ASSESSMENT OF HEALTH CARE WASTE MANAGEMENT COMPLIANCE IN THE NORTHERN CAPE DEPARTMENT OF HEALTH

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DECLARATION OF INDEPENDENT WORK

I, Mokete Frans Motlatla, hereby declare that this research document submitted to the Central University of Technology, Free State, is my own independent work and has not been submitted before to any institution by myself or any other person to any other institution in fulfilment of any requirement for the attainment of any qualification.

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STUDENT SIGNATURE DATE

ABSTRACT

Poor handling of health care waste has posed many adverse health effects for health care workers, the general public and the environment. The vastness of the Northern Cape Province has directly impacted negatively on the poor performance of health care facilities, particularlyin terms of health care waste management. Public health care facilities in the region are the major generators of health care waste (HCW) in the Northern Cape Province.

This study reports on the assessment of the HCW management practices in terms of the health care waste life cycle within the Northern Cape Department of Health (South Africa). The results of the assessment were compared with applicable legislative requirements and global practices in HCW management.

The study was conducted in five districts of the Northern Cape Department of Health and 11 hospitals were selected randomly as study sites from a total of 17 hospitals. Data obtained from the service provider wereused to determine the quantities of the health waste at each study site. Interviews using a structured questionnaire were also used to assess the knowledge and practices of HCW handlers.

An estimated 16 070 kg of health care waste was generated by 36 437 patients per month at the 11 surveyed hospitals. The survey illustrated that the main health care waste types generated in the hospitals were general infectious waste, sharps waste, anatomical waste and pharmaceutical waste.

It was concluded that the heath care waste management practices in the hospitals in the Northern Cape Department of Heath, South Africa, did not meet the recommended standards for the management of HCW as recommended by the World Health Organisation (WHO). There was a very low prioritisation of HCW management by top management. Inadequate human and financial resources allocated for HCW management were highlighted.

Complete health care waste management requires adequate resource allocation and appropriate support from senior management within the Northern Cape Department of Health. Reprioritisation of funding and human resources towards HCW management in

all health care facilities is required to improve the environment and make it safe for humans and animals.

LIST OF ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DHIS	District Health Information System
DoE	Department of Environment
DoH	Department of Health
EEPA	European Environmental Protection Agency
EU	European Union
GDACE	Gauteng Department of Agriculture, Conservation and Environment
GHCRWR	Gauteng Health Care Risk Waste Regulation
HBCV	Hepatitis B and C Virus
HIV	Human Immune Deficiency Virus
HCW	Health Care Waste
ICP	Infection Control and Prevention
ISWA	International Solid Waste Association
IOD	Injury on Duty
IWMSA	Institute of Waste Management in South Africa
KZN DoH	Kwazulu-Natal Department of Health
LGH	Local Government Handbook
MDR	Multi Drug Resistance Tuberculosis
NC DoH	Northern Cape Department of Health

NEMA	National Environmental Management Act, Act 109 of 1998
NEMWA	National Environmental Management Waste Act, Act 58 of 2009
NIOSH	National Institute for Occupational Safety and Health
NW DoH	North West ProvinceDepartment of Health
NWMS	National Waste Management Strategy
OHS	Occupational Health and Safety
PHCFs	Primary Health Care Facilities
PPE	Personal Protective Equipment
RSA	Republic of South Africa
SALGA	South African Local Government Association
SANS	South African National Standards
SAS	Statistical Analysis Software
SHCW	Solid Health Care Waste
Stats SA	Statistics South Africa
TB	Tuberculosis
UNCED	United Nations Conference on Environment Development
UNEP	United Nations Environmental Protection Agency
WHO	World Health Organisation
WC	Western Cape
XDR	Extreme Drug Resistance Tuberculosis

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CHAPTER 1

GENERAL BACKGROUND

1.1 Background

Approximately 42 200 tons of health care waste (HCW) is generated in South Africa annually (South Africa, 2008). The facilities of the Northern Cape Department of Health (NC DoH) produce just a fraction of the total amount of HCW generated in South Africa, which varies from 250 to 300 tons per annum (Tshenolo Resources, 2011). Tshenolo Resources has been the contracted Health Care Waste service provider for Northern Cape Department of Health since 2011.

The Northern Cape Province is the largest province in terms of land occupancy space in South Africa as it extends over 372 889 square kilometres. It covers at least 30.5% of South African land area (Stats SA, 2011) and it has the smallest population of about 1 016 631, which comprises only 2.2% of the total population of South Africa. According to the South African Local Government Association (SALGA), the Northern Cape Province is divided into five district municipalities namely Frances Baard, Siyanda, John Taolo Gaetsewe, Pixley Ka Seme and Namakwa District, and 27 local municipalities (SALGA, 2011).

The 2010 annual report of the Northern Cape Department of Health (NC DoH) indicates that the province has one tertiary hospital, 16 public hospitals and 162 public health care facilities (NC DoH, 2009/2010). To ensure that effective and efficient health care waste services are rendered, any contracted HCW service provider must travel to every health care facility. The service provider is expected to travel to approximately 179 health care facilities scattered throughout the province. The fact that treatment facilities with compliant treatment capacity are located far from the Northern Cape health care facilities impacts negatively on storage times as required by law; consequently collection of HCW through different routes becomes a challenge. Other challenges are travelling costs, increased risks for potential accidents, and illegal dumping (South Africa, 2008). The large scale illegal dumping that occurs may be as a result of the long distances between HCW generation sites and treatment facilities and sites (South Africa, 2009).

1.2 Introduction

Handling of health care waste (HCW) in the Northern Cape Province has posed serious health risks to communities and the workers. Health care activities lead to production of waste that may lead to adverse health effects (WHO, 1999) and this has a negative impact on the surrounding environment. Lack of environmentally acceptable treatment options and associated performance standards is one of the key contributors to these risks (South Africa, 2009).

The life cycle of health care waste management is an inter-related operating system and is significant in understanding the relationship between the environment and the health and safety requirements for waste management. The key steps in the management of HCW start with waste generation at health care facilities. It is then followed by the process of segregation of waste by health care workers through correct containerisation. Containerisation goes hand in hand with correct labelling of waste containers. Collection from the point of waste generation and removal to a temporary storage area is the last process which takes place inside the health care facility. Transporting the health care waste by using an appropriate internal transport system from the patient care area to the dedicated on-site storage area is the final point where health care workers are involved with the handling of the health care waste. External transportation of health care waste from the on-site storage areas through approved compliant transportation to a licensed treatment facility follows the internal processes. Finally, treated waste ashes are transported to hazardous disposal landfill sites for disposal. In every step the handling of HCW waste is undertaken by different health care providers and other people connected to health care waste management. Figure 1.1 shows the inter-relationship of the different stages in the HCW management processes.

The first six steps in the HCW handling process (Figure 1.1) are carried out in the facilities themselves. The remaining three processes in the life cycle (external transportation, treatment and disposal) of the HCW management process have been delegated to a service provider through out-sourcing of the service to an external contractor.

The researcher, appointed as the Health Care Waste Provincial Coordinator, observed that prior to 2011 the NC DoH found it difficult to ensure that all the stages within the demonstrated life cycle were carried out properly. Some of the problem areas and issues identified by the researcher were related to lack of knowledge of correct procedures of the HCW management life cycle. However, external transportation, treatment and disposal of HCW delegated to the current service provider have shown a substantial improvement since 2011 when this contractor took over health care waste service in the NC DoH. Since the current contractor took over these functions, the researcher observed that there have been no reported cases of waste accumulation in clinics and hospitals due to poor service delivery. Health care facilities are no longer reporting any lack of supply of HCW containers and consumables to the researcher as a result of the implementation of the new turnaround strategy.

Dueto the improvementsby the service provider in the last three stages (external transportation, treatment and disposal) of the health care waste life cycle, the NC DoH is obliged to improve the first six stages (generation, containerisation, labelling, temporary storage, collection and on-site storage) of HCW in its health care facilities. However, to improve health care waste management in health care facilities, it is important to assess the facilities" current health care waste practices (Johannessen, Dijkman, Bartone, Hanrahan, Boyer and Chandra, 2000). The purpose of this study was therefore to conduct aHCW survey and to identify problematic areas within the HCW life cycle currently being used by the NC DoH. The results recorded in the survey could be used to make recommendations for the introduction of corrective measures in the HCW management system in the NC DoH, particularly in terms of the first six steps of the cycle.

Figure 1.1 was designed by the researcher to demonstrate the HCW life cycle in the Northern Cape Department of Health.

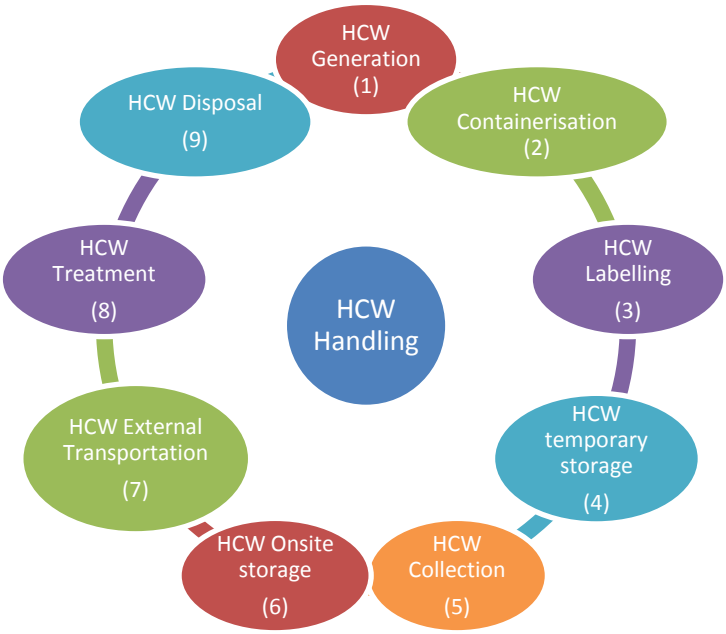

Figure 1.1: HCW life cycle

1.3 Problem statement

The Department of Environmental Affairs and Tourism delisted and decommissioned all incinerators in health care facilities in South Africa in 2005. The delisting and decommissioning prevented treatment of HCW by non-compliant treatment facilities and now all HCW treatment can be done by certified incinerators only (South Africa, 2008). Most of the incinerators that meet the required standards are situated in the Western Cape, Gauteng, Northwest and Free State provinces. This represents a challenge in terms of HCW transportation and treatment. Other treatment systems currently used in the country such as autoclaving, are not available in the Northern Cape Province (South Africa, 2008).

