AN EVALUATION OF OPERATIONAL AND ADMINISTRATIVE PROCEDURES FOR HEALTH CARE WASTE MANAGEMENT IN PUBLIC DISTRICT HOSPITALS OF SOUTH AFRICA

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DECLARATION:

I hereby declare that the dissertation submitted for the degree Doctor of Technology: Business Administration, at the Durban University of Technology is my own original work and has not been previously submitted in any candidature for any degree. This dissertation is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by explicit references: A reference list is appended.

Sipho Bongane Vumase

Signed:_____

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Abstract

Although there is an abundance of health care waste information in South Africa, not enough studies have been done in public district hospitals particularly in rural areas. Hospitals find it difficult to comply with the minimum requirements of health care waste management guidelines, such as segregation of waste. If hazardous waste gets mixed with non-hazardous waste, waste disposal and treatment become costly. Furthermore, there has been a sharp increase in the amount of waste generated from health facilities. However, there seem to be uncoordinated efforts in each province in dealing with waste problems.

The purpose of this study was to evaluate the process of operational and administrative procedures of health care waste management in hospitals. The study was conducted to facilitate the optimisation of waste management. A quantitative approach was chosen for this study because cause and effect relationships can more easily be identified, and the research is more structured and controlled. The project involved an enquiry into the perception of respondents on the procedures used in managing health care waste. Data was collected from 270 respondents out of 27 hospitals in nine provinces of South Africa. The informants were health care waste workers who were either directly or indirectly involved in waste management. A questionnaire was used as a research instrument. Results were analysed statistically using a special package for scientific studies.

It has been found that in the midst of financial challenges, hospitals are unable to prioritise and rank absolutely important activities that are necessary to be undertaken to meet minimum requirements of health care waste management as laid out in the health care waste guidelines and directives. Shortages of waste equipment such as trolleys, waste containers, and temporary storage areas were the main challenges facing hospitals. The recommendations set the tone and provide a blueprint that health care managers may consider in facilitating improvement in the management of health care waste.

Acronyms

ACB	:Awareness and Capacity Building
CEO(s)	:Chief Executive Officer (s)
DACEL	:Department of Agriculture, Conservation and Environmental Affairs
DANCED	:Danish Council for Environmental Development
DANIDA	:Danish International Development Aid.
DEAT	:Department of Environmental Affairs and Tourism
DoH :	:Department of Health
DWAF	:Department of Water Affairs and Forestry
EC	:Eastern Cape
EPR	:Extended producer responsibility
FS	:Free State
G	:Gauteng
GDACE	:Gauteng Department of Agriculture, Conservation and Environment
GDACEL	:Gautend Department of Agriculture, Conservation, Environment, and Land
HCF	:Health care facility
HCF's	:Health care facilities
HCGW	:Health care general waste
HCRW	:Health care risk waste
HCW	:Health care waste
HCWH	:Health Care Without Harm
HCWM	:Health Care Waste Management
HIV	:Human Immune Deficiency Syndrome
ISAT	:Internal Storage and Transportation
KZN	:KwaZulu-Natal
L	:Limpopo
M	:Mpumalanga
MS	:Management Support
MSW	: Municipal Solid Waste

NC	:Northern Cape
NDoH	:National Department of Health
NHS	:National Health System
NGO	:Non-Governmental Organisation
NC	:Northern Cape
NW	:North-West Province
OHS	:Occupational Health and Safety
PPE	:Personal Protective equipment
R	:South African Rand
RSA	:Republic of South Africa
SABS	:South African Bureau of Standards
USA	:United States of America
WIS	:Waste Information System
WHO	:World Health Organisation
WMP	:Waste Management Practices

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CHAPTER ONE

INTRODUCTION

1.1 Background

The modern health sector generates growing amounts of health care waste (HCW). This waste includes both health care risk waste (HCRW), which presents special health and environmental risks, as well as health care general waste, which can be considered to be similar to general waste.

Increased generation of HCW

During the past two decades, the world has experienced a dramatic increase in the amount of hazardous waste generated. As a result, this period also witnessed a vigorous drive for sustainable development and increased awareness, as well as concern for the environment (Ketlogetswe, Oladirang & Foster, 2004:67). The United Nations Environment Programme (UNEP) (UNEP, 2006:2) argued in their International Sourcebook on Environmentally Sound Technologies for Municipal Solid Waste Management that among all the wastes, HCW was one of the most problematic types. The developing world, including South Africa, has to grapple with managing HCW against the backdrop of competing priorities such as the HIV/AIDS pandemic. Incidentally, it is also the developing world that has been affected the most by the pandemic (UNAIDS, 2002:43). As a result of the high HIV/AIDS prevalence in this part of the world, there has been a considerable rise in hospital admissions and a high morbidity among the general population.

Consequently, there has also been a sharp increase in the amount of waste generated from health facilities. According to World Health Organisation (WHO), between 10 and 25 percent of waste generated in health facilities is regarded as hazardous due to its composition. The remaining 75 to 90 percent poses no risk of infection, as it is comparable to domestic waste (UNAIDS, 2002:44).

Use of incinerators

Globally, the management of HCRW has evolved considerably since the time when each hospital operated its own incinerator without any environmental protection measures. The emergence of alternatives to HCRW incinerators, as well as incinerators that comply with the highest international standards, has resulted in the introduction of several alternative technologies, as well as higher costs for HCRW treatment.

Human Resources and material resource capacity

Most researchers agree that the hospitals do not have enough capacity in terms of human resources and material resources to mitigate HCW problems (Gabela, 2007:ii), (African Development Bank, 2005:3); (DACEL, 2005:3), and (Brent, Rogers, Siimane, and Rohwer, 2007:4). The unacceptable management of HCW in the Public District Hospitals of South Africa (Public District Hospitals) is a case in point. This problem was the focus of various articles of South African origin (Brent *et al*., 2007:4), (DEAT, 2005:6) and (Molefe, Gcwensa, Kristiansen, and Rogers, 2006:7).

Coordination of the HCW management strategy

As part of National Waste Management Strategy, a most comprehensive, detailed study was carried out to determine the current HCRW generation

in South Africa (Molefe *et al*., 2006:7). However, there seem to be uncoordinated efforts in each province in dealing with waste problems (Molefe, *et al*., 2006:8). For example, Western Cape and Gauteng Provinces have gone ahead in developing HCW management legislation while the other seven provinces have not. These asymmetrical developments will make it difficult for the National Government to coordinate a national action plan.

Centralization of power in HCW management

Apart from uncoordinated efforts in dealing with waste problems, willingness on the part of the hospital management to implement available HCW management guidelines is thwarted by bureaucratic procedures imposed at provincial level (Molefe *et al*., 2006:16). For example, Naledi (2005:11) studied the decentralization of powers from provinces to the hospital managers. The study was confined to five tertiary and three district hospitals, that is, one hospital in each province. The interest herein is, however, on the findings for the three district hospitals. Hence, the focus of this study is public district hospitals. Naledi found that, in two out of three district hospitals studied, the procurement powers as well as human resource delegations had not been conferred. In other words, provinces decided for their hospitals in terms of what, where and when to procure goods and services.

As a result of the centralization of powers to provincial offices, the African Development Bank (2005:21), and Faye (2007:22) found that health facilities in the South African Region had obvious challenges. These challenges include lack of capacity to implement HCW management guidelines, lack of information and consistency throughout the provinces on HCW management practices, uncoordinated practices in the treatment

and disposal of HCW, lack of clarity with regard to roles of personnel within hospitals, and absence of models to epitomize HCW best practice.

Transportation of waste

Another problem concerns transportation of waste outside the hospitals. Transporting of HCRW is often done in vehicles not suitably designed or equipped for transporting waste. The Department of Agriculture, Conservation and Environmental Affairs (DACEL) (2005:13) noted that inadequacies in the waste tracking system were evidenced by HCRW from Gauteng finding its way to dams and neighbouring provinces. An example relates to the use of a trailer for the collection of HCW in a Zeerust small generator project. The Zeerust sub-district manager instructed the driver of the bakkie not to use the trailer since it was too heavy, difficult to maneuver, used too much fuel, and the quantities of waste were much less than first anticipated. Once it was explained to the manager that the trailer was the only legally registered vehicle for transporting hazardous waste, he gave instructions for the trailer to be used from then on (DEAT, 2006b:41-42).

Enabling regulations

In South Africa at the national level, there have been a number of initiatives that the Government embarked upon to address the HCW problem. An example is the legislation which includes the Environment Conservation Act (DEAT, 2006b:42). It was under this Act that the Gauteng Department of Environment developed the Gauteng HCW Management Regulations (DEAT, 2006b:42*).* However, what is important is not just the presence of Acts or Regulations. Waste management regulations require HCW generators to take all reasonable measures to ensure that HCRW generated at its facility is stored, transported, treated,

and disposed off in strict compliance with such regulations. This responsibility is called extended producer responsibility (EPR Working Group, 2008:2). The regulations further oblige HCW generators to ensure regular training of all employees on environmental awareness (Ramokate, 2007:17). Lessons learnt from both the Zeerust and Ekurhuleni small generator, rural projects (which this study builds upon) were that Government processes were problematic to complete in time. For example, the lengthy procurement procedures in the Zeerust study were the cause for delays in completing HCW improvement projects (DEAT, 2006a:17).

Administrative versus capacity problems

Poor administration and planning are also major weaknesses of waste management systems in Africa. The African Development Bank (2005:4) argues that success in any plans to upgrade waste programmes in Africa would first have to focus on the administrative and operational systems. For example, in 1992, the United Nations sponsored Earth Summit in which African Governments and Western donors pledged more than $2 billion to a World Bank-managed Global Environmental Facility designed for environmental rehabilitation in Africa. However, many Western donors refused to participate because they considered that African countries too often lack working policies, or if policies exist, they are not being monitored and/or evaluated (African Development Bank, 2005:5).

Since the last decade, there has been an increased environmental awareness in South Africa about dangers that HCW poses to humans and environment. This awareness forced authorities to take a responsible action to mitigate inherent dangers of waste management (DACEL, 2005:8 and DEAT, 2006a:2). However, a lack of capacity manifested by

the absence of administrative and operational procedures resulted in HCRW not being segregated from the general waste stream.

Misclassification and mixing of wastes

In a similar study conducted by Weir (2002:34) in Toronto children's hospital in Canada, it was found that HCRW comprised of other items that are not classified as HCRW. This misclassification was very costly since it was estimated that disposing HCRW was sixteen times more expensive than it was for health care general waste. The investigator concluded that the issue of the cost of HCW management is often overlooked by Government facilities in particular.

Recent studies have shown that there are problems regarding HCW practices, particularly segregation and storage of HCW. In a study conducted by Taru and Kyarega (2005:153), to evaluate HCW practices at Parirenyatwa Hospital in Harare, Zimbabwe, an overwhelming 98 percent of the employees interviewed reported that HCW was neither segregated nor stored according to its composition. It was also observed that HCRW and General waste were largely collected and stored together before final disposal.

1.2 Motivation for the study

The South African health care facilities consist of a mixture of rural and urban district hospitals. The rural nature of district hospitals is demonstrated by poor resources including poor roads, buildings, and communication systems and thus suffers from greater inherent delays to technological development than its urban counterparts (DEAT, 2004b:14). Further, for some rural health care facilities that generate small quantities

of infectious wastes, the high costs of morden incineration mean that this is not often a cost effective solution to the waste problem. Alternative options, such as transporting the waste to the urban facility are often impractical because of high transport costs. Moreover, the DEAT (2000a:14) feels that the proper management of HCW has social consequences since illegal dumping usually impacts on the poorer sections of the community where scavengers and other persons can access the landfills.

In the funding motivation for representatives from the DEAT and National Department of Health (NDOH) to attend a HCW international study tour, Otto (2008:3) wrote:

> *"Although the Gauteng Department of Agriculture, Conservation, Environment, and Land Affairs (DACEL) recently successfully executed a Danish funded project on sustainable HCWM in Gauteng, that project was primarily aimed at addressing HCW management in the urban environment. And, although it is assumed that the results from the Gauteng project would enable both public and private areas to address most of their HCW management problems, there may be some urban areas in South Africa where the Gauteng system cannot be replicated, whilst the problems in the rural hospitals and clinics are to be addressed in totality"* (Otto, 2008:3).

It is, therefore, evident from the above that a very limited number of public hospital studies is available in the country concerning HCW management. Also, where these studies were conducted, they were confined to the urban Public District Hospitals. The exception is the Zeerust rural HCW project.

In their assessment of the government commitment to Polokwane targets of the zero reduction of wastes to landfill by 2022, Taiwo, Otieno, and, Venter (2007:1) were pessimistic of success. Taiwo, *et al*., (2007:4) claim that, although South Africa is the most economically developed country on the African continent, the country is faced with numerous priority issues such as public safety, housing, education, and health. They argue that the HCW management is generally perceived to be of lower importance. This study attempts to highlight the status quo of the hospital in terms of the Polokwane declaration, specifically the safe disposal of HCW.

The need for a study in rural HCW is also supported by Ramokate (2007: 50) who stated in her concluding remarks after completing HCW study in Baragwanath Hospital:

> *"Since this study was only confined to Baragwanath hospital, a further (sic) research is needed in hospitals as the findings would assist the hospitals in the management of HCW. There is a need to conduct research in other areas which have to date not been researched" (*Ramokate, 2007:50).

In addition, the DEAT made a pertinent statement in the HCW project steering committee meeting held in Limpopo on the 30th of November 2004. This statement suggests that there was a need for HCW studies; however, funds were not available.

> *"Insufficient project funds disallow further similar projects in other provinces. However, the absence of any requests for support from provinces could be indicative of some resistance by provinces in terms of support from the National departments, which may justify investigations to be conducted on the new approaches to rural HCW management problems"* (DEAT, 2004a:4).

The responsibilities of a public hospital chief executive officer (CEO) includes facilitating safe HCW management, and the CEO is actually held responsible for any HCW mismanagement which may endanger the staff, patients, visitors or the environment due to the negligence of the staff in terms of handling and disposal of the HCW. The study will offer useful insights into the HCW management. This study is also important as it will reveal any inconsistencies in the discourse used for HCW management by the Department of Health.

1.3 Problem statement

A literature search highlights that most hospitals do not characterize or classify waste. The DEAT (2000b:15) found that hospitals in eight of the nine South African Provinces did not classify waste into categories. If hospitals do not quantify waste into its categories, namely, HCRW versus General waste, these wastes get mixed and becomes expensive in terms of disposal and treatment. Characterizing HCW enables identification of the most problematic wastes. This helps in quantifying daily needs for waste collection and handling equipment, as well as materials needed, for instance, yellow plastic bags, sharps, and the size of the treatment facility

needed. Financial and human resource needs can only be determined after waste classification has been made. Gabela (2007:7) notes that, in South Africa, there was no legislation promulgated to enforce reporting of HCW generated, and that there were no guidelines in respect of the type of information to be collected. Gabela (2007:13) argues that limited information about waste characteristics was as a result of poor segregation of HCW.

According to the Department of Health (2007:9), rural and remote hospitals have no acceptable or even substandard HCW treatment capacity available. This results in the use of unacceptable disposal methods such as an open pit burning, indiscriminate dumping, disposal with municipal waste, and the use of placenta pits. In most cases, rural hospitals have a number of poorly performing incinerators that need to be upgraded or replaced with acceptable technologies (Department of Health, 2005:9). In a similar but small scale study, DACEL (2005:3) found that waste handling and storage facilities in the generating points were inefficient and unacceptable. Fischer (2007:12) reports that there was limited incineration capacity and perceived high costs of treating HCW caused Public District Hospitals to illegally dispose of general waste in unguarded landfill sites.

Capacity building and awareness raising is a cross-cutting need in HCW management. According to the DEAT (2007b:41) the results involving 19 clinics and two hospitals in Zeerust, in the North-West Province, found that the health facility staff had no awareness about the need to wash hands after handling HCW, as well as wearing of protective clothing, and, therefore recommended full-scale training and awareness raising around HCW management. The need for an intensified training for HCW workers

was echoed by DEAT (2007b:2), who noted that the training and awareness raising was an important factor for improving HCWM. However, Swart (2007:2) argues that reasons for poor performance could not be solely attributed to lack of training. Swart (2007:3) contends that an insight and awareness about what constitutes misbehavior in waste management was equally important to change employees' attitude to a responsible waste management practice.

The problem of the Waste Information System (WIS) has not been fully addressed. Although WIS was developed and tested in the Eastern Cape and Mpumalanga by 2002 (DEAT, 2006b:16), it has not been successfully rolled out to all the provinces, particularly in remote areas. This waste information system has clear indicators that will be utilized for informed decisions for the management of HCW.

Regarding collection and transportation of waste, the status quo report in Zeerust (DEAT, 2000:14) noted that waste was collected by the Environmental Health Practitioner using an open light delivery vehicle. Legally, the vehicle must comply with the road acts for the transportation of hazardous waste. Among other problems reported by the DEAT (2000:15), were lack of proper internal transportation equipment which resulted in the manual handling of 25 litre specicans.

In addition, the role of the Public District Hospitals' management teams in supporting the HCW programme has not been active. In the status quo report for a Zeerust rural HCW project (DEAT, 2006b:17), the overall management of the HCW, including the line of command, was centralized at the district office. The sub-district manager had no direct role including the control of the HCW budget. Further, the institutional HCW officer was

not formally delegated to take responsibility for the day-to-day running of the pilot project. The weak management system was attested by an absence of policies and monitoring tools for the HCW programme (DEAT, 2006b:13).

Additionally, the Zeerust pilot project report (DEAT, 2006b:14) reveals that some critical management procedures were not being followed. This was particularly evident on the recording and disposal of the human tissue as required by the Health Act of 1983. Further, the segregation of waste was improperly done. This was manifested by hazardous wastes. For instance, needles, broken vials, and tubes which were found lying in the pits after the pit burning.

The above synopsis of HCW issues highlights the complications for hospitals wanting to take up their producer responsibility, and the realization of Government and the international community that something needs to be done. These issues led to this research. This research, as envisaged, is of prime importance as hospitals feel more pressure to take up their producer responsibility. There is generally a lack of a speedy progress with HCW issues. Discovering an appropriate and convenient model may assist in expediting the progress.

Inferences made, as per section 1.2 above indicate the fertile ground available within the HCW management to set an example for the optimal model. The process of this research is to evaluate the literature available in search of a model.

On the basis of the above problems, HCW management in the Public District Hospitals needs to be evaluated in terms of administrative and

operational procedures in order to exemplify the best HCW management model for the hospitals.

1.4 Main research objective

The objective of the study is to evaluate critically the processes of the operational and administrative procedures on HCW management (in terms of collection and transportation, treatment and disposal, organizational structures and personnel employed, capacity building and awareness raising, as well as the information systems used) in Public District Hospitals in South Africa in order to facilitate the optimization of HCW management.

1.5 Underlying objectives

The specific underlying objectives of the study were to:

- Map the waste management practices (WMP) employed in the management of HCW;
- Build an optimal conceptual model of Public District Hospitals' HCW management on a best practice basis;
- Identify factors affecting internal storage, collection and transportation of hospital HCW;
- Determine the role of the management teams in the HCW management programmes of the Public District Hospitals;
- Identify the level of awareness amongst Public District Hospitals' HCW managers and the need for the capacity building among handlers and disposers; and
- Determine the needs relating to waste information system procedures for Public District Hospitals' HCW management.

1.6 Rationale of the study

Health care is an integral part of human development as it raises human life expectancy. Therefore, the fundamental reason for this study is to understand the procedures employed in the HCW management in an attempt to prevent harm to humans and the environment. It is necessary to evaluate the engagement of the Hospital Management System in ensuring that employees are competent in the management of HCW.

The study will also evaluate the current HCW management systems. This includes HCW collection and transportation of HCW treatment and disposal, as well as usage of Waste Information System procedures in HCW management. The research aims to recommend a best HCW management model in the context of public district hospitals.

1.7 Scope

This study focuses on the processes of the operational and administrative procedures of HCW management. The municipal and nuclear solid wastes fall outside the scope of this research.

1.8 Limitations

According to Marshall and Rossman (1999:42), no research project is without its limitations, and there is no such thing as perfectly designed research. However, the results may broadly be applicable to other settings, for instance, fixed primary health care clinics. However, the following were some of the limitations of this study:

- The hospital management teams gave permission for the research on the condition that the names of hospitals participating in the actual research are not disclosed. Therefore, details of the hospitals that participated in the study will always be unknown. As such, hospitals were coded in accordance with the provinces in which they are situated;
- Owing to the extensive nature of the study, there will be no endeavour to measure and quantify the amount of the HCW produced by the hospitals. In an attempt to gain a general appreciation of the types of the wastes generated in hospitals, the waste streams' categories will be considered in accordance with studies that tried to measure the generation of waste in the South African context; and
- The study will only be confined to Public District Hospitals. No attempt will be made to cover private health care sectors including, but not limited to private hospitals, dentists, funeral homes, blood banks, and medical laboratories.

1.9 Research design and methodology

Research process

The research process in this study involves the evaluation of the available literature in search of a model for an effective HCW management best practice for Public District Hospitals. The questionnaires were used as research instruments. These questionnaires were distributed to HCW workers within the hospitals, after which they were statistically analyzed. The specific objectives and literature were used in the formulation of questionnaires. The theories developed in this research were based on Health EnviroTech & Logistics (ETLog). The ETLog assisted the Zeerust

Health District and the National Department of Environment, Agriculture and Tourism (DEAT) in the development of integrated HCW. Internationally, ETLog made use of the Rapid On Site Assessment (ROSA) method. The ROSA was developed by ETLog. ROSA includes standardized questions and evaluation criteria which quickly identify the room for improvement in a project to which it is applied.

Type of the study

The study is evaluative because the intention is to appraise the procedures employed in the Public District Hospitals following particularly the remote pilot projects in Zeerust and Ekurhuleni (DEAT, 2006). A quantitative approach was chosen for this type of research because cause and effect relationship can more easily be identified, and the research is more structured and controlled.

Sample selection

Whereas Phelan (2006:25) noted that a large sample size alone does not guarantee a representative sample, Neuman (2006:221) argues that a large sample, without random sampling or with a poor sampling frame, is less representative than a small one with an excellent sampling frame. The sample size of this study comprises 27 hospitals. Three hospitals were chosen per province. In each hospital, ten employees, directly or indirectly working with HCW, were personally interviewed, giving a sum total of 270 respondents. Among the ten employees to be personally interviewed in each hospital was one member of the top three management members, that is, the CEO, Medical Manager, or Nursing Manager. The other respondents who were chosen because of their direct involvement in HCW, were the HCW Officer, Health and Safety

Officer, Occupational Health Nurse, Infection Control Officer, Quality Officer, Ward Manager, HCW Handler, and a General Orderly.

Population

The sampling population in this study was employees working in the hospitals. The fundamental reason for choosing this population is because public hospitals have a large share in the generation of HCW in South Africa. There are 561 Public District Hospitals, each with between 200 and 800 employees. (Health Systems Trust, 2007:1)

Sampling

The purposive sampling has been chosen for this study. In this sampling, groups are termed clusters. Saunders, Lewis, and Thornhill (2005:167) claim that, for purposive sampling, the sampling frame is the complete list of individual cases within the population. Therefore, clusters in this case were regions as per Local Government demarcations. In addition, hospitals located in remote municipal areas were targeted because this study builds up from the Zeerust Rural HCW project.

1.10 Reliability

Reliability can be explained as the extent to which a tool can be relied upon to give results that are consistent (Neuman, 2006:222). Neuman (2006:223) adds that similar results must be obtained if the same test is carried out on more than one occasion under the same conditions. In this study, structured questions were used. These types of questions are normally consistently interpreted each time they are used (Neuman, 2006:223). In order to ensure reliability in this study, the researcher conducted pretesting of the questionnaire to ten HCW workers in one hospital under the Umkhanyakude district. This hospital was not part of

the Public District Hospitals that participated in the main study. Ambiguous sounding questions were pointed out and corrected. As such, the research instrument can be regarded as reliable.

1.11 Validity

Validity of the research instrument means that the tool measures what it is intended to measure (Saunders, *et al*., 2005:168). In this study, the content validity approach was mainly used to enable the researcher to assess different aspects in terms of HCW management procedures. The inputs received from the statistician, the Durban University of Technology promoter, and the waste consultants were useful in the formulation of clear and understandable questionnaires. Further, a copy of the questionnaire was given to the Nursing Service Manager of a district hospital for comment. As a result, some questions that had been included from the ETLog ROSA standardized questions, for HCW management, were eliminated since they were irrelevant to the study. Further, minor grammatical changes were made before the administration of the instrument. Each pretest interview took about 20 – 30 minutes for respondents to complete.

1.12 Structure of chapters

The first chapter, an introduction, gives an overview of HCWM practices in South African public district hospitals. Mention is also made of the role played by other government departments, the DEAT; non-governmental organisations such as African Bank; and an international funder, the Danish Council for Environmental Development (DANCED), in an attempt to improve HCW management. The background also provides the rationale, and, also indicates the motivation to pursue this study. The chapter goes on to discern the problem statement, research objectives

and specific underlying objectives which were used to develop the research instrument.

A review of literature surrounding Public District Hospitals and HCW management processes and procedures is described in chapter two and three, respectively. Although it might seem that a host of non-related matters are noted, the consistent premise throughout the literature searches involves HCW management practices and procedures. It is not always possible to compartmentalize the items in separate chapters as many aspects, such as financial and human resources, as well as capacity building, are cross-cutting issues, and apply across all the chapters.

It is difficult to look at the technical aspects of HCW in isolation as public hospitals are amongst the greatest generators of health care risk waste. Therefore, chapter two will investigate the mechanics of hospitals, including infrastructure and the role of the hospital staff in HCW management.

Chapter three consists of two parts, that is, the best practice methods and the optimal model for HCW management. In addition, the South African standards and norms affecting HCW management are also discussed. It is also important to present the international standards because the most HCW technology, for instance, incinerators, are procured abroad and thus affected by international standards.

Chapter four outlines the research design and methodology that directs this investigation. This chapter further explains the rationale behind the

choice of a quantitative methodology. The research questionnaires are analyzed in detail.

Chapter five presents the results in accordance with the study sub-objectives. In addition, the ranking of structures and processes necessary to evaluate adherence of hospitals to regulations covering HCW management is discussed. The data collected is analysed using descriptive and analytical measures and is summarised in various tables and graphs.

Chapter six contains the interpretation of the results. The results are discussed in terms of the sub-objectives. In addition, results are discussed in terms of their importance institutionally, provincially as well as in the urban versus rural contexts.

Chapter seven, the final chapter, gives detailed recommendations, suggested measures for the implementation of HCW management and a proposal for further research.

1.13 Conclusion

This chapter gave details of the HCW problems needing to be addressed in order to provide safety for the people dealing with waste, the public, as well as the environment. The research objective related to the evaluation of the processes of the operational and administrative procedures of HCW management in Public District Hospitals.

The population targeted for the research was HCW workers employed in Public District Hospitals, directly and indirectly involved in HCW. The pilot

study of the questionnaire ensured that the research instrument was reliable and valid as it made sure that the questions were well understood by HCW workers and managers.

In chapter two, the description of the HCW as well as Public District Hospitals will be presented. This will be followed by an examination of the procedures that Public District Hospitals employ in the management of waste. Lastly, the international best practice methods, which form the basis in the development of an optimal HCW model, will be explored.

CHAPTER TWO

PROCESSES AND PROCEDURES OF HEALTH CARE WASTE MANAGEMENT

2.1 Introduction

The primary objective of the study was to evaluate the processes of the operational and administrative procedures of HCW management in the Public District Hospitals. It was held that evaluating such processes would help in the development of the model for the optimisation of HCW management. Consequently, this chapter describes and characterises HCW and Public District Hospitals. In discussing the HCW management practices, the procedures for managing waste from generation to its disposal are discussed. These procedures entail handling and storage, collection and transportation, as well as treatment and disposal.

The major role that the management team of the Public District Hospitals play in the HCW management is deliberated in terms of organisational structures and personnel employed, the manager's level of awareness, the need for capacity building among waste handlers and disposers, as well as the waste information system procedures. Eventually, the HCW management best practice methods are explored for benchmarking in the South African context.

2.2 Descriptions of Health Care Waste (HCW)

2.2.1 Definitions

There is no singular definition of HCW (Integrated waste management board, 2008:3). Therefore, for the purpose of this study, two distinct categories of

hospital waste are being defined in line with the simplest HCW management studies conducted in the hospital settings to date. This is done to enhance a more vivid understanding and ease in analysing the trends and developments that have taken place in the field of HCW management. HCW is divided into two categories, namely, waste that poses a risk of infection and non-clinical waste.

Health Care Risk Waste (HCRW)

The London Department of Health (2006:1) defines HCRW as wastes that pose a potential risk of infection. This means that all HCW, whether produced in a hospital or community setting, is assumed to be infectious until it is assessed. This assessment is based on an item and patient specific clinical assessment, which is undertaken by the health care waste officer. Any failure to segregate infectious from non-infectious wastes will mean that the entire waste stream has to be classified as infectious waste, and consigned as such for appropriate treatment and recovery, or disposal.

Health Care General waste (general waste)

This term describes waste which is both non-infectious and non-hazardous, and therefore, does not require specialist treatment or disposal. This waste, though, may cause offence to those coming into contact with it (London Department of Health, 2006:4).

On the other hand, widely used definitions of HCW were coined by the World Health Organisation (WHO). The WHO (2005b: 2) defined HCW as the total waste stream from a Health Care Facility (HCF) that includes both potentially infectious and non-infectious waste materials. In South Africa, the definition of HCW was taken from the current version of the South African Bureau of Standards (SABS) standard which includes all the wastes generated in HCFs, health care research facilities as well as that originating from healthcare

undertaken in the homes, for instance, dialysis and insulin injections (DEAT, 2005:9). While the DEAT's definition is focussed in healthcare facilities, some provinces have extended the definition to include all facilities that are potentially infectious to humans, for instance, tattoo artists and body piercers.

Further, the Health Professional Council of South Africa (HPCSA) (2008:4) defined HCW as any undesirable or superfluous by-product, emission, residue or remainder generated in the course of work by a health professional, healthcare facilities and other non-healthcare professionals. This waste is discarded, accumulated or stored with the purpose of eventually discarding it, or is stored for the purpose of recycling it, reusing or extracting a usable product from such a matter. HCW may if handled improperly, have the capacity to harm people, property or the environment. In this regard, all human anatomical waste blood and body fluids are considered to be potentially hazardous. The unsafe disposal of such waste could have detrimental effects for people who might come into contact with HCW.

2.2.2 Categories

HCW stream generated at HCF consists of General waste, HCRW, as well as health care risk liquid waste (Otto, 2008:11).

General waste

This is the non-hazardous component of HCW. In many instances, general waste is similar to domestic waste, but may also include non-infectious and hazardous liquids. General waste is produced, among other things, during the administrative and housing functions of the hospital as well as by patients and visitors. General waste may potentially consist of a number of recyclable materials.

HCRW

HCRW and medical waste terms have various interpretations. In hospitals, for example, it would be associated with sharps**,** and used bandages, while pharmaceutical firms may consider expired medicines as their HCRW (Gauteng Department of Agriculture, Conservation, and Land (GDACEL), 2000:6)

Some cities, such as Manila (Department of Health, Manila, 2005:10), have listed HCW into ten categories (Table 2.1). These include general waste and infectious waste.

Table 2.1 Categories of Healthcare Waste

HCW CATEGORIES		EXAMPLES
1	General waste	Domestic waste, does not pose risk
2	Infectious waste	Dialysis equipment,
3	Pathology, All waste	Tissues, organs, and body parts
4	Sharps	Needles, scalpels, blades
5	Pharmaceutical waste	Expired drugs
6	Genatoxic waste	These have radioactive, mutagenic or carcinogenic properties
7	Chemical waste	Toxic, flammables, and corrosive
8	Waste with high heavy metals	Mercury waste
9	Pressurised containers	Cylinders or aerosol cans, may explode if incinerated
10	Radioactive waste	Liquid or gaseous materials contaminated with radioactivity.

Source: Department of Health Manila, (2005:10)

However, South Africa has a different approach and definitions of hazardous wastes. This approach is based on the minimum requirements for classification, handling and disposal of hazardous wastes, published by the Department of Water Affairs and Forestry (DWAF) (GDACEL, 2000:6). Contrary to the Department of Health, Manila (2005:10), in South Africa, chemical, infectious, and radioactive wastes are defined as hazardous waste. Since most of the South African studies on HCW use a term “HCRW” instead of “hazardous

waste" (DEAT, 2000:6), (DEAT, 2006b:23), and (Abor, 2007:112), this study has opted for HCRW throughout this project.

2.2.3 The South African approach to the classification of HRCW

In South Africa, infectious waste is considered a sub-category of HCRW. According to GDACE (2004:13), South Africa uses SABS Code 0228, a code which divides hazardous waste into nine categories, based on their hazardous nomenclature (Table 2.2).

It is noted that, in South Africa, an infectious waste is a sub-category of Class 6. Other wastes produced by health care facilities include flammable liquids, and toxic materials such as drugs and radioactive waste (Class 7) as well as compound gas (Class 2). Radioactive and infectious wastes are generally managed separately from other categories, which are all classified as chemically hazardous wastes, whether they arise from a hospital or the chemical and petroleum industry.

Table 2.2 Classification of HCRW in South Africa

CLASS	**EXPLANATION**
Class 1	Explosives
Class 2	Compound gases
Class 3	Flammable liquids
Class 4	Flammable solids
Class 5	Oxidising substances and organic peroxides
Class 6	Toxic and Infectious wastes, subdivided into:
- Class 6.1	Toxic waste
- Class 6.2	Infectious waste
Class 7	Radioactive waste
Class 8	Corrosive waste; and
Class 9	Miscellaneous dangerous waste

Adapted from: GDACE (2004:13).

2.2.4 Composition

While the GDACEL (2000:11) claimed that the composition of South African HCRW treated in our incinerators is not known, the WHO (2005b: 1) contends that between 75 percent and 90 percent of the waste is non-risk or HGCW. WHO (2005b: 1) claims that the remaining 10 – 25 percent of HCW is regarded as hazardous or HCRW, and may create a variety of health risks. Generally, there is much difference in the use of nomenclature for the waste fractions and it seems that, in some studies (DEAT,2006b:31), and (Kristiansen, 2007:16), waste is treated indiscriminately, whether it is HCRW or general waste.

The purpose of the waste studies vary internationally, for example, studies focusing on the constituents such as paper, plastic, rubber and metal are mostly carried out for the purpose of the calorific value of the HCRW to enable engineers to design incinerators for a particular thermal loading (Kristiansen, 2007:16).

The most relevant study for South Africa was conducted by the GDACE 2004:16) in Gauteng, and the aim was to assess the risks improving segregation, thus possibly saving costs by avoiding General waste in the HCRW stream. It may be difficult to try to compare the results of composition studies conducted in countries with very different social-economic and infrastructural circumstances without assessing the context. According to Kristiansen (2007:44), the composition of waste in different countries varies depending on the size, level, and the package of services that each hospital provides. A brief summary of composition studies conducted earlier are presented (Table 2.3).

Table 2.3 Summary of composition study results

	HCRW	HCRW	HCRW	HCRW	General waste	HCW
	Vietnam	**Italy**	**U.S.A.**	**U.S.A.**	**U.S.A.**	**Nepal II Hospital**
	1998	**1992**	**1997**	**1989**	**1989**	**1992**
Paper/cardboard	0.8	34	45	31	39	
Plastic	10.1	46	15	29	20	
Food	-	-	-	-	-	
Rubber	-	-	-	12	1.4	
Textiles	-	-	-	5	2.1	
Food	-	-	10	1	11.7	
Solid waste	-	-	3	-	2.0	
Glass	20.9	7.5	7	3.2	4.8	
Metals	2.9	0.4	10.	1.1	7.2	
Fluids		12.0	-	17.7	9.9	
Misc. organics	52.9	0.1	10	-	1.9	
Anatomical	0.6	0.1		-		
Infectious waste	12.0			-		30.2
General waste				-		69.8
	100..2	100	100	100	100	100

Adapted from Kristiansen (2007:8)

It appears that the manner of classification differs between the different studies. Particular care should be taken when drawing conclusions based on these results, unless there is detailed information available about the actual classification used and the approach of the study.

In contrast to the studies presented, where most studies only sampled HCRW and the constituents such as paper, plastics, and glass, the Gauteng study focused on the parameters that would focus on the level of correct segregation. According to Kristiansen (2003:6), a comprehensive composition study was conducted in South Africa in a 720 bed Gauteng hospital. It is believed that this was the biggest study at that time in the continent as the literature review has not revealed any similar data from elsewhere.

The results show that there was a significant amount of mis-segregated general waste placed in the receptacles for HCRW. The study concluded that there was

a significant amount of waste being treated at a higher cost and unnecessarily as HCRW. It was, therefore, possible to achieve a significant improvement in the segregation of waste at the Gauteng hospitals, as a result of interventions that included new equipment, training and supervision.

2.3 Characterisation of the HCW

Waste characterisation is the process by which the waste composition of different waste streams is analysed. It is important that developers of new waste technologies know the kind of the waste streams in order to fully treat the waste. The biodegradable element of the waste stream is vitally important in the use of systems such as composting and anaerobic digestion (Wikipedia, 2009:2).

The important reasons for characterising HCW are to be able to develop an efficient HCW management plan; and be able to decide on a centralised or decentralised treatment system.

2.3.1 Types of HCW treated

In the course of the delivery of health care, various kinds of the waste streams are generated. The State of Eritrea (2004: 22) lists the following ranges of HCW:

- A non-risk (domestic) waste not contaminated by infectious agents;
- Medical HCW containing pathological waste as well as items that have been used for medical care but not necessarily contaminated, for example, placentae;
- Anatomical waste that is managed differently from medical waste for example excised body parts;
- Sharp instruments, including auto disabled;
- Pharmaceutical waste, including outdated drugs (A disposal procedure should be present in each hospital as directed by the Pharmaceutical Council of the country); and

- Specific radioactive waste, ionising radiators, x-rays, waste contaminated by radionuclides, whose ionising radiations have genotoxic effects.

