughout the investigation.

The participants were informed about the research, its purpose, confidentiality, and the client's rights to refuse participation if they so desired. Participants were asked to voluntarily sign the consent form prior to participation in the study (appendix C). Confidentiality was maintained at all times. Research assistants

were equipped with weighing scales to measure quantities of different kinds of HCW generated by each participating public clinic, as well as copies of the questionnaires.

3.5.7 Data handling

At the end of each day, research assistants submitted their completed questionnaires to the Senior Research Assistant tasked with the responsibility of ensuring completeness and accuracy of all questionnaires. When data collection was completed, all checked questionnaires were handed over to the researcher, who performed data cleaning before data capturing to spreadsheet was done. Data, in a spreadsheet format, was then handed over to the Statistician for processing.

3.5.8 Statistical analysis

The statistician used the SPSS software for analysis of the data captured on the spreadsheet. The information obtained has been used to answer the research questions, and to compare this study with studies conducted by other researchers in this field.

The researcher was in constant liaison with statistician during data analysis. Frequency tables as well as the Pearson Correlation were utilized in the analysis of data.

3.5.8.1 *List of possible confounders*

The following were identified as possible confounders: operating times of clinics, rural and urban context, cultural beliefs, and economic conditions.

3.5.8.2 *Associations measured*

The following associations were measured: quantities of waste generated per patient, quantities of waste generated per local municipality and amounts of different waste categories generated in different public clinics.

3.6 Ethics

3.6.1 Institutional ethical review

Ethical approval was granted by the University of KwaZulu-Natal Biomedical Research Ethics Committee (annexure D).

3.6.2 Permission from various concerned authorities

After receiving the Ethics Committee's approval, a letter was then dispatched to the Provincial Department of Health asking for permission to conduct the investigation in their clinics. This request was positively met (annexure E). Furthermore, permission was sought from the office of the iLembe Health District Manager. The District Manager granted permission, and informed the public clinics accordingly about this investigation (annexure F).

Informed consent was also obtained from the participants, who, after agreeing to participate, were asked to sign the consent form (annexure C). The participants were assured of the confidentiality as they participated in the investigation. Furthermore, participants were assured that no disciplinary action would be instituted against them based on the findings of this research.

3.7 Summary

The research design, sample, and data collection methods employed in this investigation proved effective and efficient for this investigation. The data collection instrument proved able to collect the desired information about health care waste management. This being an exploratory study enabled the researcher to explore new avenues in terms of health care waste management.

Utilization of a structured interview schedule allowed the researcher to focus on collecting data relevant to the variables that were being investigated, as well as to achieve a high response rate.

The next chapter focuses on describing the findings based on the data collected.

4 CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents results from the survey conducted to investigate HCW practices employed in public health clinics in the iLembe district. The following results are based on data from interviews administered to key informants by trained field workers.

Processed data on all the variables listed in section 3.5.2 of chapter 3 are presented in this chapter.

4.2 Descriptive analysis of the results

4.2.1 Type of clinic

The iLembe district has 31 public clinics but only 30 were observed, as one clinic was being renovated at the time of data collection and was not functioning normally. Of the 30 public clinics observed, two (7%) provide a 24-hour clinic service, while the remaining 28 (93%) are day clinics, although 10 (36%) of the 28 day clinics provide a 24-hour emergency on call clinic service.

The district has four local municipalities, and the clinics are evenly distributed in the four municipalities as depicted in Table 1.

Table 1: Type of clinic in each local municipality³ (number) in the iLembe District, 2006.

Municipality	Type of Clinic		
	24 hours	Day	Total
KwaDukuza	0	8	8(27%)
Ndwedwe	1	6	7(23%)
eNdondakusuka	1	6	7(23%)
Maphumulo	0	8	8(27%)
Total	2	28	30(100%)

4.2.2 Informants

Table 2: Designation, number and percentage of informants used in data collection in the iLembe District, 2006.

Informants	Number	Percentage(%)
Chief Professional Nurse	2	7
Senior Professional Nurse	6	20
Professional Nurse	18	60
Infection Control Nurse	2	7
Senior Enrolled Nurse	1	3
Registered Nurse	1	3

Most (28) of the respondents were professional nurses. Two were designated Infection Control Nurses (Table 2). Managing HCW is an infection control function.

³ Data on municipality is presented in the same order throughout this report. The order is based on the size of the population living in each municipality, from the highest to the lowest (KwaDukuza: 158 586, Ndwedwe 152 482, eNdondakusuka 128 672 and Maphumulo 120 637), based on information from Statistics South Africa census 2001.

4.2.3 Total number of patients per day

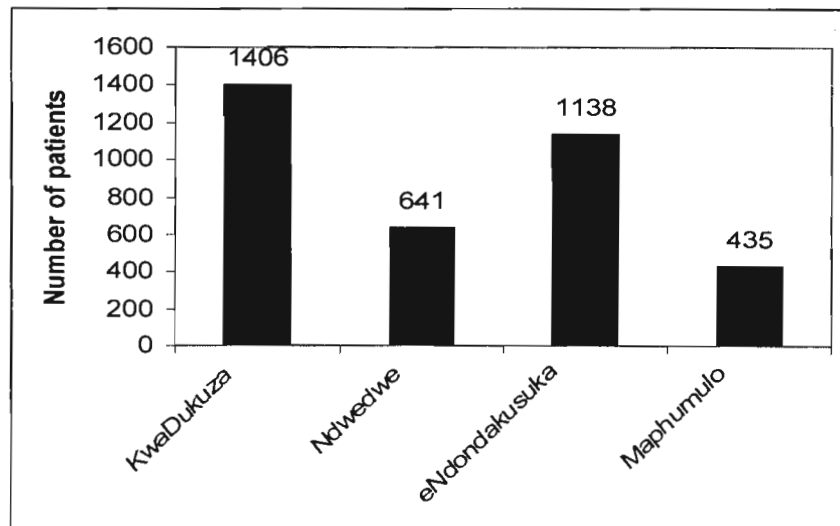


Figure 1: Total number of patients/day in each local municipality in iLembe, 2006 (N = 3620)

One of the questions in the questionnaire asked about the number of patients seen at each public clinic on the day it was visited. The total number of patients seen at different public clinics in the district on the day data was collected was 3620 patients. KwaDukuza municipality had the highest patient count at 1406 per day, which was 39% of the total. This was followed by eNdondakusuka with 31% (1138), Ndwedwe with 18% (641) and Maphumulo with 12% (435).

4.2.4 HCW generated

The HCW generated in the district varies in different municipalities. eNdondakusuka produced the most (45%), KwaDukuza produces 25%, with Ndwedwe and Maphumulo producing 18% and 12% respectively.

Table 3: HCW generated (kg & percent) in the iLembe district, 2006

	Gene- ral (kg)	Infec- tious (kg)	Sharps (kg)	Patho- logicals (kg)	Pharma- ceuti- cals (kg)	Total (kg)	Per- cent %
KwaDukuza	41.8	5.9	1.9	0.0	2.5	52.0	24.8
Ndwedwe	21.9	12.4	2.5	2.0	0.0	38.7	18.4
eNdondakusuka	67.0	13.0	5.8	1.8	7.1	94.7	45.2
Maphumulo	14.0	3.7	1.4	0.0	5.2	24.3	11.6
Total	144.6	35.0	11.5	3.8	14.8	209.7	100.00
Percent %	69.0	16.7	5.5	1.8	7.04	100.0	

About two-thirds (69%) of the total HCW produced in the district is general or non-risk HCW, and the remaining 31% was HCRW which requires special treatment and proper disposal measures.