1.3.1 Out-sourcing

The collection of health care waste was out-sourced by the Northern Cape Department of Health and is currently put out on tender for collection, transportation and treatment. In the Northern Cape Province and other provinces there was a change of service providers that were contracted to manage HCW. The NC DoH HCW contract of 2003 and 2008 expired and new contracts were signed but were only in effect until 2010 when that company was liquidated.

Subsequently, a memorandum of understanding was signed between the NC DoH and the new service provider which made provision for that company to take over the HCW services (NC DoH, 2008).

The challenges and poor planning that the previous service provider faced were primarily caused by the travelling distances between facilities. This complex situation led to this company taking short cuts; as a result they collected HCW from only eight major hospitals in the province. Other health care facilities had to transport the HCW to the main and most central hospitals. Some facilities used inappropriate vehicles ranging from private sedan vehicles to ambulances and hired vehicles (South Africa, 2008). Moreover, financial and other resource limitations created a serious challenge forcorrect HCW management. The vastness of the province which required services also contributed to the crisis which resulted in HCW not being collected within recommended time periods as outlined in paragraph 8.2.7 of Management of Health Care Waste, South African National Standards 10248-1 document (SANS, 2008).

The lack of training programmes by the service providers and health care facility managers also had a negative impact on the management of HCW (Henry and Campbell, 1995). Negligence amongst the health care workers also created a very risky and unsafe working environment. Cases of injury on duty (IOD) were rapidly increasing as a result of poor management of HCW. Some concerns included needle prick injuries which could lead to a rise in cases of HIV/AIDS and Hepatitis B/C. Increased health care treatment costs followed as a result of accidental needle prick injuries (Henry and Campbell, 1995). It was difficult to determine the scope of the negative impact on workers and their families who could have been traumatised, as no official data could be traced.

These non-compliant collection systems caused the waste generators to revert back to out-dated treatment methods. Such methods posed risks to the health care workers and the public. Dumping HCW in open areas became a practice that had major adverse effects on the population (UNEP, 2004). These dysfunctional health care waste management methods by workers led to untreated waste being dumped at the landfill sites. Many others resorted to pit burning and burial of health care waste on the health care facility grounds

(Manga, Forton, Mofor and Woodard, 2011; Azage and Kumie, 2010; Al-Khatib and Sato, 2009). Many incorrect practices were reported by local media after health care waste had been found on community playing grounds. Some of these incorrect practices were identified at Galeshewe Day Care Hospital and a report related to this was later published by the local newspaper (Beangstrom, 2009).

Many hospital mortuaries in the districts were used to store health care waste for longer periods than prescribed by law. Most of the health care waste was not kept at the correct temperatures which led to fermentation and a subsequent generation of odours. Breeding of vectors and rodents was also observed at these facilities (South Africa, 2008).

Figure 1.2: Waste storage facility in the Northern Cape Province in 2010

The researcher became aware that the central storage facility, which was used by the service provider in 2010, was investigated by the Green Scorpion unit as a result of enquiries directed to him. This investigation is related to non-compliance of waste storage practices which occurred in 2010 in the province. The previous contracted service provider failed to store the HCW appropriately and did not to transport it to the treatment site within the prescribed time frames as recommended by legislation (SANS, 2008). An estimated quantity of more than 800 kg of health care waste was found to have accumulated and deteriorated as

shown in Figure 1.2 in the storage facility of the contracted service provider (NC DoH, 2010).

1.3.2 International agreements

International agreements have been reached on a number of underlying principles that govern either public health or safe management of hazardous waste. These following principles are included in Chapter 7, Section 28 of the National Environmental Management Act, 107 of 1998 as well as in Chapter 2, Section 2 (1) of the Regulations relating to health care waste management in health establishments, National Health Act, Act 61 of 2003 (South Africa, 2003).

The principles are as follows:

- The „**polluter pays**' principle, which implies that all producers of waste are legally and financially responsible for the safe and environmentally sound disposal of the waste they produce;
- The „**precautionary**' principle, which implies that when the magnitude of a particular risk is uncertain, it should be assumed that the risk is significant and protection measures should be designed accordingly;
- The „**duty of care**' principle, which stipulates that the person handling or managing hazardous substances or related equipment is ethically responsible for using the utmost care in that task; and
- The „**proximity** ' principle, which recommends that the treatment and disposal of hazardous waste take place at the closest possible location to its source in order to minimize the risks involved in its transportation (South Africa, 1998; South Africa, 2003; UNEP, 1999).

These principles highlight issues that were identified within the HCW management section of the Northern Cape Department of Health and the researcher concluded that poor compliance systems were at the root of the problem. The „proximity principle" was not adhered to and nor could the „duty of care" principle be confirmed at NC DoH facilities and services.

The current study therefore focused on the existing practices of HCW management by the Northern Cape Department of Health by, inter alia,

comparing these practices with the international principles and other legislative frameworks dealing with health care waste management.

1.3.3 Aim

The aim of the study was to provide an integrated environmental, social, economically sustainable HCW management guideline in the Northern Cape Department of Health that would be occupationally and environmentally safe for workers and the public.

1.3.4 Objectives

The objectives of the study were to:

- develop improved base line data for the health care risk waste generated in all relevant facilities;
- establish an effective health care waste information system criteria for the department;
- develop improved criteria for the HCW management system that will result in reduced incidences of spillages, needle prick injuries, crude dumping and proper waste segregation;
- develop improved Occupational Health and Safety and Infection Control criteria;
- identify the criteria for developing monitoring mechanisms for HCW management;
- develop guidelines for a constructive training programme for waste handlers and health care workers; and
- make recommendations for alternative treatment of HCW in the Northern Cape Province.

1.3.5 HCW strategy

HCW guidelines would be developed by identifying and analysing the current practices in the Northern Cape Department of Health regarding the HCW management life cycle and assessing the available resources to determine their relevancy and efficacy. Review of the existing non-compliant systems could assist in refining the HCW strategy in the Northern Cape Department of Health.

1.4 Conclusion

The Northern Cape Department of Health has experienced many problems in dealing with the management of health care risk waste and it has frequently been unable to render an effective service because of poor management systems as experienced by the researcher. Moreover, a lack of commitment to health care waste management and the failure to prioritise strategies have resulted in the breakdown of systems which, in turn, resulted in the application of non-compliant systems by health care workers. For example, crude or illegal dumping of HCW, backyard pit burning, backyard burial of HCW, and an increase in needle prick injuries have occurred.

The development of methods and systems that are aimed at achieving the stated objectives is the priority in the interest of safety of the public and the environment in the province. Compliance with the Constitution of South Africa, Section 24(a), which clearly stipulates that “all human beings are entitled to an environment that is not harmful to their health and well being” (South Africa, 1996) must be pursued.

1.5 Delimitations of the study

Limitations of this study included the following:

- That data obtained from the Northern Cape Department of Health and the service provider that were used in the study lacked comprehensive detail and were therefore limited in scope and applicability;
- Only major generators of health care waste could be investigate in all five districts; and
- Treatment systems were not compared in assessing the service provider`s performance.

1.6 Structure of the thesis

The format of this document includes a general background and literature review. However, Chapters 3 and 4 are written in article format which leads to duplication of some sections of the introduction and abstract. Conclusions, discussions, recommendations and references are included in each chapter.

This study report follows the following format:

Chapter 1: General background

This chapterprovides the background and introduction of HCW management in the Northern Cape Department of Health. The challenges and problems associated with HCW management when many treatment facilities were delisted in 2005 are highlighted. The aims and objectivesof the study are presented in this chapter.

Chapter 2: Literature review

Key concepts and definitions relevant to the study are discussed in the literature review. International legislation governing HCW is compared with national legislation, and global HCW management practices and treatment systems are discussed in detail.

Chapter 3: First Article - Health care waste management practices in the Northern Cape Department of Health

An assessment of HCW management practices in the Northern Cape Department of Health is presented with the focus on generation rates, types of waste, and segregation practices. Moreover, the research methodology is outlined and the analysed results and conclusion for the first article are presented in this chapter.

Chapter 4: Second Article- Occupational health services, HCW management teams and on-site storage areas in the Northern Cape Department of Health

Occupational health services, management team practices and compliance with HCW storage areas requirements were assessed and results are discussed in detail in Chapter 4. Similar to Chapter 3, the research methodology, results, discussions and conclusion are presented.

Chapter 5: General discussion

Based on the results presented in Chapter 3 and Chapter 4, the discussion in this chapter summarises the general status concepts of HCW management in the Northern Cape Department of Health.