2.3.2 Estimation of quantities produced

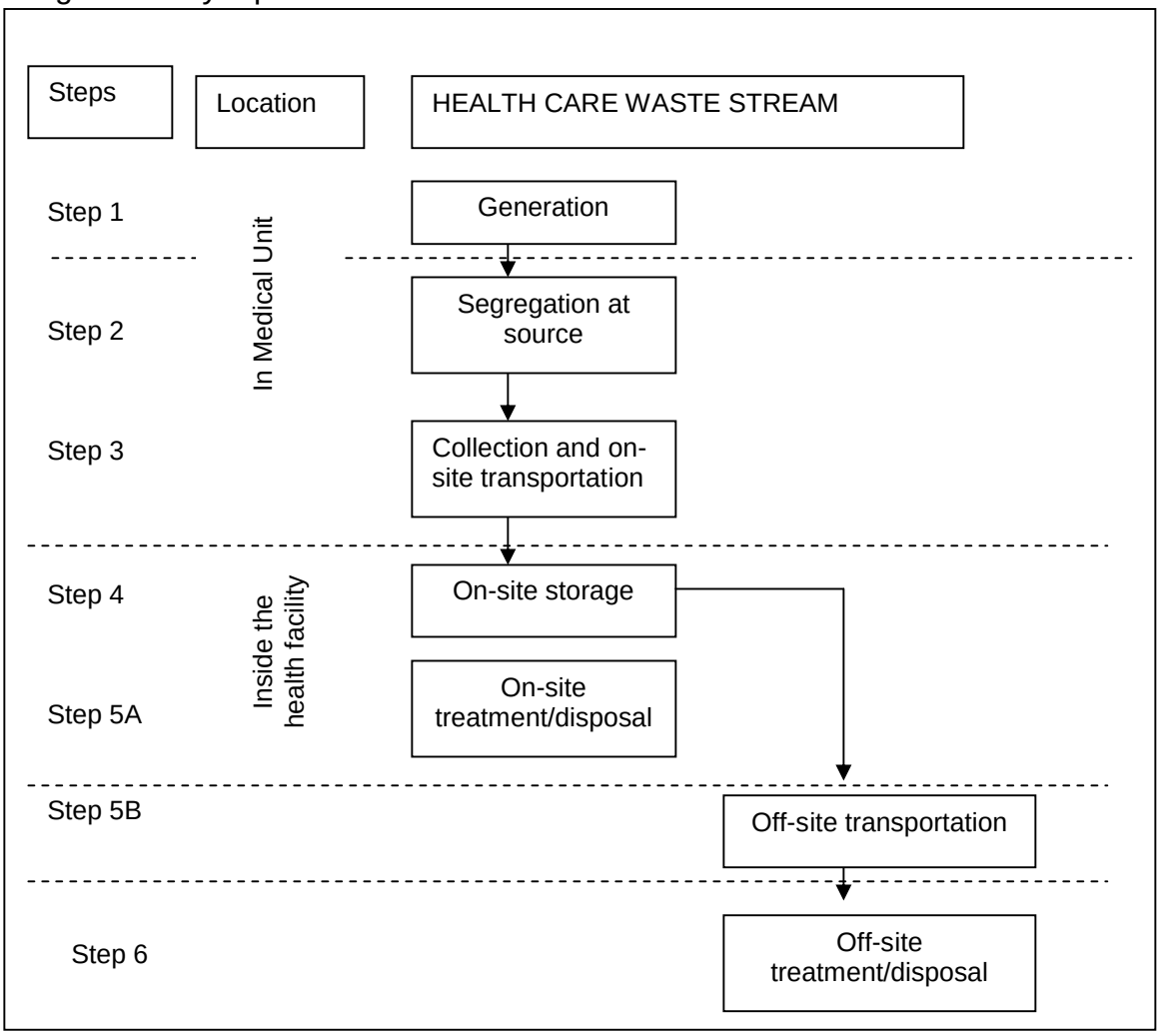
This involves estimating the number of containers used for medical waste collected during a defined period of time. This information is necessary in determining the number of bags, rubbish bins, and the number of HCW workers to be involved in the HCW team (The State of Eritrea, 2004:14).

2.3.3 Characterisation of HCW management practices

HCW produced in hospitals should follow an appropriate, well-identified stream from their point of generation until their final disposal (Kristiansen, 2007:7). The stream comprises several steps that include generation, segregation, on-site transportation, on-site storage, off-site transportation and final disposal or off-site treatment. However, the most important key point is always the minimisation of HCW generated. Therefore, ensuring efficient and reliable segregation remains the most important step. Like WHO (2005a), the State of Eritrea (2005:6) produced a HCW stream synopsis for translating HCWM plans at a healthcare facility level (Figure 2.1).

A systematic approach is indispensible from step 1 to step 4. The same personnel are involved from generation (step 1) to segregation (step 2). Then, waste collectors transport waste from a ward, normally from a temporary storage area to an on-site storage, also called the central storage area (State of Eritrea, 2004:25). From the on-site storage area, waste will either be transported to an on-site treatment/disposal area if waste is treated or disposed of locally or handed over to the service provider if the waste is treated or disposed of outside the hospital. The State of Eritrea (2004:25) advises that written procedure manuals be available in order to minimise risks associated with HCW injury.

Figure 2.1 Synopsis of the HCW Stream



Adapted from the State of Eritrea, Ministry of Health (2004:24).

2.4 A description of Public District Hospitals

2.4.1 Definition of a Public District Hospital of South Africa

A district hospital is defined by Cullinan (2006:3) as a facility at which a range of outpatient and inpatient services are offered. Such a hospital is open twenty-four hours a day, and seven days a week. A district hospital would have between 30

to 200 beds. In contrast, the Health Systems Trust (2007:2) defines a district hospital as an institution that supports Primary Health Care (PHC) clinics in its catchment area, and has between 50 to 200 beds.

On the other hand, the national documentation indicates that a district hospital would have between 30 and 400 beds (ezeeDiabetes, 2008:7). The size of a hospital is important in waste management because there is a link between quantities and types of waste generated and the number of beds.

2.4.2 Sizes of Public District Hospitals and services provided

By June 2007, South Africa had 434 Hospitals and 119 310 beds (UNAIDS, 2007:6). The Government, through the National Department of Health is responsible for the overall management of national health care institutions, which include infrastructure and budgets for the operation of hospitals. Apart from public hospitals, there are also 204 private hospitals with a total of 26 593 beds (Biermann, 2007:17). Notably, public hospitals have 76.6 percent of the total number of beds in South Africa (SA) hospitals, while private hospitals have 20.4 percent. It is important to know private hospital beds because, although not part of this study, private hospitals also generate the HCW needing special attention. Biermann (2007:18) contends that it is through integrated HCW management that any dangers that waste poses for the environment and people could be abated. Integrated waste management was understood by DEAT (2008:4) as inclusive of roles that NGOs, private and public health care facilities play in waste management. The National Department of Health has classified public health care facilities using a service level system (Gauteng Department of Health, 2004:1). The levels of the Public District Hospitals could be divided into three (3) categories. A service level one HCF includes primary health care up to general practitioner services. These include all immunization, accidents and emergencies and are provided by Clinics, Community Health Centers and

District Hospitals. Although service level one (1) has three components as above, the focus of this study is on Public District Hospitals. There are also service level two facilities. These facilities are specialist support health care hospitals to level one facility. The specialist support includes general surgery, obstetrics and gynecology, radiology and anesthetics, pediatrics, orthopedics, and general medicine and is mostly provided by regional hospitals. Service level three facilities are sub-specialist support hospitals provided to the level two facilities, and include, for example, sub-specialist surgery, urology, neurosurgery, plastic surgery, and cardiothoracic surgery and are mostly provided by Provincial Tertiary and National Central Hospitals (Health Systems Trust, 2007:1).

2.5 Waste management practices (WMP)

Waste generated in the medical industry consists of a wide variety of materials, including sharps, chemo-therapeutic, to pathological waste (Vermont Department of Environmental Conservation, 2001:1). Although a vast majority of Public District Hospitals' waste is considered regular solid waste, a small percentage of these wastes require special handling and treatment prior to disposal. This is done to protect public health, safety and the environment (Vermont Department of Environmental Conservation, 2001:2).

2.5.1 Waste minimisation

Under the Vermont State and Federal Law, waste minimisation and pollution prevention are the first priority for managing waste (Vermont Department of Environmental Conservation, 2001:2). Procedures that are considered in waste minimisation and pollution prevention include recycling, source segregation, product substitution and use of less toxic materials.

This minimisation of waste is supported by the Health Care Without Harm (HCWH) South Asia (Vermont Department of Environmental Conservation, 2001:3) who believes that as much as 80 percent of waste produced in hospitals is not hazardous. They add that waste could either be reused or recycled. In addition, HCWH South Asia (Vermont Department of Environmental Conservation, 2001:4) collaborated with Philippine hospitals and found that it was useful to form a HCW management committee responsible for HCW management plan that would oversee the development of HCF policies and guidelines on the proper waste management, training and development. This committee was useful in using various ways to utilise the money saved or earned from new waste management practices. In one case, there was enough money to pay the salary of the waste manager, making the whole system self sustaining.

2.5.2 Segregation of Waste

According to the Vermont Department of Environment Conservation (2001:10), the key to effective management of HCW is segregation. This is the responsibility of the producer and should take place as close as possible to where the waste is being generated. The Vermont Department of Environmental Conservation (2001:10) found that waste practice in many hospitals was that all waste is potentially infectious. Wastes emanating from offices**,** kitchen, operation theatres, pharmacies as well as wards were mixed together as they were generated, and were all collected, transported and finally disposed of together. As a result of this failure to establish and follow segregation protocols and infrastructural requirements (storage areas), wastes leaving hospitals, as a whole, is potentially infectious and hazardous.

No matter what final strategy for treatment and disposal of waste is selected, it is critical that waste is segregated. The Vermont Department of Environmental Conservation (2001:10) found that some hospitals burnt their waste. Serious health risk can be caused by the burning of heavy metals and chemical solvents and preservatives, which are known as carcinogens, and by the burning of the PVC which can produce dioxin.

2.5.3 Keeping focussed on reduction

Research has established that clear guidelines for product purchasing, that emphasises waste reduction, would benefit the hospital financially (Otto, 2008:78). The Health Care Without Harm Asia (HCWHA) (2004:1) stated that a policy to eliminate the use of mercury-containing products and technologies has been implemented successfully in the Philippines. Otto (2008:78) adds that hospital procurement departments should consider the amount of toxicity of waste generated by a specific product before purchasing, for example, products containing PVC, mercury, or other toxic materials should be avoided in preference to sterilisable and reusable materials (HCWH, 2004:11).

2.5.4 Waste handling and storage

The Cardiff and Vale NHS Trust (2008:2) prescribed that waste should be handled with a duty of care in accordance with legislative requirements. Where possible, waste produced through the routine cleaning of outside areas can be minimised through prevention of litter accumulation and through on-site combusting of general waste. There should be a policy spelling out the safe disposal of, among others, liquid waste, redundant information technology equipment and the strict tracking of these from the generation to the disposal of waste (Cardiff and Vale NHS Trust, 2008:3)

As part of good segregation practices, WHO (2005b: 6) recommends that the colour coding of waste containers be practised as follows:

- General HCW should join the stream of domestic refuse for disposal;
- Sharps should all be collected together, regardless of whether or not they are contaminated. Containers should be puncture proof and always be fitted with covers;
- Bags and containers for infectious waste should be marked with the international infectious waste symbol;
- Highly infectious waste should where possible, be sterilised immediately by autoclaving; and
- Cytotoxic waste (pharmaceuticals) should be collected in strong, leak-proof containers, clearly labelled “cytotoxic waste”.

In addition, the WHO (2005b:6) recommends that the same colour coding be used for the storage of waste. The use of international colour codes is useful as some waste is moved across national borders for disposal and research purposes (WHO, 2005b:6) (Table 2.4).

Table 2.4 Recommended Colour Coding of HCW

Type of Waste	Colour Container and Markings	Type of Container
Highly Infectious Waste	Yellow, marked “Highly Infectious”	Strong leak-proof plastic bag or container capable of being autoclaved.
Other Infectious Waste. Pathological and Anatomical Waste	Yellow	Leak-proof plastic bag or container.
Sharps	Yellow marked “Sharps”	Puncture proof container.
Chemical and Pharmaceutical Waste	Brown	Plastic bag container
Radioactive Waste	-	Lead box, labelled with radioactive symbol.
General HCW	Black	Plastic bag.

Source: WHO (2005a:63).

The WHO (2005b:63) emphasises that since the cost of treatment and disposal of hazardous HCW are typically more than ten times higher than those for general waste, all general wastes (HCGW) should be handled in the same manner as domestic refuse and collected in black bags. WHO (2005a:12) stresses that, in most instances, staff should be warned not to remove needles from syringes because of the risk of injury. If removal of the needle is needed, special care must be taken.

As South Africa is a multi-cultural country, cultural and religious constraints may make it unacceptable for anatomical waste to be collected in the yellow bags. Due to these constraints, the WHO (2005a: 63) maintains that such waste may be disposed in accordance with the local custom, which commonly specifies burial.

Acknowledging the fact that handling HCW comes with inherent risks of exposure to many infections, the United Kingdom developed a policy in which all HCW workers are offered vaccines against diseases such as hepatitis B. All HCW workers are given the policy to read and urged to get immunised. Hucker (2008: 12) maintains that not all HCW workers agree to be immunised. As such, workers, refusing to be vaccinated, have to sign an acknowledgement form that they do not want immunisation. If they still refuse to sign, they are moved out of the HCW field.

Regarding the storage of waste, African countries face a number of infrastructural problems. Abor (2007:IV), in his research in Tygerberg Hospital, found that the hospital faced huge problems including the lack of use of coloured bags, thus limiting the storage of all kinds of waste to one colour bag. This problem was also found by DEAT (2005:16), in the Zeerust pilot project, where it

was found that there were no storage containers in the facility. Waste was disposed of in the pit as it was generated, irrespective of whether it was HCRW or general waste.

2.5.5 HCW treatment and disposal capacity for South Africa

The National Waste Management Strategy Action Plan for waste treatment and disposal focuses on the improvement in the segregation of all waste treatment facilities, including the revision and enforcement of air emissions standards (Molefe, *et al*., 2007:3). That being the case, a most comprehensive assessment study of the HCRW quantities, including treatment and disposal capacity, was conducted (Molefe, *et al*., 2007:3). The study concluded that the HCRW generation and treatment capacity on a national scale matches well. There was nevertheless inequity in terms of the treatment capacity, where some regions had limited HCRW treatment capacity compared to others. This inequity resulted in some regions paying more for HCRW treatment than others (Table 2.5).

Table 2.5 HCRW treatment Capacity in South Africa, 2005

	HCRW RX Service Providers	**Public Hospitals**	**Non-Public Hospitals**	**Total**
Tonnes per annum	24 615	3 185	158	27 959
Number of RX facilities	12	146	3	161
Average daily throughput (kg/day)	7 178	84	203	7 465
Percentage total waste RXed	88%	11%	1%	100%

Adapted from Molefe *et al.,* (2007:27)

Otto (2007:92) investigated the reasons for the lack of appropriate HCRW treatment facilities in certain provinces. The first reason was that HCRW service providers, with the state of the art equipment, and legally compliant companies,

unfairly competed with poor HCRW service providers because of the poor enforcement of HCRW management tender specifications. The disparity in standards (uneven playing field) resulted in service providers with the state of the art treatment facilities going insolvent. This, in turn, created more opportunities for service providers who had not complied with the standards to acquire an even larger share of the HCRW treatment facilities in an illegal manner without fear of action taken against them for contravening the regulations and tender specifications. The next problem causing lack of appropriate HCRW treatment facilities in each of the provinces was the lack of appropriate HCRW treatment facilities in some provinces that forced departments to transport HCRW to other provinces. For example, Otto (2008:93) reports that half of the HCRW generated in the Eastern Cape was transported to KwaZulu-Natal for treatment while the remaining half was transported to North West Province for treatment by a third party. The HCRW from Free State was partially treated in Free State while half was treated in KwaZulu-Natal (Otto, 2008:93)

The other problem noted by Otto (2008:93) was the lack of uniform standards for waste treatment efficiencies or emissions legislated through South Africa. For instance, provinces closed down non-compliant HCRW treatment facilities in provinces where regulations are in place, instead of applying appropriate financial penalties. This resulted in worsening of the current HCRW management situation.

Apart from HCRW treatment costs, the Leratong hospital study in Gauteng revealed that the 770 litre wheelie bin and a set of reusable boxes were more expensive than disposable containers, but, because of their durability, they were most preferred (DEAT, 2006b:4). The high cost of reusable containers,

according to the DACEL (2002:11), was because of disinfectants used in cleaning the containers that were not used in the disposables.

2.5.6 Organisational structure and personnel employed for HCW management

Several writers agree that staffing difficulties thwart the effective health care waste management programmes (KZN DOH Infection Prevention and Control, 2007:4, Aluyi & Banka, 2007:5, and Citywatch, 2008:3). In an attempt to ameliorate the above problem, the KZN DOH Infection Prevention and Control issued a policy in 2007, whereby staff categories and their duties relating to health care waste were listed.

Nepeon (2008:2) observed that where a hospital manager had a passive role in HCWM, general orderlies, meant for HCW, did other unrelated duties including driving of hospital vehicles, delivering meals to patients and preparing baby formula feeds.

Apart from staffing issues, the management responsibilities involve appointment of HCW committee members as well as ensuring availability of HCWM issues in the orientation and induction programmes for newly employed staff, on continual basis. The health care waste starter documents (DEAT, 2000:19), which provide the framework for subsequent studies in South Africa, failed to unpack categories of staff to work in the HCW programme. However, the KZN Waste Management plan (KZN Infection Prevention and Control, 2007:4) provides an outline of staff to be directly and indirectly involved in HCW programmes of a public district hospital.

The WHO (2005a: 6) maintains that the success in the management of HCW depends largely on the good administration and organization as well as the

active participation of the senior hospital management managers. On a best practice note, the WHO (2005a: 6) advises that the head of the hospital forms a waste management team in order to develop a waste management plan. The waste management team, led by the hospital's chief executive officer, should include heads of sections, infection control officer, chief pharmacists, hospital engineer, and waste management officer (WMO) (KZN Infection Prevention and Control, 2007:6). The WMO is further tasked with a day-to-day operation and monitoring of waste disposal system. Officials from the local municipality should be invited to assist in the development of the waste management plan. The plan should include a diagram that outlines the management structure and the liaison paths. A list of names and telephone numbers should be made available in the event of an emergency (WHO, 2005b: 6)

Since waste is a management problem, the hospital management teams should have robust plans to mitigate the risks that waste poses to health (World Bank, 2002:57).

2.6 Awareness and capacity building (ACB)

The United Nations, through the Basal Convention, has clarified HCW to be the second most hazardous waste after the radioactive waste (Garwal, 2007:11). The main bottleneck to sound HCW management comes from the lack of training and appropriate skills. There is need for continuous provision of training and in-service education for HCW workers (Garwal, 2007:11). To cater for these needs, the WHO (2009:14) decided to develop and launch a certificate programme in HCW management in countries of South East Asia region. The programme was offered for six months through open and distance learning in 2005 (WHO, 2009:14). The aim was to develop basic awareness about HCW management practices and equip learners with enough skills to effectively

manage HCW while safeguarding themselves and their communities against adverse health impacts of HCW.

The healthcare workforce of 35 million people worldwide represents 12 percent of the working population (Wilburn and Eikemans, 2004:452). Occupational health of the significant groups working with waste has long been neglected both organisationally and by governments (Wilburn & Eikemans, 2004:452). The misconception exists that the healthcare industry is “clean” and without hazards, when, in fact, the chemical and blood borne exposures encountered can be career and life ending (Wilburn and Eickemans, 2004:452). Serious challenges regarding poor training and capacity building for HCW workers have been reported widely. The World Bank (2005:57) conducted a study in Kenya as a first step in setting the framework for the development of action on HCW management in Kenya. The study was conducted in 56 government hospitals, including teaching communities. Among the challenges realised was that the training contributions were more academic than practical, yet there is no quick fix for waste management and disposal. It was found that healthcare workers often burnt HCRW and saw nothing wrong with that. This problem was prevalent among senior professionals including nurses and doctors. It was further revealed that nurse training took four years, but apart from infection control, there were no modules on waste management (McInery, 2009:554-557).

In another study conducted by Abor (2007:ii) in Tygerberg hospital, South Africa, it was found that there were no policies on staff training in the hospital at all although this is the hospital where 48 children were treated with AZT (HIV/AIDS treatment) after they were pricked by needles they had found in Elsie’s River (Abor, 2007:ii). This lack of training indicates that HCW was not viewed in a serious light following the treatment of the 48 children.

It is because of these problems that the WHO (2006:6) believed that any policy of the management of waste cannot be effective unless it is applied carefully, consistently and universally. Training both medical and administrative staff in implementing the policy is thus critical if the HCW programme is to be successful. The WHO (2006:7) believes that the aim of HCW training is to create a competent workforce and develop awareness of the health, safety and environmental issues relating to HCW and how these affect employees in their daily work.

According to the WHO (2006:7), most healthcare workers need the same basic sets of skills, information and attitudes towards good waste management. Nurses, doctors and general orderlies can be trained together in their wards. If the training is conducted on the job, it should help reinforce good practice and team work. Before training is conducted, it is important to ensure that training needs are identified. The WHO (2006:7) believes that training needs are generally at the level of:

- **Knowledge**. The training is about what health workers need to know such as knowing that HCRW is taken for incineration or autoclaving;
- **Skills.** Skills are defined as something that healthcare workers do such as sealing of sharps' containers when three quarters full. Skills gaps are often related to use of equipment and protective clothing; and
- **Attitudes**. The attitudes are linked to people behaviour. If a person holds a positive attitude to the care of environment and protection of the health and safety in the workplace, then he/she is more likely to be conscientious about waste disposal. Constant interviewing the staff usually pinpoints the knowledge, attitudes and skills gaps quite easily.

2.7 Internal storage and transportation (ISAT)

The on-site collection and transportation of waste is done in order to avoid an accumulation of waste in the wards (The State of Eritrea, 2004:26). As such, the frequency of the collection of HCW depends on the type of hospital and human resources available. One to two collections per day are normally scheduled. The State of Eritrea (2004:26) revealed a few problems encountered in Eritrea. The collection of waste was not done on a regular basis, or along well-defined routes within the HCFs. In a few places, the nursing assistants transported and dropped off the waste directly to storage and disposal points. This practice needs to be avoided in order to minimise the risk of spreading infections, once nurses are back in the wards.

The medical waste included syringes and needles often dropped from the over-filled bins (sharps' boxes) and could be found scattered on the ground inside the hospital compounds.

CGH Environmental Strategists (2002:1) offered advice to mitigate these problems where they felt that if the benefits of segregation are to be realised, there has to be secure internal and external collection and transportation systems for waste. If waste is segregated at the point of generation, only to be mixed together by labourers as they collect it or if a hospital has segregated its waste and secured it in separate containers for ultimate disposal, only to have municipal workers mix it together after a single collection, then the ultimate value is lost. Further, while worker safety may have been enhanced, the ultimate cost of damage to the environment and the general public is negative.

In addition, the very real concern of hospital administrators to prevent the reuse of medical devices, containers and equipment after disposal should be taken into account in any management meetings. According to McRae (1998:7), street

vendors sell used latex gloves or using cidex (a disinfectant regulated as a pesticide in the USA) containers to hold water for making tea. In addition, the practice of cleaning and reselling syringes, needles, medicine vials and bottles, is not well documented, but there appears to be enough informal evidence to indicate that it is a serious concern. It is, therefore, suggested (McRae, 1998:8) that items that could potentially be reused illegitimately either be rendered unusable after their use, for instance, cutting needles, puncturing intravenous bags or be secured for legitimate recycling by a vendor.

The transportation of HCRW from health care facilities to the treatment facilities contributes a significant proportion of the overall cost of HCRW management. Vehicles used for the transportation of HCRW require custom-built van bodies, which allow for securing of the load internally to prevent HCRW containers from falling over or shifting in transit. The design must also prevent the spillage of any liquids out of the vehicles and the vehicles must carry a “spills kit” that can be used in emergencies. (Otto, 2008:91).

Where a reusable container is used, (such as boxes and wheelie-bins) and where the same vehicles are used for the collection of full containers as well as the return of the empty (clean) containers to the health care facilities, separate load compartments must be provided in the vehicle (Otto, 2008:91). In view of all these requirements, the KZN Department of Health (2008:12) preferred to outsource the HCRW management and disposal services for their hospitals, whereby the contract packages of tendering are administered by the department at a provincial level.

The major advantage of outsourcing the collection and transportation of the HCW is that a service provider will generally utilise a range of different size of vehicles, in order to cater for the expected quantity of HCRW to be collected, the

distance to be travelled, and the type of containers to be transported, and this becomes less of a problem for the hospital management (Otto, 2008:98).

2.8 Management support (MS)

Powers of hospital managers

One of the specific objectives of this study is to evaluate the role of hospital management in the hospital HCW management. The WHO (2005a:7) argues that HCW management is a management issue before being a technical problem, and that success in any process of HCW management depends on full commitment of the entire hospital management. Naledi (2005:11), however, found that there was a tendency for provincial officials to adopt an authoritarian attitude towards senior managers in hospitals and treat them as junior employees. Naledi (2005:12) further insists that the lack of the cooperation between the hospital and head office meant that hospital management was dependent on provincial offices for development of administrative and operational systems. Therefore, it could be deduced that hospital management fears to rock the boat, be innovative, and take risks.

Active involvement of hospital managers

Bloomberg (2007:2) warned that if management structures of hospitals are dysfunctional, there would be the danger of initiatives being paralyzed and a lack of accountability. The overall effect of a dysfunctional management structure is pervasive disempowerment of managers, giving rise to a management culture in which the administration of rules is more important in managing people and operations or solving problems. Nxumalo-Friedman (2008:1) argues that if management members are involved in HCW management, they would influence environmentally-compliant treatment

facilities through the employment and / or designation of their employees in HCW committees to ensure adequate day-to-day operations on their behalf, and importantly, influencing purchasing practices.

Procurement contracts

According to Nxumalo-Friedman (2008:4), a public hospital, as an instrument of the Government, often does not have control of many of its most significant operations. For instance, services such as purchasing, engineering and maintenance, personnel and information systems are often delivered under the jurisdiction of other government departments. These departments are generally slow to react to the needs of the hospital and do not always deliver a quality service.

The Department of Health has a fixed contract with Compass waste to collect waste in most provinces. However, if a particular hospital had an urgent infectious waste to be collected a day after Compass company had left, the hospital would have to wait for the next six days or rather pay an exorbitant price for a special collection. The scenario mentioned above attests that contracts are not always agreed. Contractors are not mindful of the special needs of hospitals, and economic terms are concluded in the interest of the government as a whole. This implies that hospital issues such as reimbursement trend factors, recruitment priorities and work rule issues are overlooked.

Hospital construction projects are most often controlled outside the hospital management structure in accordance with statutory or procedural requirements that significantly add to the time cost of a project (Naledi, 2005:13). For example, a hospital wanting to install a new incinerator would have to apply for a permit from the DEAT, which could take months before a permit is issued. The

DEAT (2006a:17) found that obstacles concerning budgets, difficult procurement procedures and staffing situations were cause for delays in the implementation of the national waste management strategy initiatives.

Competency of hospital managers in finance management

According to the District Health System philosophy, provinces have to devolve responsibility for health to district level, including financial responsibility (Biermann, 2007:4). According to Cullinan (2006:11), the competency of the hospital managers in financial management presents a big challenge. This view is supported by Naledi (2005:12) who, in the assessment of the financial delegations to three South African provincial hospitals, found that none of the hospital managers had been capacitated in financial management since their appointment, implying that learning of financial skills was through trial and error.

The DEAT (2008:10) has demonstrated that the failure of projects is not about budgets. For an example, substantial work was done by the Gauteng Province during 2001 to 2003 on the development of a system to manage HCRW. Despite the availability of funds, in the subsequent years after 2001, the project had not rolled out by October 2008. Having piloted the HCW management system in rural (Zeerust) and urban (Gauteng) contexts, the challenge was to determine the best roll-out strategy for various waste management systems in the country (DEAT, 2008:9).

Public hospitals tender system

The DEAT (2008) further reports that the Danish Aids Development Agency (DANIDA) had donated R4 million to be used in three years (2008 to 2010) to support the rollout methodology for the HCRW management system. From the available business plan, the DEAT (2008:9) states that while funding was

available, challenges arose in respect of the methodology for the standardization of provincial tenders. The delay in Government and non-governmental agencies in finding a South African waste management model means that the solutions could only be finalized after 2010 (DEAT, 2008:3). The best option to manage HCRW countrywide would have to be approved by the Cabinet for the National funding before implementation.

Financial difficulties in hospitals

Regarding the financial status of public hospitals, Naledi (2005:3) found that the hospital financial departments were generally under-resourced and lacked capacity to draw up or monitor budgets. It was also noticed that budgets bore little relation to the operational reality, and it was clear that budgets were meaningless as they were based on historical rather than zero-based budgets. Zero-based budgeting, according to Williamson (2008:2), are budgets developed from a zero base: that is, at the beginning of the budget development process. According to this definition, all budget headings have a value of zero. This is in sharp contrast to the incremental budgeting system in which a new budget tends to start with a balance at least equal to the previous year's total balance.

Case studies (LaFaire, 2008:14) about businesses that have adopted zero-based budgeting or some hybrid of it generally report some improvement quantitatively or qualitatively. This means that the process has either saved money, improved services or both. Consequently, hospitals doing badly in HCW management are unlikely to perform better as long as their budgeting form is incremental.

On the other hand, zero-based budgeting can stimulate improvement in HCW management activities because, with this budgeting, all activities are costed. Further, managers' performances are evaluated in accordance with success in

planned, funded, and agreed upon activities (KZN Infection Prevention and Control, 2007:7). This implies that, once HCW management has been prioritized and funded, the hospital CEOs must report on the project in their progress reports.

2.9 Waste Information System (WIS) procedures for Public District Hospitals

Historically, waste management in South Africa was not afforded the priority it warranted. Only in 1998, that the Integrated Pollution and Waste Management processes were identified as a key issue (Delcarme, 2007:1). An important intervention to preventing health problems, associated with exposure to HCW, is an integrated waste information system. The implementation of a waste information system has been considered as a high priority (Delcarme, 2007:1) because reliable, accurate and timely information is essential for the success of the National Waste Management Strategy (NWMS).

A WIS baseline study, conducted in 2005, revealed four significant shortcomings regarding South African WIS. These shortcomings were summarized by Delcarme (2007:2) as follows:

- While a number of relatively comprehensive information sets exist, there is no consistency of scope between information sets. This renders comparisons of these information sets tenuous;
- Most of the information sets have a static reflection of waste generated in a specific time period. The information is not updated making it difficult to use this information for strategy development and to evaluate the efficiency of these strategies;
- Up to 50 percent of the hazardous waste stream is never reported or disposed of properly; and

- A significant deficiency in the existing information sets is the lack of information on the agricultural and health sector. During the time of this research, negotiations were ongoing with the Department of Agriculture to address this deficiency.

A most recent research report (Purnell, 2009:1) reveals that the inadequate management of HCW has been classified by the South African Government as a significant environmental and public health risk. According to the report, fragmented and unreliable data still forms the basis of HCW management policies (Purnell, 2009:1).

Inadequate enforcement of existing legislation has resulted in poor management of HCW management establishments. The illegal dumping, especially in rural areas, together with the general mismanagement of landfill sites in the country, presents significant public environmental health threats (Purnell, 2009:1).

It is recommended that, for health, the hospital information system urgently considers health care waste information as one of the elements in its data (Purnell, 2009:2).

2.10 Best practice methods of HCW Management

Over the past few years, there has been a growing concern over the disposal of waste produced by healthcare facilities in South Africa (The Kwazulu-Natal Parliamentary Monitoring Group, 2001). GroundWork (2006:2) accused the government of not punishing illegal dumping acts by hospitals; and the Cape Argus (2005:i) reported an incident where amputated body parts and foetuses were found piled up in the sun outside a warehouse in Cape Town. These complaints culminated in The Isipingo declaration (2002) whereby NGO's, led by GroundWork, put pressure on the government to introduce legally enforceable

standards for the safe establishment, operation and decommissioning of treatment facilities and close down on-site hospital incinerations and replace them with non-combustion technology.

Five main best practice methods, adapted from four Philippine hospitals to act as role models for best HCW management, are unpacked.

2.10.1 Best Practice 1: Administration and policy-making level

Appropriate healthcare waste management practices depend largely on the administration of the hospital (Healthcare Without Harm Asia (HCWHA), 2004:3). In order to activate this practice, there must be, firstly, a healthcare waste management Committee (HCWMC) in hospitals. On the four hospitals studied by Healthcare Without Harm (2004:3), it was observed that:

- The Hospital HCW committee was recognised as an integral part of the hospital organisation;
- Active members represented key departments in the hospital;
- There was a visible and tangible support from the hospital management committee including support in funds, policy support, resource availability and participation in the HCW events;
- Management members attended the HCW meetings; and
- A dedicated waste management officer (WMO) was appointed.

There were numerous benefits brought by the existence of the waste management committee.

Cooperation of hospital staff

The study consistently learned through interviews and focus group discussions, that the cooperation of the hospital staff in the waste management programmes

was largely due to the visibility and vigilance of the committee as well as the support given by the management committee members (HCWH, 2004:4-7).

Development and updating of the facility's waste management plan

A primary function of a HCWMC is to establish baseline data and develop the facility's healthcare waste management plan which should include a minimisation plan, training, as well as written guidelines on waste management. The importance of a written HCW management plan was also emphasized by the KwaZulu-Natal Department of Health directive, whereby hospital CEO's were instructed to form such a plan or, if not, be prepared to be disciplined (KwaZulu-Natal Department of Health, 2006:3).

An example of such a plan is the 5S system, which was used by one hospital in the Philippines (HCWHA, 2004:13). Accordingly, the 5S system refers to five Japanese words that describe standardised cleanup often translated as "sort, straighten, shine, systemise and sustain".

Existence of sample policies and programmes

This was manifested by waste minimisation programmes. These programmes are useful in reducing the overall risk of exposure of HCW workers to HCW risks. In doing this, policies that ensure occupational safety of workers are generated. HCWHA (2004, 14) reported that, in some hospitals studied, there was, for example, a policy that dictated that all HCW workers be given Hepatitis B and Anti-Tetanus vaccines. When staff members are accidently pricked by needles, they are immediately sent to the staff clinic where they are given anti-tetanus injections.

Communications and training

The level of awareness of the hospital staff on the HCW programmes and policies immensely contribute to the success of the waste management system (HCWHA, 2004:14). The four hospitals researched by HCWHA (2004:14) had two activities:

- Orientation of staff through training programmes, workshops; and
- Printed information materials such as posters, brochures and leaflets.

One hospital even had a dedicated bulletin board for this information.

HCW programmes are monitored

The four hospitals researched by HCWHA (2004:15) used several programmes to monitor the following areas:

- Compliance to the waste processing procedures;
- Amount, types and sources of waste generated;
- Disposal costs and savings;
- Success of waste minimisation activities;
- Awareness and compliance; and
- Incidents/accidents relating to waste handling.

2.10.2 Best Practice 2: Waste reduction activities

Waste reduction activities have been subdivided into six components and include source reduction, reuse, recycling, segregation, composting and policies. These sub-components are discussed next.

Source reduction

Source reduction involves measures that either completely eliminate or reduce the use of a material to generate less waste (Green Guide, 2006:6). In its simplest explanation, source reduction involves not creating waste in the first

place. However, it involves sophisticated risk management, liaison with manufacturers and communication with staff. This is done by carefully evaluating the hospital's purchasing practices, product choices and operating procedures to reveal several opportunities for waste reduction (HCWHA, 2004: 16). In a sound example of the source reduction in the United States, Kayser Permanente, one of the largest healthcare providers, collaborated with manufacturers to reduce packaging in a variety of products (HCWHA, 2004:17). For instance, they requested manufacturers to shift to recyclable packaging such as corrugated cardboard, thus, reducing the size of the package and requiring less packaging. Purchasing supplies in bulk further reduced packaging and handling costs (HCWHA, 2004:18).

In Japan, one of the hospitals heavily discourages the use and entry of polystyrene foam products in its facility. Styrofoam products, as solid waste materials, are particularly problematic because of their being non-biodegradable and the lack of options available in the country for reusing or recycling it. To set the record straight, hospital staff and patients are asked not to bring food contained in Styrofoam packaging (Sharley, 2006:10).

Re-use

Before the advent of disposables, hospitals used various reusable products in their facilities. It is only in the last two decades that there has been a sharp rise in the use of disposables in the healthcare facilities (Green Guide, 2006:1). Hospitals, adopting re-use as a waste reduction strategy, returned to the use of some reusable materials, which is a suitable option especially with new technologies for disinfection and sterilisation readily available (Sharley, 2006:1). In the United States of America and in other parts of the world, the demand for reusable supplies that have refillable packaging has increased. Apart from

environmental benefits, the use of these types of products can produce enormous financial benefits (Sharley, 2006:11).

Recycling

Recycling is collecting waste and processing it into something new. Many items in the hospital can be recycled. Recyclable items in the hospital include mostly general waste such as plastics, paper, glass and metal (Sharley, 2006:12). In Manila, the four hospitals researched collected recyclable items from the waste they produce and sold these to generate profit (Department of Health, Manila, 2004:16). In 2004, the highest income generated among the four hospitals amounted to $7 852,55. This amount was enough to cover the annual salaries of two additional waste management personnel for a year. On the other hand, the lowest income generated still totalled $3 157,54, enough to cover the annual wage of an employee or purchase at least 65 mercury-free infrared ear thermometers (Department of Health, Manila, 2004: 17-18).

According to Department of Health, Manila, (2004:18) effective waste segregation systems and monitoring of proper waste disposal are carried out by hospital waste management committees. There is, therefore, an increased income from the sale of recyclable materials. Profits from the sale of recyclables go to any of the three beneficiaries:

- Housekeeping department: profits are used for purchasing cleaning agents, additional trash bins, trash liners, and doormats. The generated income from recycling covers some of the housekeeping department's expenses, and is sometimes used for emergency purchases of housekeeping materials (Department of Health, Manila, 2004:11);
- Hospital General Fund: profits are added to the hospital's revenue amount; and
- Employees: profits become part of the employees' benefits.