Table 4: HCW generation rates in the iLembe District, 2006

Local Municipality	HCW (kg/day)	Number of patients	Generation rate (kg/patient/day)
KwaDukuza	52	1406	0.04
Ndwedwe	39	641	0.06
eNdondakusuka	95	1138	0.08
Maphumulo	24	435	0.06
Total for district	210	3620	0.06

KwaDukuza had the highest population in the district, and generated the most HCW, but at the lowest rate (0.04 kg/day). On the other hand, eNdondakusuka had a lower number of patients per day, but has the highest mass and rate of generating HCW (0.08 kg/day).

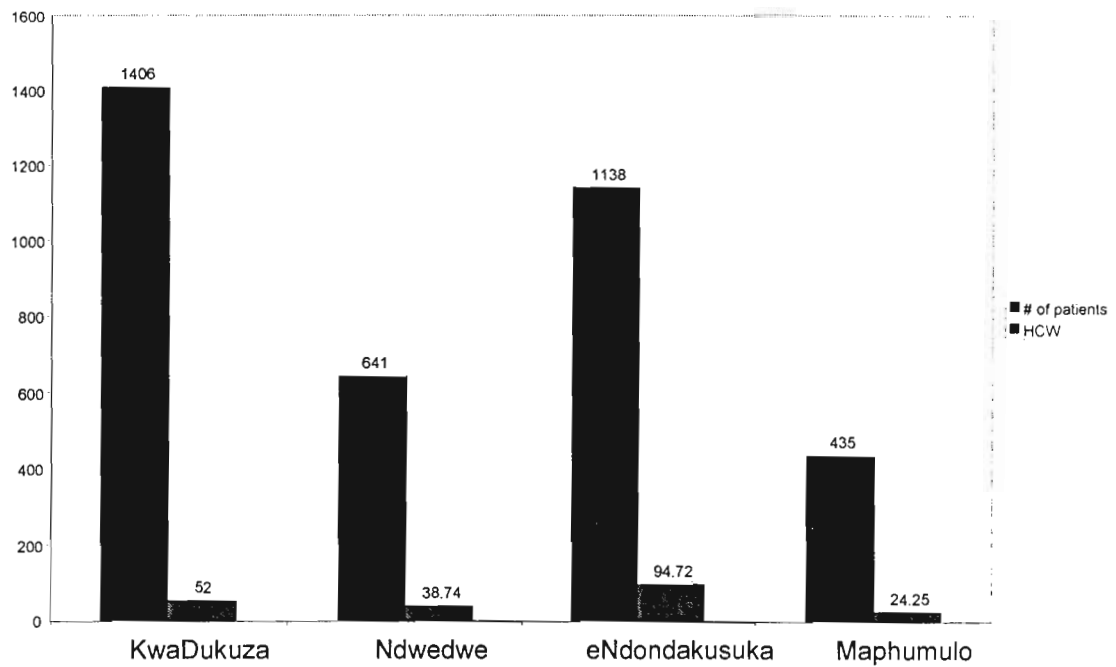


Figure 2: Total number of patients/day and total HCW (kg) generated/day in the iLembe District, 2006

There is a positive correlation between the amount of HCW generated and the number of patients attending public clinics in the district (Figure 2). This relationship is explored further using a Spearman Correlation (See Section 4.3 below).

4.2.4.1 Health care general waste

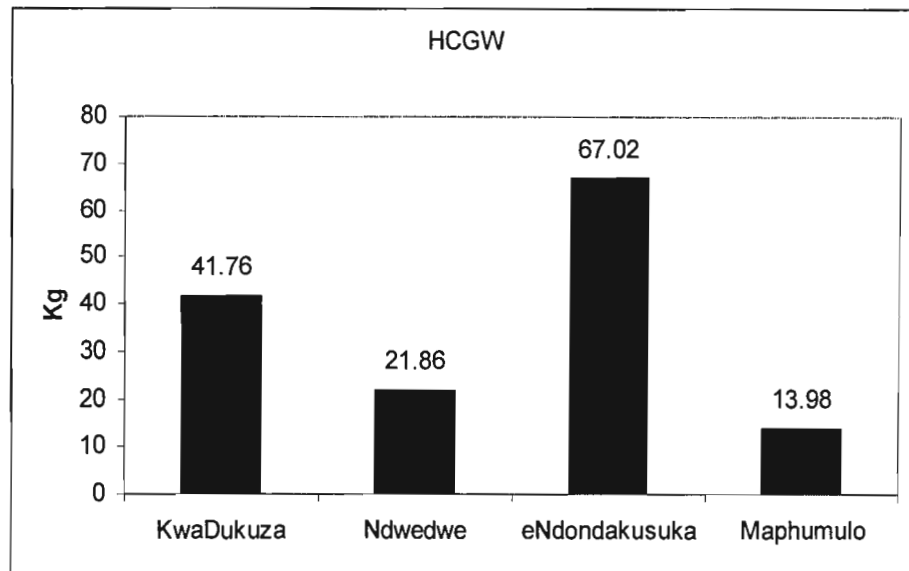


Figure 3: Amount of HCGW generated/day in the iLembe District, 2006

The district is generating a total of 145 kg/day of HCGW with 46% of the total HCGW generated coming from eNdondakusuka followed by KwaDukuza (29%). Ndwedwe and Maphumulo generate 15% and 10% respectively.

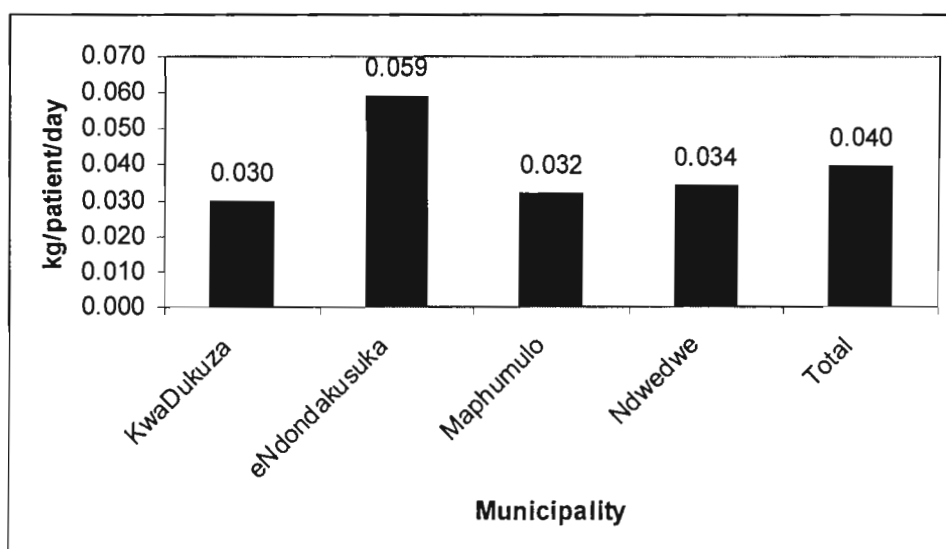


Figure 4: Amount of HCGW kg/patient/day in the iLembe District, 2006

ENdondakusuka generated 0.059kg/patient/day of HCGW, which was disproportionately higher than the rest of the local municipalities in the district. The other three municipalities generated a very similar quantity of waste per day.