Chapter 6: Conclusion and recommendations

This is the final part of the research report. Conclusions are drawn and recommendations are offered in combination in this chapter to provide an overall view of the study findings and to suggest the way forward regarding HCW management in the Northern Cape Department of Health.

REFERENCES

Al-Khatib, I and Sato, C. 2009. Solid health care waste management status at health care centres in the West Bank – Palestinian Territory. *Journal of Waste Management,* 29:2398-2403.

Azage, M and Kumie, A. 2010. Health care waste generation and its management system: the case of health centres in West Gojjam Zone, Amhara Region, Ethiopia. *Journal of Health Development*, 24(2).

Beangstrom, P. 2009. Aids needle pricks a baby. *Diamonds Fields Advertiser* (DFA), April: 2.

Henry, K and Campbell, S. 1995. Needle stick/sharps injuries and HIV exposures among health care workers: national estimates based on a survey of U.S. Hospitals. *Journal of Minn Med,* 78:1765-1768.

Johannessen, LM., Dijkman, M., Bartone, C., Hanrahan, D., Boyer, M.G and Chandra, C.2000. Health care waste management guidance notes. Health nutrition and population.Washington: International Bank for Reconstruction and Development, World Bank.

Manga, E.V., Forton, O.T., Mofor, L.A., and Woodard, R. 2011. Health care waste management in Cameroon: a case study from the South Western Region. *Journal of Resource Conservation and Recycling*, 57: 108-116.

Northern Cape Department of Health (NC DoH). 2008. Removal of medical waste. Northern Cape Province, P/Bag X5049, Kimberley, 8300. (Internal departmental letter).

Northern Cape Department of Health (NC DoH). 2010. Report of status of HCW storage facility: Psychem Waste Solution, Northern Cape Province, P/Bag X5049, Kimberley, 8300.

Northern Cape Department of Health (NC DoH). 2009/2010. Annual Report: Vote 10, Northern Cape Province, P/Bag X5049, Kimberley, 8300.

South Africa. 1996. *Constitution of the Republic of South Africa*. Act 106 of 1996. Cape Town:Government Printer.

South Africa. 1998. *National Environmental Management Act***.** Act 107 of 1998. Cape Town: Government Printer.

South Africa. Department of Environmental Affairs and Tourism (DEAT). 2008. Survey of generation rates, treatment capacities and minimal costs of health care waste in the 9 provinces of South Africa. Available from: http://www.kobusotto.co.za/45401.html (Accessed 13 June 2012).

South Africa.Department of Environmental Affairs and Tourism (DEAT). 2009. HCRW implementation strategy, Summit 18th and 19th May 2009. Available from: https//:www.HCWforum.org/HCW/usersfiles/files/dec% 20 fisher.pdf (Accessed 23 May 2011).

South Africa. Department of Health. 2003. *National Health Act. Act 61 of 2003.* R375. Regulations relating to HCW management in health establishments. Pretoria, South Africa. Available from: http://www.gpwonline.co.za/docs/legislation-f.html (Accessed 17 July 2014).

South Africa. Local Government Association (SALGA).2011. Northern Cape Municipalities. Available from: http://www.salga.org.za/pages/AboutSalga/.../SALGA (Accessed 15 May 2011).

South African National Standards (SANS). 2008. *Management of health care waste, Part 1: management of health care risk waste from a health care facility SANS10248-1,* Pretoria, South Africa. Standards South Africa (division of SABS).

Statistics South Africa (Stats SA). 2011. Census 2011: municipal report. Available from: https//:www.statssa.gov.za/census2011/Product/NC Municipalities report.pdf (Accessed 12 June 2011).

Tshenolo Resources. 2011.HCW information, GroupWise. Unpublished raw data, 12 December.

United Nations Environmental Programme (UNEP).1999. *Basel Convention on the trans-boundary movements of hazardous waste and their disposal:*adopted by the conference of the plenipotentiaries (6 to 10 November, 1999). Switzerland. United Nations Environmental Programme.

United Nations Environmental Programme (UNEP). 2004. *Preparation of national health care waste management plans in sub-Saharan countries: guidance manual.* Switzerland: Secretary of Basel Convention and World Health Organisation. United Nations Environmental Programme.

World Health Organisation (WHO). 1999. *Safe management of wastes from health care activities.* Geneva. World Health Organisation.

CHAPTER 2

HEALTH CARE WASTE LEGISLATION AND PRACTICES

2.1 Introduction

Health care waste management is without a doubt one of the topics that must be dominant within sustainable development programmes. The principle of sustainable development has not been fully addressed by international and national organisations when determining best practices for health care waste management (Townend, n.d.). As a result of the World Summit in Johannesburg in 2002, a worldwide shift towards sustainable HCW management programmes of resources has begun (Townend, n.d.).

The safe and sustainable management of health care waste is imperative to public health and is the responsibility of all health workers. The improper management of health care waste poses a significant risk to patients, health care workers, the community and the environment (WHO, 2007). The World Health Organisation (WHO, 2007) further emphasises that in addressing the improper management of health care waste, the focus should be on the correct investment of resources and commitment, which will reduce the disease burden and lead to health expenditure savings.

The International Solid Waste Association Technical (ISWA) policy on health care waste advocates that proper attention should be given to sustainable development subjects in the acquisition and use of resource minimising and, where possible, re-using items when appropriate medically, maximising recycling materials and taking into account of sustainable development issues in the management of waste (ISWA, 2007).

The researcher indicated that in contrast with the ISWA technical policy requirement, the Northern Cape Department of Health has not been able to assess these resources appropriately, nor has it been able to address best practices of health care waste management. The lack of assessing these resources, which would ensure the adequate allocation of services, is an aspect which the World Health Organisation identified as a cause of improper management of health care waste. In light of this, the literature review of this study explored the measures and systems used by different nations when handling issues of health care waste management with the purpose of

establishing applicable criteria for sustainable HCW management development programmes.

The World Health Organisation (WHO) recommends to government that when establishing and sustaining the maintenance of sound systems for health care waste management, a sufficient budget must be allocated, active donor funding is required, and monitoring systems and support capacity must be implemented to ensure worker and community health (WHO, 2007).

The Northern Cape Department of Health has difficulty in providing a complete health care waste management service in all its health care facilities due to the lack of sustainable development approach in its current HCW management strategy.

2.2 Definitions of health care waste and infectious diseases

The WHO indicates that health care activities lead to the production of waste that may lead to adverse health effects. One of the categories of health care waste which has an undesirable effect is infectious waste which includes sharps waste, body parts waste, chemical or pharmaceutical waste, radioactive waste and cytotoxic waste (WHO, 2004:1).

Infectious health care waste is defined by different organisations or bodies in a similar way, but with subtle differences. This is evident in the definitions of the United Nations Environmental Programme (2003) which defines infectious health care waste as “discarded materials or equipment contaminated with blood and derivatives, other body fluids or excreta from infected patients with hazardous communicable diseases” (UNEP, 2003:5). According to the Department of Environment (DoE), the United Kingdom"s (UK) Controlled Waste Regulations document (1992:1) defines infectious waste as “any waste which consists wholly or partly of human or animal tissue, blood or body fluids, excretion, drugs, or other pharmaceutical products, swabs/dressings or syringes, needles or other sharps instruments”. Unless it is rendered safe, this waste may prove hazardous (DoE, 1992:1).

Universally, the description of infectious waste is basically the same because of the common components referred to in most definitions such as tissue, blood and

body fluids. These words emphasise the strong relationship between infectious waste and health care waste in the management of health care waste. Terms that are used interchangeably in health care waste management are „medical waste" and „health care waste". Health care waste is the term used specifically to isolate the waste generated by health care establishments from any other sources. Health care waste thus includes all the waste generated by health care establishments, research facilities and laboratories. In addition, it includes waste originating from „minor" or „scattered" sources, for example the waste produced in the course of health care undertaken in the home such as dialysis and insulin injections (Pruss, Giroult and Rushbrook, 1999).

About 80% of the total quantity of waste generated by health activities is general waste, whereas remaining waste (about 20%) is considered as hazardous material (WHO, 2011). The approximate quantity of 20% may sound very small, but mismanagement of this waste may result in disastrous situations in as far as the health of both the public and workers is concerned. It was found that 75% to 90% of the waste generated by health care providers is general waste (HCGW) and that it mainly originates from the administrative and housekeeping functions of establishments. The remaining 10% to 25% is hazardous waste or health care risk waste which poses a variety of health and environmental risks (IWMSA, n.d.).

According to the South African National Environmental Management, Waste Management Act 59 of 2008 (SA NEMWA, 2008) (Section 1), hazardous material or waste means “any waste that contains organic or in-organic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have detrimental impact on health and the environment” (South Africa, 2008).

Mohan, Spiby, Leonardi, Robins and Jefferis (2006:1) define sustainable development in terms of the quality of life and state that it “must ensure that waste management sites pose minimum risk to health”. Sustainable development is the kind of development “that meets the needs of the present, without compromising the ability of future generations to meet their own needs” (Brundtland, 1987:1-20).

Table 2.1 indicates the pathogens in body fluids that are capable of contaminating health care waste items and thus hold potential risk for humans (Rushbrook, 2010).