According to the HCWHA (2004:24), items from hospitals that could be sold as recyclables include the following (Table 2.6):

Table 2.6 Recyclables generated by hospitals

Offices and Clinics	Central Supply and Pharmacy	Housekeeping	Cafeteria	Engineering
Boxes and cartons; old newspapers; magazines; shredded paper; old phone books; directories and ink cartridges.	Boxes and cartons; intravenous fluid bags; assorted plastics and glass bottles.	Boxes and cartons and plastic bottles.	Boxes and cartons; used kitchen oil; empty cans of cooking oil; dietary slops; assorted plastics; plastic bottles and glass bottles	Boxes and cartons; car batteries; assorted metals; assorted tin cans and scrap waste.

Adapted from HCWHA (2004:24)

Other items, which cannot be sold to recycle, are encouraged to participate in contests held by some of the local hospitals, usually during holidays, where the last Christmas decorations fashioned out of recycled materials are rewarded. HCWHA (2004:25) reports that one of the Philippines hospitals has projects made from recycled items. Other examples of projects include parts of the old cribs and beds transformed into fences and trolleys used for waste transport and aluminium oil cans transformed into dust pans.

Although the burden of collecting recycling materials commonly falls on the waste handlers, hospitals have employed other strategies to make their recycling programme more easy and effective. One hospital out of the four researched by HCWHA (2004:26), for example, strategically locates dedicated recyclable waste receptacles along the hallways. These are labelled accordingly and encourage people to throw the listed items in these bins.

Segregation

Segregation is a process of separating different types of waste at the point of generation and keeping them isolated from each other. Appropriate resource recovery and recycling techniques can be applied to each waste stream. Moreover, the amount of hazardous waste that needs to be treated will be minimised or reduced, subsequently prolonging the operational life of the disposal facility (Department of Health, Manila, 2004:13). For example, Mount Sinai Medical Centre, located in New York City, United States Of America, provides one of the best examples of the economic benefits of a waste reduction activity (Vosburgh, 2001:1). The hospital was able to develop a waste segregation programme that generated savings of more than one million dollars per year. This was achieved by training nurses to distinguish the red bag (red bags in the United States are for infectious waste) items from municipal solid waste (MSW) items, and by withdrawing red-bag containers to centralised locations such as medical rooms, treatment and soiled utility rooms.

In South Africa, GroundWork (2006:14) assisted Ngwelezane Hospital of the northern part of KwaZulu-Natal in implementing colour coding systems. This helped reduce costs for the removal of waste from R55 000 to R35 000 per month. The high cost of waste removal was associated with the mixing of HCRW with the municipal solid waste (MSW). After the intervention by GroundWork NGO, the number of red bags which contained a mixture of infectious and general waste was reduced, hence, the savings made.

In the case of the four hospitals researched by HCWHA (2004:24), proper segregation has been the key factor in the success of their waste management and minimisation programmes. Waste segregation benefited the hospitals in two ways:

- Proper segregation significantly reduced the amount of infectious wastes and thereby directly reduced the costs of waste disposal. Key practices that contributed to this were:
  - Placement of yellow trash cans only in areas where infectious waste is generated;
  - Placement of puncture-proof sharp containers in nurses' stations and treatment rooms; and
  - Proper labelling of the yellow trash cans and other hazardous waste containers.

- Efficient waste segregation as the foundation for other waste minimisation activities such as recycling and composting.

According to HCWHA (2004:28), colour-coded and properly-labelled trash bins are readily available and strategically placed in most of the areas of the hospital, encouraging proper segregation at source. The success of the hospital's segregation programmes as waste minimisation activities were found to rely heavily on the following:

- Cooperation of the waste producers and handlers;
- The dedication and leadership of the hospital management;
- Information materials of the hospital on proper waste segregation; and
- Incentive system for best practices in the segregation of waste.

An example of how the incentives could be used to encourage segregation was reported by HCWHA (2004:4). In one of the Philippine's hospitals, a profit sharing scheme for the sale of hospital domestic waste was employed, wherein people were rewarded for their waste segregation efforts. Staff directly involved in waste segregation received incentives from the sale of the food waste. Free

annual check-ups for tetanus and hepatitis B immunisation were provided to prevent staff from contracting diseases.

Composting

Composting is another strategy to minimise waste such as food discards, kitchen waste, cardboard and yard waste (HCWHA, 2004:5). For success, sufficient land space for on-site composting far enough from patient care and public access area would be needed. The Department of Health, Manila, (2004:17) agree that food scraps can provide most of the nitrogen while bulking agents commonly found in hospitals such as cardboard and wooden chips could provide carbon. The resulting rich compost can be sold or donated to local farmers and gardeners or used for plants around the hospital grounds. An example from two of the Philippine hospitals (HCWHA, 2004:34) revealed that these hospitals produced compact material that was used as fertilizer for their vegetable garden. This project was the brainchild of the project of a hospital employee, a graduate of the hospital waste management training programme.

Policies

According to WHO (2005a:152), the success of any type of waste management and minimisation programme is largely dependent on the cooperation of the actual waste producers and the waste handlers. The contribution of waste reduction strategies made at the policy-making level has a huge impact on the success of the waste management system (WHO, 2005a:153).

In purchasing departments of the participant hospitals, for instance, a “take-back policy” is usually stipulated in contracts with medical suppliers. The return policy provides the hospital with the option to return products near their expiry dates.

This practice alone has contributed immensely to the sharp decline of the volume of pharmaceutical waste of the hospitals (Department of Health, Manila, 2004:17). The research findings by HCWHA (2007:35) conclude that monitoring the rate of consumption of different types of medical and pharmaceutical supplies as well as regularly checking the expiry dates of these materials are good examples of effective waste minimisation policies. The usefulness of the First-In-First-Out (FIFO) approach was echoed by the South African Pharmacy Council (2004:91), which stated that medicines should be checked for expiry on delivery. Any medicine that had about three weeks before expiry should not be received as this would not only end as pharmaceutical waste, but would result in a financial loss to the hospital budget.

2.10.3 Best Practice 3: Best Practice in HCW Processing

Individuals exposed to hazardous HCW are potentially at risk, Such individuals include those within the healthcare facilities (HCF) that generate waste and those outside those resources who either handle such waste or are exposed to it as a consequence of careless management (Molina, 2007:17). As such, hospitals should examine the safety of people who handle or encounter the waste material.

Molina (2007:17) continues to assert that, within the hospitals, it is the staff, patients, visitors who are at risk of acquiring infections from improperly kept needles or poorly segregated infectious waste. Moreover, outside the hospital, waste pickers, who scour through piles of unsorted trash, as well as the public in general, are also at risk.

Therefore, the WHO (2007:36) recommends that sorting of waste into colour coded plastic bags should be done at all costs. The WHO (2005c:43)

recommends the application of international colour coding of waste bags, described in chapter three, as a necessity.

A relevant good practice learnt in the four hospitals researched by HCWHA (2004:38) was that, in addition to correct placement of waste in their correct waste bags, other hospitals have needle destroyers in every ward. Therefore, the possibility of needle stick injuries are minimised as needles are crushed to reduce them into shapeless trash.

Again, Molina (2007:7) maintains that storage areas for hazardous waste must have designated areas for different types of waste, ensuring that waste is segregated until final disposal. In some hospitals, the storage areas are only opened in accordance with the collection schedule.

2.10.4 Best Practice 4: Healthcare Waste Disposal

After the waste minimisation strategies have been carried out to reduce the volume of waste produced, the final step waste in waste management is the proper end-disposal of the remaining waste.

While general waste in the Philippines is collected by the hospitals' respective transport system, each of the four hospitals has contracts with a private waste treater that uses a non-burn technology in the treatment of infectious waste (Department of Health, Manila, 2004:20).

Kayser (2006:1) maintained that the health sector is a major source of dioxin (persistent organic pollutants) and mercury (a persistent toxic substance) in the global environment. They argue that this is mostly because of medical waste incineration of substances containing mercury such as thermometers and sphygmomanometers. Kayser (2006:1) recommends the use of an affordable

infectious waste treatment technology that avoids formation and release of persistent organic pollutants. This technology, they argue, will help demonstrate best practices in HCW management in model facilities with a focus on the replicability of these models to permit country operationalisation of the Stockholm Convention.

2.11 Conclusion

It has been shown that, by their nature, hospitals inevitably generate wastes that may be hazardous to health or have harmful effects on the environment. The literature review has also revealed that although hospitals generate 75 to 90 percent of waste hospitals generate, the rest can be considered infectious waste (WHO, 2005b:1). Also, Otto (2008:114) maintained that some wastes such as sharps and infected blood carry a higher potential for infection and injury than any other types of waste.

It could then be held that the improper waste management measures to prevent the exposure to hazardous HCW results in otherwise avoidable risks both to humans and the environment. It is, therefore, important to learn of tried and tested HCW management procedures (Ramabitsa-Siimane, 2006:36). The best practice methods developed internationally can be benchmarked, modified, and applied to perfectly suit developing countries such as South Africa.

The best practice methods discussed in this chapter forms the basis for the development of a model discussed in the next chapter.

CHAPTER THREE

HCW MANAGEMENT MODEL

3.1 Introduction

Chapter two covered the practices employed in the management of HCW. This entailed waste management practices (WMP), awareness and capacity building (ACB), internal storage and transportation (ISAT), management support (MS), as well as waste information systems (WIS). In addition, the national and international HCW best practices were explained and examined.

The focus of this chapter is the development of a conceptual model for the optimisation of HCW management on a best practice basis. The model is defined in terms of five core components, that is, waste minimisation; incorporating costing, legislation and options; segregation comprising HCRW and General waste; the nature of waste including characteristics and types of waste; healthcare waste treatment involving different kinds of treatment systems; and transportation.

3.2 Model defined

According to Yourdictionary (2004:1), a model implies making a plan in order to conform to a standard of excellence. Merriam-Webster (2009:1) further simplified the meaning by indicating that a model is similar to a pattern,

exemplar, an ideal mean set before one for guidance or imitation, and, therefore, it is something taken or proposed as worthy of imitating.

HCW models not only conformed to standards of excellence, but also gave attention to problems of sub-systems. For instance, models covered the location of landfill sites, types of incinerations to be used and the waste collection processes. Recently, models cover waste management in the whole, for example, all the process from the generation to the final disposal of waste (Begyl, Wassermann, Schneider and Salhoter, 2004; and Solano, Ranjithan, Barlaz and Bril, 2002).

3.3 Core components of the HCW model

3.3.1 Waste minimisation

This is defined as the prevention of waste production and/or its reduction (WHO, 2005c, 7:1). It involves formulation of specific strategies as well as management and behavioural change. Methods of waste reduction include modification of purchasing procedures, reduction of waste and waste re-use.

3.3.1.1 Modification of purchasing

The modification of purchasing is also called green procurement. This is a process of intentionally selecting products during the purchase process that will not only assist in generating less waste, but that will also ensure that waste being generated can be treated and/or disposed of in an environmentally sound manner (GDACE, 2005:4). According to Environmental Engineers Consultants (2007:1), implementing green procurement does not require any organisational changes. If the hospital management is committed to the minimisation of waste, a green procurement policy indicating the kind of goods to be procured should be crafted. However, this may need reviewing of the contracts in place in order

to prevent litigation from the existing contractors. After the green policy has been developed, this information may need to be communicated to the staff to prevent resistance to change, and stakeholders including the existing service providers or contractors. Practice Green Health (2008:1) maintains that green purchasing is not without problems. They claim that, in America, for instance, hospital purchasing is sometimes limited to a list of products contracted to the department procurement section at a central level. This is in agreement with Naledi (2005:7), who found that the procurement of goods in South African hospitals was centralised to the Provincial Government sections. Naledi (2005:7) further claimed that hospital Chief Executive Officers had no power in deciding the quality and type of goods but only the quantity.

3.3.1.2 Reduction of waste

An increase in waste generation is a world-wide problem (California Integrated Waste Management Board, 2007:2-3). Practice Green Health (2008:3) claims that waste reduction is a cost effective approach of reducing waste. To achieve this reduction, HCWHA (2005:4) maintains that the hospital management must have a strategy to target the largest component of the waste stream, for instance, cardboard, plastics, disposable linen and then draw an action plan of reducing these wastes.

California Integrated Waste Management Board (2007:1) reported success by enlisting views from the hospital staff on how to reduce waste. It is reported that some hospitals reward employees with cash bonuses and recognition for the best ideas and, as such, staff members strive for medical waste reduction.

On the other hand, the CGH Environmental Strategists (2007:2) reported that the excessive waste generation in the United States of America (U.S.A.) is as a result of over reliance on disposable instruments and materials. The authors

maintain that reliance on disposable equipment has not necessarily resulted in lower infection rates or better patient care outcomes, hence, the need to change to re-usable equipment.

In South Africa, GroundWork (2005:2) helped Ngwelezana Hospital of KwaZulu-Natal province in formulating a hospital waste reduction programme. The plan included building a secure storage area for red bags, from which HCRW is deposited. After a year of the implementation of the programme, the hospital managed to reduce HCRW red bags from 1 402 to 987 bags and, in the process, saved a sum of R20 000 per month.

CGH Environmental Strategists (2007:1) proposed that a new and increased emphasis be put on waste reduction of hazardous materials. For instance, hospital waste management would benefit from a policy to eliminate the use of mercury-containing products and technologies. Digital and electronic technology is available to replace mercury-based diagnostic tools, for example, non-mercury blood pressure equipment. This reduction policy may make a serious contribution to cleaning up the hospital waste stream.

3.3.1.3 Waste re-use

Waste re-use is one of the most common minimisation strategies because purchasing re-usable products, rather than single-use or disposable products, minimise recurring of waste streams (Practice Green Health, 2008:4). This involves purchasing durable products such as washable bed linen.

Furthermore, some re-usable materials may have a second useful life for a different purpose, such as using worn-out linens as cleaning cloths (Practice Green Health, 2008:4). The Practice Green Health (2008:5) adds that although individual cost of re-usable items may be higher than that of disposable

alternatives, there are long-term financial benefits. These benefits include less administrative procurement functions. Some examples of re-usable products are re-usable dishes and mugs, bulk beverage dispensers for milk, hot-air dryers in the bathrooms, instead of paper towels, re-usable diapers, and rechargeable batteries (EPA, 1990:12, and Practice Green Health, 2008:6).

3.3.3.4 Waste management options

In its 1989 report, the EPA outlined what is referred to as a hierarchy of waste management actions with re-use, reduction and recycling as its apex and land filling and incineration as its base (EPA, 1992:7).

It is important to note that the hierarchy is not the result of any scientific study of waste management options, and, therefore, it makes no attempt to measure the impact of the individual options or of the overall system. Despite these shortcomings, the hierarchy has become accepted as a dogma in some countries and among other policy makers (Robertson, 1998:20).

General HCW management practices, such as resource reduction, involve altering the design, manufacture or use of products and materials to reduce the amount of toxicity of what gets thrown away. Recycling diverts items such as paper, and plastics from the waste stream. These materials are sorted, collected and processed and then manufactured, sold and bought as new products. Composting involves microbial decomposition of organic waste such as food scraps and yard trimmings as well as uncoated paper and other biodegradable packaging materials, to produce a humus-like structure (Robertson, 1998:21).

Other practices address those materials that require disposal. According to Robertson (1998:22), landfills are engineered areas where waste is placed into or on the landfill, usually have liner systems and other safeguards to prevent

ground water contamination. Combustion is another HCW practice that has helped reduce the amount of landfill space needed (IPWIS, 2006:1). Combustion facilities burn general waste at a high temperature, reducing waste volume, and, in many cases, also generating electricity from the waste heat. Given the wide variability in HCW composition, it follows that there can be no single, global solution to the issue of packaging recovery and recycling (California Integrated Waste Management Board, 2008:13). Specific approaches for each waste management programme are required, reflecting geographic differences in both composition and the quantities of waste generated as well as differences in the availability of some disposal options (for instance, general waste incinerators are rare in many countries).

The economic costs of using different waste management options also show large variations between and within countries, for example, the costs for sorting collected post-consumer packaging (Robertson, 1998:22). Since mid-1990, the concept of integrated waste management has begun to replace the hierarchy as a more useful, organizing framework for thinking holistically about waste management. It recognizes that all disposal options can have a role to play in integrated waste management and stress the interrelationships between the options. Today, a management of waste management options is employed depending on the specific local conditions, the objectives being to optimize the whole system rather than its parts, making it economically and environmentally sustainable (IPWIS, 2006:4).

3.3.1.5 The availability of guidelines and legislation

The question that one may ask is why is there so much focus on health care waste, and what about the rest of other hazardous waste stream? HCW management was identified as one of the issues of priority in the National Waste Management Strategy that requires immediate action, and has been selected for

inclusion in the National Waste Management Strategy Implementation project, co-funded by the Government of South Africa and Denmark (DEAT, 2006b:27). The approach to addressing HCRW may serve as a model for addressing other priority waste streams in the future. Furthermore, the inclusion of HCRW is motivated by the high level of public concern regarding the transmission of blood borne diseases via needle-stick injuries caused by mismanagement of HCRW (DEAT, 2006b:27).

Consultation on HCRW policy

According to Molefe *et al.,* (2007:10), the draft of the document for HCRW policy was developed following the multi-stakeholder consultative workshops that were held in seven of the nine provinces (with the exception of Gauteng and Limpopo Provinces) across the country in 2004/5. Similar problems were identified by stakeholders in all the provinces where the workshops were conducted. The discussion document for the policy was further consulted within the DEAT and National Department of Health as well as key selected stakeholders whose countries were noted and further incorporated to form part of the draft policy that is currently under the discussion. This policy was not finalized on the writing of this report.

Local laws, rules and regulations

Although there are national regulations regarding HCRW, provinces are supposed to develop their own laws and by-laws for monitoring purposes (Molefe *et al*., 2007:12). Some provinces have nonetheless gone ahead with the development of provincial HCW management legislation and/or regulations such as the Western Cape and Gauteng Provinces. The HRCW policy has been formed by the provincial initiatives and will be produced national legislations and guidance to be implemented at the provincial and local government level. In South Africa, several legislations have been passed, for example, the Integrated

Pollution and Waste Management Policy, 2000 (prevention of pollution), the National Environmental Act 107 of 1998 (to enforce environmental protection), the Air Quality Management Act 39 of 2004 (guarding against the burning of hazardous wastes), the National Health Act 61 of 2003 (advising, on amongst other things, the disposal of human tissue), and the Occupational Health and Safety Act 85 of 1993 (for the protection of workers and other people from hazardous waste).

Hospital guidelines

In Manila, the Hospital Licensure Act No. 4226 requires all hospitals in the country (and mandates the Department of Health) to provide guidelines for hospital technical standards regarding personnel, equipment and physical facilities. The revised rules and regulations (Department of Health Administration Order Number 70-1) provided for the registration of, licensure and proper operation of hospital and other healthcare facilities. The code of sanitation of the Philippines mandates the Department of Health (DOH) to promote and preserve public health and upgrade the standard of medical practice. In line with the DOH mandate, a manual on hospital management was published in 1997 and the implementing rules and regulations of Chapter XVIII, Refuse Disposal of PD856 was promulgated. Hospitals must conform to these guidelines as they design their waste minimization strategies (Department of Health, Manila, 2005:39).

Franka, Zoka, Hussein, Hussein, Elbakosh, Arafa, and Ghenghesh, (2009: 258-261) and the International Council of Nurses (2009:10) maintain that hospitals must make simple guidelines and policies to inform day-to-day operational duties. The duties could include the need for weekly disinfection of trolleys, and immunization of HCW staff.

Colour coding scheme

The manual on hospital management recommended colour coding schemes for segregated waste to avoid any accidents and hazards to personnel. When the Department of Health released the implementing rules and regulations (IRR), the classification of waste was expanded by recognizing the existence of different types of hospital waste such as bio-degradable waste, chemical waste, infectious waste, pathological waste, pharmaceutical waste and radio-active waste. The IRR also provided the detailed sanitary requirements for segregation, storage and disposal.

3.3.1.6 Importance of estimating costs for various options

When recommending appropriate waste management systems to national, provincial or district officers, it is important to provide realistic estimates of the cost of various treatment options. Moreover, when introducing systems for waste management, the cost of the activities should be monitored to facilitate budgeting and planning. In this section, a methodology for estimating and reporting the costs of waste management in the Public District Hospitals is outlined.

Waste generation

Costs related to waste are in accordance with the amounts of waste generated (WHO, 2005c:12). The optimal solution to waste management varies between hospitals, depending on the opportunities for transporting waste to nearby treatment facilities if it is not done on-site. The first step, is therefore, to define the amounts of waste generated in the hospital. It is recommended to count the number of HCW bags and weigh the mass of the waste managed during a period of at least one month and if possible, three months, to account for any periodical variations. The amount of waste managed should be estimated from the figures obtained during the monitoring phase.

System costing

In this approach, the focus is on defining the costs of the whole HCW management system. All activities and equipment related to HCW management should be included in the cost analysis. They comprise direct costs of supplies and materials used for collection, transportation, storage, treatment, disposal, decontamination and cleaning, as well as the cost of labour and material for training and maintenance costs. These costs will vary depending on the treatment method chosen, the capacity of the treatment facility and the waste quantity. If revenue is being generated from recycling of waste, this amount should be subtracted from the cost of waste management to arrive at a net cost estimate (WHO, 2005c:13).

A full description of the system is necessary to provide an appropriate cost estimate. The number and type of hospitals using each disposal site needs to be stated, and the system for collection including frequency, mode of collection and itinerary, should be described. The specific data about the hospital size, services offered, average bed occupancy (ABO) and, in the case of an out-patient department (OPD), the population catchment also needs to be outlined. As a general indication, it would be interesting to know the percent of the hospital's budget that is allocated to HCW management. Costs shall be divided into capital and current costs for all options available. Capital costs are defined as resource items with a life time above one year, as opposed to recurrent costs that are items that are used on a regular basis and have a life time of below one year (WHO, 2005c:15).

3.3.2 Segregation

Segregation is the process of separating different types of waste at the point of generation and keeping them isolated from each other (Department of Health, Manila, 2005:23). Appropriate resource recovery and recycling techniques can

be applied to each separate waste stream. Moreover, the amount of hazardous waste that needs to be treated will be minimized or reduced subsequently. Consequently, the operational life of the disposal facility will be prolonged, and hospitals may gain benefits in terms of conservation of resources.

The two important reasons for practising segregation are financial and environmental. The segregation of HCRW from general waste following a robust risk assessment allows the two waste streams to be treated and disposed of separately. Sniffer (2007:2) observed that the majority of the HCRW is subjected to onerous consignment and disposal requirements, as the cost of disposing HCRW is approximately four times higher than the cost of disposing General waste. Sniffer (2007:4) cautions that if waste is not segregated in terms of HCRW and general waste streams, the whole waste should be considered HCRW. This procedure will usually command more expensive treatment. According to the Department of Health, Manila (2005:23), hospitals should develop their own segregation procedures in accordance with the WHO guidelines.

Codification

As part of segregation, codification is a colour coding system that defines the containers in which the waste must be stored once segregated (WHO, 2005c:5). An international colour coding scheme for HCW is shown in Table 3.1.

Table 3.1 Colour coding scheme for containers

Colour of bag/container	Type of waste
Black	Non-infectious dry waste
Green	Non-infectious wet waste (kitchen, dairy etc)
Yellow	Infectious and pathological waste
Yellow with black band	Chemical waste including those with heavy metals
Orange	Radioactive waste
Red	Sharps and pressurized containers

Adapted from: Department of Health, Manila (2005:27).

According to the Department of Health, Manila (2005:27), apart from colour coding for the HCW, hospitals should observe the best practice examples. Residuals of the General waste should join the stream of domestic refuse or municipal solid waste for proper waste management. Sharps should be collected together, regardless of whether or not they are contaminated. Containers must be puncture proof (usually made of metal or high-density plastics) and impermeable to contain not only sharps, but also any residual liquids from syringes. To discourage abuse, containers should be tamper-proof (difficult to open or break) and needles and syringes should be rendered unusable. Where plastics or metal containers are unavailable or costly, containers made of dense cardboard are recommended (WHO, 2005c:27). Bags and containers for infectious waste should be marked with the international infectious substance symbol (WHO, 2005c:28). Large quantities of obsolete or expired pharmaceuticals stored in hospital wards should be returned to the pharmacy for disposal (Department of Health, Manila, 2005:29). Other pharmaceutical waste generated at this level such as expired drugs, should be returned because of the risk of contaminating the pharmacy. Large quantities of chemical waste should be packed in chemical resistant containers and sent to specialized treatment facilities. The identity of the chemicals should be clearly marked on the containers. Hazardous chemical waste of different types should be separated. To prevent injuries, the staff should never try to correct the errors of segregation by retrieving items from a bag or container after disposal or by placing one bag inside another bag (packing) of a different colour. If general, or if hazardous waste is accidentally mixed, the mixture should be classified as HCRW (Department of Health, Manila, 2005:28).

3.3.3 Nature of waste

3.3.3.1 Infectious sharps

Sharps mainly comprise needles, syringes and blades (WHO, 2005c:30). Contaminated sharps can contain diseases (WHO, 2005c:31). According to Path (2006:11), most people are aware of the risk of contracting HIV, the virus that causes AIDS, from dirty needles. However, many HCW workers and patients are not aware of the high risks of contracting Hepatitis B or C from the same needles and syringes. The WHO (2005c:6) estimates that, every year, unsafe injections and needles-stick injuries cause 8 to 16 million Hepatitis B infections, 2.3 to 4.7 million Hepatitis C infections and 160 000 HIV infections. It is, therefore, important that needles and syringes, in particular, be handled with caution.

The WHO (2005b:2) maintains that most injuries occur when syringes, needles or other sharps have not been collected in rigid puncture-proof containers. Moreover, inappropriate design and/or overflow of existing sharps' containers, as well as unprotected disposal pits, increase the risk of exposure for healthcare workers and the community to needle-stick injuries.

Misplacement of needles in general waste is a problem in many countries (Path, 2006:6). This was confirmed by Kristiansen (2007:8) in a study that was conducted in Leratong Hospital, Gauteng. One of the objectives of the study was to assess the pre- and post-intervention efficiency of the HCW segregation of sharps. It was found that, as in other public healthcare facilities, there was a significant mis-segregation of healthcare waste occurring with adverse financial impacts. The post-intervention results demonstrated that although, there were improvements in the segregation of sharps, there were still misplacements (Table 3.2).

Table 3.2 Correct use of sharps containers (Proportions by weight)

	Correctly placed	Misplacements of waste in kilograms per day			Total misplaced
	Sharps	**Misplaced HCRW**	**Misplaced chemicals**	**Misplaced HCGW**	
Pre-intervention	0.85891	0.12055	0.01992	0.00061	0.14109
Post-	0.77509	0.21478	0.00074	0.00940	0.22491

Source: Kristiansen (2007: 9)

The WHO (2005c:7) recommends that intensive training be conducted for HCW workers regarding segregation of sharps. This follows a World Health Organisation (WHO) assessment of misplacement of sharps in twenty-two development countries where it was found that 18 to 64 percent of HCFs do not use proper waste disposal methods.

3.3.3.2 Infectious non-sharps

Despite the awareness regarding the need for proper disposal of HCW, there was still a misconception at some hospitals regarding the need to apply proper hazardous waste disposal practices for waste containing General waste and HCRW components (WHO, 2005c:31).

Generally, any waste mixture of the general waste and HCRW must be handled as HCRW. Items that are routinely handled as non-infectious waste include gauze pads, gowns, and bedding. Once these items are contaminated with hazardous waste, they should be handled as hazardous waste (Environmental Protection Agency) (EPA), 1990:7).

3.3.3.3 Non-infectious waste

This waste stream is called non-risk HCW or municipal solid waste (MSW) and comprises of 75 to 90 percent of all waste produced by hospitals (WHO, 2000:17). It refers to the stream of garbage collected through office and

sanitation services. According to the EPA (2005:1), 30 percent of the MSW produced by USA is recycled. While not providing this waste, in the first place, is the preferred management strategy, this waste can be directly combusted in waste-to-energy facilities to generate electricity (EPA, 2005:2). This is true because no new fuel services are used other than the waste that would otherwise be sent to landfills. MSW is often considered a renewable power source. However, although MSW consists mainly of renewable resources such as food, paper, wood, it also includes non-renewable materials derived from fossil fuels, such as tins and plastics (EPA, 2005:3). In addition, it is reported that in the USA waste generates approximately 2.500 megawatts, or about 0.3 percent of the total national power generation (EPA, 2005:3).

Burning MSW is not without problems. The WHO (2000:56) reports that when MSW containing batteries and tins is burned, toxic materials can be released into the air, causing water pollution (EPA, 2005:4).

According to Suchitra and Daschner (1985:283), knowledge is important in curbing infectious diseases. Devi (2009:340) added that the hospital spillages of hazardous waste and infectious diseases are common in hospital units characterized by wandering of patients, including children and psychiatric patients. These patients are generally known to be careless in that they eat on the floor potentially infected by hazardous waste (Devi, 2009:340).

3.3.4 HCW treatment

3.3.4.1 Incineration

Incineration is a high temperature dry oxidation process that reduces organic and combustible waste to organic, incombustible matter and results in a very significant reduction of waste volume and weight (WHO, 2006:14).

The combustion of organic compounds produces mainly gaseous emissions including steam, carbon dioxide, nitrogen oxides, and contains toxic substances, for instance, metals, halogenic acids, and particulate matter, plus solid residues in the form of ash (WHO, 2006:14; WHO, 2005c:11).

Incinerators range from extremely sophisticated, high temperature operating plants to very basic combustion units that operate at much lower temperatures. All types of incinerators, if operated properly, eliminate pathogens from waste and reduce the waste to ashes (WHO, 2005c:79). However, certain types of HCW, for example, pharmaceuticals or chemical waste, require higher temperatures for complete destruction. Higher temperatures and clearing of exhaust gases limit the atmospheric pollution and odours (WHO, 2005c:50). However, for incinerators to work efficiently and with minimal pollution, maintenance thereof must be up to date. This becomes uneconomically costly to individual hospitals.

In the pursuit to reduce the burden of disease, HCW needs sound management, including alternatives to incineration (WHO, 2005c:1). According to the WHO (2007:4), during the last few years, there has been growing controversy over the incineration of HCW. This was because, in some instances, low burning incinerators (below 800 degrees Celsius) in which, for example, plastics containing polyvinyl chloride (PVC) are incinerated, dioxins and furans and other toxic air pollutants may be produced as emissions.

The long-term effects of dioxins and furans lead to impairment of the immune system and the impairment of the nervous system; while short-term results include skin lesions and altered liver function (WHO, 2007:8).

The WHO (2005c:80) advises that pyrolytic incinerators be used. These are able to burn to a temperature of 900 to 1 200 degrees Celsius required to prevent air pollution.

Thermal processes

Thermal processes rely on heat to destroy pathogens (disease-causing microorganisms) and use four methods. Pyrolysis is the thermal decomposition of substances and materials in the absence of supplied molecular oxygen in the destruction chamber in which the said material is converted into gaseous, liquid or solid form. Waste residues may be in the form of greasy aggregates or slugs, recoverable metals, or carbon black. These residues could be disposed of in a secure facility, that is, a sanitary land fill. There are wet and dry thermal treatments. Wet thermal is a steam disinfection based on exposure of shredded infectious waste to high temperature, high pressure steam, and is similar to the autoclave sterilization process. It deactivates most types of microorganisms if temperature and contact time are sufficient. Autoclave uses steam sterilization to render waste harmless. This technique has been used for many years in hospitals for the sterilization of re-usable medical equipment. Autoclaves come in a wide range of sizes. A typical autoclave designed for medical waste treats about 100 kilograms per cycle (a cycle being about one hour) to several hundred kilograms per cycle for larger hospitals. Autoclaves used in centralized treatment facilities can handle as much as 3 000 kilograms in one cycle. Microwave exposes waste to a microwave that raises the temperature to 1 000 degrees Celsius for at least 30 minutes. Micro organisms are destroyed by moist heat which irreversibly coagulates and denatures enzymes and structural proteins.

Chemical disinfection

Chemical disinfection is now being applied for the treatment of HCW. Chemicals such as aldehydes, chlorine compounds, and phenolic compounds are added to

waste to kill or inactivate pathogens present in HCW. Chemical disinfection is most suitable in treating blood, urine, stools and sewage.

3.3.4.2 Availability of appropriate sites for waste treatment and disposal

Most government strategies are not to foreclose any options for managing waste by actions taken by them exclusively. This implies that all alternatives that can play any role in the future are kept open in any ongoing research programme. However, some disposal methods such as dumping of waste at sea, were discarded due to international treaties, such as the London Dumping Convention (Dodd, 2000:33) and the OSPAR agreements (Ospar, 1992:1-22), or because of safety reasons, for example, in outer space and in onshore shallow geological formations (Harverkate, 2002:27).

In 1993, the Dutch Government issued a policy directive stating that underground disposal of highly toxic waste was permissible provided that it remained retrievable over the long-term (Dutch Government, 1999;17). Recent studies (Commission CORA, 2007:3) do not report any factors prohibiting the technical feasibility of two retrievable disposal options, that is, long-term surface storage for some hundreds of years, and onshore, deep underground repositories in either salt formations or clay layers. It is thus very likely that a waste management method in the long-term will be established with a staged decision process of various storage options.

This means that surface storage and retrievable disposal in the deep underground could both be applied at different stages, depending on strategic demands at that time, particularly those relating to safety, environmental impact and economy.

3.3.4.3 Funds

It is also necessary to consider the regionalization of HCRW treatment where waste treatment is for a particular number of hospitals rather than each hospital having its own costly plant. Having identified a need for more co-ordinated integrated HCRW management in the country, the Gauteng Department of Agriculture, Conservation and Land Affairs (DACEL) appointed consultants to investigate regionalization of HCRW in the Gauteng province (GDACE, 2000:2). It was discovered that Gauteng alone had 600 hospitals, community health centers and clinics, classified as major generators of HCRW and 9 700 minor generators (medical doctors and veterinary surgeons). Further investigation revealed that, of 70 incinerators located in 58 (83%) healthcare facilities, only 58 were operational, of which 25 to 37 percent were registered with the regulating authorities (Silimela Africa, 2004:16). The GDACE (2000:2) found that the current practice of incinerating HCRW on-site at provincial hospitals were comparatively uneconomical. The cost of on-site incineration of HCRW plus costs associated with the use of a third party for removal or incineration was estimated to be R810 000 per month. The study suggested that the monthly cost could be reduced to R570 000 if two new facilities were brought into operation for the entire Gauteng province (GDACE, 2000:2).

Mangizvo and Chinamasa (2008:196), in their study to explore the possibility of regionalisation of HCRW in the KweKwe region of Zimbabwe, confirmed an urgent need for the central government to allocate a budget to procure a regional waste treatment plant for KweKwe. In their research, they found that the KweKwe area had six hospitals and seventeen clinics, all finding their own way of disposing of HCRW. Mangizvo and Chinamasa (2008:196) also found that incinerators in all healthcare facilities had broken down and it was difficult to resuscitate them due to foreign currency problems, as parts had to be imported. It became imperative, therefore, to take all the medical waste to the council

incinerator which was at the council abattoir. The incinerator was used to burn carcasses of condemned cattle, dead dogs and cats from the city's suburbs. In the study, it was observed that medical wastes of various types were strewn around the incinerator. These included sharps, empty drug bottles, and soiled bandages. In essence, casual dumping was taking place at the site. No attempt had been made to cover the waste with soil. Council workers at the site showed that their attempts to burn the waste, using cardboard paper, as they did not have firewood, had been futile. The amount of heat generated was not high enough and what was observed during the study were piles of half-burnt waste sharps, such as needles that required temperatures above 1 000 degrees Celsius in order to reduce them to ash (Mangizvo and Chinamasa, 2008:198). Broken bottles, plastics and sharps surrounded the incinerator. This exposed scavengers, who attempted to recover usable materials from the waste to possible injuries. The fact that medical waste was being disposed of in the abattoir's premises exposed residents of KweKwe to health hazards. The beef that was being consumed in the city was from this abattoir. Flies were seen on the waste and these could easily come into contact with meat in the abattoir. Dogs and cats frequented the premises as well, and they were in danger of being contaminated. Mangizvo and Chinamasa (2008:198) argued that because of the immense financial difficulty in Zimbabwe and complete malfunctioning of incinerators in the city, the procurement of at least one regional incinerator was an absolute necessity.

The lack of budget for HCW management, particularly in the developing countries, was contributory to poor HCW management. However, investing in long-term equipment will not only prevent pollution but will also incentivize HCW staff (Suess, 1992, 6-8).

3.3.4.4 Recycling

Enviroserv (2008:1) defines recycling as "*one way to reduce waste to land fill",* and adds that it means reprocessing material back to its original useful format.

Recycling is another way of waste reduction (Wisconsin Department of Natural Resources, 2008:2). In ensuring that recycling thrives, the Washington DC government banned certain materials from being land filled (Wisconsin Department of Natural Resources, 2008:1). This automatically forced health facilities to turn to recycling as a way of their waste management (Wisconsin Department of Natural Resources, 2008:1). Materials banned from land filling included office paper, newspaper, magazines, corrugated cardboard, aluminum and steel cans, bottles and jars, waste tins and yard waste.

Due to banning of the landfilling, many institutions developed action plans, which included procurement of separate containers for the materials banned from incinerators and land fills and arrangement for the collection and delivery of the recyclables to a recycling processing facility (Wisconsin Department of Natural Resources, 2008:9).

Enviroserv (2008:3), however, advised that institutions should start off with one or two products, for example, paper or cardboard and only target the next item after becoming acquainted with recycling system. In addition, Enviroserv (2008:3) reports that in South Africa, 35 700 people derive employment directly and indirectly from collecting paper and cardboard for recycling. This is, therefore, an employment opportunity for some people.

3.3.4.5 Land disposal methods

Biological processes

The process uses an enzyme mixture to decontaminate healthcare waste and the resulting by-product is put through an extruder to remove water for sewage disposal. The technology is suited for large applications and is also being developed for possible use in the agricultural sector. Design application is mainly for regional HCW treatment centre. Composting is an example of biological processes for treating and disposing HCW (Enviroserv, 2008:9).