Three (10%) of the respondents disposed of surgical gloves with HCGW, and 4 (13%) included glass and 2 (7%) included syringes in HCGW.

4.2.4.2 Health care risk waste

KwaDukuza produced the lowest ratio of HCRW at 0.007 kg/patient per day. The HCRW generated by the other three municipalities ranged from 0.024 kg/patient/day to 0.026kg/patient/day.

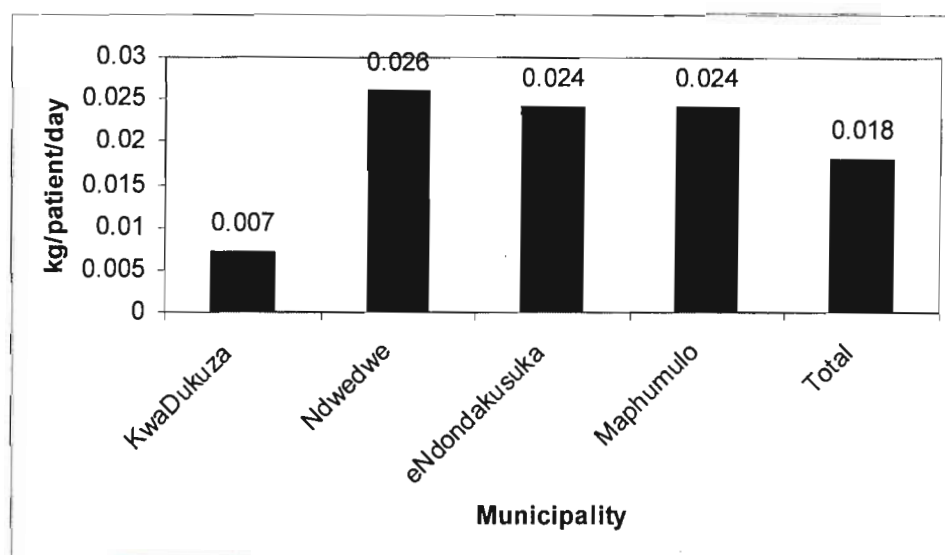


Figure 5: Amount of HCRW kg/patient/day generated per municipality in the iLembe District, 2006.

4.2.4.2.1 *Infectious waste*

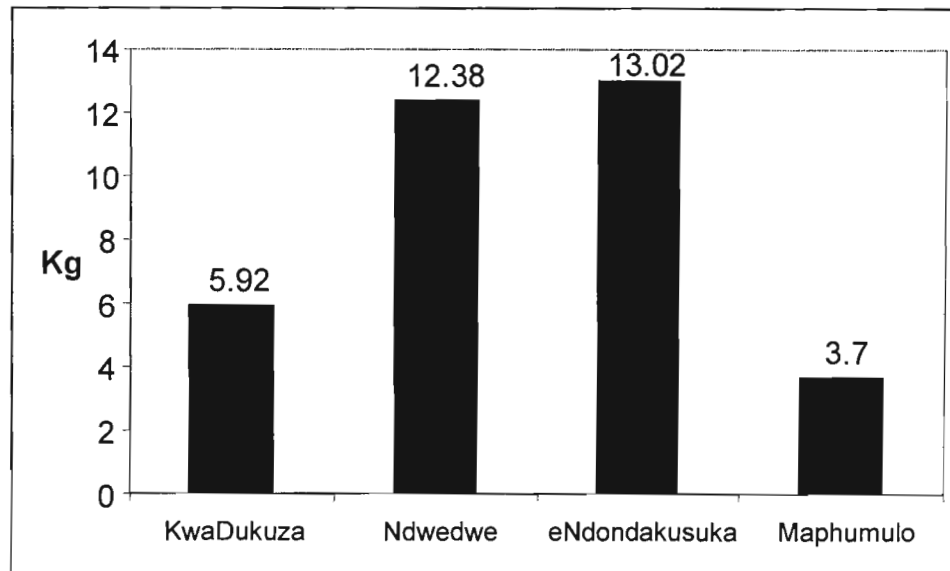


Figure 6: Amount of infectious waste generated per local municipality in the iLembe District, 2006

Endondakusuka generates the highest amount of infectious waste at 13.02 kg/day (37%) followed by Ndwedwe at 12.39 kg/day (35%), while KwaDukuza and Maphumulo generate 5.92 kg/day (17%) and 3.7 kg/day (11%) respectively.

4.2.4.2.2 *Sharps generated*

Sharps made up only 5% of the total HCW produced. About 50% (11.5 kg) of sharps waste in the district was generated by public clinics in eNdondakusuka, 22% (2.52 kg) came from Ndwedwe clinics, while 16% (1.87 kg) and 12% (1.35 kg) was produced by KwaDukuza and Maphumulo clinics respectively.

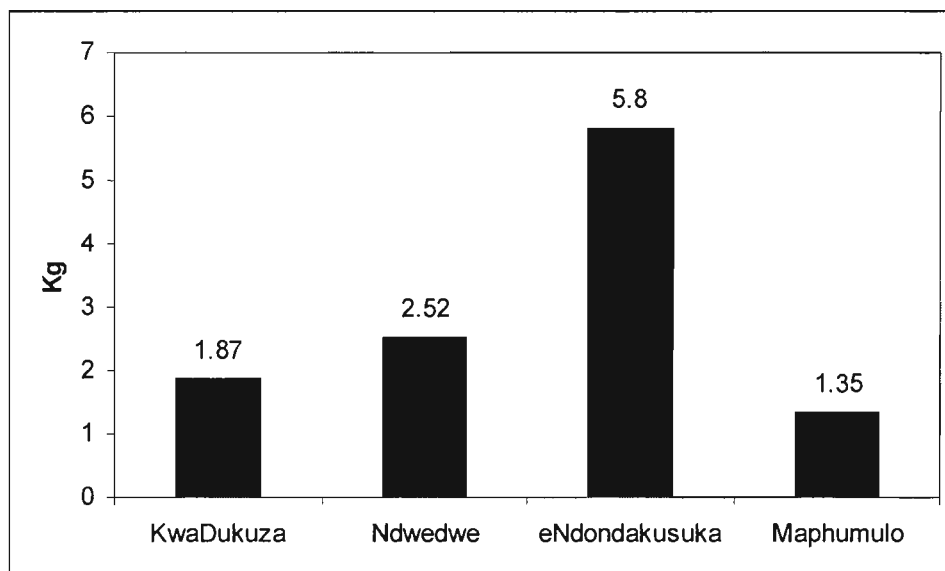


Figure 7: Amount sharps (kg) generated per local municipality in the iLembe District, 2006

4.2.4.2.3 Pathological waste

Only two (7%) of all the clinics generated amounts of pathological waste. In both cases, this was made up of placenta.

4.2.4.2.4 Pharmaceutical waste

Four of the clinics had expired pharmaceutical waste. The system used in most of the clinics was that drugs were sent back to the mother hospital or Community Healthcare Centre (CHC) before they could expire.

4.2.5 Separation of HCW

All clinics reported separating the HCW into five categories at source. These categories are general, infectious, sharps, pathological, and pharmaceutical wastes. One (3%) of the clinics was found to be using a black plastic bag for infectious waste, 6 (20%) disposed of their HIV/AIDS test kits with sharp waste,

while 2 (10%) disposed of theirs with infectious waste. Most of the clinics correctly disposed of their test kits by disposing of them in sharps containers.