Table 2.1: Examples of pathogens in body fluids contaminating HCW

Source	Pathogens in body fluids	Types of infections
Blood	Staphyloccus sp.	Septicaemia
	Human immunodeficiency virus (HIV)	Acquired immunodeficiency syndrome (AIDS)
	Staphylococcus aureus, Enterobacter, Enterococcus, Klebriella streptococcus sp.	Bacteraemia
	Candida albicans	Candidaemia
	Hepatitis B and C virus	Viral hepatitis B and C
	Junim Lassa, Ebola and Marburg virus	Haemorrhagic fevers
Faeces and /or Vomit	Salmonella, Shigelasp, Vibrio cholera and Helminths	Gastroenteric infections
	Hepatitis A virus	Viral Hepatitis A
Saliva	Mycobacterium tuberculosis, measles, virus, streptococcus pneumonia	Respiratory infections
Pus	Streptococcus sp	Skin infections

Source: Rushbrook (2010)

Table 2.1 summarises the association between infectious materials and diseases as reported by different researchers in various studies (Park, Lee, Kim, Lee, Seong and KO, 2009; WHO 1999). The link between infectious diseases and health care waste concepts is important, and the association between infectious diseases and the medium of transport provides a background for understanding the importance of health care waste management in health care facilities. The potential risks should encourage health care workers to implement and consistently improve sustainable and total HCW management in the Northern Cape Department of Health.

2.3 Legislation applicable to health care waste management

2.3.1 Introduction

Health care waste management practices that are applied in countries in Europe, Asia and Africa and other neighbouring countries on health care waste management were reviewed. Subsequently, legislation in various countries was compared with the objective of identifying best practice for health care waste management in underdeveloped countries. Published and unpublished literaturewas consulted and is referred to in this chapter.

2.3.2 HCW legislation in Europe

European countries have promulgated significant legislation to regulate and control HCW management. Two prominent pieces of legislation which regulate the management of waste are the European Union`s (EU) Framework Directives (75/442/EEC) Pudussery (2011) and the Environmental Protection Act enforced by the UK Department of Environment (DoE, 1992). Tudor, Bannister, Butler, White, Jones, Woolridge, Bates and Phillips (2008) and Pudussery (2011) list other applicable legislation promulgated in Europe (Table 2.2).

In South Africa, the National Environmental Management Act, Act 107 of 1998 ensures the coordination of all environmental issues, whereas in the UK the European Environmental Protection Agency (EEPA) is a platform where environmental issues are discussed. The EEPA is a network forum which elevates issues of common interest to organisations involved in the practical day-to-day implementation of environmental policies. The main fields dealt with by the EEPA network include air, fresh water and waste (EEPA, 2012).

Tables 2.2 and 2.3 summarise the HCW legislation in European and other countries respectively.

Table 2.2: Main HCW management legislation used in England and Wales

Legislation	Year
Environmental Protection Act	1990
Environmental Protection (Duty of Care) Regulations	1991
Controlled Waste Regulation	1992
Radioactive Substances Act	1993
The Waste Management Licensing Regulations	1994
Management of Health and Safety at Work Act	1999
Ionising Radiation Regulations	1999
European Agreement on the International Carriage of Goods	1999
Directive 2000/76/EC on the incineration of waste	2000
Integrated Pollution Prevention Control (IPPC) Act	2000
Animal By-products (Amendment) Order	2001
Control of Substances Hazardous to Health (COSHH)2002 Act (Schedule 3)	2002
Animal By-products Regulations	2003
Hazardous Waste (England and Wales) Regulations	2005
Carriage of Dangerous Goods and use of Transportable Pressure Equipment Regulations as amended	2005
Landfill(England and Wales) Regulations I	2005
Waste Electrical and Electronic Equipment Regulations (2002/96/EC	2005

Source: Tudor *et al* (2008)

The waste regulations and waste management licensing regulations in England and Wales were promulgated between 1992 and 1994. A neighbouring country such as Lithuania, which is an eastern European country, promulgated its waste management regulations and waste management laws in 2008. The National Environmental Act, Waste Management Act, Act 58 of 2009 promulgated in South Africa is similar to legislation presented in both Table 2.2 and Table 2.3, such as Controlled Waste Regulations and the Law on Waste Management. The National Environmental Management Act, Act 109 of 1998 of South Africa, which promotes the protection of the environment, can be identified with the Environmental Protection Act of 1990 of England and Wales.

Table 2.3: HCW management legislation used in Europe and neighbouring countries

Country	Legislation	Source
Turkey	Turkish Medical Waste Control Regulation adopted in 1993	Alagoz and Kocasoy (2008)
Greece	The Joint Ministerial Decision 37591/2031/03	Tsakona Anagastopoulou and Gidarakos (2007)
Lithuania	Law on Waste Management, 2008 Waste Management Regulations, 2008	Stasiskiene, Gaiziuniene and Zidoniene (2011)
Spain	Law 10/98 on waste Decree 2263 of 1974 regulates morgues Royal Decree 134/2003 regulates radioactive waste Ministerial order 13 July 1998 and July 2001 Royal Decree 952/1997 hazardous waste	Insa, Zamoranoand Lopez (2010)
Brazil	BRAZIL Federal Law No. 12305, August 2010	Moreira and Gunther (2013)

Table 2.3 was compiled by the researcher to reflect the relevant laws and regulations developed in terms of health care waste management in states that were not included in Table 2.2.

Even though Europe is more advanced than the rest of the world (probably with the exception of the United States of America) in dealing with health care waste management, the legislative frameworks of many European countries do not deal with health care waste independently from other environmental legislation and other waste legislation. Conversely, in South Africa some of the accredited guidelines which include national standards focus specifically on health care waste management.

2.3.3 HCW legislation in Asia

Different legislation is applicable in various countries in Asia, whilst some countries do not have any legislation at all. In Korea, medical waste used to be regulated by the Ministry of Health and Welfare and was enforced under the

Medical Law until 1999. In 1999 there was a modification of the Waste Management Act (Jang, Cargro, Yoon and Kim, 2006). This modified Waste Management Act brought positive changes that included amongst others, certification system for legal treatment of hazardous waste including hospital waste in order to monitor waste generation and its treatment path, and it also introduced levy systems to the waste discharger aimed at improving waste reduction and waste recycling programmes (UNCED, 2002:55).

In 1998 the Bureau of Indian Standards compiled guidelines for hospital waste management in India (Patil and Shekdar, 2001). Alagoz and Kocasoy (2008) report that management of health-care waste in Turkey is conducted according to Turkish medical waste control regulations. In Mongolia there is no comprehensive policy and strategy on health care waste management (Shinee, Gombojav, Nishimura, Hamajima and Ito, 2008) where Japanese waste management practices are performed according to the Waste Cleansing Law (i.e., Waste Disposal Law of 1991) (Miyazaki and Une, 2005).

Table 2.4: Legislation, policies and guidelines for HCW in countries in South Asia

Country	Legislation
Bangladesh	No proper legal framework to regulate health care waste in National Environment Act, 1995
India	Bio-Medical Waste Rules (1998), 1st Amendments: March 2000 and 2nd Amendments June 2000.
Bhutan	Guidelines for infection Control (Ministry of Health) Health care waste is addressed Environmental Code of Practice for Hazardous Waste Management, 2001 Policy
Maldives	No separate rules related to health care waste management in Environmental Protection and Preservation Act 1993.
Nepal	No policies and legislation dealing with hazardous waste
Pakistan	Hospital waste management rules, August 2005
Sri Lanka	No proper legal framework to regulate health care waste in National Environmental Act, A draft National Policy in HCW management exist in 2001
Palestine	Draft Environmental law of 1999

Source: Visvanathan and Adhikari (2006)

Table 2.4 presents some of the legislation of South Asian countries that were scrutinised in a study by Visvanathan and Adhikari (2006). Tables 2.4 and 2.5 provide an overview of the HCW legislation of both southern and eastern Asian countries.

In 1998, India promulgated the Bio-Medical Waste Rules, and China promulgated the Medical Waste Management Statute in 2003. In 1999, Korea also developed a Waste Management Act like in European countries such as England and Wales. It was only in 2009 that South Africa managed to promulgate a waste management actsimilar to those promulgated in developed countries in the late 1900s.

Table 2.5: Legislation, policies and guidelines for HCW in countries in East Asia

Country	**Legislation**	**Source**
China	The Medical Waste Management Statute, 2003 The hazardous waste landfill standard, 2001	Xie, Li, Li, Wu and Yi (2009)
Japan	The Waste Disposal Law, 1991	Miyazaki and Une (2005)
Korea	Waste Management Act of 1999	Jang*et al.* (2006)
Mongolia	The Minister of Health order No.293, 2009	WHOWPR (2013)

Table 2.5 was compiled by the researcher to include information about legislation in East Asian countries that are not included in Table 2.4. The legislative frameworks in East Asian countries are better developed than those in South Asian countries. This can be deduced from the fact that most South Asian countries do not have legislation that deals with health care waste management or waste management, except India and Palestine, as shown in Table 2.4. The national strategy on the improvement of heath care waste management in Mongolia was approved by the Mongolian Ministry of Health in 2009 which ensured that the 2009-2013 plan of action emphasise environmentally friendly programmes such as the decommission of incinerating technology (WHOWPR, 2013:5).

2.3.4 HCW legislation in Africa

Many developing countries acknowledge that not enough attention has been afforded to health care waste management and they agree that the impact of mismanagement is a great concern. The waste generated by hospitals is now recognised as a serious problem that could have detrimental effects either on the environment or on human beings through direct or indirect contact (El-Salam, 2010).

Research regarding HCW conducted in Africa and other developing countries provides a platform for better management and the development of sustainable systems for health care waste. In Africa the results of the studies should guide the authorities to pay more attention and allocate more resources to health care waste management. Not many people are aware that medical waste contributes significantly to environmental pollution (Coker, Sangodoyin, Sridhar, Booth, Olomolaiye and Hammond, 2009).