Radiation Technology

The disposal of biologically contaminated waste from hospitals, clinics, and laboratories is of particular concern. Waste containing potentially infectious micro organisms (sewage sludge, biomedical waste and waste water) is treated using irradiation systems which are currently being used in waste treatment operations (Enviroserv, 2008:10)

Encapsulation

Encapsulation involves the filling up of containers with waste, adding immobilizing material, and sealing the containers. The process uses either cubic boxes made of high-density polyethylene or metallic drums, that are three quarters filled with sharps or chemical or pharmaceutical residues. The main advantage of the process is that it is very effective in reducing the risk of scavengers gaining access to healthcare waste (Enviroserv, 2008:10).

Inertization

Inertization is especially suited for pharmaceutical waste, and involves the mixing of waste with cement and other substances before disposal. This is to minimize the risks of toxic substances contained in the waste migrating into surface water or ground water.

3.3.4.6 Shredding of needles

Shredders cut sharps into small pieces. According to the WHO (2005c:1), this technology requires a worker skilled in the operation and maintenance of heavy duty and rotating equipment. Simple shredders can be made from a manually operated grain mill.

Shredding of needles has not been welcomed without problems. Quinn, a supervising waste specialist with the county of Sacramento's public works agency cited in Hall and McCoy (2005:3), states that:

> *"For safety and operational reasons, we much prefer bagged waste. Shredded medical waste on the other hand, presents problems for us since it can be scattered by wind, increasing potential worker and customer exposure and, we must be able to verify that medical waste received at the landfill has been properly treated".*

This implies that shredding alone does not constitute treatment of waste, shredding is hazardous because it can easily be scattered by wind (Hall and McCoy, 20005:3). It, therefore, seems that treating infectious wastes at the point of generation is necessary in order to prevent public exposure.

3.3.5 Transportation of waste

To prevent prolonged storage of HCW at the point of generation, the internal collection and transportation of waste is required (GDACE, 2003:1-6). The internal transportation involves the removal of waste from the intermediate storage to the central storage area (GDACE, 2003:5).

The transportation of waste should be done on dedicated containers, preferably usable containers (WHO, 2005a:1). Types and sizes of containers depend on the size of the treatment system that the hospital uses, for instance, reusable

containers should be able to fit into the hospital's autoclave (Health Care Coalition for Emergency Preparedness, 2009:6).

Outsourcing the transportation of waste may be required when hazardous waste is treated outside the hospital. According to the WHO (2007:65), the HCW producer is responsible for HCW until the return of the filled and signed consignment note from the contractor, indicating that the waste has been finally disposed of. The out-sourcing of the HCW disposal is suitable for small hospitals, whereby the increasing costs associated with treatment processes is above their waste budgets (Health care coalition for emergency preparedness, 2009:6). This is true for hospitals that previously relied on their on-site incinerator and have no staff or vehicles to transport waste (Abor & Bouwer, 2008: 356-364).

3.3.6 Conclusion

Many models have been developed and applied effectively in the first world.
They do not necessarily prove to be perfectly applicable to developing countries due to the different conditions under which they are applied. In this chapter, the HCW model for rural hospitals was based on core components applicable to the country.

Waste minimization emphasizes waste reduction activities through modification of the purchasing practices in favour of reusable products and waste reuse. Segregation was expounded on and described as a key strategy with two-fold advantages, namely, financial and environmental. It was mentioned that segregation allows risk wastes and general wastes to be treated and disposed of separately.

The nature of waste was discussed in terms of infectious sharps, infectious non-sharps and non-infectious wastes, each needing a special treatment technology. Examples of these special treatments are incineration, autoclave, and biological processes. Transportation of waste was consequently discussed as an important factor in deciding whether the hospital could afford on-site or off-site methods of waste disposal. The research methodology is discussed in the next chapter.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

The literature review in chapters two and three explores the trends in HCW management in the Public District Hospitals. The latter chapter establishes the model for the optimization of HCW management. This serves as basis for the development of the interview questions used in conjunction with the objectives to collect information from the selected respondents in respect of HCW management practices. The focus of this study was ensured through the two-fold course of actions, namely, the overview of the available literature on HCW management, as well as the empirical research in the Public District Hospitals.

The research design entailing the type of the study, the target population, and a sample are now examined and discussed. This is followed by the explanation of the data collection process used. In addition, the analysis process involving the data preparation and interpretation are expounded on. A pilot test was done to examine the content of the questionnaire. This also ensured the reliability and validity of the research instrument. Moreover, the structures of HCW management were ranked by the HCW workers and managers of the hospitals which did not take part in this study. This was done to obtain an order of importance of the structures used in this research, and was necessary for the analysis of the results.

4.2 Research design

4.2.1 Type of the study

This is a quantitative study, which entailed empirical research by means of a questionnaire as a measuring instrument analyzed statistically.

4.2.2 Target population and sample selection

The target population in this study is defined as employees working in the Public District Hospitals, and actively involved in the HCW management (Henning, 2007:23). The rationale for choosing this population was because public district hospitals have a large share in the generation of HCW in South Africa. South Africa has 388 public district hospitals, each with between 30 and 800 beds (National Department of Health, 2007:1).

The hospitals selected were identified from the National Department of Health (2008:1-8). The criteria used for selection were the relevant province, number of beds, rural or urban hospitals, whether the facility was previously involved in the HCW management study, and using the onsite incinerator.

South Africa is identified by the United Nations (UN) as a developing country. It is assumed to be a good point of departure and reference base as it contains first and third world socio economic structures, as held in the target population in this study.

The qualifiers specified for the person completing the questionnaire are that they have to be Public District Hospitals' employees directly or indirectly involved in HCW management. Bias might be present with the sampling procedures (Neuman, 2006:221). Therefore, the chosen sample represents all races, genders, and religions from South Africa. Further, bias has also been prevented by involving all provinces instead of just one or a few in the country.

4.2.3 Sample size

Phelan (2006:25) maintains that a large sample size alone does not guarantee a representative sample. However, Neuman (2006:221) claims that a large sample with a poor sampling frame is less representative than a small one with an excellent sampling frame. The sampling size of this study comprises of 27 Public District Hospitals of which three hospitals per province are targeted. In each hospital, 10 employees involved in HCW management were personally interviewed, giving a sum total of 270 respondents. Among the 10 employees who were personally interviewed per hospital were the Hospital CEO, head nurse, and the person handling waste.

A Hospital CEO

The fundamental reason for choosing the CEOs is because they are often caught between conflicting requests, that is, national legislation versus limited financial means at their disposal. It was felt that hospital CEOs were in a good position to give an overall view of how HCW management was dealt with.

Head Nurse

It was held that a head nurse was the best person to give information regarding waste generation and segregation because, according to the WHO (2005a:25),she/he is in charge of nurses, who by virtue of their nursing care giving, generate the most HCRW.

HCW Officer

This person is involved in the day-to-day operation of the Public District Hospitals' HCW management activities regarding HCW collection, transport, treatment and final disposal.

Persons handling waste

These persons included health and safety officers; pharmacists, occupational health nurses; quality assurance managers; infection control officers; HCW collectors; staff nurses ; and nursing assistants. These workers are crucial in providing information about actual practices regarding HCW collection, transport, treatment and final disposal (if done on-site).

As such, the sampling populations of this study were employees working in the urban or rural public district hospitals, using on-site incinerators, and previously involved in the HCW study.

Questions 1.1 to 1.32 required the respondents to indicate awareness of structures in place in their hospitals. The responses required were: Yes/No/Don't know. In order to get a measure of what structures are in place in each hospital, a rule was adopted (Table 4.1).

Table 4.1 A rule indicating existence of structures

Structure	Rule
Present	It was assumed that the particular structure was present in the hospital if 7 or more of the 10 respondents indicated 'Yes'
Absent	A particular structure was not present in the hospital if 7 or more of the 10 respondents indicated 'No'
Not sure	If the split was 4/6 or 5/5 or any combination with some 'Don't know' responses, it was unclear whether the structure was present or not. It could be that workers were not aware of their surroundings; or perhaps some hospitals had these structures in some areas but not all. This then became a 'Maybe/Not sure' category.

Unit of analysis

The unit of analysis of this research is the people in Public District Hospitals working directly or indirectly with HCW. Employees working directly are those that either generate waste such as nurses or handle waste such as general orderlies, waste collectors and waste disposers. On the other hand, officials

working indirectly with waste are institutional managers who supervise, and or generate institutional policies and ensure implementation, monitoring and evaluation of these policies.

In order to retain anonymity of hospitals as requested by the hospital management teams, hospital codes were use (Table 4.2)

Table 4.2 Hospital codes used for anonymity of hospitals

Province	Hospital	Province	Hospital	Province	Hospital
NorthWest	NW1 NW2 NW3	Western Cape	WC1 WC2 WC3	Gauteng	G1 G2 G3
Free State	FS1 FS2 FS3	Eastern Cape	EC1 EC2 EC3	Mpumalanga	M1 M2 M3
Northern Cape	NC1 NC2 NC3	Limpopo	L1 L2 L3	KwaZulu-Natal	KZN1 KZN2 KZN3

4.2.4 The sampling method

Saunders *et al*., (2005:175) maintain that purposive sampling enables the researcher to use own judgment in selecting cases that best enable the researcher to answer the set question(s) and to meet the study's objectives. For this reason, this method was chosen for this study.

4.3 Data collection

To facilitate reliability and validity, the questionnaires were administered personally. Interviews were conducted in one day per hospital listed in annexure 1. The initial planning was that the interviewing takes place from Monday to Friday because it was assumed that HCW workers would be off-duty during weekends and holidays. However, some hospital CEOs requested that the

interview be held on weekends because it was less busy. Therefore, the Public District Hospitals' visit schedule was adjusted to accommodate hospitals that preferred weekends to office days.

A list of hospitals from which data would be collected was sent to the National Department of Health for approval. Permission was also obtained from the relevant hospitals' CEOs on condition imposed that the name of the hospital was not be used in the dissertation.

The researcher was asked by the hospital CEOs to interview the respondents during lunch times in order not to interfere with the daily routine and the running of units. To make the respondents free and relaxed, interviews were not conducted in offices, but were held in the boardroom, as negotiated with each hospital. Confidentiality and anonymity was guaranteed by stipulating that no names would be written on the questionnaires and that participation was voluntary. Questionnaires were distributed personally, completed by respondents and returned on the same day.

4.4 Data analysis

The completed questionnaires were edited to ensure that they were filled out completely and to check the interviewer and respondent errors (McDonald and Gates, 2002:27). Questionnaires were adapted from ROSA ETLog (ETLog health projects, 2008:2), and questions that fell outside the sample parameters were discarded. Thereafter, the responses were checked and assigned numerical codes to identify various responses with a particular question.

Frequencies and percentages are used to represent variables throughout the study (Aakar, 2008:3). Frequencies and percentages are widely used in all

academic studies because the relative importance of figures is revealed more clearly by these simple tools than by the original data (Aakar, *2008:4*).

Descriptive statistics techniques such as frequencies and percentages are used in most scientific studies. Bar and pie charts are also used to present the findings (McDaniel and Gates, 2002:28).

Inferential statistics are concerned with the inferences that can be made about the population indices on the basis of corresponding ones obtained from the samples drawn randomly from the population (Welman and Kruger, 2002:41). The methods used in this research covers Chi-square tests and analysis of variance (ANOVA).

4.5 Pilot testing of questionnaire (Pretesting)

The questionnaire was pre-tested by ten respondents in one hospital of the UMkhanyakude District. This was done to refine the questionnaire and to enable ease in the answering of the questions by respondents, and to prevent problems in recording data (Saunders, *et al*., 2005:308). Expert opinions were elicited from health care workers and managers who did not participate in the actual research. These experts agreed that the questionnaire items were relevant to the research topic and that the questions were clearly formulated. No item required to be modified.

4.6 The measuring instrument

4.6.1 Style and approach of the questionnaire

A questionnaire following the parameters set by Dillman (2005:17) was used to gauge the opinion of the hospital HCW workers about the status and possible

improvement of HCW management. These aspects entailed limiting the length of questions, keeping the layout simple and logical, obtaining answers to all the questions, and avoiding bias. Answering time was also set to a maximum of 20 minutes to ensure a good response rate.

This layout was also used in respect of issues such as vertical flow, numbering and font sizes. It was felt that the respondents needed to feel that the progress was being made with the answering to ensure the completion of all the questions. Common questions and wording problems also received attention, for instance, questions asked were of the closed-ended type with ordered answer choices which enabled statistical analysis of the responses to highlight thinking of respondents.

4.6.2 Sub-sections of measuring instrument

Questions relating to sub-objectives (Q1.1-1.32): These questions entailed waste management practice (WMP), awareness and capacity building (ACB), internal storage and transportation (ISAT), management support (MS), and waste information system (WIS):

Adequacies (Q2.1- 2.16): Contained similar content as Q1.1- 1.32 but, in addition, explored the extent to which structures and processes were adequate;

HCW treatment (Q3.1- 3.4): Entailed four questions which involved health care waste treatment (HCWT) systems; and

HCW containers (Q4.1- 4.5): Specifically covered internal storage and transportation (ISAT) questions.

4.6.3 Questions related to sub-objectives (Q1.1 – 1.32)

Information sheet and introduction to the study

As an introduction to the question, an information sheet was used to introduce the respondent to the next section. The sheet reassured a respondent about confidentiality and details of the study. This covered a description of the study as well as a consent form. If the respondent confirmed participation, a consent form was signed and dated by both the interviewee and the interviewer (For reference purposes, see annexure 2 for the information sheet).

Biographics of respondents

This section contained eight questions where the respondent selected and ticked one option for each of the questions. The questions included gender, age, primary education, secondary education, whether the respondent had acquired a diploma or degree, whether the respondent was directly or indirectly involved in the HCW management, the experience in the hospital, as well as an experience in the HCW field. These questions (Q) were important in determining the role and the understanding of the HCW management by the respondent.

Gender (Q1)

This question established the percentages of male and female participants in the study. The relationship between the gender and the rest of the structures of the survey was established to determine whether there is a link. If the link was determined, some deductions were made regarding the occurrence of the phenomenon.

Age (Q 2)

This question determined the basic demography of the sample group which participated in the survey and was compared with the experience of respondents in the HCW field.

Level of education (Q3, 4, and 5)

These questions assisted in indicating if the respondent had basic reading and writing skills or was a professional. Information obtained was useful in indicating if the respondent was able to read policies, brochures, and written instructions, as well as recording, for instance, the number of HCRW bags handed over to the private contractor for final disposal.

Nature of involvement in the HCW management field (Q6)

The respondents were either directly or indirectly involved in HCW management. While workers directly involved in HCW refer to persons that collect, dispose, and generate waste, workers indirectly involved were managers who either supervised or generated HCW management policies.

Experience in the hospital and in the HCW field (Q7 and 8)

Experience refers to the period people in the sample group, who participate in the survey, have worked in the hospital as well as in the HCW field. It was anticipated that the experience gained at the working environment and in the HCW field would affect the efficiencies and effectiveness of the respondents in the HCW management.

Questions relating to sub-objectives of the study

This covered 32 short questions sorted according to the sub-objectives, namely, waste management practices (WMP), awareness and capacity building (ACB), internal storage and transportation (ISAT), management support (MS), and waste information system (WIS).

This section seeked to gain an understanding of the respondent's awareness regarding HCW structures available in each hospital. The findings were

explained by a short discussion followed by a table representing the relevant structures and the question numbers.

Waste management practices (Q1.4, 1.7, 1.13, 1.21-1.31*)*

Waste management practices relate to the reduction of the amount of waste produced through segregation, source reduction, resource recovery and recycling. These practices do not only protect the environment and help minimize risks of waste acquired diseases but make good business sense as this saves a substantial amount of money. WMP structures contained administrative as well as none-administrative structures. For convenience, they were classified as follows (Table 4.3):

Table 4.3 Waste management practices questions

Question No.	**Administrative structures**
Q1.23	Records for HCW generated
Q1.24	Records for HCRW bags collected
Q1.25	Records for HCW received from wards
Q1.26	Register for HCW handed over to contractor
Q1.27	Weighing of HCRW
Q1.28	Records for waste injuries
Q1.29	Records for spillages of HCRW
Question No.	**Non-administrative / "Other" structures**
Q1.4	Existence of spillage procedures
Q1.7	System to separate HCRW from General waste
Q1.22	Incentives for HCW best practices
Q1.30	Observation of Occupational Health and Safety Act
Q1.31	Integrated HCW management plan
Q1.21	Individual for tracking HCRW
Q1.13	Colour coding of trolleys

Awareness and capacity building (ACB) (Q1.1 – 1.3, 1.6, 1.11)

Awareness and capacity building involves cross-cutting issues in all the stages of HCW management. The DEAT (2002:14) emphasizes that the overall aim of awareness and capacity building is to enhance the performance of organizations or systems. Therefore, a question about awareness and capacity building seeks to discover whether HCW management programmes are sufficiently addressed for the successful implementation and long-term sustainability (DEAT, 2002). The personnel dealing with waste need to develop an awareness that HCRW, if handled injudiciously, could lead to dangers such as needle pricks which predisposes to HIV and hepatitis (Table 4.4).

Table 4.4 Awareness and capacity building structures (ACB)

Question No.	Structures
Q1.1	Water taps for washing hands
Q1.2	Immunisation programme for HCW workers
Q1.3	Personnel protective clothing
Q1.6	Orientation and induction of staff
Q1.11	Weekly disinfection of trolleys

Internal storage and transportation (ISAT) (Q1.8- 1.10, 1.12, 1.20*)*

It is generally accepted that each hospital should have a facility-based storage structure to keep waste not exceeding 48 hours final disposal or hand over to an out-sourced company (WHO, 2005c:37) (Table 4.5).

Table 4.5 Internal transportation and storage structures

Question No.	Structures
Q1.8	Storage area at a ward level
Q1.9	Central storage area in the Public District Hospitals
Q1.10	Fixed schedule for the collection of waste
Q1.12	Dedicated trolley for HCW
Q1.20	Secure storage area for HCRW

Management support (MS) (Q1.5, 1.14 – 1.19)

Brannen, and Goldberg, in the WHO (2005c:81), hold that hospital managers have reportedly been unyielding in setting up budgets for HCW management programmes. There are five questions in which respondents will indicate whether their hospitals' management gives financial support to HCW management programmes, and two questions concerning other management support issues (Table 4.6).

Table 4.6 Management support structures

Question No.	Structures
Q1.14	A separate budget to purchase trolleys for HCW
Q1.15	A budget for the waste related labour
Q1.16	A budget for HCW consumables
Q.1.17	A budget for the maintenance of the HCW buildings
Q1.18	A budget for contracted HCW management services
Q1.19	Attendance of HCW meetings by management teams

Waste information systems (WIS) (Q1.32)

According to the DEAT's, PSC completion report (2006), WIS software has been developed, tested and revised through piloting in Mpumalanga, and the Eastern Cape. The DEAT (2005b:11) indicated that the software would be rolled-out for implementation to other provinces by 2007. This research wants to establish the success in the implementation of WIS software in the Public District Hospitals. As such, in this study, respondents will be asked to indicate whether their hospitals have dedicated computers for HCW programmes. (Q1.32). Responses to this question will indicate the extent to which WIS has advanced in the Public District Hospitals.

Adequacy structures (Q2.1 – 2.16*)*

This section contained 16 questions which aim to establish if these related structures were adequate in the Public District Hospitals in which the respondents worked. The respondents were asked to indicate their level of agreement regarding adequacy of HCW management on the relevant structures. In order to obtain a degree of adequacy, as seen by respondents in their hospitals, the ratings of respondents were averaged. This was done for each of the 16 questions (Table 4.7).

Table 4.7 Adequacy structures

Question No.	Structures
Q2.1	Immunisation programme for HCW workers
Q2.2	The protective material for personnel
Q2.3	Knowledge of the HCW policy in the facility
Q2.4	Clear roles and responsibilities of staff in the HCW management
Q2.5	Procedures to handle HCW related injuries and accidents
Q2.6	Procedure availability in the case of accidental needle stick injury
Q2.7	Orientation and induction programme for HCW staff
Q2.8	Colour coding to differentiate trolleys for HCRW and general waste
Q2.9	The disinfection of trolleys
Q2.10	Capital to purchase HCW trolleys
Q2.11	Operation budget for labour
Q2.12	Operating budget for consumables
Q2.13	The budget for maintaining buildings
Q2.14	Records for waste at each step of the HCW disposal process
Q2.15	Segregation of hazardous from non-hazardous wastes
Q2.16	Detailed operating manuals or instructions for HCW staff

*Health care waste treatment (HCWT) (Q3.1 -3.4**)***

HCWT relates to four basic processes of destroying pathogens (micro-organism). Firstly, thermal, which relies on heat to destroy pathogens; secondly, the use of chemicals which employs disinfectants to destroy pathogens; thirdly,

irradiation which involves ionizing radiation to destroy micro organisms, and, fourthly, biological processes using enzymes to decompose organic matter (Health Care Without Harm, 2001:13). The four questions relevant to HCW treatment are:

Kind of HCW treatment system is used in the hospital (Q3.1)

The respondent was given the following choices, Disposable, sterilisable, auto-disable, safety syringe, and “I don’t know”. If the respondents tick “disposable”, it would imply that they have an increased generation of HCW and, hence, there is a need to explore usage of material. Washable diapers using sterilizers, for example, is regarded as a good practice because incinerators, such as the PLC monitor, could ensure that 100 percent of all bacteria in a waste batch is killed (Komar Industries, 2009). If the option “sterilisable” is ticked, it would indicate that the hospital could serve as a best practice model in terms of HCW management because sterilizing equipment indicates that the hospital uses life-long equipment instead of disposables which increases the generation of waste.

Number of times a respondent was pricked by a needle in the last 12 months (Q3.2)

This question examines whether safety precautions are taken by the hospital to protect workers from dangers of HCW. The respondent was given the following choices: never pricked; once; twice; three times; and four times or more.

Most causes for HCW treatment system failures (Q3.3)

The question evaluates whether financial resources are adequate to cover maintenance, servicing of waste treatment resources and also the investment in personnel such as artisans for repairs and maintenance of treatment plants. The respondent was given the following choices; no failure experienced; lack of money; poor maintenance; unavailability of spares; and staff incompetence.

*Hospital practices in the event of the failure of the HCWT system (Q3.4***)**

The respondent was given the following choices; burns the waste; just keeps the waste; out-sources the removal; ask for help from the neighboring hospitals; and never experienced a failure. The provided responses will gauge the extent of danger posed by poor practices to the community and staff. For example, if the hospital is burning the waste during the failure of the HCW treatment system, it would imply the possibility of the hospital polluting the air with dangerous gases. However, if the hospital opts to outsource disposal of waste, this would be regarded as a best practice.

Internal storage and transportation (Q4.1 -4.5)

In this study, characterizing waste means streaming waste into general waste or HCRW. For the five (5) questions pertaining to this section, respondents were required to choose and provide the most appropriate answer. The questions involved the following issues:

*The kind of waste container used by the hospital (Q4**.1)***

The respondent was given the following choices: there are no specific containers used; plastic containers; metallic containers; and bag box. It is believed that the answers will provide an indication about the extent of commitment and the ability of the hospital to improve HCW management. For example, if “no specific containers” is chosen by the respondent, it could indicate that streamlining of waste is not done in the hospital. It is, therefore, possible that general waste gets mixed up with HCRW, which poses a danger to staff. The danger can happen if a hospital that uses a faulty incinerator for burning the waste. The broken equipment containing mercury could release into the environment highly toxic methylmercury which, when taken up by living tissues and bioaccumulates over time, can cause serious health effects such as

neurological and reproductive disorders in humans and wildlife (Department of Environmental Protection, 2009:1)

Personnel allocated to assess the amount of waste generated (Q4.2)

The respondent was given the following choices, nurses, general orderlies, waste collectors; infection control practitioners; and waste is not assessed. It is important for a hospital to know the amount of waste generated because budget allocations for HCW management are in accordance with the amount of waste that each hospital generates.

*Shortages of waste containers in the last 12 months (Q4.3***)**

The respondent was given the following choices: yes; no; and do not know. This question explores the extent of management support in terms of HCW management programmes.

Reasons for shortages of containers (Q4.4)

The question was an extension of the former question. The question was only answered by respondents who, in the previous question, have agreed that there was a shortage of waste containers in the previous year. In this question, respondents are asked to provide reasons for such shortage. A respondent was given the following choices: lack of budget; delays in the procurement; and containers are wasted by the staff.

Allocation of workers to exclusively transport HCW from the generation to the storage points (Q4.5)

The respondent was given the following choices: don't know; general orderlies; health care waste handlers; nurses; and a hired company. If a respondent selects " Don't know", it could be assumed that the segregation of waste is not done.

4.7 Ranking of the structures

4.7.1. Purpose

In order to establish the level of compliance by the Public District Hospitals of the policies and procedures of HCW management, it was necessary to rank the structures in order of importance. The unavailability of previous ranking of structures prompted that a small scale survey be done.

4.7.2. Panel

A CEO of a Public District Hospital that was not part of the research allowed the use of the hospital's HCW workers to participate in the mini survey. The panel comprised nine HCW workers with varied experience and expertise in the hospital, and included the following:

Hospital CEO

Selected because of the vast management role, and for being the key decision maker affecting HR, human, as well as financial resources in the HCW management programmes;

The nursing service manager

Included owing to the complex decision making experience, as the head of the nursing profession, and her/his knowledge of the HCW management programme;

Quality assurance manager

It was important to have in the panel an official responsible for ensuring adherence of the hospital to norms and standards as laid down in the policy manual of the institution;

Infection control officer

Has a pivotal role in the drawing of the HCW management policies and ensuring compliance thereof, for instance, hand-washing procedures, and ensuring the availability of the HCW equipment;

Occupational health nurse

This official is concerned with health and morbidity of the hospital staff members. The role includes counseling, giving of immunizations, doing a variety of tests and giving of results including HIV, hepatitis B and C, as well as putting of needle stick casualties on antiretroviral programme;

Health and safety officer

Is chosen owing to his/her expertise in ensuring a safe working environment. This includes the provision of the personal protective equipment (PPE), as well as the safety and convenience of the HCRW storage facilities;

Waste collector

Commonly referred to as general orderlies, waste collectors are assigned responsibilities for the general cleaning of HCW equipment, storage and transportation of miscellaneous wastes in and out of the waste storerooms;

Professional nurse

Due to the inherent role of health care giving, a professional nurse is a major generator of HCRW, for instance, soiled bandages, used sharps including blades, needles, syringes as well as blood-stained swabs after blood invasive procedures; and

Matron

Was included because of the involvement in the supervision of professional nurses. The matron monitors, and evaluates the practice of nurses including the HCW segregation practices.

In addition, the National HCW consultant, and a statistician were informed about the weighting of the HCW management structures.

4.7.3 Procedure of data collection Instrument

A list containing 32 structures was used to elicit responses from the respondents (for clarity, see Annexure A). The data was arranged in accordance with the sub-objectives of the study for ease of the analysis.

Explanation

The respondents were asked to rate the structures from the scale of one to ten, where one was the lowest and ten the most important. The investigator read a list of structures to the participants. This was done to ensure that the questionnaire was well understood. No further clarity was needed as respondents indicated that the instruction was clear.

Interpretation

The completed questionnaires were sent to the statistician for interpretation. The scores of the respondents were weighted per structure of each sub-objective. Results were then rounded to achieve an integer weighting.

4.7.4 Results of the rankings

4.7.4.1 WMP

The respondents rated the colour coding of HCRW and general waste (Q1.13) as well as observation of the OHSA (Q1.31) as the most important (10). The need for personnel for tracking hazardous waste (Q1.21) was rated the least important lowest (3). See Table 4.9 for the average scores.

4.7.4.2 ACB

The survey showed that the personal protective equipment (1.3) and orientation and induction programmes were most considered the most important (10) in Public District Hospitals. This was not the case for weekly disinfection of trolleys (Q1.11) (4) (Table 4.9).

4.7.4.3 ISAT

The survey informants believed that a temporary storage at ward level (Q1.8); dedicated trolleys for collection of HCW (Q1.12) as well as a secure storage for hazardous waste (Q1.20) were equally more important (9). The central temporary storage area (Q1.9) and fixed collection schedule for waste (Q1.12) were ranked the least important (8) in this category (Table 4.8).

Table 4.8 Ranking of structures – averages

WMP Structures	Ave	ISAT Structure	Ave
HCW spillage procedures (Q1.4)	**7**	Temporary storage area at ward level (Q1.8)	**9**
Separation of HCRW from HGCW (Q1.7)	**9**	Temporary central storage area (Q1.9)	**8**
Colour coding for HCRW and general waste trolleys(Q1.13)	**10**	Fixed collection schedule for HCW (Q1.10)	**8**
Personnel for hazardous waste tracking (Q1.21)	**3**	Dedicated trolleys for collection of waste (Q1.12)	**9**
Incentives for HCW best practice (Q1.22)	**4**	Secure storage for hazardous waste (Q1.20)	**9**
Records for HCRW generated (Q1.23)	**7**	**MS structure**	
A register for HCRW collected (Q1.24)	**7**	A presence of HCW trainer (Q1.5)	**5**
A record for HCW received from wards (Q1.25)	**7**	Separate capital for purchasing trolleys (Q1.14)	**9**
Record for bags handed over to contractor (Q1.26)	**7**	An operating budget for labour (Q1.15)	**8**
Weighing of HCW bags (Q1.27)	**6**	Budget for HCW related consumables (Q1.16)	**9**
A record of waste related injuries (Q1.28)	**9**	Budget for maintaining buildings (Q1.17)	**5**
A record for spillages of HCRW (Q1.29)	**7**	Budget for contracted HCW management services (Q1.18)	**9**
Observation of the OHSA (Q1.30)	**10**	Attendance of HCW meetings by management (Q1.19)	**10**
Integrated HCW management plan (Q1.31)	**6**	**WIS structure**	
ACB structures		A computerized waste information system	**4**
A water tap for washing hands (Q1.1)	**9**		
Immunisation programme for HCW workers (Q1.2)	**9**		
Personal protective equipment for HCW (Q1.3)	**10**		
An orientation and induction programme (Q1.6)	**10**		
Weekly disinfection of trolleys (Q1.11)	**4**		

4.7.4.4 MS

The respondents felt that the attendance of HCW meetings by management (Q1.19) was most important (10) while the presence of HCW trainer (Q1.5) and the budget for maintaining buildings (Q1.17) were not considered as important (5).

4.7.4.5 WIS

The survey showed that WIS (Q1.32) was considered to be unimportant (4).

4.7.4.6 HCW treatment system (HCWTS)

The HCWTS structures were not included in the ranking. These questions include the kind of waste treatment containers used by hospitals (Q3.1), needle pricks in the last 12 months (Q3.2), the biggest cause for waste system treatment failure (Q1.33) and disposing of waste in the event of HCWTS failure (Q3.4). It was held that these structures were not rankable because they were found to be subjective. For instance, the structure “number of times respondent pricked by needle” can elicit varied responses depending on the experience of respondents.

4.8 Reliability

Neuman (2006:177) agrees that the reliability of an instrument is its ability to create reproducible results: thereby being equated with the dependability, consistency or stability of a measuring instrument. Reliability is the extent to which the respondents consistently give the same results, regardless of who does the measurement and when or where it occurs. In this study an attempt was made to ensure that the measuring instrument was reliable by adopting the following strategies:

Pilot testing

The relevant respondents were asked to identify errors, ambiguity of questions, problems of comprehension which could occur;

Personal distributing

The researcher distributed the questions to the respondents in the different hospitals, specifically to explain the reason for the study. The respondents were also requested to be as objective as possible. They were assured of their anonymity so that they could make contributions by clearly identifying problems regarding HCW management;

Sealing of responses

In order to assist the respondents to be as honest and objective as possible to the research questionnaires items, it was arranged that completed questionnaires, sealed in envelopes supplied with the questionnaires, would be deposited in sealed boxes to which no person other than the researcher had access;

Open-ended questions

Some questions had spaces in which respondents could freely add whatever they deemed necessary. This was done to further enhance respondents' free and open expression of their perceptions. The respondents made good use of these spaces and provided valuable inputs which suggested that questionnaires were well understood. The response to the open ended questions were analysed by categorizing similar open-ended responses into groups. These responses were portrayed in relevant sections under the discussion of the research results; and,

Anonymity ensured

As explained in the “Ethical consideration” section, there was no threat to respondents’ anonymity at any stage of the data collection process and the research process in general.

4.9 Validity

Validity refers to the degree to which an instrument measures what it is intended to measure what it is intended to measure (Neuman, 2006:178; Saunders *et al*., 2005:308). Three main approaches for estimating the validity of a measuring instrument designed to collect quantitative data, are construct validity, criterion-related validity, and content validity (Speziale, and Capenter, 2003:70).

Construct validity

Construct validity is the degree to which a measuring instrument measures a specific hypothetical construct, for example, intelligence (Speziale and Carpenter 2003:115). The items included in the questionnaire were based on information received during the literature review. This implies that most items had been tested and accepted by other researchers, and the ten participants in the pre-test provided further support to the validity of the constructs addressed in this research project.

Criterion- related validity

Criterion-related validity refers to the relationship between the measuring instrument and some already known external criterion (van Manen, 2002:77). The external criterion in this research was a best HCW management model. Independent evaluators of the research instrument, including the statistician and

a waste management expert, agreed that the questionnaire items were relevant to this HCW management study.

Content validity study

Content validity of a measuring instrument is the extent to which the instrument represents those factors under study. In this study, content validity was to establish whether the items on the instrument were representative of questions that should be asked about HCW management (Fouche, 2002:128). In the construction of questionnaire, three important aspects were considered. Firstly, the questions were formulated in a simple language for clarity and ease of understanding, secondly, clear instructions were given to respondents, and, thirdly, respondents were given sufficient time to complete the questionnaires.

For validation, the instrument was submitted to a statistician, a supervisor at DUT and a waste management consultant. A copy was also given to a nursing service manager of a Public District Hospital for her evaluation concerning the validity of the questionnaire. As a result, some questionnaires, which had been included from ETLog ROSA standardized questions for HCW management, were eliminated as being irrelevant to the study.

Rephrasing of some items was done in order to clarify questions. Some of the items were restructured to reduce potential ambiguities.

4.10 Ethical consideration

Studies involving human respondents raise unique sets of ethical issues. According to Ntlabezo and Booyens (2005:38), the term “ethics” refers to the quality of research procedures with respect to their adherence to professional,

legal and social obligations to the research subjects. Ethical standards and their acceptability were considered throughout the interaction of the researcher with respondents involved in the pre-testing. The purpose of the study was explained to all the participants while they were being orientated to the study. It was clearly stipulated to the respondents that participation in the study was voluntary. Nobody would be forced to answer any specific item. Respondents were not subjected to any form of pressure to complete the questionnaires.

The hospitals where the research was carried out, were not named, and no information was portrayed about separate hospitals but only the 27 Public District Hospitals combined. The researcher will lock up all filled questionnaires. The only person who had access to the completed questionnaires, apart from the researcher, was a statistician who transferred data to the SPSS software computer programme. All the completed questionnaires will be destroyed by the researcher after the research.

The permission to conduct the study was sought and obtained from the respondents in the form of a consent which they completed as proof of permission to participate in the research ant the hospital CEOs.

Individual letters were written to perspective respondents, who were addressed as colleagues in the letters and no names were indicated as the letters were delivered by hand on the day of the interview. This measure was done to ensure anonymity of respondents as well as confidentiality.

4.11 Conclusion

This chapter described the methodology and highlighted various techniques that were employed to conduct the study. The research design covered the type of the study, target population, and the sampling. The data collection process,

distribution and collection of questionnaires to 27 Public District Hospitals were done in person. Data analysis was included in the interpretation and descriptive statistics. Piloting was useful because it added confidence to the questionnaire. In addition, HCW workers from the Public District Hospitals, which were not part of this study, completed a mini survey in which the ranking of importance of the structures and processes was done. The analysis formed the basis for the discussion and interpretation of results.

The structure of the questionnaire was discussed, and, subsequently, the ethical consideration section showed that the research procedures adhered to the legal and social obligations of the research process as the research had permission of the respondents and Public District Hospitals' CEOs.

In the next chapter, the research findings are presented and discussed. The findings are analysed and inferences drawn.

CHAPTER FIVE

EMPIRICAL FINDINGS

5.1 Introduction

The application of the methodology for this study led to the collection of the empirical data being presented in this chapter. In most cases, the presentations start off by giving the averages of findings by province showing its three hospitals, and then, urban versus rural results. The empirical data was collected from 1 March 2009 to 26 March 2009, and continued from 6 to 11 April 2009. All 270 questionnaires distributed to the respondents were returned to the researcher after completion, translating to a response rate of 100 percent. The chapter consolidates all the data and discusses the highlights of the findings regarding the existence of structures, and procedures and processes used in the management of health care waste (HCW).

The findings entail five sub-objectives comprising waste management practices (WMP), awareness and capacity building (ACB), internal storage and transportation (ISAT), management support (MS), and waste information systems (WIS). In each sub-objective, findings are given per hospital and also per group of provinces in tables. In the tables, the row averages (Ave) indicates the total number of structures, in percentages, that each province has, while the bottom averages show the total number of provinces in which a particular structure exists. In addition to the sub-objectives, there are three other sets of enquiries concerning adequacies of structures and processes, health care waste treatment, and HCW containers. To start off, the analysis of results consists of a brief description of respondents, their demographics, and groupings of structures per province.

Subsequently, the results of the ranking of structures per province are given based on averages, where ten rates as the maximum and one the minimum.

In order to give more clarity on the results, tables, graphs, and figures, that represent the results, are inserted at the end of each discussion.

5.2 Sub-sections of the measuring instrument

Enquiries on biographics and structures relating to sub-objectives (Q1-8, 1.1 – 1.32)

The enquiries relating to biographics and structures are illustrated in Chart 5.1.