4.2.6 Waste disposal

4.2.6.1 HCGW disposal

HCGW was burnt and then buried by 6 (20%) of the clinics, while 5 (17%) had their HCGW collected by a municipality contracted company, 4 (13%) by municipal waste collectors 10 (37%) sent their HCGW to the mother hospital, and the remaining 4 (13%) of clinics sent their HCGW to a CHC.

It was observed that 7% of the respondents were disposing of syringes in HCGW while 13.3%, and 10% of glasses, and 10% surgical gloves were also disposed of in HCGW.

4.2.6.2 Infectious waste disposal

About 63% (N=30) of infectious waste in the district was sent by clinics to mother hospitals for disposal, 17% was sent to Community Healthcare Centres, 13% was burnt and buried in a shallow pit, and the remaining 7% was collected by a HCW waste management company.

4.2.6.3 Sharps disposal

Three of the clinics (7%) reported that their sharps were collected by a HCW waste management company, 17% sent their sharps to Community Healthcare Centres, and the balance (77%) were sending their sharps to their mother hospitals.

4.2.6.4 Pathological waste disposal

Three of the respondents reported that they give placenta to the patients for their own disposal, and one stated that they dispose of placenta in the clinic's pit latrine.

4.2.6.5 Pharmaceutical waste disposal

About 7% (N=30) stated that expired drugs are dissolved in the water and flushed down the drain. The rest send their expired medicine to the mother institution for collection and disposal by a waste management company.

4.2.7 Transportation of HCW to central storage point

All the respondents indicated that waste is physically carried by general workers and nurses to the central waste storage point.

4.2.8 Conditions of central HCW storage points at the clinics

Only one of the clinics in the iLembe district had a purpose-built central HCGW storage area. A range of other interim measures were used. These included storing the waste in an unused but lockable toilet (5), a lockable storeroom (4), sluice room (1), consulting room (1), patient toilet (2), purpose-built refuse area, shallow pit (2), strewn at the gate (1) or pit (1), unused locked up toilet (5), or in the clinic boardroom (1).

4.2.9 Training of staff on HCW handling

Three quarters (77%) of the clinics reported having been trained in the management of HCW.

4.2.10 Use of protective equipment

In all clinics, health care waste handlers were observed to be wearing surgical gloves, “canteen” overalls, and shoes as the only protective equipment.

4.2.11 Needle stick injuries

Only seven of the 30 clinics responded by saying that needle stick injuries have been experienced in their clinic in the previous 5 years, while workers were handling HCW. Three out of seven (43%) needle stick injuries were reported from the Maphumulo local municipality.

4.2.12 Storage and collection of sharps

All clinics reported that they were storing and collecting sharps in puncture proof containers. Clinics sent all sharp waste to either a provincial hospital or community healthcare centre (CHC) within their area of jurisdiction. Different types of vehicles are utilised to collect sharps from different clinics and transporting them to either the hospital or CHC. Vehicles that are used are not purpose-built.

4.2.13 Storage and collection of non-sharps

Different containers are used to store and collect non-sharp waste, ranging from plastic bags to cardboard boxes with liners. There is no uniform procedure, and none of them are labelled. Maphumulo and Ndwedwe clinics use clear bags for the collection of HCGW.

4.2.14 Disposal costs of HCW per month

Only 3 (10%) of the 30 respondents knew the cost of HCW disposal for their clinic.

4.2.15 Knowledge of legislation applicable to HCW management

Four (3%) of the respondents knew the legislation applicable to HCW management. None of these were from KwaDukuza. All those who had knowledge of the legislation quoted the Occupational Health and Safety Act as the legislation that deals with HCW.

4.2.16 Manual, policy, or guidelines to HCW management

When respondents were asked about knowledge of a manual, policy or document on HCW management, 77% (23) of respondents indicated that they were aware of a manual, policy, or document on health care waste management.

Comparing responses across local municipality, 88% (n= 8) of public clinics in KwaDukuza responded with a yes, while the lowest affirmative response of 57% (n=7) was recorded for clinics in Ndwedwe. The results for eNdondakusuka and Maphumulo were 86% (n=7) and 75% (n=8), respectively.

4.2.17 Waste management team

Waste management teams existed in seven (23%) of the district clinics, and 43% of the existing waste management teams are in public clinics found in eNdondakusuka.

4.2.18 Defined procedure for HCW handling

All respondents indicated that they were aware of the correct procedures for handling HCW (as shown in Table 3 above).

4.2.19 HCW management included in the job description of the person in charge

The study found that 87% (n=30) of the respondents indicated that waste management duties are included in the job descriptions of the person in charge of the public clinic. It is interesting to note that both Ndwedwe and eNdondakusuka respondents reported that in all of their public clinics HCW management is included in the job description of the person in charge of the clinic.

4.2.20 Handlers of HCW

Within the clinic, up to the central waste storage point, all the waste is physically carried or handled by general workers, except for sharps, which are handled by the nurse. From the storage point until disposal, HCW is handled by either the waste management company or municipal employees.

4.3 Analytical statistics

The following analytical statistics represent the relationship between the different types of HCW, as well as comparing it with the number of patients.

A very high Spearman correlation ($r = 0.881$ at $p < 0,001$) was recorded between the HCW and HCGW. Also worth noting is the correlation between HCGW and patients ($r = 0.517$ at $p = 0.003$).

Table 5: Spearman correlations (r) values for different relationships

	r value	p value	N value
HCW and HCGW	0.881	P<0.001	30
HCW and infectious waste	0.533	0.002	30
HCW and sharps	0.421	0.021	30
HCW and Pharmaceutical	0.400	0.600	4
HCW and patients	0.427	0.018	30
HCGW and patients	0.517	0.003	30
HCGW and infectious waste	0.411	0.024	30
Infectious and patients	0.283	0.130	30

4.4 Summary

The results show that there are divergent views and practices in HCW management. It is also evident from the results that cultural beliefs play a pivotal role in HCW management.

It is worth noting that Sundumbili CHC had the highest number of patients (641 per day) and was also generating the highest amount of HCGW and infectious waste (58.78 kg/day and 10.68 kg/day respectively). In the case of sharps, they generated about 1.58 kg/day.

In the following chapter, results are discussed in detail.

5 CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter discusses the findings presented in the previous chapter. The discussion is based on the literature reviewed in chapter 2, which includes the presented ideal HCW model, and principles of proper waste management as outlined in section 2.4.12 of this dissertation. HCW management is discussed in relation to the protocol developed by the KwaZulu-Natal Provincial Department of Health, and other principles outlined in the literatures reviewed.

5.2 Analysis of results

Health care waste results from a number of activities performed in different areas of health care facilities, such as consulting rooms, waiting area, reception, and staff canteen, but not limited to these areas. Different health care activities performed result in the generation of the different categories of health care waste, of which HCRW poses serious threat to public health and the environment, if not properly treated and disposed of.

5.2.1 Health care waste generation

This study found that about 69% of the total HCW generated in the district was HCGW while the remaining 31% was made up of HCRW. The 31% HCRW was made up of 19 % infectious and pathological waste; pharmaceutical accounted for 7%, and 5% was sharp waste. The norm, according to the World Health Organization's (WHO) guidelines, is that clinics produce about 75% to 90% HCGW, and 10% to 25% HCRW (WHO, 2005c). The results from this study are skewed away from the norm as presented by WHO.