The sustainable management of healthcare waste (HCW) has continued to generate public interest due to the health problems associated with exposure of human beings to potentially hazardous wastes arising from health care activities (Tudor, Noonan and Jenkin, 2005).

The different African countries treat HCW management with different levels of importance. Some African countries have developed regulations and laws governing health care waste management, whereas others have no policy and strategy on HCW. As the case in point Nigeria, which is one of the most powerful African countries and is respectfully referred to as the „giant of Africa", does not have a formal policy to regulate the generation and management of health care waste. The National Waste Management Policy of Nigeria on the environment was formulated in 1989 and revised in 1999. This policy alludes to hazardous waste yet excludes medical waste (Coker *et al.*, 2009). In 1996, Botswana developed a Clinical Waste Management Code of Practice (Mbongwe, Mmereki and Magashula, 2008). Egypt is currently using Environmental Law No.4 of 1994 and in this country specific issues relating to hospital waste management are specified in two decrees, namely No.338/1995 and No.1741/2005 (Azage and Kumie, 2010).

South Africa has several laws regulating the management of health care waste and most of the general environmental laws address HCW management. Many outdated laws governing environmental management issues have been repealed and replaced as shown in Table 2.6. The most notable law besides the Constitution of South Africa is the National Environmental Management (NEMA), Act 107 of 1998 which supersedes other waste and environmental laws in the country. The Department of Environmental Affairs (DEA) in South Africa is the regulator of NEMA, whilst the Department of Health (DoH) is the major generator of HCW. The Department of Health, according to the South African National Environmental Management Waste Act (SA NEMWA) Act 59 of 2008 (part 2, section 16) under General Duty is being classified as the „holder of waste" and it requires that all responsibilities as listed in part 2 must be complied with (South Africa, 2008).

Table 2.6 shows legislation associated with health care waste management promulgated in different African countries. The year of promulgation is also indicated.

Table 2.6: Legislation, policies and guidelines for HCW in African countries

Country	**Legislation**	**Source**
Nigeria	National Waste Management Policy (1989) Draft Nigeria HCW (2007)	Abah and Ohimain (2011)
Egypt	Environmental Law No.4 (1994)	El-Salam (2010)
Tanzania	There is a lack of policy framework	Mato and Kaseva (1999)
Botswana	Clinical Waste Management Code of Practice (1996)	Mbongwe*et al.* (2008)
Ethiopia	No regulations or laws for HCW management	Azage and Kumie (2010)
Cameroon	Law on the Conservation of Public Health, 1996 Framework health law, 1996	Manga *et al.* (2011)
South Africa	National Environmental Management Act, Act 107 of 1998 National Environment Management, Waste Act, Act 58 of 2009.	South African Government Printers (2011) and (http//:www.gov.za).

	National Environmental Management, Air Quality Act, Act 39 of 2004 Hazardous Substances Act, Act 15 of 1973 National Road Traffic Act, Act 94 of 1996 National Water Act, Act 36 of 1998 Medicines and Related Substances Control Act, Act 101 of 1965 Human Tissue Act, Act 65 of 1983 Occupational Health and Safety Act, Act 85 of 1993 Department of Water Affairs and Forestry, Minimum requirements for waste disposal by landfill, second edition 1998 Department of Water Affairs and Forestry, Minimum requirements for the handling, classification and disposal of hazardous waste, second edition 1998 Department of Health, Radio Active Control, 2001 SANS 10248:2004 Management of healthcare waste SANS 10248-1:2008 Management of health care risk waste from a healthcare facilities Gauteng Health Care Waste Management regulations, 2004 Western Cape Health Care Waste Management Act, 2006 SANS 10228, 1518, 10231, SANS10232-1, SANS10232-3	

Table 2.6 was compiled by the researcher to show different legislation that exists in various African countries, including South Africa.

South Africa is the only country on the continent from the listed countries shown in Table 2.6 with legislation that provides a special focus on health care waste management. Most South African legislation applicable to environmental and waste issues have sections that are solely dedicated to health care waste management. Therefore, the South African HCW legislation is performing well compared to European and particularly to African HCW legislation. The Northern

Cape Department of Health has managed to follow the trend used in South Africa through the development of its HCW policy.

2.4 Health care waste management practices

2.4.1 Introduction

This section focuses on different HCW management studies to enable comparison between health care waste management practices in Europe, Asia and Africa. Scrutinizing the different HCW management practices was helpful in identifying general compliance guidelines for all handlers and managers of HCW and comparing these practices with international guidelines such as those developed by the World Health Organisation and UNEP.

2.4.2 Europe

In Europe, the largest producer of health care waste is the United Kingdom which produces approximately 190 000 tonnes of health care waste per year. In 2011, the recorded total clinical waste generated in Norfolk and Norwich hospitals was 2.4 tonnes per day (Pudussery, 2011). Compliance in terms of various steps of health care waste management (segregation, classification, storage and transportation) in the Norfolk and Norwich University Hospital (NNUH) is measured in accordance with health care waste guidelines published by the Royal College of Nursing (RCN). The study conducted by Pudussery (2011) found that NNUH complied with the RCN HCW guidelines entitled „The management of waste from health, social and personal care" except in terms of health care waste minimisation and recycling.

In Greece, an average bed capacity of 450 beds corresponded to a 1.4 kg of infectious waste per bed per day (Tsakona, Anagastopoulou and Gidarakos, 2007). When compared to NNUH, it was found that in Greece the waste collection strategy was appropriate (i.e., different types of waste were collected in the appropriate waste containers). However, the following were found to be inadequate in the study on HCW management in Greece: poor segregation (infectious waste was not properly segregated from municipal waste and poor segregation occurred between flammable products and toxic substances); labelling (incorrect labelling of containers was identified); transportation

(inappropriate means of transportation was used); storage (intermediate storage took place in the designated area but waste was mixed with municipal waste); and poor cleaning programmes (Tsakona*et al.,* 2007).

The literature thus revealed that not all countries comply with the international guidelines as set out by the WHO and the United Nations Environmental Programmes (UNEP) on health care waste management.

2.4.3 Asia

The West Bank of the Palestinian Territory generated a total of 288 tonnes (9.6 tonnes per day) of solid health care waste per month was generated (Al-Khatib and Sato, 2009). The latter study reports that primary health care facilities were the major generators of solid health care waste (SHCW) in this region, where the majority of health care centres in the West Bank segregated SHCW partially. Disposal of sharps was done incorrectly using plastic boxes, carton boxes, special bags and normal bags. Internal transportation of SHCW was carried out by handlers with their hands and no wheeled trolleys or carts were used. Treatment of SHCW took place inside the premises of health care centres while open pit burning was a common disposal method. It was also recorded that SHCW collection occurred at least four to six times a week (Al-Khatib and Sato, 2009).

In Dhaka City, poor medical waste management was reported. Some of the health care establishments which were assessed did not segregate medical waste and small facilities did not have temporary storage facilities (Hassan, Ahmed, Rahman and Biswas, 2006). This city produced far less than what the West Bank of the Palestinian Territory produced in terms of HCW; e.g., a total of about 2.65 tonnes of health care waste was produced each day in Ulaanbaatar. The following were also found to be inadequate: segregation practices were also found to be the same as those of the West Bank (the HCW was not properly segregated); collection system (there was a poor collection programme for HCW); and disposal of HCW (poor disposal systems of HCW were reported) (Shinee, Gombojav, Nishimura, Hamajima and Ito, 2008). Shinee *et al.* (2008) also report that health care facilities in Dhaka City had contracts with the District Upgrading Services for waste collection, yet no special transportation was used for medical

waste collection. Outpatient facilities generated between 0.01 and 0.14 kg/patient/day and the inpatient facilities generated between 0.03 and 0.14 kg/patient/day (Shinee *et al.*, 2008).

The average solid and health care waste generated by a hospital in Turkey was recorded to be 5 kg/bed/day (Alagoz and Kocasoy, 2008). This study revealed some similarities between the findings of their study and those of Hassan *et al.* (2006) in Dhaka City. Both studies found a lack of strategy to manage health care waste:

- No waste management officers had been appointed to manage HCW.
- Poor budget allocations at different hospitals were reported,
- Segregation, collection and handling of health care waste were inconsistent.
- Most health care institutions did not have temporary storage rooms or containers.
- Where storage facilities were found, they had not been constructed appropriately and were not operated according to applicable regulations (Alagoz and Kocasoy, 2008:6-7).

The average quantity of waste generated per general hospital in 2002 in Korea was 68.5 tonnes (Jang *et al*, 2006). An estimated bed occupancy rate of 100% in Korea General Hospital and generated medical waste of 0.48 kg/bed//day whereas 6.34 kg/bed/day was reported for the private clinics of Taiwan (Cheng, Li and Sung, 2010). Jang *et al*. (2006) found that the segregation of medical waste was done at the point of generation and was commonly practised in most health care facilities in Korea.

After the introduction of guidelines for HCW in Iran, the total waste in the Namazi Hospital was reduced to 5.9 kg/bed/day from 6.67 kg/bed/day. Infectious waste was reduced to 3.6 kg/bed/day from 4.89 kg bed/day (Askarian, Heidarpoor and Assadian, 2010).

2.4.4 Africa

A study that was conducted at a tertiary health care facility (teaching hospital) in Nigeria recorded HCW quantities of 0.62 kg/person/day from outpatient wards and 0.81 kg/person/day from inpatient wards respectively (Abah and Ohimain, 2011). Poor HCW management related to poor waste segregation, packaging, and storage in Abada, Nigeria (Coker *et al.,* 2009) and this finding was later re-affirmed by Abah and Ohimain (2011) who found that no health care waste management officer had been appointed to manage HCW although there was an established committee responsible for hospital sanitation (Abah and Ohimain, 2011). The steps within the HCW management life cycle (segregation, packaging and storage) in Nigeria were not compliant with the WHO and UNEP HCW management guidelines.