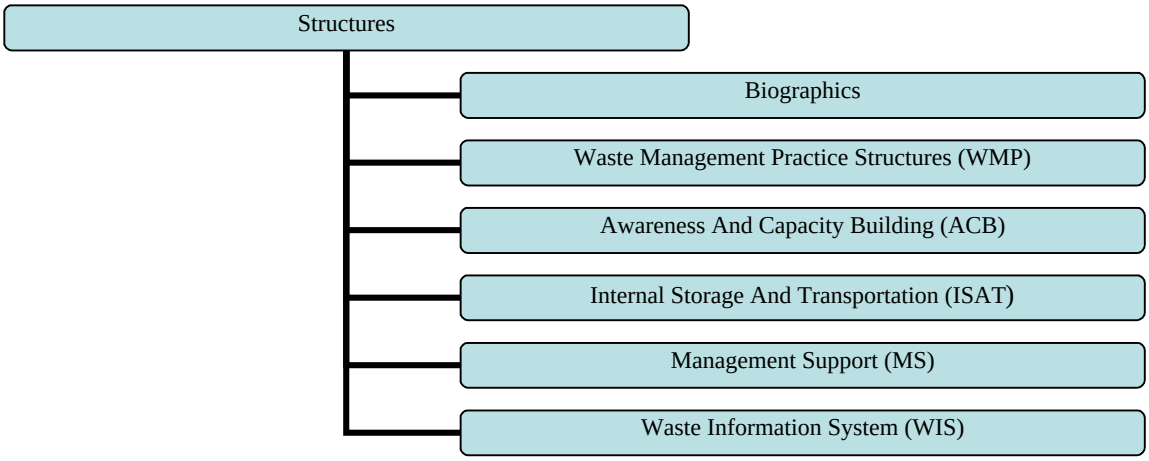


Chart 5.1 Enquiries relating to biographics and structures

The enquiries relating to processes are illustrated in Chart 5.2 below:

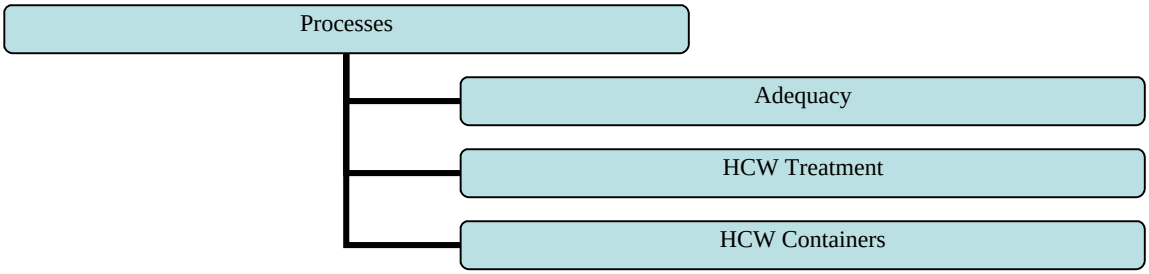


Chart 5.2 Enquiries relating to processes

5.3 Enquiries on structures relating to sub-objectives (Q1.1 – 1.32)

5.3.1 Nature of structures and processes stated

To facilitate the interpretation of the findings, the categories and classifications of the structures are repeated (Tables 5.1 – 5.4).

Table 5.1 Categories and classification of structures

Question No.	Structures	Sub-objectives
Q1.4	Procedures for spillages	WMP
Q1.7	System to separate HCRW from general waste	WMP
Q1.13	Colour-coded trolleys	WMP
Q1.21	Personnel to track hazardous wastes	WMP
Q1.22	Incentives for HCW best practice	WMP
Q1.23	Records for HCRW generated	WMP
Q1.24	Records for bags of HCW collected	WMP
Q1.25	Records for HCW received from the wards	WMP
Q1.26	Records for HCW handed over to contractors	WMP
Q1.27	Presence of a scale to weigh HCW bags	WMP
Q1.28	A register for waste-related injuries	WMP
Q1.29	Records for spillages of HCRW	WMP
Q1.30	Observation of OHSA	WMP
Q1.31	Integrated HCW management plan	WMP
Q1.1	Presence of water taps for washing hands	ACB
Q1.2	Immunisation programme	ACB
Q1.3	Personnel protective material	ACB
Q1.6	Orientation and induction programme	ACB
Q1.11	Weekly disinfection of trolleys	ACB
Q1.8	Storage area at a ward level	ISAT
Q1.9	Storage area at a central area	ISAT
Q1.10	A fixed schedule of collection of HCW	ISAT
Q1.12	Dedicated trolleys for HCW	ISAT
Q1.20	Central storage area secured and locked	ISAT
Q1.5	Presence of HCW trainer	MS
Q1.14	Separate budget to purchase trolleys	MS
Q1.15	Budget for waste- related labour	MS
Q1.16	Budget for HCW consumables	MS
Q1.17	Budget for maintenance of buildings	MS
Q1.18	Budget contracted for HCW management services	MS
Q1.19	Attendance of meetings by management	MS
Q1.32	Computer for waste information system	WIS

Enquiry related to processes

In addition, there were three categories of questions not included in Table 5.1 because, although they are extensions of the sub-objectives, their class and format are different from the previous questions.

- Adequacy

Table 5.2 Adequacy of structures and processes

Q2.1	Immunization programme for health care waste workers
Q2.2	The protective material available to personnel
Q2.3	Knowledge of the health care waste management policy
Q2.4	Roles and responsibilities with regards to HCW management
Q2.5	Procedures are present in cases of accidents and spillages
Q2.6	Procedures in the event of accidental needle-stick injury
Q2.7	Orientation and induction programme for staff in this hospital
Q2.8	Colour coding system to differentiate trolleys for HCRW and for general waste
Q2.9	The disinfection and cleaning of trolleys is sufficient
Q2.10	Capital for the purchase of trolleys
Q2.11	The operating budget for labour
Q2.12	The operating budget for consumables
Q2.13	The budget for maintaining the buildings
Q2.14	Adequate records of waste are kept at each stage of the waste disposal process
Q2.15	HCRW separated from general waste
Q2.16	Detailed operating manuals or instructions

Adequacy questions were used to establish the extent to which responses to the availability of structures and processes applied.

- HCW treatment

Table 5.3 HCW treatment processes

Q3.1	Kind of health care waste treatment system used in the hospital
Q3.2	Number of the times respondents pricked by a needle(s) in the last 12 months
Q3.3	Biggest cause for HCW treatment system failure in the last 12 months
Q3.4	Action taken by a hospital in the event of HCW treatment failure

These questions enabled respondents to expand on the problems encountered regarding HCW treatment.

- HCW containers

Table 5.4 HCW and containerisation processes

Q4.1	Kind of waste containers the hospital uses
Q4.2	Assessment of the amount of waste generated by the Hospital
Q4.3	Shortage/ shortages of waste containers in the last 12 months
Q4.4	Causes for shortages of HCW containers
Q4.5	Person transporting waste from generation to storage points

These questions established challenges hospitals face about HCW containers.

5.3.2 Biographics of respondents (Q1-8)

Eight aspects of the demographic profiles appeared in the first section of the questionnaire. The demographics of the respondents may have influenced the findings and, therefore, it was necessary to establish their profiles. The results of questions relating to the following aspects of their profiles are covered.

Gender and age of the respondents (Q1 and 2)

It was found that there were slightly more males (51%) than females in the survey with the majority of the respondents being between 30 and 39 years old. This is prevalent throughout all the provinces, except for KwaZulu-Natal (KZN), which showed more females (64%) than males, and Eastern Cape which had half of their respondents over 50 years old (Table 5.5).

Table 5.5 Gender and age of the respondents

Gender	**NW**	**FS**	**NC**	**WC**	**EC**	**L**	**G**	**M**	**KZN**	**AV**
Male	56%	43%	52%	52%	56%	45%	52%	64%	36%	**51%**
Female	44%	57%	48	48%	44%	55%	48%	36%	64%	**49%**
Age	**NW**	**FS**	**NC**	**WC**	**EC**	**L**	**G**	**M**	**KZN**	**AV**
20 – 29 years	32%	19%	26	27%	21%	27%	23%	33%	19%	**25%**
30 – 39 years	30%	17%	37	29%	12%	29%	30%	26%	21%	**26%**
40 – 49 years	20%	30%	12	32%	19%	32%	35%	30%	21%	**26%**
50+ years	18%	34%	26	12%	50%	12%	13%	12%	38%	**24%**

Level of education and involvement in HCW management (Q3, 4, 5, and 6)

The results indicated that most of the respondents (36%) had secondary education. However, the Eastern Cape had some respondents (3%) with no formal education.

With regard to the involvement of the respondents in the HCW management, it was found that almost two thirds of the respondents (65%) were waste handlers. This ratio was true for most provinces. The exception was Mpumalanga where the opposite applied with more managers (62%) than handlers (Table 5.6).

Table 5.6 Highest level of education and involvement in HCW management

Education and position in the HCW field	**NW**	**FS**	**NC**	**WC**	**EC**	**L**	**G**	**M**	**KZN**	**Ave**
No formal education	0%	0%	0%	0%	3%	0%	0%	0%	0%	**0%**
Primary education	38%	32%	28%	17%	38%	29%	23%	30%	46%	**31%**
Secondary education	35%	29%	42%	43%	31%	45%	43%	34%	24%	**36%**
Diploma or degree	27%	40%	30%	40%	28%	26%	34%	36%	30%	**32%**
Position in HCW field	**NW**	**FS**	**NC**	**WC**	**EC**	**L**	**G**	**M**	**KZN**	**Ave**
Waste handlers	68%	66%	67%	66%	67%	67%	65%	38%	67%	**65%**
HCW managers	32%	34%	33%	34%	33%	33%	35%	62%	33%	**35%**

Experience in the hospital and HCW field (Q7 and 8)

The research revealed that a large portion of the respondents (30%) had worked in the public hospitals for a period of one to five years, whereas a small portion (11%) had worked for less than a year. Similarly, the ratio was true for the experience in the HCW field where it was confirmed that the majority of the respondents (43%) had one to five years' experience in the HCW field.

On the other hand, the results per province showed that the majority of the respondents from the Western Cape (57%) had worked in the hospitals for under a year while most (21%) of the respondents from the Eastern Cape had worked in the hospitals for more than 15 years. At the same time, it was

interesting to note that Mpumalanga was the only province where none of the respondents had served in the HCW field for less than a year (Table 5.7).

Table 5.7 Experience in the hospital and HCW field

Experience in the hospital	**NW**	**FS**	**NC**	**WC**	**EC**	**L**	**G**	**M**	**KZN**	**AV**
< 1 year	29%	0%	0%	57%	0%	0%	0%	0%	14%	**11%**
1 to < 5 years	28%	33%	42%	22%	20%	32%	36%	30%	29%	**30%**
5 to < 10 years	21%	35%	34%	12%	20%	28%	35%	38%	36%	**29%**
10 to <15 years	12%	15%	18%	4%	19%	28%	10%	22%	20%	**16%**
15 + years	10%	17%	18%	4%	21%	15%	19%	10%	15%	**14%**
Experience in the HCW field	**NW**	**FS**	**NC**	**WC**	**EC**	**L**	**G**	**M**	**KZN**	**AV**
< 1 year	21%	10%	20%	22%	3%	2%	14%	0%	15%	**14%**
1 to < 5 years	44%	49%	46%	34%	31%	45%	44%	48%	40%	**43%**
5 to < 10 years	15%	20%	20%	21%	22%	37%	16%	34%	9%	**23%**
10 to < 15 years	12%	10%	11%	9%	11%	5%	17%	22%	13%	**13%**
15 + years	8%	4%	6%	14%	33%	13%	10%	7%	13%	**11%**

5.4 Findings of groups per provinces

5.4.1 WMP structures

- **Administrative (Q1.23 – 1.29)**

Records of the HCRW generated (Q1.23)

It was found that most (88%) hospitals in the urban areas kept records of the HCRW while in the rural hospitals only a few did (26%) (Table 5.8)

Table 5.8 The records for the HCRW generation per hospital and ward

Nature of records	**Urban**	**Rural**
HCW generated per hospital	88%	26%
HCRW generated per hospital ward	88%	21%

A register of bags received from the hospital wards (Q1.25)

It was found that, on average, a third (33%) of hospitals keep registers to record the number of bags of waste generated from the different hospital departments. All the respondents from Gauteng and the Western Cape indicated that such registers existed in their hospitals. However, the same cannot be said of Free State, Eastern Cape, Limpopo and KwaZulu-Natal, whose hospitals had no such records (Table 5.9).

Table 5.9 A record for the number of bags received from hospital wards, by province

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN	%
Registers present	33%	0%	33%	100%	0%	0%	100%	33%	0%	33%

Record of bags handed over to the contractor (Q1.26)

The majority (48%) of respondents indicated that records for waste bags handed over to the contractor for final disposal were not kept by hospitals. A small number (11%) of respondents were unsure if this record of bags handed over to contractor was kept (Table 5.10).

Table 5.10 Record of bags handed over to contractor

Bags of waste handed over	Number of waste bags	Percent
Number of hospitals	27	100 percent
Yes	11	41%
No	13	48%
Unsure	3	11%

A register of bags and containers generated by each ward (Q1.24)

The respondents believed that almost half (41%) of the hospital kept records of the number of bags and containers of waste generated while 11 percent were not sure if their hospitals kept such records *(Table* 5.10), most respondents from the urban hospitals (88%) believed that some records were kept, whereas, the respondents from the rural hospitals (79%) did not think so.

A scale to weigh bags before a hand-over for final disposal (Q1.27)

A small number (19%) of the respondents thought that there were scales to weigh HCW bags before the final hand-over for disposal. However, the results showed that most of the hospitals did not have such scales. This was true for both urban (88%) and rural (79%) hospitals (Table 5.11).

Table 5.11 Scales to weigh HCW bags before final hand-over for disposal, by urban/rural

Existence of weight scales	Rural	Urban
Yes	12%	21%
No	88%	79%

Records of waste related injuries to staff (Q1.28)

It was found that nearly half (48%) of the hospitals had kept a record of occurrences of waste-related injuries. See Table 5.14. There was a big difference between the results of the urban and rural hospitals. The results showed that a three quarter of the urban hospitals kept the records while, almost two thirds (63%) of the rural respondents had no such records (Table 5.12).

Table 5.12 A record of occurrences for waste related injuries

A record of waste related injuries	Urban	Rural
Yes	75%	26%
No	25%	63%

Records for spillages of hazardous substances (Q1,29)

The results showed that a small number (7%) of hospitals did not keep records for the spillages of hazardous substances. Although most (82%) of the respondents thought they did not keep records, there was a small number (11%) of respondents who were not sure if their hospital kept such records (Table 5.13).

Table 5.13 A record of spillages of hazardous waste, by hospital

Existence of a record of spillages	No. of Public District Hospitals	Percent
Yes	2	7%
No	22	82%
Unsure	3	11%

The research indicated that records of waste-related injuries were more present (48%) in provinces than those of HCW spillage (4%). In addition, the comparison of the presence of records per province indicated that the Western Cape (81%) followed by Gauteng (71%) had more records than Free State and Limpopo who had none. Further, the weighted score averages for the Public District Hospitals showed that the Western Cape (2) hospitals had the most records while the Eastern Cape (1) hospitals had the least records (Table 5.14).

Table 5.14 Existence of WMP structures regarding administrative functions

Province	HCW records generated (Q1.23)	HCRW bags collected (Q1.24)	HCW received from wards (Q1.25)	HCW handed over to contractor (Q1.26)	Scales to weigh HCRW (Q1.27)	Waste injuries (Q1.28)	Spillage of HCRW (Q1.29)	Ave
NW	NW2,3	NW3	NW2	NW2,3	NW2	NW1,2,3	None	**48%**
FS	None	None	None	None	None	None	None	**0%**
NC	NC1,2	NC1.2	NC2	NC2,3	NC2	NC3	None	**43%**
WC	WC1,2,3	WC1,2,3	WC1,2,3	WC1,2,3	WC1	WC1,2,3	WC2	**81%**
EC	None	EC2	None	None	None	None	None	**5%**
L	None	None	None	None	None	None	None	**0%**
G	G1,2,3	G1,2,3	G1,2,3	G1,2,3	None	G1,2,3	None	**71%**
M	M2	M2	M2	M2	M2	M2	None	**29%**
KZN	KZN1	None	None	None	KZN3	KZN1,2	None	**9%**
Ave	**44%**	**41%**	**33%**	**41%**	**19%**	**48%**	**4%**	

- **Non-administrative questions (Q1.4, 1.7, 1.13, 1.21, 1.22, 1.30, 1.31)**

Accidents and spillage procedures (Q1.4)

The findings per hospital showed that the most (56%) respondents did not believe that accident and spillage procedures existed in their hospitals, whereas

a small number (18%) of hospital respondents were unsure whether or not these procedures were present at their hospitals (Table 5.15).

Table 5.15 Procedures in cases of accidents and spillages, by hospitals

Responses	Number of procedures	Percent
Number of the hospitals	27	100%
Yes	7	26%
No	15	56%
Unsure	5	18%

The respondents were asked to rate the availability of accidents and spillage procedures in terms of the urban and rural contexts. It was found that, urban hospitals had more (38%) accident and spillage procedures compared to their rural counterparts (21%) (Table 5.16).

Table 5.16 Availability of accident and spillage procedures

Existence of accidents and spillage procedures	Urban	Rural
Yes	38%	21%
No	62%	79%

A system to separate HCRW from general waste (Q1.7)

The respondents were asked to indicate whether there were systems to separate HCRW from general waste in their respective hospitals. It was found that, on average, 56 percent hospitals had such systems. However, a large number (15%) of the respondents were not sure if such a system existed in their hospitals (Table 5.17).

Table 5.17 A system to separate the HCRW from general waste

A system to separate HCRW from general waste	No. of systems	Percent
Number of hospitals	27	100%
Yes	15	56%
No	8	30%
Unsure	4	15%

About three quarters (75%) of the respondents from the urban hospitals believed that a system to separate the HCRW from the general waste was available. On the other hand, slightly more than half (53%) of the respondents in the rural hospitals did not think they had such a system (Table 5.18).

Table 5.18 Availability of systems to separate HCRW from General waste by urban/ rural

Availability of a system	Urban	Rural
Yes	75%	47%
No	25%	53%

A colour coding system for general and hazardous waste trolleys (Q1.13)

The results showed that a large number of hospitals (41%) had no colour coding to differentiate trolleys for general and hazardous waste (Table 5.19).

Table 5.19 A colour coding system for general and hazardous waste trolleys, by hospital

Colour coding system	No. of systems	Percent
Number of hospitals	**27**	**100%**
Yes	12	44%
No	11	41%
Unsure	4	15%

An individual person in charge of hazardous waste tracking (Q1.21)

A small number (12%) of the urban respondents believed that hazardous waste tracking was controlled by an individual person employed or designated for this function. However, the results showed that most of the hospitals did not employ such a person. This was true for both urban (88%) and rural (95%) hospitals (Table 5.20).

Table 5.20 An individual for hazardous waste tracking in the Public District Hospitals

An individual for tracking	Urban	Rural
Total number of Public District Hospitals	100%	100%
Yes	12%	5%
No	88%	95%

Sectional incentives for HCW best practice (Q1.22)

The research showed that incentives or awards for the HCW best practice were not provided in any of the hospitals in the sample.

The requirements of the Occupational Health and Safety Act (OHS) (Q1.30)

A third (33%) of hospitals complied with the OHS act. However, more than half (52%) of the respondents were uncertain whether or not their hospitals complied (Table 5.21).

Table 5.21 The requirements of the OHS act, by hospital

Requirements of OHSA complied with	No. of Public	Results of compliance
Yes	9	33%
No	4	15%
Unsure	14	52%

A large number (63%) of the respondents from the urban hospitals believed that urban hospitals complied with the requirements occupational health and safety. At the same time, a large number of respondents (79%) from the rural hospitals maintained that they did not comply with the Act (Table 5.22).

Table 5.22 The requirements of the Occupational Health and Safety Act

Requirement of the OHSA complied with	Urban	Rural
Yes	63%	21%
No	37%	79%

An integrated HCW management plan (Q1.31)

A plan existed for an integrated HCW management in, on average, almost half (41%) of the hospitals in the provinces. As previously seen, all Gauteng province respondents confirmed the availability of such a plan in their hospitals. This was,

however, not the case in the Eastern Cape and Free State, where none of the hospitals had a plan (Table 5.23).

Table 5.23 An integrated HCW management plan, by provinces

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN	Ave
Yes	66%	None	33%	33%	None	66%	100%	33%	33%	41%

While half of the respondents in urban hospitals believed they had such a plan, a large number (63%) of the rural hospital respondents did not think a plan was available (Table 5.24).

Table 5.24 Presence of an integrated HCW management plan

Presence of a plan	Urban %	Rural %
Yes	50%	37%
No	50%	63%

Other than administrative functions, the incidences of WMP were further examined in terms of “other structures” present in hospitals. It was found that a system to separate HCRW from general waste was most common in hospitals. The exceptions were the Eastern Cape and Mpumalanga where it was found that none of their hospitals had such a system. None of the hospitals had made provisions for the incentives for HCW best practices (Q1.22) (Table 5.25)

Table 5.25 Incidence of WMP regarding "Other" structures

Province	Spillage procedure (Q1.4)	System to separate HCRW from general waste (Q1.7)	Colour coding (Q1.13)	Person to track HCW (Q1.21)	Incentives for HCW best practice (Q.22)	Observance of OHSA (Q1.30)	Integrated HCW plan (Q1.31)	Ave
NW	NW1,2	NW1,2,3	NW2,3	NW1	None	NW2	NW2,3	**52%**
FS	FS1,3	None	None	None	None	None	None	**10%**
NC	NC2	NC2,3	NC2,3	None	None	NC2	NC2	**33%**
WC	WC1,2	WC1,2,3	WC3	WC2	None	WC2,3	WC3	**48%**
EC	None	None	EC2	None	None	None	None	**4%**
L	None	L2	None	None	None	None	L2,3	**14%**
G	None	G1,2,3	G1,2,3	None	None	G1,2,3	G1,2,3	**57%**
M	M2	None	None	None	None	None	M2	**10%**
KZN	KZN1	KZN1	KZN1,2,3	none	None	KZN1,2	KZN2	**38%**
Ave	**26%**	**56%**	44%	**7%**	**0%**	**33%**	**41%**	

5.4.2 Awareness and capacity building (ACB) structures (Q1.1-1.3, 1.5, 1.6, 1.11)

Water taps in the waste storage and treatment areas (Q1.1)

The results showed that nearly two-thirds of the hospitals had water taps in the waste store rooms and treatment areas. A small number of respondents disagreed with this question (Table 5.26).

Table 5.26 Water taps in the waste storage and treatment areas

Water taps	No. of hospitals	
Number of hospitals	**27**	**100%**
Yes	17	63%
No	8	30%
Unsure	2	7%

Immunisation programme for HCW workers (Q1.2)

The research indicated that an immunisation programme was not available in the majority (44%) of the hospitals. A small number (15%) of respondents were

unsure if an immunisation programme was available for the HCW workers (Table 5.27).

Table 5.27 Immunisation programme for HCW workers

Immunization programmes	No. of hospitals	Percent
Number of hospitals	**27**	**100%**
Yes	11	41%
No	12	44%
Unsure	4	15%

Personal protective equipment for HCW workers (Q1.3)

A large number of hospitals had protective equipment for the HCW staff. A few (19%) respondents were unsure if protective equipment was available (Table 5.28).

Table 5.28 Personal protective equipment

Personal protective equipment	No. of hospitals	Percent
Number of hospitals	27	**100%**
Yes	22	81%
No	0	0%
Unsure	5	19%

Orientation and induction programme for HCW workers (Q1.6)

Nearly three quarters (74%) of the hospitals offered their workers orientation and induction programmes. However, a small number of respondents (7%) disagreed with this question (Table 5.29).

Table 5.29 Orientation and induction programme

Orientation and induction programme	No. of hospitals	
Number of hospitals	**27**	**100%**
Yes	20	74%
No	2	7%
Unsure	5	19%

Weekly disinfection of trolleys (Q1.11)

The study showed that the weekly disinfection of trolleys was not done in the majority (85%) of the hospitals. Only a few (4%) of the respondents had believed that weekly disinfection of trolleys was done (Table 5.30).

Table 5.30 Weekly disinfection of trolleys

Weekly disinfection of trolleys	No. of hospitals	Percent
Number of hospitals	**27**	**100%**
Yes	1	4%
No	23	85%
Unsure	3	11%

A higher recording of protective clothing availability (78%) was observed in most provinces although the same could not be said of a weekly disinfection of trolleys which had the lowest incidence (4%). Once more, the Western Cape had the most (67%) ACB structures while Limpopo (19%) had the least (Table 5.31).

Table 5.31 Incidence of the ACB structures concerning personnel and other

Province	Water taps (Q1.1)	Immunisation (Q1.2)	Protective clothing (Q1.3)	HCW trainer (Q1.5)	Orientation and induction (Q1.6)	Weekly disinfection of trolley (Q1.11)	Ave
NW	NW1,2,3	NW2	NW2	NW2,	NW1,2	NW2	**48%**
FS	FS1,2	FS2	FS1,3	FS3	FS1,2	None	**38%**
NC	NC2,3	NC3	NC1,2,3	NC2	NC1,2,3	None	**48%**
WC	WC1,2,3	WC1,2,3	WC1,2,3	WC1,2	WC1	None	**67%**
EC	EC2,3	None	EC1,2,3	EC3	EC1,3	None	**38%**
L	None	None	L1,2	None	L1,2	None	**19%**
G	G1,2,3	G1	G1,2,3	G1	G1,2	None	**48%**
M	None	M2	M2	None	M1,2,3	None	**24%**
KZN	KZN1,3	KZN1,2,3	KZN1,2,3	KZN1,2	KZN1,2,3	None	**72%**
Ave	**63%**	**41%**	**78%**	**37%**	**74%**	**4%**	

5.4.3 Internal storage and transportation (ISAT) structures

Temporary storage for HCRW at a ward level (Q1.8)

It was confirmed that only a small number (19%) of the respondents believed that temporary storage was present at a ward level. Again, a small number (5%) of the respondents in the rural areas did not agree that such storage existed.

Temporary storage area present at the central storage area (Q1.9)

It was found that all the respondents from the urban areas felt that storage areas existed. Similarly, the majority (89%) of the rural Public District Hospitals believed that such an area was present (Table 5.32).

Table 5.32 Presence of a storage area at the ward and central level

Nature of storage	Urban	Rural
Temporary storage area at a ward level	50%	5%
Temporary storage at the central area	100%	89%

A fixed internal collection schedule for temporary stored waste bags (Q1.10)

It is a requirement that waste be removed from the temporary storage areas at a ward level to a lockable central storage area (Department of Health, Manila, 2004). To meet this requirement, an internal collection schedule needed to be fixed. As it turned out, all (100%) the urban respondents indicated that the schedule existed whereas fewer (89%) rural respondents also thought so (Table 5.33).

Table 5.33 Fixed internal collection schedule for bagged waste

Existence of a fixed collection schedule	Urban Public District Hospitals	Rural Public District Hospitals
Yes	100%	89%
No	0%	11%

Dedicated trolleys for the collection and transportation of waste (Q1.12)

It was found that only half of the urban respondents believed the schedule existed. A large number (89%) of the rural respondents felt that dedicated trolleys were not present in their hospitals (Table 5.34).

Table 5.34 Presence of a fixed internal collection schedule for bagged waste

Existence of dedicated trolleys	Urban Public District Hospitals	Rural Public District Hospitals
Yes	50%	11%
No	50%	89%

The storage of hazardous wastes in a secure centralized storage (Q1.20)

The results showed that the majority (63%) of the respondents from the urban hospitals believed that the secure storage area existed. The majority (63%) of the respondents from the rural hospitals also believed that such storage areas existed (Table 5.35).

Table 5.35 Presence of a secure centralized storage

Presence of a centralised storage	Urban Public District Hospitals	Rural Public District Hospitals
Yes	63%	63%
No	37%	37%

The results indicated that whereas almost all the Public District Hospitals (93%) had a central storage area (Q1.9) in place, a few (19%) had a temporary storage area at a ward level (Q1.8). Again, the results showed that Gauteng (80%) and the Western Cape (73%) had the most storage as well as trolleys for HCW-related activities than any other province. The same was not true for Limpopo (27%), who had the lowest ISAT structures of all the provinces (Table 5.36).

Table 5.36 Incidence of ISAT structures

Province	Temporary storage in the ward (Q1.8)	Central storage area (Q1.9)	Fixed collection schedule (Q1.10)	Dedicated trolleys (Q1.12)	Locked storage area (Q1.20)	Ave
NW	None	NW1,2,3	NW1,2,3	None	NW1,2,3	**60%**
FS	None	FS1,2,3	FS1,3	None	FS1	**40%**
NC	NC1	NC1,2,3	NC2	NC2	NC1,2,3	**60%**
WC	WC1,2	WC1,2,3	WC1,2	WC1,3	WC1,2	**73%**
EC	None	EC2,3	EC1	EC3	EC2	**33%**
L	None	L1,2,3	None	None	L2	**27%**
G	G1,2	G1,2,3	G1,2	G2,3	G1,2,3	**80%**
M	None	M1,2,3	M2	None	M2	**33%**
KZN	None	KZN1,3	KZN1,3	None	KZN1,2	**40%**
Ave	**19%**	**93%**	**52%**	**22%**	**63%**	

5.4.4 Management support structures (Q1.14-1.19)

Dedicated budget for the HCW management programme (Q1.14 – 1.18)

The respondents were asked to rate the existence of the capital budget for building maintenance and purchasing of separate trolleys. It was found that although the budget for maintaining the buildings was available in a quarter of the hospitals, none of the hospitals had allocated a separate budget to purchase trolleys.

Attendance of HCW management meetings (Question 1.19)

The research showed that more than half (59%) of the respondents believed that the hospital management team members attended the HCW management meetings (Table 5.37).

Table 5.37 Management team members attend HCW meetings

Hospital management team attend HCW meetings	
Yes	59%
No	37%
Unsure	4%

It was found that nearly two thirds (63%) of the urban hospital respondents reported that their management team members did not attend the HCW meetings, whereas slightly more than two thirds (68%) of the rural hospital respondents believed that they did (Table 5.38).

Table 5.38 Attendance of HCW meetings

Hospital management team attend HCW meetings	Urban Public	Rural Public District
Yes	37%	68%
No	63%	32%

Inconsistencies in the hospitals in terms of the support hospital management teams gave to HCW performances were observed. The results indicated that the majority of the Public District Hospitals (78%) had budgeted for the HCW collection while the same was not the case for a separate capital budget to purchase. North West (67%) followed by Western Cape (52%) appeared to have paid more attention to exclusive budgets for HCW programmes than KwaZulu-Natal (28%) and the Eastern Cape (28%) (Table 5.39).

Table 5.39 Incidence of MS structures

Prov.	Separate capital for trolleys (Q1.14)	HCW related labour (Q1.15)	HCW consumables (Q1.16)	Budget for buildings (Q1.17)	HCW collection (Q1.18)	Other: attendance of meetings (Q1.19)	Ave
NW	None	NW2,3	NW1,2,3	NW2,3	NW2,3	NW1,2,3	**67%**
FS	None	FS2	FS2	None	FS1,2,3	FS1,2,3	**44%**
NC	None	NC1,2	NC1,2	None	NC1,2	NC2	**39%**
WC	None	WC2,3	WC2,3	WC2,3	WC2,3	WC2	**52%**
EC	None	EC1	EC1	None	EC2	EC1,2	**28%**
L	None	L2	L2	L2	L1,2,3	L2	**39%**
G	None	G1,2,3	G1,2,3	G1,3	G1,2,3	None	**61%**
M	None	M1,3	M1,2,3	None	M1,2,3	None	**44%**
KZN	None	None	None	None	KZN1,2	KZN1,2,3	**28%**
Ave	**0%**	**52%**	**59%**	**26%**	**78%**	**59%**	

The respondents were then asked to rate the operational budget for the waste-related labour, HCW consumables, and payment of the HCW related contracts.

The results indicated that more than half of the respondents believed that budgets for waste related contracts were provided in their hospitals. Once again, the results showed that, in most cases, the budget existed in Gauteng (73%), North West (60%), and the Western Cape (53%). The Eastern Cape and KwaZulu-Natal were the lowest (20%) (Table 5.40).

Table 5.40 Availability of budget for HCW programme

Province	Separate budget (Q1.14)	Building maintenance (Q1.17)	Waste related labour (Q1.15)	Waste related labour (Q1.16)	HCW contracts (Q1.18)	Ave
NW	None	NW2,3	NW1,2,3	NW1,2,3	NW2,3	**60%**
FS	None	None	FS2	FS2	FS1,2,3	**33%**
NC	None	None	NC1,2	NC1,2	NC1,2	**40%**
WC	None	WC2,3	WC2,3	WC2,3	WC2,3	**53%**
EC	None	None	EC1	EC1	EC2	**20%**
L	None	L2	L2	L2	L1,2,3	**40%**
G	None	G1,3	G1,2,3	G1,2,3	G1,2,3	**73%**
M	None	None	M3	M1,2,3	M1,2,3	**53%**
KZN	None	None	None	None	KZN1,2	**20%**
Ave	**0%**	**26%**	**52%**	**59%**	**78%**	

5.4.5 WIS structures (Q1.32)

It was found that only NW2 and M2 had a computer for recording and reporting HCW information.

5.4.6 Adequacy of the health care waste (HCW) management structures per hospital

5.4.6.1 Overview

An account of the levels of agreement about the adequacy of HCW management was attained through attitude scales, namely: strongly disagree;

disagree; neutral; agree; strongly agree. Responses were analysed using the "degree of adequacy" to determine whether it was acceptable. Acceptability was categorised considering five as the optimum, three as neutral, and below three as negative (Hendry, 2009). In addition, the interview questions were separated on the basis of waste management practices (WMP), awareness and capacity building (ACB), internal transportation and storage, management support, and Waste Information System (WIS).

5.4.6.2 Adequacy of waste management practices per hospital

Six adequacy components were identified for waste management practices, namely: clear roles and responsibilities regarding HCW management; spillage procedures; procedures undertaken in case of injury; colour coding of trolleys; registers of wastes at each stage; segregation of hazardous and non-hazardous wastes; and operating manuals for HCW staff.

The clarity of the roles and responsibilities of the HCW management (Q2.4)

The results indicated that there were no clear roles and responsibilities in the majority of the hospitals. However, the urban hospital respondents felt that the level of adequacy of their roles and responsibilities were better defined than their rural (3.3) counterparts

Procedures for accidents and spillages (Q2.5)

The research results indicated a feeling of uncertainty among all the respondents about the existence of adequate procedures to deal with accidents and spillages. This was so for both the urban and rural hospitals.

Procedures for accidental needle stick injuries (Q2.6)

The research indicated that there was consensus (3.9) in the hospitals about the adequacy of procedures for accidental needle stick injuries. The same (3.9%) applied for the urban and rural hospitals (Table 5.41).

Table 5.41 Procedures for the needle stick injuries, by province

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	4.1	3.8	4.1	3.9	3.7	4.0	3.9	3.6	4.1

Colour coding system for general and hazardous waste trolleys (Q2.8)

The research showed that there was a disparity on the level of adequacy between the hospitals in the various provinces. For example, Gauteng (4.0), KwaZulu-Natal (3.6), North West (3.6) were considered adequate with Northern Cape (3.4), Western Cape (3.4) being marginally adequate. In contrast, the rest of the provinces were considered inadequate (Table 5.42).

Table 5.42 Colour coding system used for general and hazardous waste trolleys

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	3.6	2.7	3.4	3.4	2.6	2.8	4.0	2.2	3.6

Registers for waste disposal processes (Q2.14)

Once again, there was disparity on the level of adequacy of records on the hospitals of the various hospitals. For example, Western Cape hospitals (4.0) were considered adequate while Mpumalanga hospitals (1.9) were considered inadequate (Table 5.43).

Table 5.43 Registers for waste disposal processes

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	3.4	2.5	2.0	4.0	2.1	2.0	4.0	1.9	2.4

Segregation of the hazardous from non-hazardous waste (Q2.15)

The research indicated that only a few of the hospitals in various provinces were regarded as adequate, for instance, Western Cape (4.1), Gauteng (4.0), and Northwest (3.6), with the rest being inadequate (Table 5.44).

Table 5.44 Segregation of hazardous from non-hazardous wastes, by province

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	3.7	2.3	2.9	4.1	2.5	2.0	4.0	1.9	2.9

Operating manuals for handling, storage, transportation and disposal of HCW (Q2.16)

It was found that the adequacy levels in terms of provinces that provided their HCW staff with the operating manuals varied greatly per province. For instance, hospitals in Gauteng (3.5), and Western Cape (3.5) were considered marginally adequate, whereas the rest were not (Table 5.45).

Table 5.45 Manuals for handling waste

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	3.0	2.1	2.5	3.5	2.2	2.0	3.5	1.9	2.7

5.4.6.3 Awareness and capacity building (ACB) per hospital

Five adequacy components associated with ACB were identified. These were: immunisation programme; protective material; orientation and induction of staff; disinfection of trolleys; and knowledge of HCW policy.

Immunisation programme for HCW workers (Q2.1)

The research found that less than half of the provinces had adequate immunisation programmes. KwaZulu-Natal (4.1) was the only province that was considered adequate. Western Cape was considered marginally adequate. The rest were inadequate (Table 5.46)

Table 5.46 Adequacy of the immunisation programme for HCW workers by province

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	2.9	3.2	2.9	3.8	1.9	2.6	2.7	3.3	4.1

The availability of protective material (Q2.2)

The results showed that most of the hospitals in various provinces had either adequate or marginally adequate protective material. The exception was, however, Mpumalanga hospitals (2.9) (Table 5.47)

Table 5.47 Adequacy of the protective material for HCW personnel, by province

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	3.4	3.5	3.9	4.1	3.6	3.9	4.0	2.9	3.8

Orientation and induction programme for the HCW staff (Q2.7)

It was found that most provinces had adequate orientation and induction programmes for HCW staff. The exception was, once again Mpumalanga hospitals (2.9) whose results confirmed that the hospitals had an inadequate level of programmes (Table 5.48).

Table 5.48 Adequacy of orientation and induction programmes for HCW staff

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	3.5	3.2	3.5	3.1	3.7	3.6	4.0	2.9	3.8

The disinfection of trolleys (Q2.9)

The results showed that all the provinces had inadequate disinfection of trolleys (Table 5.49).