Comparative clinics, in India generated 71% HCGW, 19% infectious waste, 8% pathological, 1% pharmaceutical and 1% sharps (Patil, Shekdar, 2001). HCRW was about 10% of the total HCW generated in Mauritius (Mohee, 2004), while it was 26.5% in Nigeria (Bassey, Benka-Coker, Aluyi, 2006). At the Leratong hospital (South Africa) HCGW was 84% and HCRW was 16%. These two figures correspond with WHO's norms (Kristiansen, Senaoana, 2003).

The conspicuous difference is attributed to a lack of proper segregation of HCW into the five known categories. In some instances syringes and surgical gloves were disposed of in HCGW containers. There is a tendency to over-dispose HCRW because of fear of transmitting pathogens from waste suspected to be contaminated. The proper implementation of HCW management plan will change the proportions of volumes. With proper segregation of HCW, less than 10% of the total HCW will be HCRW (Leonard, Unpublished).

Compliance with existing segregation systems, as well as the implementation of an easy and accessible colour-coding system, will play a crucial role in bringing volumes down to a level comparable with WHO guidelines. Segregation must be simple, and applied uniformly and universally through out the district (WHO, 2005c).

5.2.2 Generation rate

Maphumulo and Ndwedwe (regarded as rural municipalities) had a similar HCW generation rate of 0.06kg/patient/day, while KwaDukuza and eNdongakusuka (regarded as urban municipalities) were at the opposite ends of the spectrum at 0.04kg/patient/day and 0.08kg/patient/day respectively, which was contrary to the belief that urban health facilities tend to have a higher HCW generation rate (Patil, Shekdar, 2001).

KwaDukuza had the lowest HCRW generation rate at 0.007kg/patient/day. The highest was Ndwedwe, with 0.026kg/patient/day. Compared to a study in Mauritius where 0.179kg/patient/day of HCRW was generated (Mohee, 2004), the district has a very low waste generation rate.

The waste generation rate for health care waste is influenced by a number of different factors, such as the number of patients, size of the clinic, type of health care services rendered, socio-economics status of the patient, and a variety of other factors (Mohee, 2004; Yimer, 2005; Askarian, *et al.*, 2004b).

5.2.3 Segregation of health care waste

All the clinics in the district indicated that they are separating waste into five categories, but of concern was that in some of the clinics, HCGW contained elements of HCRW such as syringes, surgical gloves, and other infectious waste. The iLembe District results were similar to those in Brazil in the study conducted by Da Silva *et al* (2004), where all public clinics demonstrated strict adherence to segregating sharps waste. Public clinics were using rigid, puncture-proof, yellow containers with the international hazardous waste logo.

The presence of HCRW in HCGW indicates poor HCW segregation. It also exposes all those who come into direct contact with the HCRW to the risk of being infected by pathogens and possibly renders the environment unsafe. HCRW must be appropriately labelled and segregated from HCGW, from the facility where it is generated to the point of treatment and disposal (McLean, Watson, Muswema, 2006).

This means that HCRW is not given the proper attention it deserves, as it is still being disposed of with HCGW in municipal waste disposal sites (Uysal, Tinmaz, 2004).

Segregation at the point of generation must be the common practice at all health care facilities (Jang, Lee, Yoon, Kim, 2006). Many health care workers are not fully aware of what constitutes HCRW (Akter, Hussain, Trankler, *et al.*, 2002), which results in misclassification of waste. The KZN provincial HCW protocol emphasizes waste segregation at the point of generation. The results of this survey suggest that not all HCW generators in the district are adhering to the principle of segregation at the point of production, as stated in the provincial protocol. Public clinics can reduce their disposal costs by implementing appropriate HCW segregation systems (Miyazaki, Une, 2005; Da Silva, *et al.*, 2005; McLean, *et al.*, 2006; Hagen, *et al.*, 2001; Klangsin, Harding, 1998; Kizlary, Iosifidis, Voudrias, *et al.*, 2005).

When significant amounts of mis-segregated HCGW are placed in HCRW containers, HCGW is treated at a higher cost. Significant savings can be achieved by appropriately segregating HCW (Kristiansen, Senaoana, 2003).

5.2.4 Training of staff

It is encouraging that about 77% (N=30) of the respondents responded affirmatively on the question of staff being trained in HCW management, compared to the 40% reported in the study conducted in Iran (Askarian, *et al.*, 2004b). Proper training in HCW reduces the negative impact that can be caused by improper HCW management. Lack of proper training of personnel in HCW poses a serious risk to patients, the public, and the environment (Mayazaki, Une, 2005).

Training of staff in HCW management must not be once-off, but should rather be a continuous process. If education is effective, it should have positive spin-offs in terms of protecting the environment and public health.

It is imperative that regular training is offered to all involved in the generation and handling of HCW, in order to achieve the goals set out in the HCW management plan (Oweis, Al-Widyan, Al-Limoon, 2005; Carvalho, Silva, 2002).

Cleaners and nursing assistants are responsible for the collection, storage, and transportation of HCW and these workers usually do not wear sufficient protective gear during waste handling (Da Silva, Hoppe, Ravanello, *et al.*, 2004).

Changing staff attitudes and motivating them to behave responsibly in terms of HCW management, from the point of generation to the point of final disposal, is critical.

5.2.5 Needle stick injuries

Needle stick injuries are an acknowledged occupational hazard for health care workers, and there are numerous reports to show that transmission of pathogens occurs because of needle stick injuries (Sneddon, Ahmed, Duncan, 1997). The reported 23% (N=30) needle stick injuries in this study is considered higher, compared to the 8.7% recorded in the study conducted in Dar es Salaam (Mato, Kassenga, 1997), but lower than the 30% reported amongst municipal workers in Japan (Miyazaki, Une, 2005).

The high percentage of needle stick injuries in the district demonstrated that information acquired during training sessions is not translated into practice. Therefore, there is a need for a continuous training programme for personnel handling HCW, as changing people's attitudes and perceptions can not occur overnight.

The OSHA seeks to protect workers in their places of work. In this context, the OSHA seeks to eliminate needle stick injuries among health care workers who are dealing with HCW sharps in particular, in the work place. Changing staff

attitudes through training and education on proper HCW management can significantly reduce the number of needle stick injuries in the district.

5.2.6 Storage and collection

In the case of sharps, all clinics stored and collected sharps in colour-coded puncture-proof containers as per the requirements of the provincial protocol. There is concern with the storage of infectious waste, as some of it was found mixed with HCGW. This situation exposes waste handlers to infectious pathogens. Challenges identified in terms of infectious waste collection and disposal was the lack of container labelling. Containers were used without the necessary labels, such as the international logo for infectious material, and the point of generation as required by WHO (2005c). This was similar to findings made by Blenkharn (2006), where satellite storage areas were found to be freely accessible to visitors and other unauthorized persons. Proper storage, using colour coded and labelled containers based on the type of waste, is important in terms of providing relevant treatment and disposal of HCRW. The use of different areas, most of them not secured, suggest a need to develop a plan that would ensure proper, safe and secure HCRW storage in order to prevent easy access, thereby protecting the environment and public health.

5.2.7 Transportation

High-risk HCW items such as sharps and infectious wastes need to be transported in a safer manner, to prevent accidental injuries and infection of any who come into contact with it during transit. This would safeguard the environment against possible contamination. According to the HCW management model outlined in chapter 2, all HCRW must be transported in dedicated and purpose built vehicles. During data collection, it emerged that some public clinics were transporting their HCRW with other goods and passengers. These vehicles were being driven by people who were not equipped

to deal with this kind of waste. The drivers, according to WHO (2005c), who transport HCRW must, at all times carry consignment documents detailing the HCRW being transported, and the vehicles used for HCRW collection must be purpose-built, fully enclosed, seamless, and easy to clean. There is insufficient training of staff that are handling and transporting HCRW (McLean, Watson, Muswema, 2006).