In Egypt, El-Salam (2010) found that the quantity of medical waste generated was about 1 249 kg/day in total, and the rate at which medical waste was generated was at a rate of 0.85 kg/bed/day. Although segregation of various medical waste types was carried out in all the surveyed hospitals in Egypt, not all the applicable rules and standards were complied with in any of the hospitals. Whereas the labelling, colour coding and packaging system of HCW were correctly done, the collection frequency of HCW from wards was two or three times per day while collection from central storage areas occurred only two days per week. However, the central storage facilities were compliant with the rules and standards for safety, isolation and adequate ventilation. A serious oversight was that the health care waste handlers did not use protective clothing during the collection of waste (El-Salam, 2010).

In Dar es Salaam hospitals, solid medical waste (SMD) generation averaged 0.66 kg/patient/day (Mato and Kaseva, 1999). These researchers found that external collection of solid medical waste was done from the hospitals by two local government agencies namely Dar es Salaam City Council (DCC) and Multinet Africa. Segregation of solid medical waste was not done properly due to ignorance and lack of knowledge about health hazards associated with solid medical waste. Collection of SMD from the wards was severely inadequate due to the following reasons: it was collected in metal receptacles, buckets and other

improvised receptacles; the SMD handlers were not well incentivised or trained in the handling of SMD; and they were not provided with the necessary tools and PPE to provide adequate SMD services. Moreover, external collection services were not reliable in collecting solid medical waste from hospitals and their service did not extend to peri-urban areas. Mato and Kaseva (1999) also uncovered that crude dumping of SMD was still practised as opposed to sanitary land filling. The researchers concluded that the solid medical waste management practices in the hospitals of Dar es Salaam were still far behind in ensuring safety of the public, workers and the environment as promoted by WHO and UNEP.

The generation rate of health care waste in West Gojjam, the Amhara Region of Ethiopia, was estimated between 0.035 kg and 0.05kg per day (Azage andKumie, 2010). These scholars found that six out of ten health centres used safety boxes for contaminated sharps. However, there was no colour coding or labelling of containers and waste management processes such as minimisation and segregation were not prioritised (Azage and Kumie, 2010).

A study conducted in the south-western region of Cameroon reports poor information management systems for recording quantities of waste generated in surveyed health care facilities. The estimated waste generation at facility B, which was located in Buea, was reported to be 44.9 kg/day, according to Manga, Forton, Mofor and Woodard (2011). The packaging of health care waste in Cameroon hospitals was done in colour coded plastic bins (blue, red and black). In surgical and maternity wards, silver metallic bins were provided with the intention of segregating pathological waste from other health care waste. Segregation of health care waste at facility B was not done in accordance with the colour coding system and bins provided; instead, collection of health care waste was done manually from point of generation to the disposal site and storage area without trolleys, and this created health risks associated with potential infections to health care waste handlers. In some of the hospitals, general and health care waste was collected by a municipal waste collection service and transported to municipal authorised landfill sites as general waste (Manga *et al.*, 2011). It was thus reported that the health care waste management system (segregation, collection, transportation and disposal) in Cameroon hospitals did not comply with

HCW management guidelines as provided by WHO and UNEP and this oversight exposed public and landfill workers to the risk of contracting infectious diseases.

The National Department of Environmental Affairs and Tourism (DEAT) in 2008 reported that South Africa is generating quantities of approximately 42 000 tonnes of health care waste between public and private health care institutions (South Africa, 2008). Studies conducted in different parts of South Africa reported similar poor health care waste management practices to those practices in other African countries, in spite of legislation promulgated in South Africa (Table 2.7).

Tables 2.7 (parts 1 and 2) presents a summary of the HCW management practices used in South Africa at various health care facilities.

Table 2.7: HCW management practices used in South African hospitals (part 1)

Area/ Facilities	**Key performance areas**				**Source**
	HCW management policy in place	**HCW treatment from heath care general waste**	**Segregation of HCW done at facility level**	**Colour coding system of HCW bins in place**	
Gauteng province; Johannesburg Hospital	Yes, 84% respondent knew about the policy	Yes, 90% of respondent treated waste differently	Yes, 96% of the respondent separated waste correctly	Yes, 96% of the respondent affirmed colour coding of H CW	Ramokate (2008)
Limpopo province; Tshilidzini hospital and Elim hospital	Yes, provincial policy available with gaps	Yes, no percentage was allocated	Yes, segregation is done only for sharps waste, intensive care unit and gyneacology unit	Yes, no percentage was allocated	Nemathaga, Maringa and Chimuka (2007)
North-Eastern Free State; Regional, District and specialised Hospitals	Yes, 77.5% respondent did not know about the legislation	Yes, No percentage allocation	Yes, 21 percent agreed with segregation methods	Yes, 89% knew colour coding system for HCW	Mahasa and Ruhiiga (2014)
Northwest Province, Central District hospitals	No policy or legislation in facilities	Yes, there were different types of HCW waste containers	No, observation showed poor segregation systems in place	No	Mudau (2007)

Western Cape; Tygerberg Hospital	No policy or guidelines	Yes, HCW is stored and disposed of separately	No, Poor segregation of HCW	No,	Abor (2007)

(Yes = systems are in place: No = systems are not in place)

Table 2.7: HCW management practices used in South African hospitals (part 2)

Area	**Key performance areas**			**Source**
	Use of PPE	**On- site transportation of HCW**	**Storage facility conditions**	
Gauteng province; Johannesburg Hospital	Yes, 95% used protective clothing mainly gloves	Nil report	Ni report	Ramokate (2008)
Limpopo province; Tshilidzini hospital and Elim hospital	Nil report	Nil report	Yes, no locking system and it was not in good condition	Nemathaga, Maringa and Chimuka (2007)
North-Eastern Free State; Regional, District and specialised Hospitals	No, no provision of PPE	Nil report	Yes, central waste storage and temporary waste storage areas are not compliant	Mahasa and Ruhiiga (2014)
Northwest Province, Central District hospitals	No, no provision of PPE	Yes, wheeled trolleys were used.	Yes, central waste area not compliant to HCW storage guidelines.	Mudau (2007)
Western Cape; Tygerberg Hospital	Yes	Yes, wheeled trolleys	Yes, well structured storage area but poorly sanitized.	Abor (2007)

(Yes = systems are in place: No = systems are not in place)

Table 2.7 (parts 1 and 2) were compiled by the researcher to show health care waste management practices used in various hospitals in South Africa.

Unknown HCW generation rates and composition made planning and development of appropriate intervention strategies difficult in the Ilembe health district, KwaZulu-Natal (Gabela, 2007). Mahas and Rahiiga (2014) confirmed that if hospitals do not maintain correct waste generation records, it could lead to technical and managerial inefficiency of HCW management systems.

Tygerberg hospital did not present HCW quantities generated in its facility as a result of ineffective HCW registers and records (Abor, 2007) whereas, the study conducted at Johannesburg hospital, which was a qualitative research study based its investigation on the knowledge of different health care workers on HCW

management (Ramokate, 2008). Ramathage*et al.* (2007) conducted visual assessments and field investigations in two hospitals of Limpopo province and the average waste generation rates recorded in Tshiidzini hospital and Elma hospital were 0.65 and 0.60 kg/patient/day, respectively. The health care waste generation rates of four hospitals in the central district of Northwest were recorded after using volumetric billing systems. The following results were recorded per month; Thusong hospital (1 4406 ℓ), Gelukspan hospital (4 275 ℓ), Zeerust hospital (5 416 ℓ) Mafikeng hospital (107 783 ℓ), whereas Victoria hospital in the same central district captured its HCW generation rates in kg`s per month and reported an average of 911 kg/month (Mudau, 2007).

Similar to the central district of Northwest province heath care waste quantities were measured in volumes in the north-eastern Free State province per day, Regional hospital (0.55 ℓ), District hospital (0.79 ℓ) and Special hospital (0.08 ℓ) (Mahasa*et al*., 2014). In the Ilembe health district of KwaZulu-Natal, primary health care centres (clinics) generated an average of 0.06 kg/patient/day of health care waste (Gabela, 2007). With the exception of Johannesburg hospital, as a result of the research design used, a summary of HCW management practices which included knowledge and application of legislation, handling, segregation, colour coding, personal protective clothing, on-site transportation and storage areas as presented in Table 2.7, confirms non-compliance with South African National Standards 10248-1 adopted in 2004 and WHO guidelines on heath care waste management.

2.5 Treatment and disposal methods of HCW

2.5.1 Introduction

The main purpose of treating infectious waste is to destroy any infectious agent so that it does not pose a hazard to anyone exposed to it (Tsakona*et al.*, 2007).

The objective of treating hazardous waste is two-fold:

- to reduce the toxicity of the harmful components in order to minimise the impact of waste on the environment; and

- to comply with the relevant Acts and minimum requirements for treatment and disposal of HCW.

2.5.2 HCW treatment methods used globally

Different treatment methods for HCW are used globally with different degrees of efficiency in various countries. Treatment technologies for hazardous waste are grouped as physical treatment, immobilisation, solidification, encapsulation, and incineration in section seven (South Africa, 1998).