Table 5.49 Adequacy of the disinfection of trolleys per province

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	2.3	2.5	2.4	2.3	2.4	2.1	2.9	2.4	2.7

Knowledge of the HCW management policy (Q2.3)

The consensus was that all the respondents were either adequately or marginally adequately knowledgeable about the HCW policy. However, the respondents from Mpumalanga (2.8) were clearly inadequate in terms of their knowledge about such policy (Table 5.50).

Table 5.50 Adequacy of knowledge of the HCW management policy

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	4.0	3.2	3.8	3.3	3.8	3.0	3.1	2.8	3.6

5.4.6.4 Management support per hospital

The management support had four adequacy components, namely: capital to purchase the trolleys; operating budget for labour; adequate budget for consumables; and adequate budget for the maintenance of the buildings.

There is enough capital to purchase trolleys (Q2.10)

The results revealed that almost all the respondents from the hospitals perceived inadequacy with regard to capital to purchase trolleys. Conversely, Western Cape (3.1) was the only province where respondents were unsure if such a budget was adequate (Table 5.51).

Table 5.51 Adequacy of the capital to purchase trolleys, by province

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	2.6	2.6	2.3	3.1	2.1	2.1	2.1	2.5	2.3

The budget for labour involved in HCW handling (Q2.11)

The research showed that the majority of respondents felt hospitals had marginally adequate operating budgets for labour involved in the HCW management. The exception was the Eastern Cape (2.8) (Table 5.52).

Table 5.52 Adequate operating budget for labours involved in the HCW management

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	3.4	3.0	3.3	3.7	2.8	3.1	3.5	3.7	2.5

The operating budget for HCW consumables (Q2.12)

The results indicated that the majority of hospitals had adequate budgets for waste management consumables. The exception was Eastern Cape (2.8) and KwaZulu-Natal hospitals (2.6) that were considered marginally inadequate (Table 5.53).

Table 5.53 Adequacy of the operating budget for HCW consumables per province

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	3.5	3.1	3.3	3.7	2.8	3.1	3.9	3.9	2.6

The budget for the maintenance of buildings (Q2.13)

The results showed that respondents in all provinces felt hospitals had inadequate maintenance budgets except for Northern Cape (3.0) and Western Cape (3.0), who were both considered neutral (Table 5.54).

Table 5.54 Adequacy of the budget to maintain buildings, per province

Provinces	NW	FS	NC	WC	EC	L	G	M	KZN
Agreement	2.7	2.4	3.0	3.0	2.2	2.9	2.7	2.2	2.6

5.4.7 HCW treatment processes (Q3.1 – 3.4)

Kind of HCW treatment system used (Q3.1)

It was found that there was no consistency in the use of HCW treatment system by hospitals of the same province. They used disposable, reusable, or both systems. This was the case for all provinces except for Gauteng and Western Cape, where only reusable containers were used, and Mpumalanga, where all the hospitals in the study used incinerators (Table 5.55).

Table 5.55 Kind of HCW treatment system used

Province	Disposable	Reusable	Both disposable and reusable	Incinerator
NW	NW1	NW2,3	None	None
FS	FS1,2,3	None	None	None
NC	NC1	NC2	NC3	None
WC	None	WC1,2,3	None	None
EC	EC1	None	EC2,3	None
L	None	None	L1,2,3	None
G	None	G1,2,3	None	None
M	None	None	None	M1,2,3
KZN	KZN3	KZN2	KZN1	None
Ave	**26%**	**33%**	**26%**	**11%**

Needle pricks in the last 12 months (Q3.2)

The results indicated that all provinces were affected by needle-stick injuries. Although a large number (63%) in KZN and NC (67%) claimed they had none, for the Northern Cape a few respondents reported to have been pricked four or more times in the past 12 months (Table 5.56).

Table 5.56 Number of times HCW workers pricked by HCW needles

Province	Never	Once	Twice	Three times	Four or more
NW	50%	37%	10%	3%	None
FS	60%	30%	7%	3%	None
NC	67%	30%	1%	None	3%
WC	63%	37%	None	None	None
EC	40%	40%	16%	4%	None
L	57%	27%	10%	6%	None
G	80%	17%	3%	None	None
M	40%	53%	4%	3%	None
KZN	63%	30%	4%	3%	None

Causes of HCW treatment failure (Q3.3)

The study revealed that all provinces cited a lack of budget as the main cause of HCW treatment failure. This feeling was, however, more prevalent in the Northern Cape (87%), Free State (77%), and Eastern Cape (77%). Staff incompetence seemed to be the lowest cause of failure (Table 5.57).

Table 5.57 Causes of HCW treatment failure

Province	Lack of money	Poor maintenance	No failure experienced	Spares problems	Staff not competent	Other
NW2	NW1	None	NW3	None	None	None
FS	FS1,2,3	None	None	None	None	None
NC	NC1,2,3	None	None	None	None	None
WC	WC1,3	None	None	WC2	None	None
EC	EC1,2	EC3	None	None	None	None
L	L1,3	L2	None	None	None	None
G	G2,3	None	G1	None	None	None
M	M1,2	None	M3	None	None	None
KZN	KZN2,3	None	KZN1	None	None	None
Ave	**70%**	**7%**	**14%**	**4%**	**0%**	**0%**

Disposing of waste in the event of HCW treatment failure (Q3.4)

The research findings revealed that, once again, there were inconsistencies within hospitals of the same province in the manner in which waste was disposed of. They burnt, out-sourced, stockpiled waste or received help from other hospitals. This was true for all the provinces except for Eastern Cape and Free State, where burning the waste was the preferred method (Table 5.58).

Table 5.58 Disposing of waste in the event of failure

Province	Burn	Out-source	Stockpile	Get help from other hospitals	Never experienced	Don't know
NW2	None	NW3	None	NW1,2	None	None
FS	FS1,2,3	None	None	None	None	None
NC	NC1	NC2	NC3	None	None	None
WC	None	WC1,2	WC3	None	None	None
EC	EC1,2,3	None	None	None	None	None
L	L2	None	L1,3	None	None	None
G	None	G1,2	None	G3	None	None
M	M1	M3	M2	None	None	None
KZN	KZN2	KZN3	None	None	KZN1	None
Ave	**37%**	**30%**	**19%**	**11%**	**4%**	**0%**

Containers

Kind of waste containers used for infectious waste by hospitals (Q4.1)

Most of the respondents (64%) felt that plastic reusable containers were most widely used throughout the provinces. However, a few of the respondents did not agree with this agreement, and felt that the incinerators were used in their hospitals (Table 5.59).

Table 5.59 Waste containers used for infectious waste, by province

Containers	NW	FS	NC	WC	EC	L	G	M	KZN	Ave.
Not specific	0%	37%	0%	0%	70%	37%	0%	37%	7%	21%
Plastic reusable	60%	50%	67%	100%	13%	63%	100%	53%	70%	64%
Box with red plastic liner	30%	13%	33%	0%	3%	0%	0%	0%	3%	9%
Other: incinerator	10%	0%	0%	0%	13%	0%	0%	10%	0%	6%

It was, however, found that urban hospitals mostly (86%) used plastic reusable boxes. Similarly, although to a lesser extent (55%), the rural hospitals also used plastic reusable boxes (Table 5.60)

Table 5.60 Waste containers used for infectious waste

Location of the Public District	Not specific	Plastic reusable	Box with red plastic liner	other
Urban	11%	86%	0%	3%
Rural	27%	55%	13%	7%

The assessment of waste (Q4.2)

The research showed that one third (33%) of the respondents claimed that the categories of waste were not being assessed at all in their institutions. However, some hospitals believed that waste was assessed by the general orderlies (24%); waste collectors (22%); and infection control nurses (20%) (Table 5.61).

Table 5.61 Personnel assessing waste in the Public District Hospitals, by province

Containers	NW	FS	NC	WC	EC	L	G	M	KZN	Ave
General orderlies	10%	20%	3%	0%	3%	87%	30%	53%	10%	24%
Waste collectors	57%	53%	3%	30%	23%	13%	0%	3%	3%	22%
Infection control practitioner	33%	3%	33%	23%	3%	0%	33%	30%	23%	20%
Waste not assessed	0%	23%	60%	47%	70%	0%	33%	7%	57%	33%

Shortages of waste containers (Q4.3)

A large number (92%) of the respondents felt that a shortage of the containers had affected almost all the hospitals. A few (0, 3%) of the respondents did not know if their hospitals had a shortage (Table 5.62).

Table 5.62 Shortage of waste containers, by province

Containers	NW	FS	NC	WC	EC	L	G	M	KZN	Ave.
Yes	90%	87%	100%	83%	100%	100%	100%	93%	63%	92%
No	10%	3%	0%	7%	0%	0%	0%	7%	33%	7.5%
Don't know	0%	0%	0%	0%	0%	0%	0%	0%	3%	0,3%

Reasons for the shortages of waste containers (Q 4.4)

Whereas it was found that nearly three quarters (72%) of the respondents believed that the inadequate budget was the cause of shortages, a few (2%) of respondents believed that such a shortage was due to wastage by the staff (Table 5.63).

Table 5.63 Reasons for the shortage of waste containers, by urban/ rural

Containers	NW	FS	NC	WC	EC	L	G	M	KZN	Ave
No budget	56	81	80	56	90	72	87	28	89	72
Procurement delays	33	19	7	44	7	17	13	72	0	24
Wasted by staff	7	0	3	0	0	10	0	0	0	2
Other	4	0	0	0	3	0	0	0	11	2

A lack of budget was cited by both urban (95%) and rural (91%) hospitals as the most likely cause for the shortages of waste containers (Table 5.64).

Table 5.64 Main causes of shortages of waste containers

Location of the Public District Hospitals	No budget	Procurement delays	Wasted by staff	Other
Urban	95%	5%	0%	0%
Rural	91%	6%	3%	11%

Transporting of the waste to a central storage area (Q4.5)

It was found that almost half (49%) of respondents believed that it was the responsibility of the HCW handlers to transport waste. However, a small number (1%) of the respondents believed that the transportation of waste to such storage was done by nurses (Table 5.65).

Table 5.65 Transportation of waste to a central storage area by percent

Containers	NW	FS	NC	WC	EC	L	G	M	KZN	Ave
Don't know	3	3	0	3	0	0	0	0	0	**1%**
General orderly	3	40	10	0	20	62	23	77	73	**37%**
HCW handler	50	53	90	27	77	38	43	20	10	**49%**
Nurses	0	0	0	3	3	0	0	0	0	**1%**
Hired	43	0	0	0	0	0	33	0	13	**11%**
Other	0	3	0	0	0	0	0	3	4	**1%**

The results showed that the majority (30%) of the urban hospitals hired a private company for the transportation of waste, whereas the rural hospitals used the services of the HCW workers (52%) (Table 5.66).

Table 5.66 Transportation of waste to a central storage area

Location of the Public District Hospitals	Don't know	General orderly	HCW workers	Nurses	Hired company	Other
Urban	1%	30%	29%	0%	39%	1%
Rural	1%	36%	52%	1%	9%	1%

5.4.8 Application of rankings to the study

It was necessary to establish the compliance by the hospitals with the policies and procedures concerning HCW management. The unavailability of previous weightings of structures prompted that a small-scale survey be done. Respondents who were not part of the main study, rated structures in accordance with their perceived importance. The maximum score for the ranking of structures was ten and the minimum was one (Chart 5.3).

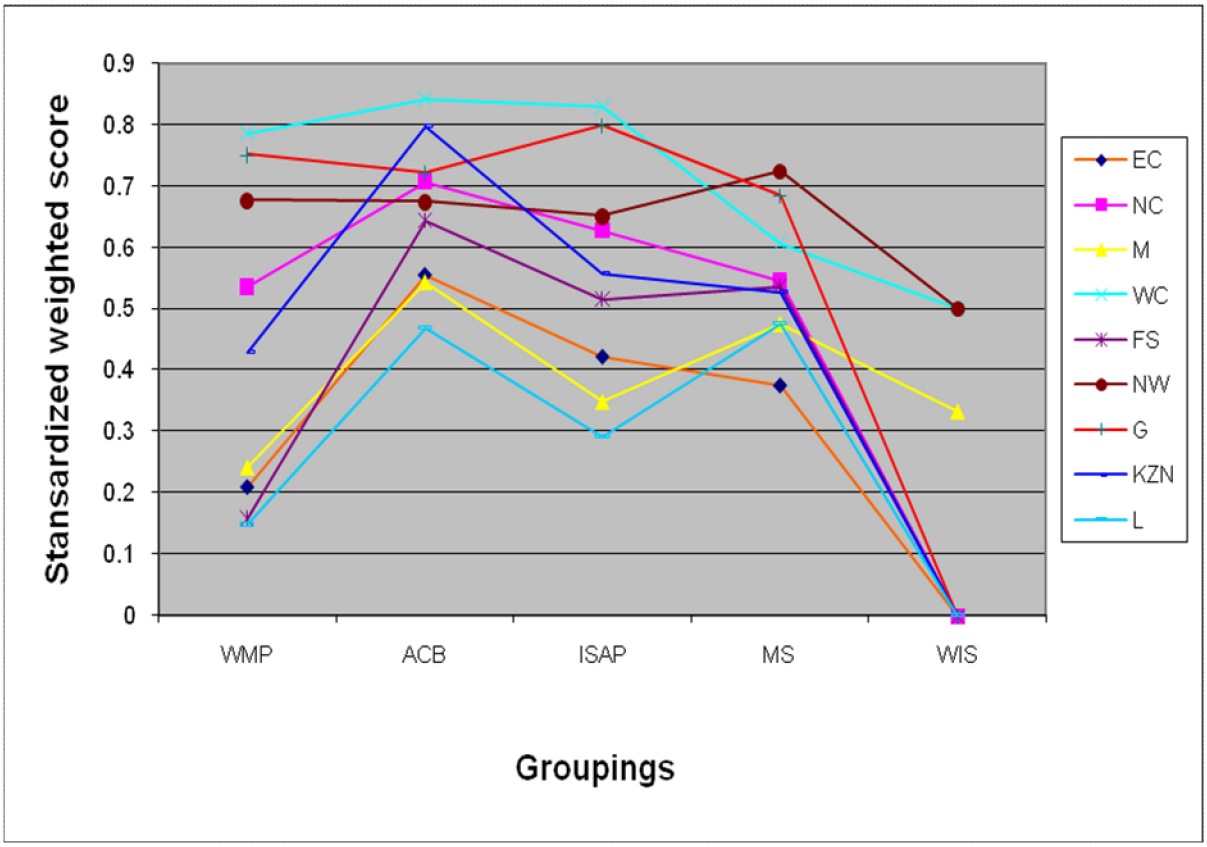


Chart 5.3 Ranking Structures

5.4.8.1 Waste management practices (WMP) per province

The results showed that the separation of HCRW from general waste (Q1.7) was mostly complied by [5.0] in provinces. This was not true for tracking HCRW (Q1.21) and incentives for HCW management best practices (Q1.22), where none of the provinces complied.

Regarding compliance of the Public District Hospitals with the waste management practice guidelines, it was found that Gauteng [5.3] had on average the most WMP structures. Free Sate and Eastern Cape were the least [0.4] compliant (Table 5.67).

Table 5.67 Ranking of WMP structures

WMP Structures	NW	FS	NC	WC	EC	L	G	M	KZN	Ave
HCW spillage procedures (Q1.4)	4.0	0.0	2.3	4.7	0.0	0.0	0.0	2.3	2.3	**1.8**
Separation of HCRW from general waste (Q1.7)	9.0	6.0	6.0	9.0	0.0	3.0	9.0	0.0	3.0	**5.0**
Colour coding for trolleys (Q1.13)	6.7	0	6.7	3.3	3.3	0	10,0	0	10,0	**4.4**
Individual to track HCRW (Q1.21)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Incentives for HCW best practice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Records for HCRW generated (Q1.23)	4.7	0.0	4.7	7,0	0.0	0.0	7.0	2.3	2.3	**3.1**
A register for HCRW collected (Q1.24)	2.3	0.0	4.7	7.0	2.3	0.0	7.0	2.3	0.0	**2.9**
A record for HCW received from wards (Q1.25)	2.3	0.0	2.3	7.0	0.0	0.0	7.0	2.3	0.0	**2.3**
Record of bags handed to contractor (Q1.26)	4.7	0.0	4.7	7.0	0.0	0.0	7.0	2.3	0.0	**2.8**
Scale to weigh HCW bags (Q1.27)	2.0	0.0	2.0	2.0	0.0	0.0	0.0	2.0	2.0	**1.1**
A record of waste-related injuries	9.0	0.0	3.0	9.0	9.0	0.0	0.0	9.0	6.0	**4.3**
A record for spillages of HCRW	0.0	0.0	0.0	2.3	0.0	0.0	2.3	0.0	0.0	**0.5**
Observation of the OHSA (Q1.30)	3.3	0.0	3.3	6.7	0.0	0.0	10.0	0.0	6.7	**3.3**
Integrated HCW management plan (Q1.31)	4.0	0.0	2.0	2.0	0.0	4.0	6.0	2.0	2.0	**2.4**
Ave	**3.8**	**0.4**	**3.0**	**4.8**	**0.4**	**0.5**	**5.3**	**1.3**	**2.5**	**2.4**

5.4.8.2 Awareness and capacity building (ACB)

It was found that personal protective clothing (PPE) (Q1.3) was the most [8.2] complied with structure. The same could not be said of the weekly disinfection of trolleys (Q1.11) [0.2].

It was also confirmed that KwaZulu-Natal was, on average, most [6.4] compliant with ACB structures while Limpopo [2.7] was least compliant (Table 5.68).

Table 5.68 Ranking of ACB structure

Structures	NW	FS	NC	WC	EC	L	G	M	KZN	Ave
Water tap (Q1.1)	9.0	6.0	6.0	9.0	6.0	0.0	9.0	0.0	3.0	**5.3**
Immunisation programme (Q1.2)	3.0	3.0	3.0	9.0	0.0	0.0	3.0	3.0	9.0	**3.7**
Personnel protective equipment (Q1.3)	3.3	6.7	10.0	10.0	10.0	6.7	10.0	6.7	10.0	**8.2**
Orientation and induction (Q1.6)	6.7	6.7	10.0	3.3	10.0	6.7	6.7	10	10.0	**7.8**
Weekly disinfection of trolleys (Q1.11)	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**
Ave	**4.7**	**4.5**	**5.8**	**6.3**	**5.2**	**2.7**	**5.7**	**3.9**	**6.4**	**5.0**

5.4.8.3 Internal storage and transportation (ISAT)

The research found that a temporary central storage area (Q1, 9) was most complied with [7.4] in the hospitals while a temporary storage area in the ward (Q1.8) was not adequately complied with [1.7]. Concerning compliance with the safe ISAT, it was found that Gauteng was the most [7.4] compliant while Limpopo [2.2] was the least compliant (Table 5.69).

Table 5.69 Ranking of ISAT structures

Structures	NW	FS	NC	WC	EC	L	G	M	KZN	Ave
Temporary storage in ward (Q1.8)	0.0	0.0	3.0	6.0	0.0	0.0	6.0	0.0	0.0	**1.7**
Temporary central storage area (Q1.9)	8.0	8.0	8.0	8.0	5.3	8.0	8.0	8.0	5.3	**7.4**
Fixed collection schedule (Q1.10)	8.0	5.3	5.3	2.7	2.7	0.0	5.3	2.7	5.3	**4.1**
Dedicated trolleys for HCW (Q1.12)	0.0	0.0	3.0	6.0	3.0	0.0	6.0	0.0	0.0	**2.0**
Secure storage for HCRW (Q1.20)	9.0	3.0	9.0	6.0	3.0	3.0	9.0	3.0	6.0	**5.7**
Ave	**5.0**	**3.3**	**5.1**	**6.2**	**2.8**	**2.2**	**6.9**	**2.7**	**3.3**	**4.2**

5.4.8.4 Management support (MS)

The results indicated that the hospitals received [7] management support on budgets for contractual HCW management services (Q1.18), but no support regarding separate capital for trolleys (Q1.14) [0]. Again, it was found that the Gauteng hospital management gave more [5.4] support pertaining to financial and administrative aspects while the same could not be said of Eastern Cape [2.7] management (Table 5.70).

Table 5.70 Ranking of MS structures

Structures	NW	FS	NC	WC	EC	L	G	M	KZN	Ave
Presence of HCW trainer (Q1.5)	1.7	1.7	1.7	3.3	1.7	0.0	1.7	0.0	3.3	**1.7**
Separate capital for trolleys (Q1.14)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Operation budget for labour (Q1.15)	5.3	2.7	5.3	5.3	2.7	2.7	8.0	5.3	0.0	**4.2**
Budget for HCW consumables (Q1.16)	9.0	3.0	6.0	6.0	3.0	3.0	9.0	9.0	0.0	**5.3**
Budget for maintaining buildings (Q1.17)	3.3	0.0	0.0	3.3	1.7	1.7	3.3	0.0	0.0	**1.5**
Budget for HCW contracts (Q1.18)	6.0	9.0	6.0	6.0	3.0	9.0	9.0	9.0	6.0	**7.0**
Managers attend HCW meetings (Q1.19)	10.0	10.0	3.3	3.3	6.7	3.3	6.7	0.0	10.0	**6.0**
Ave	**5.0**	**3.8**	**3.2**	**3.9**	**2.7**	**2.8**	**5.4**	**3.3**	**2.8**	**3.7**

5.4.8.5 Waste Information Systems (WIS)

It was found that none of the Public District Hospitals provided computers for recording and reporting of WIS. The fact that WIS existed in each hospital of Mpumalanga (M2) and Western Cape (WC3), respectively, did not affect the whole picture of the country's average of the WIS availability.

5.5 Conclusion

Based on the eligibility of the respondents, the research findings were considered valid as all the informants were involved in the management of HCW, either directly or as managers. For the most part, respondents were able to complete the questionnaire without the assistance of the researcher, who was in the same room where questionnaires were filled. The demographic highlights showed that the Western Cape (57%) and North West (29%) had the majority of respondents who had served in their hospitals for less than a year, while most (33%) of the Eastern Cape respondents had worked in the HCW field for more than 15 years. On the other hand, two-thirds of respondents from Gauteng had either secondary education, diploma, or degree. It was also interesting that more of the KwaZulu-Natal respondents were managers (62%) than HCW workers (38%).

Of all the structures, the incentives for HCW best practice (Q1.22) and having a separate budget to procure trolleys (Q1.14) appeared to be given less attention in all the provinces. On a positive note, the existence of a central storage area (Q1.18) (78%) and the availability of personal protective clothing (Q13) (78%) were mostly available in the hospitals.

With reference to the ratings on the adequacy of structures, the inadequacy of funds for HCW projects was unanimously cited by a large number (62%) of

respondents as the greatest cause of HCW mismanagement. The economic challenges were commonly found in all the provinces irrespective of the locations of the hospitals. In many instances, the urban hospitals performed better, with regard to the existence and adequacy of the structures than their rural counterparts.

Lastly, the ranking of structures indicated the level of adherence of hospitals to the HCW management guidelines, and showed areas where improvement is needed. On average, the HCW requirements per sub-objective showed that the requirements for ACB were complied with most by all the hospitals [5.0]. On the other hand, none of the hospitals complied with the WIS category.

The study showed that Gauteng was more compliant in almost all sub-objectives except ACB, whereas KwaZulu-Natal [6.4] and Western Cape [6.3] were more compliant. These findings form the basis of the interpretation of results in chapter six.

CHAPTER SIX

INTERPRETATION OF RESULTS

6.1 Introduction

In the previous chapter, the results of the statistical data were presented, and evaluated. In chapter six, the results and findings are integrated and assessed based on recent research literature. Biographic information preceded the analysis of the sub-objectives. The discussion of the results was separated by themes, mostly derived from the study sub-objectives as follows:

- WMP as the support management give to the entire HCW programme;
- ACB interpreted in terms of the performance of the hospitals in terms of personal protective clothing, orientation and induction, availability of water taps, weekly disinfection of trolleys, as well as immunisation programmes;
- ISAT encompasses waste storage areas;
- WIS; and
- MS in both financial and non-financial issues.

Also included are questions relating to the health care waste treatment (HCWT) system which addresses the failure of the waste treatment system, the causes of such failure and what practices hospitals carry out in the event of such failures. This was followed by questions about the HCWT system regarding the interpretation of the extent to which HCW management is influenced by waste assessment, the containers used as well as the personnel involved in the transportation of waste to storage areas.

The ranking of structures and its application to the study are also covered. This was necessary to establish adherence by the hospitals to the available HCW regulations, and to advise on the most important structures that provinces need to prioritize for the success of the HCW programme.

6.2 Biographics of respondents

Gender and age (Q1 -2)

It was found that KZN had more females (64%) than males, while Mpumalanga had more males (64%) than females. The possible explanation for more females in KZN could be that there was a directive in 2007 for hospitals to absorb community health workers (who were working as temporary workers and paid through contracted Non-Government Organisations (NGO). These workers were predominantly females. The absorption of these workers created an abundance of general orderlies without professional qualifications who were employed in another capacity. Consequently, these workers may have been deployed in many hospital sections, including the HCW management field. This assumption is attested by a low (46%) level of education among these workers. The high number of males (64%), as opposed to females, in Mpumalanga may be assumed to be an accurate reflection of the fact that females are normally in the minority in similar work environments.

The results showed that half (50%) of the respondents in the Eastern Cape (EC) were 50 years or older. This is in line with the finding of Eastern Cape having the most (21%) experienced workers in the hospitals in the sample (Q7), and the most (33%) experienced workers in the HCW field of the hospitals in the sample (Q8). The combination of long service with low level of education (Q3) in the HCW field for the Eastern Cape may have contributed to the non-adherence to HCW rules and regulations affecting waste management.

Level of education (Q3 – 6)

A large number (36%) of respondents had secondary education. However, results showed that, once again, most (46%) respondents with primary education came from KZN. This may be indicative of the fact that the HCW workers might have come from former community health care workers, where formal education was not a requirement for employment, which was the situation in KZN.

A small number (3%) of respondents from Eastern Cape had no formal education. The inability of the HCW workers, directly involved in the HCW to read and write, may have affected non-adherence by the province to the recording of HCW bags received from wards, HCW handed over to the contractor for final disposal as well as weighing of HCRW (Table 5.7).

Position in the HCW field (Q6)

It was found that Mpumalanga had more managers (62%) than workers directly involved in HCW. These results were evidenced by Mpumalanga being the third most province (36%) whose respondents had a diploma or degree (Table 5.6). At the same time, Mpumalanga respondents had the longest experience in both the hospitals (38%) and the HCW field (22%) among all the respondents in the 10 to 15 years service bracket (Table 5.7)

Experience in the hospital (Q7)

Results indicate that a large number (30%) of respondents had worked in their hospitals for a period of one to five years, while only a small number (11%) had less than one year's experience. The mix of younger and older experience also increased the validity of the study as HCW issues require opinions from both the experienced and the younger generation.

In addition, the Eastern Cape had a large number of HCW workers with 15 years and above experience in hospitals. Mani and Wankhede (2008:209), in their study in India, found that the issue of long experience in the same field of work brings about complacency. This could be true for workers in the Eastern Cape as this study has found that Eastern Cape respondents were least knowledgeable about the current practices and procedures. For example, none of the respondents had known about the existence of institutional integrated HCW management plan (Q1.31). This may have contributed to Eastern Cape respondents being not aware of precautionary measures in place to deal with, for instance, the prevention of waste-related injuries (Q1.28).

6.3. Waste management plan (WMP)

6.3.1 WMP regarding administrative functions (Q1.23 -1.29)

Records for waste generated, collected, received and handed over (Q1.23 – 1.27, 2.3, 2.14)

Although knowledge of HCW management policy was found to be adequate (Q2.3), the keeping of records at each stage of waste management was inadequate (Q2.14). Furthermore, a large number of respondents (37%) reported burning of waste (Q3.4) in the event of HCW treatment system's failure in their hospitals. Therefore, many have found no reason to weigh the waste (Q1.27), or to keep adequate records.

Adequacy of records was only confirmed in the Western Cape, Gauteng, and North West (Table 5.42). In essence, this meant that only one-third of provinces had adequate HCW records. Further, the investigation revealed that none of the hospitals in Limpopo and Free State had kept any records for HCW. Considering that no major financial reason could be attributed for this shortcoming, the

enforcement of policies and guidelines about record keeping is recommended (WHO, 2002:11). In addition, keeping of HCW records is a minimum requirement in the safe management of HCW (DEAT, 2001:13, and DEAT, 2000:2).

These results are similar to findings from Nepal. Recognising HCW mismanagement in Nepal, the Ministry of Health in Nepal commissioned a study in order to establish a framework strategy and action plans. Important findings were that records of wastes generated by Nepalise hospitals were not kept at all. Waste was being dumped at the shallow public dumpsites without any accountability. Moreover, no hospitals could take responsibility for injuries and needle pricks as nobody knew who produced what, and where these wastes were being disposed (Nepal Ministry of Health, 2003).

Records of waste related injuries (Q1.28) and HCW spillages (Q1.29)

Although records for waste related injuries were most prevalent in all provinces (48%), the problem was that the recording of the spillages of HCW was seldom (4%) done. According to Suchitra and Davi (2009:183), this is also common in India. They claim that the failure to keep records of HCW spillages stems from a belief by hospitals that, once pathogens are exposed to air and sun, the virulence (capability to infect) is attenuated. Suchitra and Devi (2009:184) add that HCW spillages must get the same attention in terms of recording, as keeping records of staff members injured at work.

6.3.2 WMP regarding Non-administrative functions (Q1.4, 1.7, 1.13, 1.21, 1.22, 1.30 - 1.31).

Procedures for spillages (Q1.4, 2.5)

Although an orientation and induction programme was available in 74 percent the Public District Hospitals (Table 5.15), procedures for spillages were not

present in a large number (74%) of the hospitals. This could also be linked to the fact that most of the hospitals (77%) did not adhere to the OHSA (Q1.30). This is supported by the fact that there is a feeling of uncertainty about the adequacy of the procedures for accidents and spillages (Q2.5) by all the respondents.
In general, only a small number of hospitals (7%) kept records of HCRW spillages. The fact that very few procedures (Q1.4) are in place for spillages and only a small number of spillages are recorded, means that the actual level of risk is uncertain and should be examined.

Further, it was found that no hospitals in Gauteng, Limpopo, or Eastern Cape had such procedures at all. On investigation of the extent of the adequacy, it was established that none of the hospitals were considered adequate in this procedure.

The problem of the lack of procedures for accident and spillage management in hospitals was also found by Patil and Pokhrel (2005: 592-599) in a case study conducted at a hospital in India. The study found that a lack of knowledge about dangers that HCRW could pose to individuals was the main reason for lack of procedures. Consequently, continual education and staff training was highlighted as a solution.

Incentives for HCW best practice (Q1.22)
Although the budgets for labour (Q1.15) (52%) and consumables (Q1.16) (59%) were marginally adequate (Q2.12), none of the hospitals had considered using part of the budgets for incentives for HCW best practices.

The DEAT (2004:5) claims that motivation for HCW best practice could be improved among nurses by encouraging a culture of work well done. This statement was put in another way by Suess (1992: 6 – 8;) and Mostafa, *et al*.,

(2008: 430 – 430). These authors felt that although budgets appear to be problematic, particularly in developing countries, prioritisation of the meagre available budget could make a big difference. They made an example of procuring HCW management equipment such as autoclaves, and claimed that this was not only controlled pollution but was a way of incentivising and promoting staff satisfaction with a good working environment.

Tracking of medical waste (Q1.21)

None of the personnel considered the tracking of HCRW as significant or awarded it a ranking at all (Table 5.3).

The fact that the HCW trainer (Q1.5) was present in only a small number of hospitals (37%) could imply uncertainty of hospitals about the impact that these personnel would have in the HCW management. This could be true as the Zeerust sub-district declined to allocate a full-time officer to work as a waste management officer, citing insufficient work in this role as the reason (DEAT, 2005 15). It is, therefore, possible that an official could be identified, trained and be made in-charge of the tracking of waste (Q1.5). The salary level of the HCW trainer could be determined by the national or provincial organisation development and efficiency department (OD&E).

Separation of HCRW from general waste (Q1.7)

Although the expectation was that the programmes would educate and prepare the HCW workers to separate risk waste from general waste and 74 percent of the respondents underwent orientation and induction programmes, the findings proved the opposite

Only one third of the respondents separated general waste from HCRW (Q2.15). Since there are no clear guidelines for the separating of general waste from

HCRW (Q2.4) and training offered does not have the required impact, the training and orientation procedures should be revisited.

Lack of a system to separate waste in hospitals was encountered by Kristiansen (2003:1) who found that, in Leratong hospital, of Gauteng, there was generally a significant amount of municipal waste incorrectly placed in the receptacles for hazardous and infectious wastes. This was, according to Kristiansen (2003:2), caused by the failure of the hospital to separate waste streams.

The problem concerning the mixing of waste categories was also noted by the DEAT (2009:11) which was reported that the Department of Health (DOH) had in its own assessment, and established that there was a widespread mis-segregation of HCW resulting in people being put at risk of exposure and a subsequent excessive cost of waste treatment. In order to mitigate this, the DOH formulated strategic goals, one of which was to prioritize segregation of HCRW from general waste at the source of generation.

It was, therefore, necessary to establish the cause of the hospitals' failure to separate waste. Therefore, a cross-tabulation of the people who assess waste was conducted. It appeared that most of the respondents, who believed waste was assessed in their hospitals, indicated that such assessment was done by the infection control practitioners as opposed to general orderlies. See Figure 6.1

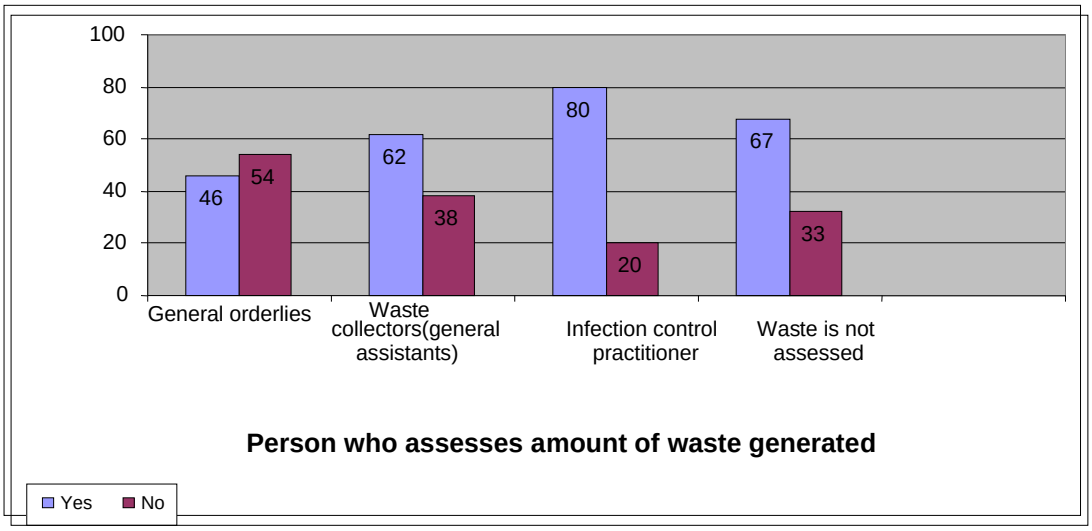


Figure 6.1 Assessment of waste generated

This finding indicates that it may be necessary for infection control practitioners to be fully entrusted with the responsibility of the segregation of waste. This was suggested for South Africa (Swart, Coulson and Nteo, 2009:23), and Massachusetts (Slatin, 2007:1). While it is understood that an infection control practitioner has other pressing functions, institutions may decide roles that could possibly be offloaded from this officer and be allocated to other officers.

Colour coding of trolleys (Q1.13)

Although 44 percent of the hospitals do have colour coding (Q1.13) to differentiate between general waste and HCRW, only 22 percent of the respondents have trolleys dedicated to either risk or general waste.

The respondents who believed colour coding was done in their hospitals were further asked to indicate the degree to which this system was adequate (Q2.8). The colour coding of trolleys was found to be inadequate in most provinces except for Gauteng (4.0), and marginally adequate in KZN, NW, NC, and WC.

These results were in line with other South African studies (Kristiansen, 2007:39 and Abor, 2007:1) which concluded that there was, generally, a lack of policies and/or enforcements for colour coding of trolleys to be applied.

Observation of the occupational Health and Safety Act (Q1.30)

Regardless of the fact that compliance with OHSA was given a maximum ranking of 10 (Table 4.9), this research established that OHSA was only adhered to by one third (33%) of the hospitals. This finding could be attributed to the fact that a poor adherence to OHSA was evidenced through inadequate budgets (Q2.13), inadequate guarantee of safety in the maintenance buildings (Q1.30) (26%) and a lack of temporary storage of waste at ward level (Q1.8)(19%). Also, an OHSA trainer was only present in a small number (37%) of hospitals.

Considering that the majority of the respondents (65%) were directly involved in HCW management, these results could mean that the OHSA is not visible enough to workers. These results confirm findings made in a study conducted in Tygerberg hospital in the Western Cape. Abor (2007:2) reports that the invisibility of the OHSA was evident when workers were ignorant of health and safety measures at the workplace.

It is for this reason that the adequate protection from exposure of hazardous waste is assured in accordance with OHSA (Act 85 of 1995). Similarly, HCW workers in the world are protected by regulations; for example, in the U.S.A; workers are protected under the Occupational Safety and Health Act of 1970 (Thomusnet Industrial News Room, 2007). As such, OHSA's role in the workplace is to assure the safety of employees by setting and enforcing standards, training and encouraging development and improving workplace

safety. In order to ensure workers' safety, every organization that has a minimum of fifty employees must designate an occupational health and safety officer (Institute of Waste Management of Southern Africa, 2007:1).

Integrated health care waste management plan (Q1.31)

Although central storage areas existed in almost all (93%) of the hospitals, the inadequacy of the budget for HCW labour (Q2.11), inadequate capital to purchase trolleys (Q2.10) and inadequate procedures for needle-stick injuries (Q2.6) showed that the integrated waste management treatment plan was not appropriately implemented.