It has been emphasised by other authors that during the 'hygienic' transportation of HCW, it must not come into contact with patients or the public, so as to prevent the spread of communicable diseases (Sharma, Bansal, Sharma, 1994).

HCRW handling in the iLembe district is very high, as waste is moved from the generation point to the waste storage site, then transported by vehicle to the mother hospital or Community Health Care Centre where it is stored until it is picked up by the waste company for treatment and final disposal.

5.2.8 HCW disposal

About 10% of the clinics were giving pathological waste, such as placenta, to patients for dispose at their homes. A similar practice has been reported in Iran where pathological waste (with bones attached) is given to the patient or a relative for burial according to religious rites (Askarian, *et al.*, 2004b).

Comparatively, results from the iLembe district are far better than results in Dar es Salaam, where 70% of health care facilities surveyed were disposing of HCRW in open pits dumping, or by burning and burying. Such practice has a potential negative impact on the environment, as it can cause water, ground, and air pollution. The findings of this investigation were similar to those made by Leonard (unpublished), in that some of the HCW was unaccounted for, as it was burnt and buried at some of the public clinics.

Expired pharmaceuticals were being dissolved in water and flushed into the drainage system. This practice is against the National Water Act, which seeks to protect all watercourses. In all the clinics where this practice was used, drains are not connected to municipal waste water lines, which mean that the local ground water is potentially being contaminated with harmful chemicals.

5.2.9 HCW disposal cost

Nearly all (90%) of the clinics reported that they did not know how much it was costing them to dispose of the HCW. As a result, they cannot monitor whether their disposal costs are increasing or decreasing. This situation is similar to the one in Japan, where health care institutions do not obtain accurate information on quantities of individual waste categories, nor on treatment and disposal costs (Miyazaki, Une, 2005).

Information on disposal cost is an important management tool in monitoring trend and patterns in HCRW disposal.

5.2.10 Knowledge of legislation applicable to HCW

It is apparent from data collection that personnel at district public clinics know about the OHSA. According to the OHSA, employers must ensure protection of workers from the negative impact of HCW, and have the obligation of ensuring environmental protection. None of the respondents referred to other important pieces of legislation that deal with the disposal of HCW, such as NEMA and the ECA.

5.2.11 Manual, policy, or guidelines for HCW management

Some of respondents were not aware of any manual, policy, or guideline that deals with HCW management, yet there are a number of manuals, policies, and

guidelines. These include KwaZulu-Natal HCW protocol, South Africa National Standards code 100428, and DWAF's Minimum Requirements, all of which specifically deal with HCW management.

5.2.12 Waste management team

The health care waste management team plays a pivotal role in the successful implementation of a HCW management plan, as it is formed by representatives from all categories of staff in the health care facility. The HCW management team must meet on a regular basis (at least once a month), and must oversee the implementation of a HCW management plan (Oweis, Al-Widyan, Al-Limoon, 2005).

It was disappointing to note that majority of public clinics in the district do not have a structure in dealing with HCW. Many do not have health care waste management teams which are central to a proper HCW management plan.

5.2.13 Defined procedure for HCW handling

All clinics responded affirmatively in knowing the procedure for handling HCW, but during data collection, it was observed that not all are aware of proper HCW handling practice. Some of the clinics were not following the correct waste segregation system. Other clinics were burning their infectious waste. This was as a result of some health care workers being unaware of HCW related hazards (Uysal, Tinmaz, 2004).

This reflects an attitude of carelessness, as people are aware of proper procedures in handling HCW, and yet are performing the opposite of the defined procedures. Health care workers do not perceive handling and disposal of HCRW as hazardous work (Akter, Hussain, Trankler, *et al.*, 2002). About 87% of

the respondents responded affirmatively that HCW management responsibilities are included in the job description of the person in charge of clinic.

5.2.14 Use of protective equipment

In all the clinics, HCW handlers were provided with and wore surgical gloves, which is contrary to the minimum requirement standards as laid down in the WHO (2005c) document that requires HCW handlers to wear heavy-duty gloves. Surgical gloves do not provide adequate protection, particularly against sharps. These findings are similar to the findings of the study conducted in Tanzania, where inadequate provision of personal protective gear to HCW handlers was identified as a serious health risk to the workers (Mato, Kassenga, 1997). This is in contravention to the requirements of the OHSA.

5.3 Limitations

There are a number of limitations that this study has in order to generalize the findings. The three limitations that have been noted are; information bias, selection bias, and response bias.

5.3.1 Information bias

The information on waste quantities was measured in one day, and this does not reflect true volumes of waste generated in the district. For the true volume, the generated volumes have to be measured over a longer period of time. The other concern regarding accuracy of waste volumes is that some of the clinics were not properly segregating their waste. Consequently, these results must be treated with caution.

The study was also limited in that it did not cover liquid waste from public clinics, which forms part of HCW, such as radioactive waste, and mercury from broken thermometers.

This investigation intended to establish patterns in terms of disposal cost, but this information was not readily available at most of the public clinics that were studied.

Respondents indicated that they were aware of the OHSA, but this did not mean that respondents understood and applied principles contained in the legislation.

5.3.2 Selection bias

Findings from this study cannot be generalised in terms of private clinics, general practitioners, hospitals, and veterinary practices, as they were not represented in the study. The investigation concentrated on all public clinics in the iLembe District, with an even urban-rural mix. Consequently, the results are only generalizable to KwaZulu-Natal public clinics.

There was also an element of selection bias in terms of who actually responded to the questionnaire. The person-in-charge of each public clinic was the intended respondent, which was a limitation, as it presented response bias in the case of personal protection in terms of findings.

5.3.3 Response bias

In terms of needle stick injuries, respondents were required to recall from memory whether there had been any such injuries in the last five years.

5.4 Conclusion

The management of certain health care waste categories is of great concern, particularly sharps, infectious, pathological, and pharmaceutical waste. Each of these categories poses challenges to health care waste managers, from the point of generation to disposal. These challenges include segregation, storage, handling, and disposal.

The proper development and implementation of an information-based HCW management plan has significant benefits for health care facilities (Mayazaki, Une, 2005). This must be supported by a representative and fully functional health care waste management structure, which is able to monitor and control all HCW management activities.

6 CHAPTER SIX: RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

The previous chapter has presented all the findings made in terms of health care waste management in the iLembe district. It is evident that a number of gaps exist regarding proper health care waste management in the district. Following are recommendations regarding the different aspects of health care waste management that need to be addressed so as to ensure proper disposal in order to protect the environment and public health.

6.2 Conclusion

For a long time, health care service has been rendered without taking into consideration the impact of its waste on the environment and public health. HCW has played a role in depleting natural resources, degrading the natural environment, and in causing harm to human health. The onus is on HCW generators to apply the principle of care, by ensuring proper disposal of HCW. It is encouraging that health care facilities worldwide are beginning to fulfil societal goals for a cleaner and safer environment.

It must be understood that health care providers are mandated to improve or better quality of life by using the best available resources. It is therefore imperative that health care providers fulfil their mandate within a regulated framework that will ensure public health and the protection of the environment against the ills of HCW.