The most frequently used treatment practices for solid medical waste are incineration (El-Salam, 2010; Lee, Ellenbecker and Ersaso, 2004; Miyazaki and Une, 2005). Incineration is a process of mixing HCW with combustible materials such as fuel and exposing them to high a temperature within a combustion chamber to ensure a complete combustion condition (Prusse*t al.,* 1999). In Korea, incineration is the traditional treatment method to handle medical waste that typically contains infectious and hazardous materials. Incineration has several advantages when used to treat medical waste, including a reduction in the waste volume, sterilisation, detoxification of the waste materials, and the recovery of heat or electricity (Jang *et al.*, 2006).

In the capital city of Mongolia, Ulaanbaatar 90% of the healthcare facilities de-regulated combustion (low-temperature incinerators, simple stores or open burning) to dispose of medical waste (Shinee *et al.*, 2008). In the West Bank (Palestine), open burning is the most common method employed by both primary and secondary health care centres (Al-Khatib and Sato, 2009).

In India, large hospitals" waste is disinfected and disposed of along with general waste.Waste from operation theatres, wards and pathological laboratories are disposed of without any disinfection or sterilisation. Amputated body parts (anatomical waste) and other highly infectious waste are incinerated wherever incineration is available; the remainder is burnt in some corner of the hospital grounds (Patil and Shekdar, 2001).

The current disposal method adopted in Nigerian health facilities is dumping and open burning on the facility premises. This poses health risks to patients and people residing close to the healthcare facilities (Coker *et al.*, 2009). A

surveyundertaken in Cameroon hospitals indicated that the most common waste management options adopted for HCW treatment are open dumps, uncontrolled landfill and incineration (Manga *et al.*, 2011). In Ethiopia, disinfectant of waste storage/collection utilities is non-existent. Incineration, burial in the health centres" premises (placenta pit) and burning in open pits are employed as final waste disposal means (Azage and Kumie, 2010).

By out-sourcing the HCW management services such as collection, transportation, treatment and disposal of waste, South Africa has taken significant steps ahead of its counterparts in Africa. Since the promulgation of NEMWA and delisting of many private and public incinerators which are not compliant with national emission pollutants standards, incidences of pit burning and burial of waste in health care facilities have decrease significantly, especially in the Northern Cape Department of Health.

It can be acknowledged that the South African public health care system seems to have improved in terms of health care waste management in health care facilities because of strict HCW legislation promulgated in recent years. However, the challenge remains to eradicate the use of unauthorised limited treatment facilities found in South Africa. Incineration and autoclaving remain the only treatment systems used in South Africa. However, these limited systems will still have significant drawbacks,which include:

- Stage 2 incinerators with efficient gas cleaning potential (temperature above 800°C) are very expensive to maintain;
- Single chamber incineration with dust reduction (temperature below 800°C) produce significant emissions of atmospheric pollutants, slag and soot; and
- Autoclave wet thermal treatment shredders are subject to many breakdowns and poor functioning. Operating them requires qualified technicians. Moreover, these systems are not adequate to treat pharmaceutical, anatomical and chemical (UNEP, 2003:30-33).

Thelimited provision of these facilities also leads to avoidance of the „proximity" principle which requires that the treatment and disposal of hazardous waste

takeplace at the closest possible location to its source in order to minimize the risks involved in its transport (UNEP, 1999).

It is evident that two types of treatment systems are currently used in South Africa. Northern Cape, Eastern Cape, Mpumalanga and Limpopo provinces do not have the types of treatment systems as listed above. Gauteng has more than three licensed treatment facilities compared to all the other provinces in South Africa. In South Africa, incineration has historically been the most common type of treatment, but the imposition of higher emission standards in Gauteng has significantly increased the costs associated with incineration (South Africa, 2008). The Northern Cape Province has no treatment facility and relies significantly on Gauteng, Northwest and the Free State provinces for treatment of health care waste. This means that waste has to be transported safely over long distances, which has many potential risks.

2.6 Conclusion

An efficient, complete health care waste management has two most important components, namely legislation and sound policy for the disposal and treatment of HCW. The first component that needs to be in place is the legislation that governs health care waste management. Every country has to establishlegal measures and strategies for HCW management. Countries need to identify specific agencies that will take responsibility for monitoring the implementation of these laws. Most developed countries have legislation that manages health care waste processes of minimisation, segregation, collection, transportation, treatment and disposal of health care waste, but the same cannot be said of underdeveloped countries. The various studies perused showed that most Asian and African countries do not have legislation to facilitate health care waste management effectively, whereas European countries have legislation related to the management of health care waste.

The literature review also revealed that health care waste management practices differed from one country to the other. Most studies showed that various countries did not prioritise HCW management through adequate human and financial resources and did not achieve WHO goals and standards (Alagoz and Kocasoy, 2008; Abah and Ohimain, 2011; Manga *et al.*, 2011).

The second component that needs to be in place is a sound policy for the disposal and treatment of HCW. Inadequate disposal and treatment measures have been identified as the main obstacle in achieving total or complete health care waste management. Facilities and workers that treat HCW inadequately and inappropriately are at the root of the problem.The most widely used technologies in developed countries include incineration and autoclaving for the final treatment of health care waste. The common treatment systems used in underdeveloped countries, however, include incineration, open burning and pit burial of health care waste. If not properly carried out, incineration and open burning of HCW are known to produce flue (exhaust) gases which contain fly ash particulates composed of heavy metals, dioxins, furans and thermal persistent organic compounds. These components are very toxic to humans and the environment (Prüss*et al.,* 1999).

A change in mindset from different ministries of different countries towards prioritising HCW management is necessary. It is important to ensure that the health and safety of all people are maintained and that the protection of the environment is prioritised. The preservation of natural resources for sustainable development purposes through safe health care waste management practices should be pursued.

REFERENCES

Abah, S.A. and Ohimain, E.I. 2011. Healthcare waste management in Nigeria: a case study. *Journal of Public Health and Epidemiology*, 3(3):99-110.

Abor, A.P. 2007. Medical waste management at Tygerberg hospital in the Western Cape, South Africa Cape Peninsula University of Technology. Dissertation. Cape Town. Faculty of Applied Sciences: 58-69.

Al-Khatib, I.A. and Sato, C. 2009. Solid health care waste management status at health care centers in the West Bank – Palestinian Territory. *Journal of Waste Management*, 29:2398-2403.

Alagoz, A.Z. and Kocasoy, G. 2008. Determination of the best appropriate management methods for the health care wastes in Istanbul. *Journal of Waste Management,* 28: 1227-1235.

Askarian, M., Heidarpoor, P. and Assadian, O. 2010. A total quality management approach to health care waste management in Namazi Hospital, Iran. *Journal of Waste Management*, 30:2321-2326.

Azage, M. and Kumie, A. 2010. Health care waste generation and its management system: the case of health centers in West Gojjam Zone, Amhara Region, Ethiopia. *Journal of Health Development*, 24(2).

Brent, A.C., David, E., Rogers, C., Ramabitsa-Siimane, T.S.M. and Rohwer, M.B. 2007. Application of the analytical hierarchy process to establish health care waste management systems that minimise infection risks in developing countries. *European Journal of Operational Research*, 181:403-424.

Bruntland, G. (Ed.). 1987. *Our common future*: *the World Commission on Environment and Development*. Oxford: *Oxford University Press*.

Cheng, Y.W., Li, K.C. and Sung, F.C. 2010. Medical waste generation in selected clinical facilities in Taiwan. *Journal of Waste Management*, 30:1690-1695.

Coker, A., Sangodoyin, A., Sridhar, M., Booth, C., Olomolaiye, P and Hammond, F. 2009. Medical waste management in Ibadan, Nigeria: obstacles and prospects. *Journal of Waste Management*, 29:804-811.

El-Salam, A.M.M. 2010. Hospital waste management in El-Beheira Governorate, Egypt. *Journal of Environmental Management*, 91:618-629.

European Environmental Protection Agency (EEAP). 2012. European network of the heads of environmental protection agencies: connecting EPAs across Europe. Available from: http://www.epanet.ew.eea.europa.eu/european-epas (Accessed 19 April 2012).

Gabela, S.D. 2007. Health care waste management in public clinics in the Ilembe district: situational analysis and intervention strategy. University of KwaZulu-Natal. Dissertation. eThekwini. Department of Public Health Medicines, 66-75.

Hassan, M.M., Ahmed A.S., Rahman, K.A. and Biswas, T.K. 2006. Pattern of medical waste management: existing scenario in Dhaka City, Bangladesh.*Journal of BioMed Central Public Health***,** 471:1471-2458-8-36.

Institute of Waste Management of Southern Africa (IWMSA). (n.d.). Policy on health care waste. Available from http://www.iwmsa.co.za (Accessed 24August 2012).

Insa, E., Zamorano, M. and Lopez, R. 2010. Critical review of medical waste legislation in Spain.*Journal of Resources, Conservation and Recycling*. 54:1048-1059.

International Solid Waste Association (ISWA). 2007. Health care waste management: technical policy No 1.Available from http://www.iswa.org (Accessed 12 March 2012).

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

Lee, B.K., Ellenbecker, M.J. and Ersaso, R.M. 2004. Alternatives for treatment and disposal cost reduction of regulated medical waste. *Journal of Waste Management,* 24:143-151.

Mahasa, P.S. and Rahiiga, T.M. 2014. Medical waste management practices in north eastern Free State, South Africa. *Journal of Human Ecology*, 48:439-450.

Manga, E.V., Forton, O.T., Mofor, L.A. and Woodard, R. 2011. Health care waste management in Cameroon: a case study from the South Western Region. *Journal of Resource Conservation and Recycling,* 57: 108-116.