The consequence of inadequate planning can be found in the conditions experienced in landfill sites, where used needles and blood soaked bandages are frequently mixed with the general waste. Magner (2007:8) points out that an integrated HCW management plan includes what happens prior to the waste being generated, for example, purchasing of equipment that will not result in highly toxic waste substances. The lack of an integrated plan shows poor planning by hospital management teams.

6.4 ACB (Q1.1 -1.3, 1.5, 1.6, 1.11)

In general, the results showed that provinces adhered to most ACB structures and processes. It was found that personal protective equipment (78%), orientation and induction (74%) as well as availability of water taps (63%) were complied with. The exceptions are the weekly disinfection of trolleys (4%), the HCW trainer (37%), and the immunisation programme (41%).

A fixed schedule for collection of HCW (Q1.10)

A small number of respondents (4%) considered weekly disinfection of trolleys to be important. These findings were in line with the results of the ranking survey, where respondents considered weekly disinfection of trolleys insignificant.

It is common sense that if waste cannot be moved away from patient and staff areas, it poses a threat to the health and safety of patient and staff. It was, therefore, problematic that although more than half (52%) of hospitals had a fixed schedule for waste collection (Table 5.6), a few hospitals (1%) used nurses (Table 5.65) to transport these wastes (Q4.5).

Weekly disinfection of trolleys (Q1.11)

Weekly disinfection of trolleys was only done by a small number (4%) of hospitals. See table 5.26. According to Path (2006:2), disinfection of trolleys is seldom done in health care facilities because the workers are not aware of the high risks posed by infectious hospital equipment. This was also alleged by Daschner (2009: 280-283), who, in his seven week investigation of trolleys in a German hospital, found that 20 to 27 percent of trolleys were contaminated. Daschner (2009:283) argues that bacterial and virus infections could be reduced if trolleys used in hospital wards could be decontaminated at least daily or weekly, and be cleaned daily.

Immunisation programme for HCW workers (Q1.21, 2.1)

Immunisation of HCW workers (Q1.2) was inadequate (Tables 5.31 and 5.46). This was the case even though the personal protective equipment (Q1.3) was available and adequate (Q2.3) in the majority (78%) of the hospitals. The hygiene provided by the existence of water-taps (Q1.1), in nearly two thirds

(63%) of the hospitals, is rendered pointless by the inadequacy of the immunisation programme in some provinces.

In terms of the adequacy of immunisation, the results showed that all KZN (41%) hospitals adequately provided immunisation programmes. The same finding was not true for Limpopo, where none of their hospitals offered immunisation to HCW staff. See Table 5.26.

Lack of information was cited as a possible reason for the inability of authorities to immunise their workers (Franka *et al*. 2009:258). Further, a one-year study was conducted with non-medical waste workers and medical waste workers in Libya to determine the risk of infection for these two groups of workers. It was found that the hepatitis B virus was more hazardous to medical waste workers than non-medical waste workers. Immunisation was recommended as a solution to reduce the risk of infectious diseases.

6.5 Internal storage and transportation (ISAT) (Q1.8-1.10, 1.12, 1.20)

The research showed that a central storage area was present in most (93%) hospitals, compared to the temporary storage at a ward level (19%). The next question required respondents to indicate if the central storage areas were well secured and locked: only 63 percent indicated it was so. This finding implies that the rest of the respondents, who indicated that central storage areas existed, may have only considered the availability of the structure irrespective of whether it was lockable and safe from intruders.

The absence of a temporary storage area in the wards raises two concerns. The first concern is that if a storage area for HCW in the ward is not present, it means that nurses must leave patients in the wards and transport waste to the

central storage area (DEAT, 2000:14). If the waste is stockpiled in the ward, it poses risks to workers, patients and visitors. According to the DEAT (2000a:4), in order to avoid the accumulation of waste in wards, it must be collected on a regular basis and transported from the temporary ward storage to the central storage area. The regular collection of waste for disposal is possible as the study established that HCW contracts for the removal of waste were in place in a large number (78%) of the hospitals.

The second concern was that none of the hospitals had adequate capital to purchase trolleys for HCW. See Table 5.32. The absence of trolleys implies that waste must be transported manually. According to Askarian, Mahmood and Kabir (2003:1), the absence of a temporary storage area and HCW trolleys in six hospitals of Fars, Iran, forced nurses to store hazardous materials in the unguarded sluice rooms. In addition, these sluice rooms were positioned in the middle of the wards. Waste was easily accessible to other patients, particularly psychiatric patients. Askanian *et al*., (2003:1) recommend that in order to prevent sharps' injuries to both staff and patients, as a short-term measure, a lockable container had to be procured and at least one dedicated trolley per ward should be made available.

6.6 Management support (Q1.14 – 1.19)

In this study, the management support was measured against the extent to which budget was available for HCW management activities. The results indicated that most hospitals had budgets for contracted HCW management services (78%); waste related labour (52%) and waste related consumables (59%). The opposite was true for capital for building maintenance (28%) and for purchasing of trolleys (Figure 6.2).

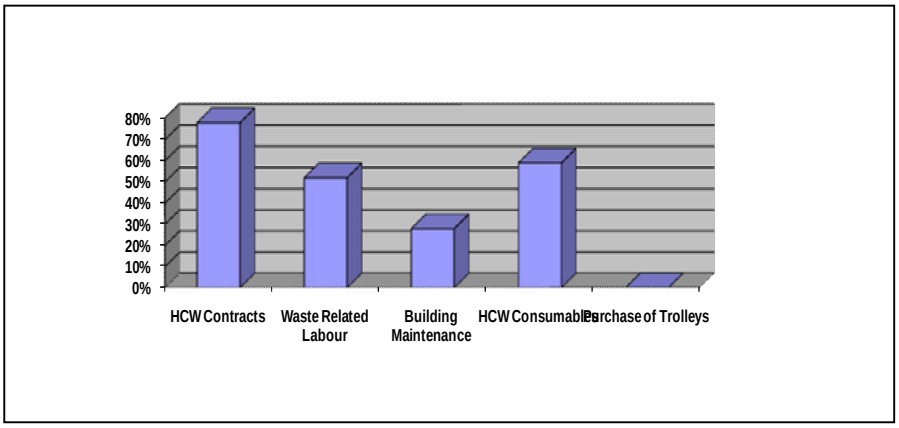


Figure 6.2 Management support concerning HCW budget

While it was pleasing to note that budget was available for most HCW services, inadequate capital budget for trolleys and maintenance of HCW buildings, which includes storage areas for full HCRW bags, was a reason for concern. See Table 5.32. This discovery is consistent with the findings by the WHO (2006:2) where the Kenyan Ministry of Health allocated a block of financial resources to hospitals without a specific budget line for HCW management. Consequently, hospitals allocated these funds to other pressing issues, for example, salaries and medicines, while hazardous waste, including used needles, was dumped in the valleys and bushes (WHO, 2006:3).

This study established that there was increased likelihood for hospitals to experience shortages of capital for building maintenance where management members did not attend HCW management meetings (Figure 6.3)

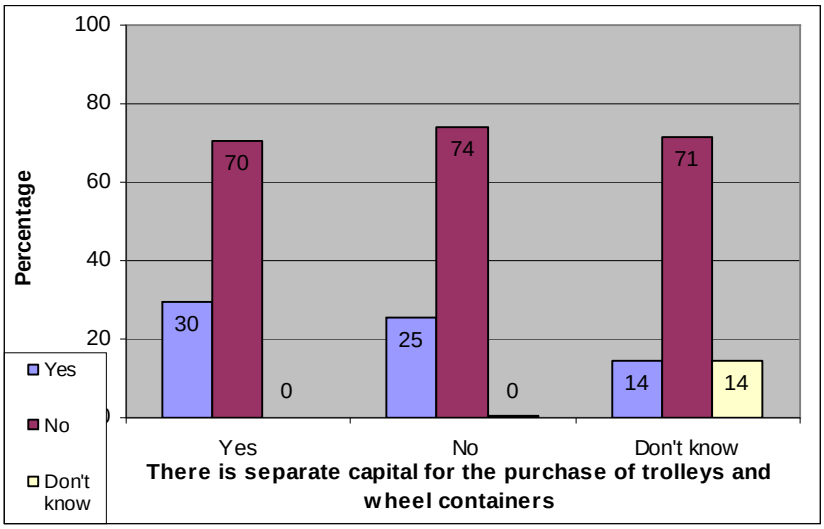


Figure 6.3 Separate capital for waste transportation

It is generally a good practice for management teams to attend HCW management meetings because they get acquainted with and learn about the operational challenges facing the employees. The World Bank (2005:22) maintains that ignorance of management regarding the financial implications of inadequate financial provisions for HCW management activities has negative consequences for hospitals. An example of this is that if sharps containers used are not equipped for the safe removal of needles from syringes, it will require that a needle and syringe be disposed of as a single unit. This, in turn, significantly increases the sharps' volumes and thereby the demand for sharps containers increases. Attendance of meetings enables management to realize this shortcoming (World Bank, 2002:23).

6.7 WIS

Waste Information Systems (Q1.32)

Although a budget was available (78%) for contracted HCW services (Q1.18), very few hospitals (7%) made use of computerised waste information systems.

Similarly, respondents did not believe that WIS was significant in the HCW management programme.

Absence of this system was noticeable in the Free State, North West, Northern Cape, Limpopo, KwaZulu-Natal, Mpumalanga and the Eastern Cape, ten years after a pilot WIS software package was developed, tested and revised (SAWIC, 2008:2).

The delay in rolling out WIS to provinces could be lack of funding (DEAT, 2005) or shortage of staff and the massive training needs for the identified officer (Medical Research Council, 2002, and DEAT, 2005). Regarding the budget, the World Bank is reportedly funding the Africa stockpiles programme for pesticides (ASP) (SAWIC, 2008:1). As such, South Africa is a beneficiary of ASP in terms of the grant agreement between the South African government and the World Bank (SAWIC, 2008).

With regard to personnel problems, this research has established that the personnel for tracking of HCW (Q1.21) were non-existent in most (93%) of the hospitals. Further, the HCW trainer (Q1.5) was also not available in most (67%) hospitals. This could imply uncertainty of hospitals about the impact these personnel would bring on HCW management. This could also be true as the Zeerust sub-district declined to allocate a full-time officer to work as the waste management officer, citing insufficient work in this role (DEAT, 2005). It is, therefore, possible that an official could be identified, trained and placed in charge of WIS, tracking of waste as well as being a trainer for HCW-related matters. The salary level of this officer could be determined by the national or provincial organizational development and efficiency department (O D & E).

6.8 Adequacy (2.1 – 2.16)

The adequacy of waste management practice structures and processes (Q2.1–2.16) was discussed under the sub-objectives into which they fall.

6.9 HCW treatment

Kind of waste treatment system used (Q3.1)

Although a large number of hospitals (33%) used reusable waste storage containers, there was inconsistency among hospitals of the same province in the type of system used. This was true for all provinces except Free State, which used disposables, Gauteng and Western Cape which both used reusables, and Mpumalanga where incinerators were used. See table 5.9.

It was observed that provinces with less HCW consumables (Q1.16) and inadequate budget for consumables (2.12) did not settle on one HCW treatment system. The exception was Mpumalanga where the budget for consumables was inadequate but the province continued with the use of incinerators.

Inadequate budget for HCW consumables may be a reason for inconsistency where the disposable system was chosen as a method of choice but a lack of budget prevents hospitals from continuing to procure the disposables.

It is common knowledge that disposable containers need to be replenished more frequently than reusables. For hospitals without adequate budgets, the choice of the disposable method may be unsuccessful if the stock cannot be replenished. This may cause hospitals to be inconsistent and force them to return to the use of both reusable and disposable methods (Neely, Maley, and Taylor, 2003: 13 – 17).

Number of times respondents pricked by needles (Q3.2)

A large number of respondents (42%) reported experiencing needle-stick injuries in the last twelve months (Table 5.56). It was worrisome that detailed operational manuals (Q2.16) were inadequate in the hospitals. However, adequate procedures were in place (Q2.6) in the event of a needle-stick injury (Table 5.41).

The results indicated that Mpumalanga had more such injuries (60%) than Western Cape (37%). It became necessary to do a cross tabulation between respondents that were pricked by needles and the extent to which respondents believed their hospitals complied with the OHSA. It was found that the frequency of injuries was high (43%) among respondents who believed that their hospitals did not meet OHSA requirements compared to respondents who believed the opposite (Figure 6.4)

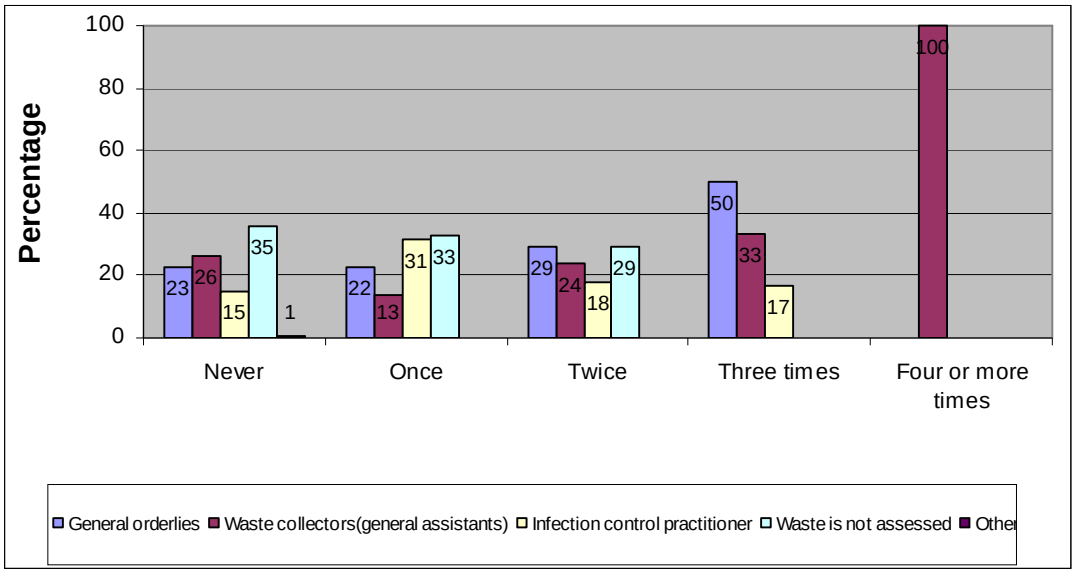


Figure 6.4 Frequency of needle pricks

A comparison of the frequency of needle pricks, and the incidence of continuous orientation and induction of staff did not show a significant relationship. This finding compares to an Italian study where results showed that reliance on education and behaviour modification did not bring about a significant reduction in the number of needle-stick injuries (Grimmond, 2003:2). Compared with previous studies, the incidence of needle-stick injuries to HCW workers has increased tremendously (37%) from 2002.

The most recent South African study, which was conducted on 150 waste handlers, reveals that 11 percent had needle pricks in the last six months of which one percent had more than six needle stick injuries (Department of Health, 2008:7).

According to the WHO (2004:2), epidemiological studies indicate that any person experiencing one needle-stick injury from a needle used in an infected source has risks of 30 percent, 1.8 percent and 0.3 percent, respectively, of becoming infected with the Hepatitis B virus, Hepatitis C virus and HIV.

Notwithstanding the emotional costs to injured workers and their families, the financial cost of each sharp injury follow up is between R4 000 and R17 000, and the annual costs associated with the treatment of the infection can be hundreds of thousands per infected person with the ultimate cost up to R7 million (Grimmond, 2003:14).

Biggest cause for HCW treatment system failure (Q3.3)

The research showed that nearly two-thirds (62%) of the respondents felt that lack of money to run HCW treatment systems was the major cause of failure. This finding was inclusive of urban and rural hospitals. These results are similar

to the recent findings by Vufo NGO (2009:1), who, in the study comprising 700 hospitals in Vietnam, concluded that 60 percent of the hospitals at the time of the study were experiencing HCW treatment system failure. As a result, the medical waste sewage was being directly discharged into a public system with little or no processing at all. When this matter was referred to officials of the health ministry, the response was that the ministry was experiencing financial problems.

Whatever the reason for HCW treatment system failure, hospitals produce various forms of hazardous waste. As their duty of care, hospitals should have their treatment system of choice in place and working twenty-four hours a day (Department of Health, Manila, 2005:56).

Disposal of waste in the case of HCW treatment failure (Q3.4)

In this study, the respondents that indicated that their hospitals did experience HCW treatment system failure were asked to indicate what they thought their hospitals did in the event of failure. The majority believed that their hospitals often burnt their waste.

These results were in agreement with findings by Gabela (2007:111) and Ground Work (2007:1) that 45 percent of HCW generated in KwaZulu-Natal alone could not be accounted for. This finding implies that waste was being illegally dumped or burnt somewhere.

Meanwhile, the WHO policy (2002:173) stipulates that open-air burning of infectious waste should only be carried out as a last resort, in rural areas and away from busy complexes.

A cross-tabulation was conducted to establish the relationship between the hospitals' choice of disposing of waste in the event of treatment system failure and the hospitals' knowledge of the HCW policy. It was concluded that hospitals, that use safer waste treatment methods such as out-sourcing and asking for help from the nearest hospitals, had clear knowledge of the HCW management policy. See Figure 6.5.

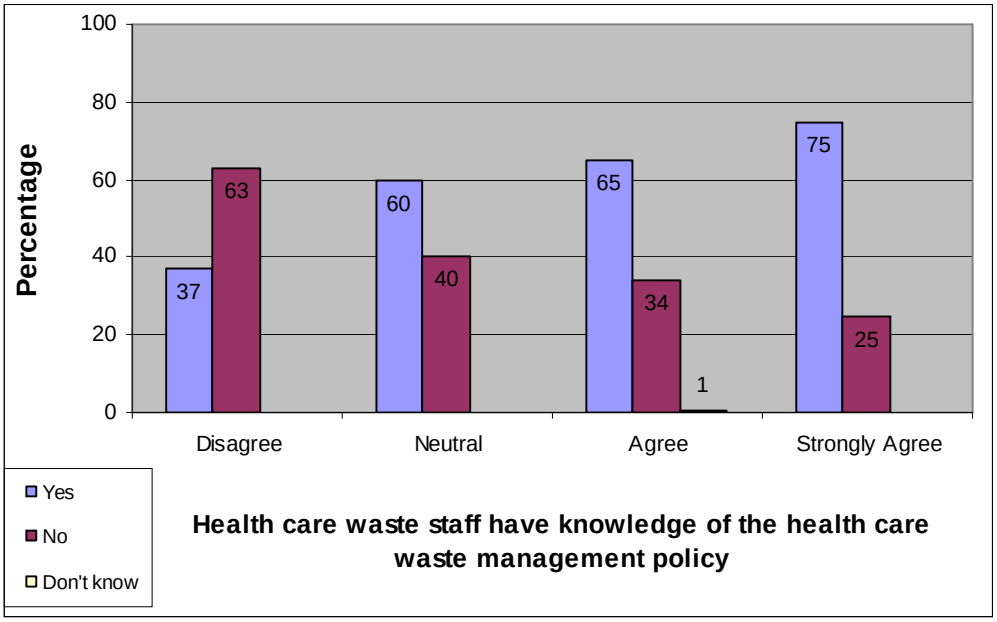


Figure 6.5 Knowledge of hospital management policy

This finding is in line with the observation made by Health Care Without Harm Asia (2007:35) that the success of any type of waste management programme is dependent on the knowledge and application of the HCW management policy.

6.10 Containers (Q4.1 – 4.5)

Kind of waste containers (Q4.1)

The results showed that a large number (64%) of hospitals used more plastic reusable containers than any other kind. This finding compares well with summary findings by the DEAT (2003:16) in the pilot testing of containers to be used for infectious waste in Gauteng. The waste experts of the pilot study in Gauteng recommend the use of plastic reusable containers based on the cost, user-friendliness, ease of implementation, and durability (DEAT, 2003:17). The fact that, in this study, all provinces had cited the shortage of money as the cause of waste treatment (Q3.3) system failure, and the fact that only just more than half (59%) of the hospitals had budgeted for HCW related consumables (Q1.16), makes the use of plastic reusable containers the obvious choice.

Assessment of waste (Q4.2)

The results demonstrated that the majority (33%) believed waste was not assessed in their hospitals. A closer examination of the results per province has shown that, among all the provinces that do not assess waste, most (70%) respondents came from Eastern Cape. Further, in pursuit of a pattern or relationships that could explain this anomaly, it was confirmed that Eastern Cape had the most (73%) respondents who attested that in the event of HCW treatment system failure, their hospitals openly burned the waste on-site. See Table 5.61. The EPA (1990:4) maintained that where waste was not assessed, the likelihood of burning it was increased.

Shortages of waste containers and their reasons (Q4.3, 4.4,)

It was found that almost all (92%) the hospitals had experienced a shortage of containers in the last 12 months. This finding could be linked to the fact that a

majority (62%) indicated that the principal reason for the shortage of containers was financial shortages.

A further examination showed that provinces that had previously expressed that lack of money (NC, 87 percent; EC, 77 percent; G, 67 percent; and L, 60 percent) was the biggest reason for HCW treatment failure seem to have experienced shortages of HCW containers. A big question that begged for an answer was, what then do hospitals do in the case of shortages of waste container? The answer for most hospitals would be the burning of waste (Q3.4).

In the similar study in Bangladesh, the directorate of general health services (2000) found that the majority (60%) of the state hospitals (N=60) who experienced shortages of HCW containers, manually handled potentially harmful wastes and, in the process, risked the health of workers.

Transportation of waste from wards to central storage area (Q4.5)

The study showed that HCW handlers are mostly (49%) used to transport waste from wards to the central storage area. A small number (1%) of respondents mostly from Western Cape (3%) and Eastern Cape (3%), believed that transportation was being done by nurses. The issue of use of nurses to transport waste is worrisome, not only because of this inappropriate use of nurses but because nurses returning from central waste storage areas may potentially reintroduce micro-organisms back to the wards (Daschner,1985:283). While there may be several possible reasons for using nurses for this function, it is thought that Eastern Cape had no health care waste trainer (Q1.5) to advise on risks associated with the use of nurses for transportation of waste. Secondly, this province had no temporary storage of waste in the ward (Q1.8). To avoid accumulation of waste, it is common practice that waste must be moved away.

6.11 Ranking of structures

Owing to the non-existence of the ranking of structures, a survey was done to establish the general perception of how the structures ranked in order of importance. Respondents ranked the structures and processes whereby the maximum score for structures and processes was ten and the lowest score was one as determined by this mini-survey results. See Table 4.9.

Waste management practices

It was found that most hospitals ranked high in the separation of HCRW from general waste. The existence of an individual to track HCW as well as the presence of incentives for HCW management best practice ranked low in most of the hospitals. Gauteng ranked adequately to WMP structures while Free State and Eastern Cape ranked the least. See Table 5.67.

Awareness and capacity building

Generally, most hospitals ranked higher in the requirement of the availability of personnel protective equipment than that of the weekly disinfection of trolleys. KwaZulu-Natal ranked the highest to ACB while Limpopo ranked the lowest. See Table 5.68

Internal storage and transportation

There was higher ranking for the presence of a temporary central storage area compared to the temporary storage at ward level. Again, Gauteng ranked the most in ISAT structures while Limpopo (2.2) ranked the lowest. See Table 5. 69

Management support

All hospitals ranked high in attendance of HCW meetings by managers except for Mpumalanga, Limpopo, Western Cape and the Northern Cape. The separate capital for trolleys was the structure in which the hospitals ranked the least.

Once again, Gauteng ranked higher in management support structures, than Eastern Cape. See Table 5.70.

Waste information system

None of the provinces, except for Mpumalanga (M2) and the Western Cape (WC3) had WIS structures.

6.12 Review of findings

6.12.1 Demographics review

In most cases, HCW programmes are run by males, except KwaZulu-Natal, where the opposite was the case. In addition, the large number (36%) consisted of respondents with secondary education. The exception was that some (3%) respondents had no formal education at all.

Regarding experience in the HCW programme, the results showed that a large number of respondents worked in the HCW programme in the one to five years bracket. However, one province had its respondents 15 years and above experience in the HCW programme. Nonetheless, as it was found, this experience did not give the province an advantage in the running of the HCW programme. For instance, with regard to waste management structures concerning administrative functions (Table 5.14), Eastern Cape had no records for HCW records generated (Q1.23), no record of HCW received from wards (Q1.25), no records for waste injuries (Q1.28) and also, records for the spillages of HCRW were non-existent (Q.29).

6.12.2 Waste management practices – Administration functions review

Adequate knowledge in the HCW management policy did not enhance the keeping of records of waste from its generation to disposal. This was the case with recording of accidental spillages of HCRW where only 4 percent of the hospitals kept record of the spillages (Table 5.14). There was also evidence that only one third of the provinces had adequate records for HCRW received from wards (Table 5.14). Moreover, there were even some provinces where no records were kept even though it is an OHSA requirement (Table 5.14).

6.12.3 Waste management practices – Non-administrative functions review

Even though the orientation and induction programmes were considered as adequate, this did not lead to the adequacy of written procedures, with particular reference to spillages of HCRW (Table 5.25). The finding about insufficient written procedures and inadequate recording of this item means that the level of risk this poses to staff and patients remain unknown by a hospital and may be unacceptably high. It is, therefore, strongly recommended that this situation be examined and corrective action be taken.

Despite the fact that the budget for HCW labour and consumables was marginally adequate, none of the hospitals forfeited some of the budget to be used as incentives for HCW best practice.

Further, the employment of a HCW trainer and a person to track HCW in hospitals were not considered important mainly because there was uncertainty about the impact that such persons will have on HCW management.

Although the in-service education was considered adequate it did not add to the improvement of the separation of HCRW from general waste. The finding that waste was mostly assessed by the infection control practitioner (Table 5.61)

could mean that this officer may need to be delegated to oversee this function. Although OHSA was ranked high by informants, this structure was inadequately adhered to by hospitals. It was further found that an advantage due to the adequacy of central storage areas in almost all the hospitals did not lead to improved HCW management. This was due to the inadequacy of HCW trolleys, poor separation of HCRW from general waste, and the lack of the assessment of waste.

6.12.4 Awareness and capacity building review

It is of concern that although most hospitals had schedules for the collection of waste, some of the hospitals used nurses to transport waste to central storage. In the process, nurses risk a danger of contaminating fellow workers and patients once they return to the ward.

The adequacy of the personal protective clothing and waste taps for washing hands is rendered pointless by inadequacy of immunisation programmes for HCW workers.

6.12.5 Internal storage and transportation review

The shortage of trolleys necessitates nurses to manually transport waste to storage areas, thereby increasing the risk of contamination and shifting away nurses' direct responsibility to render patient care.

6.12.6 Management support review

Infrastructural problems, such as HCW storages in the wards, maintenance of the buildings and shortage of trolleys, arose more where hospital management teams did not attend HCW management meetings.

6.12.7 Waste information system review

Despite the fact that money for contracted health care waste services was available in most hospitals, few hospitals had a computerised waste information system, and none had designated a waste information officer. Only few hospitals believed that WIS was significant in the HCW management programme.

6.12.8. Health care waste treatment review

The lack of money was cited as the biggest reason for inconsistency in the health care waste treatment system. This was the case where hospitals, as their waste reduction strategies, had chosen reusable wastes but had to revert to the disposables when reusable containers were not available.

The shortage of money was again mentioned by the majority of the respondents as a reason for HCW treatment system failure. As a result of this system failure, hospitals resorted to open burning of waste within their hospital premises, contributing to environmental pollution.

Although needle-stick injuries were on the rise, detailed operation manuals, including instruction on the safe usage of sharps were non-existent.

6.12.9 Containers' review

It was pleasing to find that the majority of hospitals used plastic re-usable containers for HCW management. However, the fact that almost all (92%) of hospitals had experienced shortages of containers forced them not to separate the waste.

6.12.10 Ranking of structures' review

The ranking of the structures showed the compliance of the hospital with the policies and procedures of waste management. The level of the ranking indicates measure compliance with the most important structures. For instance, it is clear that the procedure of separation of HCRW from general waste is complied with sufficiently by most hospitals. See table 5.67. The ranking of structures also identifies structures which are least complied with for instance, regarding incentives for best practice, it is clear that none of the hospitals had complied (Table 5.57).

6.13 Conclusion

The effect of poor management of HCW can be life threatening to the casualties of HCRW, particularly HCW workers, patients and visitors. The HCW management challenges are extensively covered with particular attention to the integration of the findings and the opinions of other authors and experts.

The Department of Health in particular, is faced with a daunting task of managing HCW in a way that will ensure safety for people and the environment. The need for HCW employers to protect the HCW staff from unnecessary hazards, for example, needle-stick injuries, which may result in their staff acquiring debilitating infections such as HIV, Hepatitis B and Hepatitis C, was emphasized. Also the preventable causes of HCW mismanagement such as the shortage of HCW trolleys and waste containers cannot be overlooked. Such shortcomings are against the rights of employees, and entrenched in the Occupational Health and Safety Act.

The weighting of the structures and processes determined a need to prioritize corrective actions based on the structures identified in order of importance. The

investigations have shown that while, provinces such as Gauteng adhered more to the requirements of safe HCW management, some provinces need to take HCW management more seriously.

The findings and interpretations thereof are summarised and discussed in the last chapter, together with suggestions for future research.

CHAPTER SEVEN

CONCLUSION

7.1 Introduction

The preceding chapter discussed significant points in light of the interpretation of results. A wider view of HCW management in Public District Hospitals was facilitated by the diversity of the respondents in terms of age, gender, experience, and whether they worked in urban or rural hospitals. Throughout the chapters, the sub-objectives that guided the research process were foregrounded.

This chapter reaffirms the main and specific objectives of the study and provides a reflection on the preceding chapters. The interpretations of the results are briefly presented. The limitations of the research are mentioned, followed by recommendations, conclusions, and suggestions for further research.

The insight into the extent of application of the structures and processes, revealed by questions about their adequacy and the ranking of their order of importance, are seen as the major contribution of the study to new knowledge.

7.2 Main objectives revisited

The objective of the study was to evaluate the process of operational and administrative procedures of HCW management in the Public District Hospitals. This evaluation was done to facilitate the optimization of HCW

management. The project involved enquiry into the perceptions of the respondents on the procedures used in managing HCW. An overview of the factors affecting the internal storage and transportation of waste was also gathered. The need for capacity building was established through enquiries pertaining to the level of awareness among staff of the dangers that HCW posed to humans and the environment. This was followed by measuring respondents' perception of the level of involvement of management and the use of the waste information system.

As a base for the measuring instrument, it was necessary to compile a conceptual model of best practices of HCW management. Data was collected from 270 respondents out of 27 hospitals in nine provinces of South Africa through personally administered questionnaires. The questionnaire covered the four main areas of general administration and management, adequacies, containers, and health care waste treatment. Included were questions relating to the ranking of importance of the main structures used by the Public District Hospitals.

The data was analysed statistically by a statistician using the SPSS package. However, a different measure was used for establishing the values of the adequacies (See paragraph 5.4.7.1.) and the ranking of importance (Table 4.9).

7.3 Main conclusions and recommendations

Biographics of respondents

It was found that, although the sample consisted of more males than females, the result had no influence on perceptions of HCW management. Also, the research showed that experience alone is not

sufficient to enhance effective HCW management. This finding has to be supported by a thorough knowledge of the relevant policies and procedures. More extensive training in this knowledge is necessary and recommended. This training is possible since the level of education of respondents did not prove to be important in facilitating improved HCW management.

Waste management practices – administrative functions

HCW management record keeping was not complied with sufficiently although it is a minimum requirement for HCW management according to OHSA. Inadequacy of records puts patients and staff at risk. For instance, the absence of records of HCW-related injuries prevents implementation of corrective action to prevent recurrence of such injuries. It is recommended that thorough and complete record keeping be made compulsory.

Waste management practices – non administrative functions

Beside the fact that budget for other activities, for instance, contracted HCW collection, is adequate, initiatives are not taken to fund other important HCW management activities, such as building or hiring a container to be used as a temporary storage at the ward level. Further, the fact that hospitals did not comply with the OHSA necessitates hospital management to consider employing or designating such an officer. It is recommended that an occupational health and safety officer be employed and OHSA duties are included in their job description.

Awareness and capacity building

The concern is that while hospitals have adequate money for personal protective equipment, less attention is given to the provision of

immunisation programmes for staff safety. It is recommended that the provision for immunisation be given priority.

Internal storage and transportation

Hospitals experience infrastructural problems pertinent to the storage areas at the ward level as well as financial deficits to maintain buildings. It is recommended that these be attended to as a matter of urgency as the absence of storage at the ward level forces nurses to personally transport HCRW to the central storage areas and, in the process, they risk dangers of contamination and exposure to HCRW.

The Waste Act has now made the supply of the composition and the volume of the waste generated mandatory (DEAT, 2008:13). However, the use of WIS software system for reporting purposes still remains voluntary. This study proved that WIS reporting was nonexistent in most public hospitals.

While different health departments have a variety of purposes in collecting and using HCW information, their needs frequently overlap, thus creating the need to standardize the definition, collection, and interpretation of data. It is, therefore, recommended that a training course manual be developed for continuous training of new reporters. The intent should be collecting data without placing an undue financial and capacity burden onto the hospitals which are responsible for providing data, and on government which is responsible for collection, verification, and dissemination of the data and the information.

Management support

Although hospital management teams attend HCW management meetings, this is not done frequently. Attending these meetings will inform managers of operational challenges for corrective action. It is highly recommended that attendance at HCW management meetings be made compulsory.

Attendance of HCW meetings must be added to the key result areas to be performed by CEOs. Failure to attend such meetings should cause CEOs to be liable for a charge of misconduct. It is recommended that such deviation be punishable in terms of misconduct as laid down by the public code of conduct for public servants.

Another problem regarding management support was the non-existence of a budget for HCW consumables such as plastic liners. It is recommended that such a shortage be circumvented by strict stock-level maintenance. Any stock-outs of consumables must be punishable in terms of the hospital disciplinary procedures.

Inadequate funding for building waste storages is another problem needing attention. It is also recommended that audits of waste storages be carried out in all the public district hospitals. It is recommended that to address deficits, special funds be made available to renovate and build new waste storages, as necessary.

Waste information system (WIS)

WIS is almost nonexistent in the hospitals. It is recommended that the support for implementing this function should be initiated by the National

Department of Health in consultation with the Department of Environmental Affairs and Tourism (DEAT).

Health care waste treatment system

Hospitals seem not to understand that burning of waste creates pollution which poses risk to both people and the environment. It is recommended that the regionalisation of HCW treatment be pursued not only because of cost but because expertise in maintaining treatment systems may not be available in the hospitals.

It is recommended that the provincial departments of health be assisted by the DEAT to ensure that each province has access to at least one hazardous waste disposal facility. There may, however, not be sufficient financial incentives for the private sector to venture into projects for areas that may be financially risky due to lack of economies of scale. This insufficiency may create a need for the DEAT to enter into public-private partnership with the waste disposal contractors for the development of such facilities.

Containers

Hospitals experience chronic shortages of containers due to shortfalls in their budgets. It is recommended that an annual procurement plan be drawn up by the hospitals with a budget attached to it.

Summary of ranking

It is clear that Gauteng, Western Cape and North-West hospitals complied the most with HCW structures and processes, while the other

provinces were less compliant. Further, ranking of structures established an order of importance of structures and processes for hospitals to consider in their HCW strategic planning. It is recommended that the ranking of structures be standardised so the hospitals are aware of the relevant levels of importance.

7.4 Further research

The study highlighted the need for further research in the following areas:

- Full scale ranking of the structures and processes of HCW management will be necessary to reaffirm the findings of this study;
- Research into the feasibility of the introduction of green procurement in public hospitals would be helpful. Green procurement was prioritized by the GDACEL (DEAT, 2004:12) for implementation in the hospitals of Gauteng. It will be important to conduct case studies regarding best practice hospitals for benchmarking by the rest; and
- This research found that sharps-injuries are escalating. There is need to research best practice control measures in the public hospitals.

7.5 Conclusion

The objectives of the research were fulfilled. The respondents were able to identify and report the challenges that impede effective management of HCW. Besides the development of a model, this study established a ranking of HCW structures and processes necessary for the development and implementation of corrective measures to improve HCW management. Future research will be necessary to verify and improve on the results of the ranking of structures.

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INFORMATION SHEET

Introduction

Hello. My name is **Sipho Vumase,** a doctoral student from Durban University of Technology.
I would like to invite you to participate in a study on AN EVALUATION OF OPERATIONAL AND ADMINISTRATIVE PROCEDURES OF HEALTH CARE WASTE MANAGEMENT IN DISTRICT PUBLIC HOSPITALS OF SOUTH AFRICA.

You are one out of 270 respondents that have been selected to fill this questionnaire. In scientific investigations of this kind, it is important that people with different exposure and experience, that is, those directly and indirectly involved in health care waste management express their views on health care waste management. This is not a test, so there can be no wrong or right answers.

Consent

It is up to you whether or not you are interviewed

Confidentiality

It is important to know your name will not be on the form. Your answers will become part of many other people's answers. So we will keep your answers confidential and treat it with respect. Do you have any questions? Would you like to participate?

If YES,

You now need to sign a consent form, which basically states that I have explained the research, you have understood and that you agree to be interviewed.

CONSENT FORM

I have been informed about the project and I understand that it is up to me whether or not to participate.

I understand that there will be no consequences of any kind through my responding to this interview.

I understand that the information that I will give will be treated in the strictest confidence and that my name will not be used when the interviews are analysed.