In conclusion, it is vital for the District Health Office to develop an intervention strategy that will be implemented consistently and universally throughout the district. Research findings in other parts of the world have demonstrated that improving the standard of health care waste management is practical and economically efficient (Jameton, Pierce, 2001).

6.3 Recommendations for improvement

In legal terms, all generators of HCW are responsible for the safe handling and disposal of HCW. This is based on the principles in NEMA, such as the principle of care, the polluter pays principle, and the “cradle to grave” treatment of health care waste.

6.3.1 Responsibilities of waste generators

Waste generators are required by law, as stated in section 2 of NEMA, to ensure proper handling, transportation, and disposal of the waste they generate. The White Paper on Integrated Pollution and Waste Management emphasises the duty of care as one of the responsibilities of the health care waste generator.

The employer is entrusted with the responsibility, in terms of the OHSA, of providing a safe working environment, in order to prevent needle stick injuries and provide for the protection of the environment and public health. Proper education and awareness must be implemented in all public clinics in order to safeguard public health and the environment.

It is also incumbent upon the waste generator to record waste generated, particularly HCRW in terms of its categories. Therefore, it must be made clear to all persons in charge of all facilities where HCW is generated that they are responsible and liable for the HCW their facilities generate.

Record keeping is also the responsibility of the waste generator. It is important for a number of reasons, such as being a management tool, providing a baseline for measuring progress in terms of implementing the HCW management plan, as well as for reflecting the responsibility that has been taken by the health facility in ensuring that proper care has been taken to dispose of HCW, which can be used in possible litigation in terms of NEMA (section 28).

6.3.2 Waste segregation

Before considering waste segregation, health care institutions must first consider waste minimization, and must apply the principle of green purchasing. When minimization fails, then proper waste segregation at the source must be implemented, with waste separated into the five relevant categories and not mixed from that point until disposed of. Waste segregation and colour-coding work jointly. Appropriate colour-coded containers must be used at all times. Clear plastic bags for the storage of HCGW as has been observed in other public clinics, and is strongly supported and recommended, as it can prevent injuries and misclassification of HCW.

Proper waste segregation has a number of benefits, such as worker protection, environmental protection, and the reduction of disposal costs.

6.3.3 Waste storage area

Lack of proper and purpose-built waste storage areas was evident throughout the investigation. There is a need to for all facilities to identify an appropriate area to be designated as a waste storage area, and which must meet all the requirements as stated in the previous chapter.

In future, all drawings submitted for the construction of a clinic must make provision for a dedicated waste storage area catering for both HCGW area and HCRW area.

6.3.4 Transportation

It is important for the health districts to establish a regular health care waste removal transport system, operated by a qualified and adequately trained driver operating a purpose-built and exclusively used vehicle.

In terms of the Gauteng Province HCW Management Regulations (2000) and the Western Cape Bill on HCW Management, it is incumbent upon the generator to ensure that whoever is transporting the HCRW is registered, and carries the necessary documentation. The HCW generators must practice environmentally safe waste transportation and disposal methods.

6.3.5 Health care waste management plan

All health care facilities must have a waste management plan, drafted after a properly conducted HCW audit. Data collection, segregation, transportation, storage, disposal, protective equipment, education, training and awareness must be included in the waste management plan.

6.3.6 Health care waste management team

All health care waste generators must have a functional and accountable HCW management structure that meets on a regular basis preferably once a month, and which is assigned the responsibility of evaluating progress in terms of the implementation of the HCW management plan.

6.3.7 Health care waste disposal

HCGW must be disposed of using the municipal waste removal system, where possible. However, where not possible, other means of disposing of waste must be explored, without compromising public health and environment. Isolated and poorly resourced public clinics, without access to centralised waste treatment and disposal, may identify a secluded area where proper landfill principles can be applied in order to dispose of their HCRW without compromising the environment and public health (World Bank, 2000).

All HCRW must be disposed of using HCW Management companies, as they are equipped to treat and dispose of HCRW without causing any environmental degradation and without compromising public health. In cases where pathological waste is given to the patient for disposal, proper containers must be used, and proper education must be given on how to prevent environmental degradation and ensure public health protection.

The practice of dissolving and discharging drugs into the sewer system, which is generally not connected to the municipal sewer system, must be discouraged, as it pollutes ground water, which is the contravention of the NWA.

6.4 Recommendations for further studies

- There is a need to conduct an investigation on how other waste generators, such as hospitals, private clinics, general practitioners, and private hospitals are handling their HCW.
- There is also a need to investigate the veterinary services, as to how they are managing their HCW.
- There also a need to investigate disposal costs for all public clinics in the district.

- Another area of investigation is that of liquid, and hazardous waste management in the district.
- The low waste generation rate of the district needs to be investigated particularly after the implementation of the proposed HCW management intervention strategy.

6.5 Summary

Mounting pressure in the form of scientific and technical knowledge regarding the negative impact of HCW on the environment and public health has necessitated a need to improve HCW management.

Health care providers are faced with the challenge of balancing quality health care provision against environmental protection. In the past, medical knowledge focused on issues around benefits to patients, and no consideration was given to the HCW generated, which compromised the environment and human health.

This study demonstrated that health waste has not received the attention it deserves, which has been a common observation in developing countries (Bdour, *et al.*, 2006).

It would therefore be best to introduce an aggressive awareness program that will inform all generators and handlers about best practice in HCW management. This would ensure compliance, and thereby protect the environment and public health.

It is encouraging that in South Africa environmental issues are taken very seriously. It has been noted in an article written by Victor Munnik that the DEAT is beginning to enforce its environmental protection legislation. About 800 Environmental Management Inspectors, referred to as "Green Scorpions" or Green Police, have been recruited, trained and dispatched to enforce

environmental laws (Progress Magazine, 2006, 10: pp36-39). This clearly demonstrates that the current government is placing a very high premium on environmental protection and conservation, and the community at large is challenged to do likewise.

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8 APPENDICES

Annexure A

8.1 QUESTIONNAIRE

Identification Number: _____

Name of the health care facility	
Area	
Telephone number	
Date of interview	
Interviewer	
Contact person	
Designation	
Local municipality	

1. Type of health care facility:

- ☐ Day clinic
☐ 24 hour service clinic

2. Total number of patients per day: _____

3. List of areas where waste is generated: _____

4. Do you separate HCW?

☐ yes

☐ no

If yes, into which categories:

- ☐ General waste
☐ Infectious
☐ Sharps
☐ Pathological
☐ Pharmaceutical

1. Describe current waste handling methods:

	Storage	Disposal	Quantity	Components
General				
Infectious				
Sharps				
Pathological				

Pharmaceutical				
----------------	--	--	--	--

5.1. How is waste transported to the central waste storage point?

5.2. Describe conditions of the central waste storage point:

6. Who handles health care waste?

☐ Internal staff:

Designation	Number

☐ Waste management company.

Name: _____

7. Was there any training on HCW management received by any of the HCW handling staff? ☐ yes ☐ no

8. Are waste handlers using any protective clothing? ☐ yes ☐ no

9. Have the waste handling staff experienced any needle stick injury in the last five years? ☐ yes ☐ no

10. Are sharps stored and collected in:

☐ Old bottles and containers

☐ Special puncture proof containers

☐ Other (specify): _____

11. Is the non-sharp HCW stored and collected in:

☐ Plastics bags

☐ Cardboard boxes (with liner)

☐ Cardboard boxes (without liner)

☐ Plastic bin

☐ Other (specify): _____

12. Do you know your current treatment / disposal charges costs?

☐yes ☐no

If yes, state:

General waste R _____/kg

Sharps R _____/kg

Infection, chemical and pathological R _____/kg

13. Are you aware of any legislation/s applicable to HCW management?

☐yes ☐no

If yes, list the legislations: _____

14. Are you aware of any manual, policy or document on HCW management?

☐yes ☐no

If yes, list them: _____

15. Does your clinic facility have any waste management team?

☐yes ☐no

If yes, list members:

Designation	Total number

16. Are there clearly defined procedures for collection and handling of waste in the health care facility? ☐yes ☐no

17. Are waste management responsibilities included in the job description of the person in charge of the health care facility?

☐yes ☐no

8.2 INFORMATION DOCUMENT

Study title:

Situational Health care waste management in the public clinics in the iLembe District: analysis and intervention strategy.

Greeting: Good morning / day

Introduction:

I, Sibusiso Derrick Gabela, am doing research on health care waste management. I am doing this study as part of my Master of Public Health degree at the University of KwaZulu-Natal. Research is just the process to learn the answer to a question. In this study we want to learn how the health care waste is handled at all the public clinics in the iLembe District.

Invitation to participate: We are asking you to participate in this research study by answering questions regarding the health care waste management. We will also be observing how you manage health care waste in your clinic.

What is involved in the study: The study involve answering questions related to health care waste in your clinic and also measuring the different components of health care waste. You are also expected to show us areas where the waste stored. This study involves all the clinics in the iLembe District.

Risks: You as the participant will in no way be exposed to any risk by participating to this research.

Benefits: The research will provide information on waste handling practices employed in clinic and that will inform policies and procedures on health care waste management.

Participation is voluntary, that refusal to participate will involve no penalty. Names of people and clinics involved will not appear on any of the reports.

Confidentiality: Efforts will be made to keep personal information confidential. Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law.

Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the Research Ethics Committee and the Medicines Control Council (where appropriate).

Contact details of researcher: Sibusiso Derrick Gabela, P O Box 72, Stanger, 4450. Cellphone Number 0828599948

Contact details of REC administrator and chair:

The Research Ethics Committee

University of KwaZulu-Natal
Medical School
Durban
4000

borresen@ukzn.ac.za

Tel No 031 260 4604

8.3 CONSENT FORM

Consent to Participate in Research

Annexure C

You have been asked to participate in a research study

You have been informed about the study by the Research Assistant.

You may contact Sibusiso Derrick Gabela at 08285 99948 any time if you have questions about the research or if problem arise as a result of the research.

You may contact the Medical Research Office at the Nelson R Mandela School of Medicine at 031-260 4604 if you have questions about your rights as a research subject.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to stop.

If you agree to participate, you will be given a signed copy of this document and the participant information sheet which is a written summary of the research.

The research study, including the above information, has been described to me orally. I understand what my involvement in the study means and I voluntarily agree to participate.

Signature of Participant

Date

Signature of Witness
(Where applicable)

Date

Signature of Translator
(Where applicable)

Date

19 October 2005



Mr S D Gabela
c/o Dr S E Knight
Community Health
Nelson R Mandela School of Medicine

e-mail : kwazi@telkomsa.net

Dear Mr Gabela

PROTOCOL : Health care waste management in the public clinics in the iLembe District : Situational analysis and intervention strategy. S D Gabela, Ctr for Rural Health. Ref.: H085/05

A sub-Committee of the Biomedical Research Ethics Committee considered the abovementioned application and the protocol was approved pending the submission of appropriate answers to queries raised and approval from the Postgraduate Education Committee. These conditions have now been met and the study is given full ethics approval. Please note that the study may not begin without approval from the Department of Health. Please could a copy of this approval be sent to our office for record keeping purposes.

This approval is valid for one year from 19 October 2005. To ensure continuous approval, an application for recertification should be submitted a couple of months before the expiry date. In addition, when consent is a requirement, the consent process will need to be repeated annually.

A full sitting of the Committee was advised of this study when it met on 5 April 2005.

May I take this opportunity to wish you everything of the best with your study. Please send the Biomedical Research Ethics Committee a copy of your report once completed.

Yours sincerely

PROFESSOR A DHAJ
Chair : Biomedical Research Ethics Committee

c.c. Dr S Knight, Community Health
Mr S Siboto, Postgraduate Education

**Nelson R Mandela School of Medicine, College of Health Sciences,
Head: Bioethics, Medical Law and Research Ethics**

Postal Address: Private Bag 7, Congella 4013, South Africa

Telephone: +27 (0)31 260 4604

Facsimile: +27 (0)31 260 4529

Email: dhajal@ukzn.ac.za

Website: www.ukzn.ac.za

Founding Campuses:

Edgewood

Howard College

Medical School

Pietermaritzburg

Westville

T d

12:60 50 00N 60

Annexure E



DEPARTMENT OF HEALTH

PROVINCE OF KWAZULU-NATAL

SPECIAL SUPPORT SERVICES

Natalia, 330 Longmarket Street, Pietermaritzburg, 3201
Private Bag X9051, Pietermaritzburg, 3200
Tel.: 033 395 2813, Fax.: 033 345 4433

Enquiries: Ms A. Kopman
Extension: 2813
Reference: 9/2/3/R

03 NOV 2005

Mr S.D. Gabela
KwaDukuza Municipality
P.O. Box 72
KWADUKUZA
4450

Dear Sir

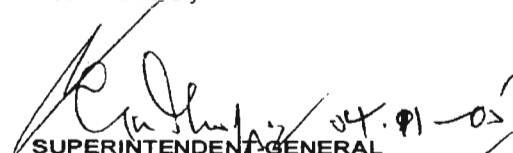
PERMISSION TO CONDUCT RESEARCH IN THE ILEMBE DISTRICT PUBLIC CLINICS

Documents dated 22 June 2005 and 28 October 2005 with regard to the above, refer.

Please be advised that authority is granted for you to conduct research entitled "**Health care waste management in the public clinics in the iLembe District**", provided that :-

- (a) Prior approval is obtained from the Heads of the clinics;
- (b) Confidentiality is maintained;
- (c) The Department is acknowledged;
- (d) The Department receives a copy of the report on completion; and
- (e) Full ethical approval is granted.

Yours sincerely


SUPERINTENDENT GENERAL
HEAD : DEPARTMENT OF HEALTH

A.J.K.gabela

Umnyango Wezempilo



Departement van Gesondheid

Annexure F



DEPARTMENT OF HEALTH

PROVINCE OF KWAZULU-NATAL

ILEMBE HEALTH DISTRICT

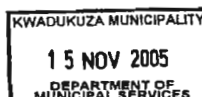
Private Bag X10620, Kwa Dukuza, 4450
Tel.: 032 4373500, Fax.: 032 5511590, Cell : 0834571163
E-mail.: dubesi@dohho.kzntl.gov.za

Enquiries: Miss S. Dube

Date: 14/11/2005

Ref: DM05/11/1243

Mr S.D. Gabela
KwaDukuza Municipality
P.O. Box 72
Kwa Dukuza
4450



Re: Permission to conduct research in the Ilembe District Public Clinics

Your letter dated 10th November 2005 refers.

Kindly note that the Heads of Clinics will be notified of your pending study so that they can give you their approval when you do request it.

Best wishes.

Yours sincerely

Miss S. Dube
District Manager - DC29
Ilembe Health District

P.01/01

10 0325512476

12-NOV-2005 23:27 FROM

Annexure G