Yes, I give my permission for the interview

Interviewee's signature: ---------- Date----------

Interviewer's name: ----------

Interviewer's Signature: ---------- Date----------

Please select and tick only ONE option for each of the following questions:

1. What is your gender?	1. Male		2. Female		
2. How old are you?	1. 20 - 29	2. 30 – 39 years	3. 40 – 49 years	4. 50 years and above	
3. Did you complete primary education?	1. ☐ Yes		2. ☐ No		
4. Did you finish secondary education?	1. ☐ Yes		2. ☐ No		
5. Do you have any of the two: diploma or degree	1. ☐ Yes		2. ☐ No		
6. Which best describes your involvement with health care waste?	1. ☐ Directly handle health care waste		2. ☐ Manage health care waste but do not handle it directly		
7. How long have you worked in this hospital?	1. ☐ Less than 1 year	2. ☐ From 1 year to less than 5 years	3. ☐ From 5 years to less than 10 years	4. ☐ From 10 years to less than 15 years	5. ☐ 15 years or more
8. For how long have you worked with waste during this time?	1. ☐ Less than 1 year	2. ☐ From 1 year to less than 5 years	3. ☐ From 5 years to less than 10 years	4. ☐ From 10 years to less than 15 years	5. ☐ 15 years or more

1. Please tick <u>ONE</u> box for each question to indicate your awareness of structures in place in your hospital for waste management		**YES**	**NO**	**DON'T KNOW**
1.1	There is a water tap for hand washing in each of the waste storage and treatment areas			
1.2	There is an immunization programme for health care waste workers			
1.3	Protective material is available for personnel who work with waste			
1.4	Procedures are present in cases of accidents and spillages			
1.5	There is an HCW Trainer in this institution			
1.6	Orientation and induction of staff happens in this hospital			
1.7	There are separate temporary storage areas and containers for hazardous and general waste			
1.8	Temporary storage areas are located away from patient areas			
1.9	There is a fixed collection schedule for temporary stored bagged waste			
1.10	There is weekly disinfection and cleaning of trolleys			
1.11	There are dedicated trolleys for collection and transportation of hazardous waste			
1.12	A colour coding system to differentiate between trolleys for general use and those for use with hazardous waste is present			
1.13	There is separate capital for the purchase of trolleys and wheel containers			
1.14	There is an operating budget for labour			
1.15	There is an operating budget for consumables e.g. purchase of plastic bags			
1.16	There is a budget for maintaining the buildings e.g. temporary storage areas for yellow and black bagged waste			

	Please tick <u>ONE</u> box for each question to indicate your awareness of structures in place in your hospital for waste management	**Yes**	**No**	**Don't know**
1.17	There is budget for contracted health care waste management services			
1.18	The management team attends hospital health care waste meetings			
1.19	Hazardous wastes are stored in a centralized area			
1.20	There is an individual in-charge of hazardous waste tracking and management throughout the hospital			
1.21	There are sectional incentives or awards for health care waste best practice			
1.22	Records are kept of waste generated			
1.23	There is a register to record the quantity of bags generated by each department			
1.24	In a temporary storage area, there is a register to record the quantity of bags received from different hospital departments			
1.25	In a temporary storage area, there is a record of the quantity of bags handed over for final disposal			
1.26	The hospital departments have a record of occurrences where waste-related injuries to staff, patients and visitors are recorded			
1.27	There are records whereby spillages of hazardous substances are recorded			
1.28	The hospital has a computer to specifically capture and report on waste generation			
1.29	**<u>If the answer to the above question (1.28) is YES</u>**, to whom is waste generation information reported? (More than one answer could be ticked).	1. ☐ Hospital management 2. ☐ District Management 3. ☐ Provincial Management 4. ☐ National Management 5. Other: specify_____		

2	**Please tick <u>ONE</u> box for each question to show your feeling about how your hospital manages the health care waste**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
2.1	There is an adequate immunization program for health care waste workers					
2.2	The protective material available to personnel is adequate					
2.3	Health care waste staff have knowledge of the health care waste management policy					
2.4	There are clear roles and responsibilities with regards to health care waste management					
2.5	Satisfactory procedures are present in cases of accidents and spillages					
2.6	Procedures are clear as to what to do in cases of accidental needle stick injury					
2.7	There is an adequate orientation and induction program for staff in this hospital					
2.8	The colour coding system used to differentiate between trolleys for general use and those for hazardous waste is clear					
2.9	The disinfection and cleaning of trolleys is sufficient					
2.10	There is enough capital for the purchase of trolleys and wheeled containers					
2.11	The operating budget for labour is adequate					
2.12	The operating budget for consumables (e.g. purchase of plastic bags) is adequate					
2.13	The budget for maintaining the buildings (e.g. the separate temporary storage areas for yellow and black bagged waste) is adequate					
2.14	Adequate records of waste are kept at each stage of the waste disposal process					
2.15	Infectious waste containing hazardous wastes are segregated from non-hazardous infectious waste					
2.16	All staff working with waste are provided with detailed operating manuals or instructions					

Read the following questions and write, in the provided column, only ONE number representing your chosen answer

3.1	What kind of health care waste treatment system is used in your hospital? 1 = Disposable 2 = Sterilisable 3 = Auto disable 4 = Safety syringe 5 = Do not know 6 = Other: Please specify _____	
3.2	How many times have you been pricked by a needle(s) in the last 12 months? 0 = Never been pricked 1 = once 2 = twice 3 = three times 4 = four times or more	
3.3	What was the biggest cause for health care waste treatment system failure in the last 12 months? 1 = No failure experienced 2 = Lack of money 3 = Poor maintenance 4 = Unavailability of spares or parts 5 = Incompetence of staff 6 = Other: Please specify_____	
3.4	In the event of a failure in the health care waste treatment system, what action is taken with regard to the disposal of waste? 1 = Burn the waste 2 = Just keep the waste in the hospital 3 = Out-source the removal 4 = Ask for help from the neighboring hospitals 5 = Never had a failure of the health care waste treatment system 6 = Other: Please specify_____	

Read the following questions and write, in the provided column, only ONE number representing your chosen answer

4.1	What kind of waste containers do you use? 1 = No specific containers 2 = Plastic 3 = Metallic 4 = Cardboard 5 = Bag box 6 = Other: Please specify _____	
4.2	Who assesses the amount of waste generated by the Hospital? 1 = Nurses 2 = General Orderlies 3 = Waste collectors 4 = Infection control practitioner 5 = Waste is not assessed 6 = Other: Please specify _____	
4.3	Have there been a shortage/ shortages of waste containers in the last year? 1 = Yes 2 = No 3 = Do not know	
4.4	**If your answer to question 4.3 above is YES**, indicate which one of the following reasons is the main cause of shortages 1 = No budget 2 = Delays in procurement 3 = Containers are being wasted by staff 4 = Other: Please specify _____	
4.5	Who transports waste from the generation point to storage? 1 = Do not know 2 = General orderlies 3 = Health care waste handlers 4 = Nurses 5 = Hired company 6 = Other: Please specify _____	

END OF QUESTIONS. THANK YOU

SPSS runs - Demographics

Time worked in the hospital * Province

Crosstab

			Province									
			orthwe	ee Sta	Northern Cape	Vestern Cape	stern Ca	impopo	autenq	oumalan	KZN	Total
Time wc	<1 year	Count	2	0	0	4	0	0	0	0	1	7
in the hospital		% within Tim in the hospit	28.6%	.0%	.0%	57.1%	.0%	.0%	.0%	.0%	14.3%	00.0%
	From 1 to <	Count	16	8	10	10	5	4	13	8	7	81
		% within Tim in the hospit	19.8%	9.9%	12.3%	12.3%	6.2%	4.9%	16.0%	9.9%	8.6%	00.0%
	From 5 to <	Count	4	8	11	3	9	14	12	9	9	79
		% within Tim in the hospit	5.1%	10.1%	13.9%	3.8%	11.4%	17.7%	15.2%	11.4%	11.4%	00.0%
	From 10 to	Count	4	5	5	9	5	4	3	11	4	50
		% within Tim in the hospit	8.0%	10.0%	10.0%	18.0%	10.0%	8.0%	6.0%	22.0%	8.0%	00.0%
	15 years or	Count	4	9	4	4	11	8	2	2	9	53
		% within Tim in the hospit	7.5%	17.0%	7.5%	7.5%	20.8%	15.1%	3.8%	3.8%	17.0%	00.0%
Total		Count	30	30	30	30	30	30	30	30	30	270
		% within Tim in the hospit	11.1%	11.1%	11.1%	11.1%	11.1%	11.1%	11.1%	11.1%	11.1%	00.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	69.562[a]	32	.000
Likelihood Ratio	67.558	32	.000
Linear-by-Linear Association	1.456	1	.228
N of Valid Cases	270		

a. 9 cells (20.0%) have expected count less than 5. The minimum expected count is .78.

Time worked with HCW * Province

Crosstab

			Province									
			orthwes	ee Stat	Northern Cape	Western Cape	stern Ca	impopo	Gauten	oumalan	KZN	Total
Time worke with H	<1 year	Count	6	3	8	8	3	1	5	0	3	37
		% within Ti worked wit	16.2%	8.1%	21.6%	21.6%	8.1%	2.7%	13.5%	.0%	8.1%	00.0%
	From 1 to <5	Count	17	15	12	15	12	7	17	10	12	117
		% within Ti worked wit	14.5%	12.8%	10.3%	12.8%	10.3%	6.0%	14.5%	8.5%	10.3%	00.0%
	From 5 to <1	Count	3	6	6	2	5	16	6	9	8	61
		% within Ti worked wit	4.9%	9.8%	9.8%	3.3%	8.2%	26.2%	9.8%	14.8%	13.1%	00.0%
	From 10 to <	Count	2	4	3	2	5	1	1	9	2	29
		% within Ti worked wit	6.9%	13.8%	10.3%	6.9%	17.2%	3.4%	3.4%	31.0%	6.9%	00.0%
	15 years or r	Count	2	2	1	3	5	5	1	2	5	26
		% within Ti worked wit	7.7%	7.7%	3.8%	11.5%	19.2%	19.2%	3.8%	7.7%	19.2%	00.0%
Total		Count	30	30	30	30	30	30	30	30	30	270
		% within Ti worked wit	11.1%	11.1%	11.1%	11.1%	11.1%	11.1%	11.1%	11.1%	11.1%	00.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	66.181[a]	32	.000
Likelihood Ratio	66.298	32	.000
Linear-by-Linear Association	8.175	1	.004
N of Valid Cases	270		

a. 27 cells (60.0%) have expected count less than 5. The minimum expected count is 2.89.

Crosstabs - Highest level of education * Involvement with HCW

Crosstabulation

			Involvement with HCW		
			Directly handle HCW	Manage but do not directly handle HCW	Total
Highest level of education	No formal education	Count	3	0	3
		Expected Count	2.0	1.0	3.0
		Std. Residual	.7	-1.0	
	Primary educated	Count	42	0	42
		Expected Count	27.5	14.5	42.0
		Std. Residual	2.8	-3.8	
	Secondary education	Count	48	7	55
		Expected Count	36.0	19.0	55.0
		Std. Residual	2.0	-2.8	
	Degree/diploma	Count	83	86	169
		Expected Count	110.6	58.4	169.0
		Std. Residual	-2.6	3.6	
Total		Count	176	93	269
		Expected Count	176.0	93.0	269.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	55.269[a]	3	.000
Likelihood Ratio	70.722	3	.000
Linear-by-Linear Association	50.969	1	.000
N of Valid Cases	269		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 1.04.

Time worked in the hospital * involvement with HCW

Crosstabulation

			Involvement with HCW		
			Directly handle HCW	Manage but do not directly handle HCW	Total
Time worked in the hospital	<1 year	Count	7	0	7
		Expected Count	4.6	2.4	7.0
		Std. Residual	1.1	-1.6	
	From 1 to <5 years	Count	67	13	80
		Expected Count	52.3	27.7	80.0
		Std. Residual	2.0	-2.8	
	From 5 to <10 years	Count	44	35	79
		Expected Count	51.7	27.3	79.0
		Std. Residual	-1.1	1.5	
	From 10 to <15 years	Count	24	26	50
		Expected Count	32.7	17.3	50.0
		Std. Residual	-1.5	2.1	
	15 years or more	Count	34	19	53
		Expected Count	34.7	18.3	53.0
		Std. Residual	-.1	.2	
Total		Count	176	93	269
		Expected Count	176.0	93.0	269.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	25.631[a]	4	.000
Likelihood Ratio	28.980	4	.000
Linear-by-Linear Association	10.823	1	.001
N of Valid Cases	269		

a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 2.42.

Time worked with HCW * Involvement with HCW

Crosstabulation

			Involvement with HCW		
			Directly handle HCW	Manage but do not directly handle HCW	Total
Time worked with HCW	<1 year	Count	31	6	37
		Expected Count	24.2	12.8	37.0
		Std. Residual	1.4	-1.9	
	From 1 to <5 years	Count	80	36	116
		Expected Count	75.9	40.1	116.0
		Std. Residual	.5	-.6	
	From 5 to <10 years	Count	31	30	61
		Expected Count	39.9	21.1	61.0
		Std. Residual	-1.4	1.9	
	From 10 to <15 years	Count	14	15	29
		Expected Count	19.0	10.0	29.0
		Std. Residual	-1.1	1.6	
	15 years or more	Count	20	6	26
		Expected Count	17.0	9.0	26.0
		Std. Residual	.7	-1.0	
Total		Count	176	93	269
		Expected Count	176.0	93.0	269.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.199[a]	4	.002
Likelihood Ratio	17.580	4	.001
Linear-by-Linear Association	3.475	1	.062
N of Valid Cases	269		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.99.

Appendix B Cont

Age * Highest level of education

Crosstabulation

			Highest level of education				
			No formal education	Primary educated	Secondary education	Degree/diploma	Total
Age	20 - 29 years	Count	0	2	15	18	35
		Expected Count	.4	5.4	7.1	22.0	35.0
		Std. Residual	-.6	-1.5	2.9	-.9	
	30 - 39 years	Count	0	12	28	70	110
		Expected Count	1.2	17.1	22.4	69.3	110.0
		Std. Residual	-1.1	-1.2	1.2	.1	
	40 - 49 years	Count	0	14	9	64	87
		Expected Count	1.0	13.5	17.7	54.8	87.0
		Std. Residual	-1.0	.1	-2.1	1.2	
	50+ years	Count	3	14	3	18	38
		Expected Count	.4	5.9	7.7	23.9	38.0
		Std. Residual	4.0	3.3	-1.7	-1.2	
Total		Count	3	42	55	170	270
		Expected Count	3.0	42.0	55.0	170.0	270.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	54.155[a]	9	.000
Likelihood Ratio	45.118	9	.000
Linear-by-Linear Association	5.786	1	.016
N of Valid Cases	270		

a. 4 cells (25.0%) have expected count less than 5. The minimum expected count is .39.

SPSS runs - structures in place

T-Test

Group Statistics

	Urban/Rural	N	Mean	Std. Deviation	Std. Error Mean
Structures in place	Urban	8	18.25	6.018	2.128
	Rural	19	10.32	5.898	1.353

Independent Samples Test

		Levene's Test for Equality of Variance		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	ig. (2-tailed	Mean Difference	Std. Error Difference	Lower	Upper
Structures in p	Equal varian assumed	.002	.966	3.174	25	.004	7.93	2.500	2.785	13.083
	Equal varian not assumed			3.147	12.981	.008	7.93	2.521	2.486	13.382

T-Test

Group Statistics

	Urban/Rural	N	Mean	Std. Deviation	Std. Error Mean
Structures not in place	Urban	8	10.50	5.976	2.113
	Rural	19	15.68	6.210	1.425

Independent Samples Test

		Levene's Test for Equality of Variance		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	ig. (2-tailed	Mean Difference	Std. Error Difference	Lower	Upper
Structures not in	Equal varian assumed	.155	.697	-2.002	25	.056	-5.18	2.590	-10.518	.150
	Equal varian not assumed			-2.034	13.710	.062	-5.18	2.548	-10.661	.292

Urban/Rural * Temp storage for HCRW at ward

Crosstab

			Temp storage for HCRW at ward			Total
			1	2	3	
Urban/Rural	Urban	Count	4	3	1	8
		Expected Count	1.5	5.0	1.5	8.0
		Std. Residual	2.1	-.9	-.4	
	Rural	Count	1	14	4	19
		Expected Count	3.5	12.0	3.5	19.0
		Std. Residual	-1.3	.6	.3	
Total		Count	5	17	5	27
		Expected Count	5.0	17.0	5.0	27.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	7.477[a]	2	.024	.034		
Likelihood Ratio	6.963	2	.031	.051		
Fisher's Exact Test	6.448			.040		
Linear-by-Linear Association	4.157[b]	1	.041	.083	.042	.036
N of Valid Cases	27					

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is 1.48.

b. The standardized statistic is 2.039.

Urban/Rural * Records kept of types/quantities HCRW

Crosstab

			Records kept of types/quantities HCRW			
			1	2	3	Total
Urban/Rural	Urban	Count	7	1	0	8
		Expected Count	3.6	3.6	.9	8.0
		Std. Residual	1.8	-1.4	-.9	
	Rural	Count	5	11	3	19
		Expected Count	8.4	8.4	2.1	19.0
		Std. Residual	-1.2	.9	.6	
Total		Count	12	12	3	27
		Expected Count	12.0	12.0	3.0	27.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	8.615[a]	2	.013	.020		
Likelihood Ratio	9.631	2	.008	.020		
Fisher's Exact Test	7.594			.020		
Linear-by-Linear Association	7.227[b]	1	.007	.009	.005	.004
N of Valid Cases	27					

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is .89.

b. The standardized statistic is 2.688.

Urban/Rural * Register - number/types of bags/containers generated

Crosstab

			Register - number/types of bags/containers generated			Total
			1	2	3	
Urban/Rural	Urban	Count	7	1	0	8
		Expected Count	3.3	3.9	.9	8.0
		Std. Residual	2.1	-1.5	-.9	
	Rural	Count	4	12	3	19
		Expected Count	7.7	9.1	2.1	19.0
		Std. Residual	-1.3	.9	.6	
Total		Count	11	13	3	27
		Expected Count	11.0	13.0	3.0	27.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	10.365[a]	2	.006	.006		
Likelihood Ratio	11.344	2	.003	.006		
Fisher's Exact Test	9.192			.006		
Linear-by-Linear Association	8.512[b]	1	.004	.003	.002	.002
N of Valid Cases	27					

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is .89.

b. The standardized statistic is 2.917.

Urban/Rural * Register - number/types of bags/containers received per dept

Crosstab

			Register - number/types of bags/containers received per dept			
			1	2	3	Total
Urban/Rural	Urban	Count	7	1	0	8
		Expected Count	2.7	4.1	1.2	8.0
		Std. Residual	2.7	-1.5	-1.1	
	Rural	Count	2	13	4	19
		Expected Count	6.3	9.9	2.8	19.0
		Std. Residual	-1.7	1.0	.7	
Total		Count	9	14	4	27
		Expected Count	9.0	14.0	4.0	27.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	15.086[a]	2	.001	.000		
Likelihood Ratio	16.076	2	.000	.000		
Fisher's Exact Test	13.314			.001		
Linear-by-Linear Association	11.649[b]	1	.001	.000	.000	.000
N of Valid Cases	27					

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is 1.19.

b. The standardized statistic is 3.413.

Urban/Rural * Record bags handed over for disposal

Crosstab

			Record bags handed over for disposal			Total
			1	2	3	
Urban/Rural	Urban	Count	7	1	0	8
		Expected Count	3.3	3.9	.9	8.0
		Std. Residual	2.1	-1.5	-.9	
	Rural	Count	4	12	3	19
		Expected Count	7.7	9.1	2.1	19.0
		Std. Residual	-1.3	.9	.6	
Total		Count	11	13	3	27
		Expected Count	11.0	13.0	3.0	27.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	10.365[a]	2	.006	.006		
Likelihood Ratio	11.344	2	.003	.006		
Fisher's Exact Test	9.192			.006		
Linear-by-Linear Association	8.512[b]	1	.004	.003	.002	.002
N of Valid Cases	27					

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is .89.

b. The standardized statistic is 2.917.

Province * number of hospitals in province

Crosstabulation

			Number of hospitals in province				Total
			0	1	2	3	
Province	1	Count	5	10	9	8	32
		Expected Count	12.0	7.9	6.2	5.9	32.0
		Std. Residual	-2.0	.8	1.1	.9	
	2	Count	19	5	5	3	32
		Expected Count	12.0	7.9	6.2	5.9	32.0
		Std. Residual	2.0	-1.0	-.5	-1.2	
	3	Count	7	12	9	4	32
		Expected Count	12.0	7.9	6.2	5.9	32.0
		Std. Residual	-1.4	1.5	1.1	-.8	
	4	Count	3	8	11	10	32
		Expected Count	12.0	7.9	6.2	5.9	32.0
		Std. Residual	-2.6	.0	1.9	1.7	
	5	Count	18	9	4	1	32
		Expected Count	12.0	7.9	6.2	5.9	32.0
		Std. Residual	1.7	.4	-.9	-2.0	
	6	Count	21	6	3	2	32
		Expected Count	12.0	7.9	6.2	5.9	32.0
		Std. Residual	2.6	-.7	-1.3	-1.6	
	7	Count	7	3	6	16	32
		Expected Count	12.0	7.9	6.2	5.9	32.0
		Std. Residual	-1.4	-1.7	-.1	4.2	
	8	Count	14	12	2	4	32
		Expected Count	12.0	7.9	6.2	5.9	32.0
		Std. Residual	.6	1.5	-1.7	-.8	
	9	Count	14	6	7	5	32
		Expected Count	12.0	7.9	6.2	5.9	32.0
		Std. Residual	.6	-.7	.3	-.4	
Total		Count	108	71	56	53	288
		Expected Count	108.0	71.0	56.0	53.0	288.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	81.699[a]	24	.000
Likelihood Ratio	82.709	24	.000
Linear-by-Linear Association	1.281	1	.258
N of Valid Cases	288		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.89.

Oneway

Descriptives

Structures in place

	N	Mean	td. Deviatio	Std. Error	% Confidence Interval Mean		Minimum	Maximum	Between-Component Variance
					ower Boun	pper Boun			
1	3	17.33	6.110	3.528	2.16	32.51	12	24	
2	3	8.00	.000	.000	8.00	8.00	8	8	
3	3	14.00	7.810	4.509	-5.40	33.40	9	23	
4	3	20.00	5.292	3.055	6.86	33.14	14	24	
5	3	6.67	1.528	.882	2.87	10.46	5	8	
6	3	6.00	4.359	2.517	-4.83	16.83	3	11	
7	3	21.00	2.646	1.528	14.43	27.57	19	24	
8	3	9.33	6.658	3.844	-7.21	25.87	5	17	
9	3	11.67	5.132	2.963	-1.08	24.41	6	16	
Total	27	12.67	6.889	1.326	9.94	15.39	3	24	
Mode Fixed Effects			5.004	.963	10.64	14.69			
Random Eff				1.904	8.28	17.06			24.293

Test of Homogeneity of Variances

Structures in place

Levene Statistic	df1	df2	Sig.
3.103	8	18	.022

ANOVA

Structures in place

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	783.333	8	97.917	3.911	.008
Within Groups	450.667	18	25.037		
Total	1234.000	26			

Oneway

Descriptives

Structures not in place

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
					Lower Bound	Upper Bound			
1	3	7.67	3.055	1.764	.08	15.26	5	11	
2	3	18.00	5.000	2.887	5.58	30.42	13	23	
3	3	12.67	3.512	2.028	3.94	21.39	9	16	
4	3	5.33	2.517	1.453	-.92	11.58	3	8	
5	3	19.00	6.245	3.606	3.49	34.51	14	26	
6	3	21.00	3.606	2.082	12.04	29.96	17	24	
7	3	10.67	2.517	1.453	4.42	16.92	8	13	
8	3	19.67	4.933	2.848	7.41	31.92	14	23	
9	3	13.33	6.028	3.480	-1.64	28.31	7	19	
Total	27	14.15	6.491	1.249	11.58	16.72	3	26	
Model Fixed Effects			4.372	.841	12.38	15.92			
Random Effects				1.865	9.85	18.45			24.938

Test of Homogeneity of Variances

Structures not in place

Levene Statistic	df1	df2	Sig.
.799	8	18	.611

ANOVA

Structures not in place

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	751.407	8	93.926	4.915	.002
Within Groups	344.000	18	19.111		
Total	1095.407	26			

Province * Number of hospitals in the province

Appendix B Cont

Crosstabulation

			Number of hospitals in the province (combined)		
			0 or 1	2 or 3	
Province	1	Count	7	7	
		Expected Count	10.2	3.8	14.0
		Std. Residual	-1.0	1.7	
	2	Count	13	1	14
		Expected Count	10.2	3.8	14.0
		Std. Residual	.9	-1.4	
	3	Count	9	5	14
		Expected Count	10.2	3.8	14.0
		Std. Residual	-.4	.6	
	4	Count	6	8	14
		Expected Count	10.2	3.8	14.0
		Std. Residual	-1.3	2.2	
	5	Count	14	0	14
		Expected Count	10.2	3.8	14.0
		Std. Residual	1.2	-1.9	
	6	Count	13	1	14
		Expected Count	10.2	3.8	14.0
		Std. Residual	.9	-1.4	
	7	Count	5	9	14
		Expected Count	10.2	3.8	14.0
		Std. Residual	-1.6	2.7	
	8	Count	14	0	14
		Expected Count	10.2	3.8	14.0
		Std. Residual	1.2	-1.9	
	9	Count	11	3	14
		Expected Count	10.2	3.8	14.0
		Std. Residual	.2	-.4	
Total		Count	92	34	126
		Expected Count	92.0	34.0	126.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	36.817[a]	8	.000	.000
Likelihood Ratio	42.955	8	.000	.000
Fisher's Exact Test	36.209			.000
N of Valid Cases	126			

a. 9 cells (50.0%) have expected count less than 5. The minimum expected count is 3.78.

Province * Number of hospitals in the province (combined)

Crosstabulation

			Number of hospitals in the province (combined)		
			0 or 1	2 or 3	Total
Province	1	Count	2	3	5
		Expected Count	2.4	2.6	5.0
		Std. Residual	-.3	.3	
	2	Count	3	2	5
		Expected Count	2.4	2.6	5.0
		Std. Residual	.4	-.3	
	3	Count	3	2	5
		Expected Count	2.4	2.6	5.0
		Std. Residual	.4	-.3	
	4	Count	0	5	5
		Expected Count	2.4	2.6	5.0
		Std. Residual	-1.6	1.5	
	5	Count	4	1	5
		Expected Count	2.4	2.6	5.0
		Std. Residual	1.0	-1.0	
	6	Count	4	1	5
		Expected Count	2.4	2.6	5.0
		Std. Residual	1.0	-1.0	
	7	Count	0	5	5
		Expected Count	2.4	2.6	5.0
		Std. Residual	-1.6	1.5	
	8	Count	4	1	5
		Expected Count	2.4	2.6	5.0
		Std. Residual	1.0	-1.0	
	9	Count	2	3	5
		Expected Count	2.4	2.6	5.0
		Std. Residual	-.3	.3	
Total		Count	22	23	45
		Expected Count	22.0	23.0	45.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	16.186[a]	8	.040	.041
Likelihood Ratio	20.428	8	.009	.036
Fisher's Exact Test	15.728			.036
N of Valid Cases	45			

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is 2.44.

SPSS runs - Section 3 Waste treatment systems

Urban/Rural * Waste treatment system

Crosstabulation

			Waste treatment system				
			Disposable HCRW containers	Reusable HCRW containers	Disposable and/or reusable containers (unsure)	Incinerator	Total
Urban/Rural	Urban	Count	0	6	0	2	8
		Expected Count	2.1	3.0	2.1	.9	8.0
		Std. Residual	-1.4	1.8	-1.4	1.2	
	Rural	Count	7	4	7	1	19
		Expected Count	4.9	7.0	4.9	2.1	19.0
		Std. Residual	.9	-1.1	.9	-.8	
Total		Count	7	10	7	3	27
		Expected Count	7.0	10.0	7.0	3.0	27.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	12.292[a]	3	.006	.004		
Likelihood Ratio	15.536	3	.001	.002		
Fisher's Exact Test	11.527			.003		
Linear-by-Linear Association	.925[b]	1	.336	.394	.230	.108
N of Valid Cases	27					

a. 7 cells (87.5%) have expected count less than 5. The minimum expected count is .89.

b. The standardized statistic is -.962.

Involvement with HCW * 3.2 Number of times pricked by a needle in the last 12 months

Crosstabulation

Count

		3.2 Number of times pricked by a needle in the last 12 mo					
		Never	Once	Twice	Three times	Four or more times	Total
Involvement with HCW	Directly handle HCW	69	83	17	6	1	176
	Manage but do not directly handle HCW	86	7	0	0	0	93
Total		155	90	17	6	1	269

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	71.212[a]	4	.000
Likelihood Ratio	84.678	4	.000
Linear-by-Linear Association	55.964	1	.000
N of Valid Cases	269		

a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is .35.

Correlations

Correlations

		2.2 The protective material available to personnel is adequate	3.2 Number of times pricked by a needle in the last 12 months
2.2 The protective material available to personnel is adequate	Pearson Correlation	1	-.213**
	Sig. (2-tailed)	.	.000
	N	270	270
3.2 Number of times pricked by a needle in the last 12 months	Pearson Correlation	-.213**	1
	Sig. (2-tailed)	.000	.
	N	270	270

**. Correlation is significant at the 0.01 level (2-tailed).

Urban/Rural * 3.4 Action taken to dispose of waste in the event of system failure

Crosstabulation

			3.4 Action taken to dispose of waste in the event of system fa							
			Burn waste the hospita	Stockpil waste in hospital	Out-sourc rempval o HCRW to private contractor	Ask for hel from neighbouri hospitals	Never experience failure	Other	43	Total
Urban/Rural	Urban	Count	6	4	44	17	0	2	0	73
		Expected Count	24.1	13.1	20.7	10.1	3.1	1.7	.3	73.0
		Std. Residual	-3.7	-2.5	5.1	2.2	-1.8	.2	-.5	
	Rural	Count	80	43	30	19	11	4	1	188
		Expected Count	61.9	33.9	53.3	25.9	7.9	4.3	.7	188.0
		Std. Residual	2.3	1.6	-3.2	-1.4	1.1	-.2	.3	
Total		Count	86	47	74	36	11	6	1	261
		Expected Count	86.0	47.0	74.0	36.0	11.0	6.0	1.0	261.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	75.437[a]	6	.000	.000		
Likelihood Ratio	81.133	6	.000	.000		
Fisher's Exact Test	76.855			.000		
Linear-by-Linear Association	3.042[b]	1	.081	.076	.072	.009
N of Valid Cases	261					

a. 5 cells (35.7%) have expected count less than 5. The minimum expected count is .28.

b. The standardized statistic is -1.744.

SPSS runs - Section 4 Waste containers

Urban/Rural * 4.1 Kind of waste containers used for infectious waste

Crosstabulation

			4.1 Kind of waste containers used for infectious wa				
			No specific containers	Plastic re-usable boxes	Cardboard box with red plastic liner	Other	Total
Urban/Rural	Urban	Count	9	69	0	2	80
		Expected Count	16.6	51.3	7.4	4.7	80.0
		Std. Residual	-1.9	2.5	-2.7	-1.3	
	Rural	Count	47	104	25	14	190
		Expected Count	39.4	121.7	17.6	11.3	190.0
		Std. Residual	1.2	-1.6	1.8	.8	
Total		Count	56	173	25	16	270
		Expected Count	56.0	173.0	25.0	16.0	270.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	26.440[a]	3	.000	.000		
Likelihood Ratio	34.023	3	.000	.000		
Fisher's Exact Test	29.697			.000		
Linear-by-Linear Association	.924[b]	1	.336	.365	.193	.046
N of Valid Cases	270					

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.74.

b. The standardized statistic is .961.

Shortages of waste containers in the last year = Yes
Chi-Square Test

4.4 Main cause of shortages[a]

	Observed N	Expected N	Residual
No budget	172	40.5	131.5
Delays in procurement	58	40.5	17.5
Containers are wasted by staff	9	40.5	-31.5
Other	2	40.5	-38.5
12	1	40.5	-39.5
23	1	40.5	-39.5
Total	243		

a. 4.3 Shortages of waste containers in the last year = Yes

Test Statistics[b]

	4.4 Main cause of shortages
Chi-Square[a]	572.679
df	5
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 40.5.

b. 4.3 Shortages of waste containers in the last year = Yes

Urban/Rural * 4.5 Person who transports waste from temporary storage area at generation point to central storage

Crosstabulation

			4.5 Person who transports waste from temporary storage area							
			Do not kn	General orderlies	Health ca waste handlers	Nurses	Hired compan	Other	23	Total
Urban/Rural	Urban	Count	1	24	23	0	31	1	0	80
		Expected Count	.9	27.4	36.3	.3	14.3	.6	.3	80.0
		Std. Residual	.1	-.6	-2.2	-.5	4.4	.5	-.5	
	Rural	Count	2	68	99	1	17	1	1	189
		Expected Count	2.1	64.6	85.7	.7	33.7	1.4	.7	189.0
		Std. Residual	-.1	.4	1.4	.4	-2.9	-.3	.4	
Total		Count	3	92	122	1	48	2	1	269
		Expected Count	3.0	92.0	122.0	1.0	48.0	2.0	1.0	269.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	36.656[a]	6	.000	.000		
Likelihood Ratio	34.735	6	.000	.000		
Fisher's Exact Test	34.586			.000		
Linear-by-Linear Association	6.666[b]	1	.010	.006	.006	.001
N of Valid Cases	269					

a. 8 cells (57.1%) have expected count less than 5. The minimum expected count is .30.

b. The standardized statistic is -2.582.

T-Test

Group Statistics

	Urban/Rural	N	Mean	Std. Deviation	Std. Error Mean
Q2.1	Urban	8	3.2500000	.93808315	.33166248
	Rural	19	2.9631579	.83945123	.19258332
Q2.2	Urban	8	3.7375125	.68230727	.24123205
	Rural	19	3.6578947	.52737904	.12098905
Q2.3	Urban	8	3.0125000	.76613594	.27086996
	Rural	19	3.5736842	.55361650	.12700834
Q2.4	Urban	8	3.8125000	.39798600	.14070930
	Rural	19	3.3421053	.55709144	.12780554
Q2.5	Urban	8	3.1875000	.71999504	.25455669
	Rural	19	2.7842105	.65511929	.15029467
Q2.6	Urban	8	3.8875000	.26423745	.09342205
	Rural	19	3.9263158	.31418697	.07207943
Q2.7	Urban	8	3.2625125	.80878193	.28594759
	Rural	19	3.5684211	.53546722	.12284461
Q2.8	Urban	8	3.3750125	.76859101	.27173796
	Rural	19	3.0684211	.72957570	.16737614
Q2.9	Urban	8	2.5625000	.65013735	.22985826
	Rural	19	2.3842105	.40860625	.09374070
Q2.10	Urban	8	2.5500000	.69075528	.24421887
	Rural	19	2.3368421	.43360315	.09947539
Q2.11	Urban	8	3.6500000	.36645015	.12955969
	Rural	19	3.0473684	.61677334	.14149751
Q2.12	Urban	8	3.8250000	.27124054	.09589801
	Rural	19	3.1210526	.66129414	.15171128
Q2.13	Urban	8	2.6125000	.77907913	.27544607
	Rural	19	2.6526316	.67112544	.15396674
Q2.14	Urban	8	3.4500125	.99139944	.35051264
	Rural	19	2.3842158	.60851305	.13960247
Q2.15	Urban	8	3.4750000	1.00959681	.35694637
	Rural	19	2.6789526	.87722552	.20124934
Q2.16	Urban	8	3.1000000	.98125284	.34692527
	Rural	19	2.3894789	.63760911	.14627756

Independent Samples

		Levene's Test Equality of		t-test for Equality of						
									95% Interval of Differenc	
		F	Sig	t	d	Sig. (2-	Mea Differenc	Std. Differenc	Lowe	Uppe
Q2.		.26	.61	.78	2	.44	.286842	.3659140	-	1.04045
				.74	11.98	.46	.286842	.3835209	-	1.12256
Q2.		.03	.85	.32	2	.74	.079617	.2423341	-	.5787142
				.29	10.70	.77	.079617	.2698726	-	.6756326
Q2.		1.57	.22	-	2	.04	-	.2615193	-	-
				-	10.22	.08	-	.2991682	-	.1034283
Q2.		2.24	.14	2.15	2	.04	.470394	.2181059	.0211971	.9195923
				2.47	18.43	.02	.470394	.1900877	.0717093	.8690801
Q2.		.09	.75	1.42	2	.16	.403289	.2840303	-	.9882609
				1.36	12.15	.19	.403289	.2956139	-	1.04645
Q2.		.13	.71	-	2	.76	-	.1268764	-	.2224911
				-	15.65	.74	-	.1179962	-	.2117714
Q2.		6.84	.01	-	2	.25	-	.2630682	-	.2358906
				-	9.69	.35	-	.3112182	-	.3905087
Q2.		.01	.90	.98	2	.33	.306591	.3121811	-	.9495405
				.96	12.61	.35	.306591	.3191493	-	.9982282
Q2.		1.39	.24	.86	2	.39	.178289	.2058540	-	.6022537
	Equal not			.71	9.42	.49	.178289	.2482380	-	.7360432
Q2.1	Equal assume	1.08	.30	.97	2	.33	.213157	.2185801	-	.6633321
	Equal not			.80	9.41	.43	.213157	.2637009	-	.8057099
Q2.1	Eq ual as ume	2.53	.12	2.56	2	.01	.602631	.2352260	.1181744	1.08708
	Eq ual no			3.14	21.66	.00	.602631	.1918521	.2044017	1.00086
Q2.1	Eq ual as ume	12.7		2.88	2	.00	.703947	.2441082	.2011969	1.20669
	Eq ual no			3.92						
Q2.1	Eq ual			Equal variances						

Appendix C

P O BOX 3066
ASSAGAY
3624
5 November 2009

TO WHOM IT CONCERNS

PROOFREADING OF DISSERTATION

Health care waste management in public district hospitals of South Africa

Student: Sipho Bongane Vumase
Number: 20823867

I have proofread this thesis indicating errors of spelling, grammar and syntax. I have suggested improvements in punctuation.

I have also pointed out where the meaning is not clear and in some instances I have made suggestions to correct the lack of clarity.

I have offered suggestions for the appropriate format for citing the works and ideas of other authors.

Where the format is not consistent I have pointed this out.

I have pointed out areas in the referencing and bibliography that do not conform to conventions.

Yours faithfully

Gavin W Storrie

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4 November 2009

To the examiners concerned:

This is to confirm that I assisted Mr Sipho Vumase, who is currently studying for his D Tech qualification at the Durban University of Technology, with the statistical analysis.

Yours faithfully

Mrs Gill Hendry