Mato, R.R.A.M. and Kassenga, G.R. 1999. Critical review of industrial and medical waste practices in Dar es Salaam City. *Journal of Resources, Conservation and Recycling*, 25:271-287.

Mbongwe, B., Mmereki T.B. and Magashula, A. 2008. Health care waste management: current practices in selected facilities, Botswana. *Journal of Waste Management*, 28:226-233.

Memathaga, F., Maringa, S. and Chimuka, L. 2008. Hospital waste management practices in Limpopo province, South Africa.: a case study of two hospitals. *Journal of Waste Management*, 28: 1236-1245.

Miyazaki, M. and Une, H. 2005. Infectious waste management in Japan: revised regulation management in medical institutions. *Journal of Waste Management,* 25:616-621.

Mohan, R., Spiby, J., Leonardi, G.S., Robins, A. and Jefferis, S. 2006. Sustainable waste management in the UK: the public health role. *Journal of Royal Institute of Public Health*, 120:908-914.

Moreira, A.M.M. and Gunther, W.M.R. 2013. Assessment of medical waste management at a primary health care center in Sao Paulo, Brazil. *Journal of Waste Management,* 33:162-167.

Mudau, S. 2007. Towards environmentally sound health care waste management in the central district municipality of the North West province. School of Animal, Plant and Environmental StudiesUniversity of Witwatersrand. Dissertation. Johannesburg, Faculty of Science: 63-90.

Northern Cape Department of Health (NC DoH). 2011. HCW Information. Unpublished document with raw data to M. Motlatla (mmotlatla@ncpg.gov.za). Groupwise. 13 September. sss

Park, H., Lee, K., Kim, M., Lee, J., Seong, S.Y. and Ko, G. 2009. Detection and hazard assessment of pathogenic microorganisms in medical wastes. *Journal of Environmental Science and Health,* 44: 995-1003.

Patil, A. and Shekdar, V. 2001. Health Care Waste Management in India, *Journal of Environmental Management,* 63:211-220.

Pruss, A., Giroult, E. and Rushbrook, P. (Eds). 1999. *Safe management of wastes from health care activities*. Geneva: World Health Organisation.

Pudussery, P.K. 2011. A study on the medical waste management at the Norfolk and Norwich University Hospital. University of East Anglia. Dissertation. Norwich:School of Environmental Sciences: 11-13.

Ramokate, T. 2007. Knowledge and practices of doctors and nurses at a large academic hospital in the Gauteng Province about management of healthcare waste. Medical School.University of Witwatersrand. Dissertation. Johannesburg. Faculty of Health Sciences: 25-40**.**

Rushbrook, P. 2010. Evaluating the link between the management of clinical waste in the National Health Service (NHS) and the risk of the spread of infections: a case study of three hospitals in England. *Internal Journal of Health and Environmental Health,* 213:432-436.

Shinee, E., Gombojav,E., Nishimura, A., Hamajima, N. and Ito, K. 2008. Health care waste management in the capital city of Mongolia.*Journal of Waste Management* 28:435-441.

South Africa. 1996. *Constitution of the Republic of South Africa*,*Act No. 106 of 1996: Bill of rights*, Chapter 2, Section 24, paragraph (a). Pretoria: Government Printers.

South Africa. 2008. *National Environment al Management Act, Waste Act. No. 59 of 2008.* Government Gazette No. 32000. Pretoria. Government Printers.

South Africa. National Department of Environmental Affairs and Tourism (DEAT). 2008. Generation rates, treatment capacity and minimal costs of health care waste in the RSA. Available from httmwww.kobusotto.co.za/45401 (Accessed 13 June 2012).

South Africa. National Department of Water Affairs and Forestry (DWAF). 1998. *Minimum requirements for the handling, classification and disposal of hazardous waste*. Pretoria: DWAF. Government Printers.

Stasiskiene, Z., Gaiziuniene, J. and Zidoniene, S. 2011. Assessing the sustainability of the Lithuanian hazardous waste management system. *Journal of industrial ecology*, 15:263-284.

Townend, W.K. (n.d.). Healthcare waste management: policies, legislation, principles and technical guidelines. Available from: http://www.waste-management-world.com/articles/print/volume-10/issue-4/features/heathcare-waste management-policies-legislation-principles and technical-guidelines,htm (Accessed 7 May 2012).

Tsakona, M., Anagastopoulou, E and Gidarakos, E. 2007. Hospital waste management and toxicity evaluation: a case study. *Journal of Waste Management,* 27:912-920**.**

Tudor, T.L., Noonan, C.L. and Jenkin, L.E.T. 2005. Health care waste management: a case study from National Health Services in Cornwell. *Journal of Waste Management*, 6(25): 606-615.

Tudor, T.L., Bannister, S., Butler, S., White, P., Jones, K., Woolridge, A.C., Bates, M.P. and Phillips, P.S. 2008. Can corporate social responsibility and environmental citizenship be employed in the effective management of waste? a case study from the National Health Service (NHS) in England and Wales. *Journal of Resources, Conservation and Recycling*, 52: 764-774.

United Kingdom. Department of Environment (UK DoE). 1990. The environmental protection act:special waste and non-controlled waste. Available from: http://www.legislative.gov.uk/ukpgal/1990/43/contents (Accessed 12 February 2014).

United Nations Conference on Environment Development (UNCED). 2002. Johannesburg summit: Republic of Korea, Country profile, Available from: http//www./un.org/esa/agenda21/natinfo/wssd/repkorea.pdf (Accessed 23 June 2013).

United Nations Environmental Programme (UNEP). 1999. *Basel convention on the trans-boundary movements of hazardous waste and their disposal: adopted by the conference of the plenipotentiaries 6 to 10 November*. Basel: Switzerland. United Nations Environment Programme.

United Nations Environmental Programme (UNEP). 2003. *Technical guidelines on the environmentally sound management of biomedical and health care waste (Y1:Y2).*Secretary of the Basel Convention International Environmental House, Switzerland. United Nations Environment Programme.

United Nations Environmental Programme (UNEP). 2004. *Preparation of national health care waste management plans in Sub-Saharan countries: Guidance Manual.* Secretary of Basel Convention and World Health Organisation, Switzerland. United Nations Environment Programme.

Visvanathan, C and Adhikari, R. 2006. Health care waste management in South Asia.Dissertation. School of Environment Resources and Development, Asian Institute of Technology, Thailand: 13-14.

World Health Organisation (WHO). 2004. Safe health care waste management, policy paper, Available from: http://www.healthcarewaste.org (Accessed 7 May 2012).

World Health Organisation (WHO). 2007. WHO core principles for achieving safe and sustainable management of health care waste. Report of the International Meeting on health care Waste held in Geneva 20-22 June 2007, Jorge Emmanuel for World Health Organisation, Switzerland. World Health Organisation.

World Health Organisation (WHO). 2011. Waste from health care facilities. Available from: http://www.healthcarewaste.org (Accessed 7 May 2012).

World Health Organisation Western Pacific Region (WHOWPR). 2013. Health care waste management in Mongolia, Ministerial Order No. (293) of 2009, Available from: http//www.wpro.who.int/Mongolia/publications/health care waste .org (Accessed 20 November 2013).

Xie, W., Li, W., Li, J., Wu, B and Yi, J. 2009. Emissions investigation for a novel medical waste incinerator. *Journal of Hazardous Materials*, 166: 365-371.

CHAPTER 3

HEALTH CARE WASTE MANAGEMENT PRACTICES IN THE NORTHERNCAPE DEPARTMENT OF HEALTH

ABSTRACT

Health care waste (HCW) management in the Northern Cape Department of Health (NC DoH) has gone through some serious changes in the past five years. Different HCW service providers were lured into the government system with the purpose of improving transportation, treatment and disposal of HCW. However, internal HCW processes such as managing generation and improving segregation remained the core responsibility of the Department of Health in each province.

The aim of the study was to assess the HCW management generation rates and practices in the Northern Cape Department of Health and to compare these generation rates and practices with national and international practices and guidelines governing safe HCW management.

The approach of the study involved convenience simple random sampling of hospitals in the NC DoH. Eleven hospitals from a total of 17 hospitals were assessed using a structured questionnaire and walk-through surveys to identify actual HCW practices. Available data from the outsourced service provider were analysed to determine the generated quantities of HCW for different periods.

The results showed that HCW averages of 2 kg/inpatient/month, 0.65 kg/outpatient /month, and 9.19 kg/bed/month were generated in the 11 surveyed hospitals. It was revealed that from all 179 health care facilities in the Northern Cape, at least 75.9% of HCW was produced from only 11 assessed hospitals. The segregation results showed that only pharmaceuticals and anatomical waste was correctly segregated in all hospitals. Sharps and infectious non-anatomical waste was correctly segregated by only 63.6% (7) of the surveyed hospitals.

Based on the results of the survey, it was concluded that any HCW strategy formulated in the NC DoH must be aligned to the hospitals as they are the major generators of HCW. It was also observed from the results that the generation rates as produced by the selected hospitals in the NC DoH were comparatively low when compared to those of other countries. Moreover, it was also shown that segregation of HCW requires more attention to attain complete health care waste management.

Keywords: Health care waste, survey, generation, segregation and hospitals

3.1 INTRODUCTION

It was in the 20th century that health care waste (HCW) management started receiving the attention it deserves globally, but particularly in most developing countries. Strategic approaches may differ from one country to another, but efforts towards complete health care waste management (HCW) are improving all the time. The most important issuesare to ensure that health and environmental risks associated with HCW management are eliminated (WHO, 2004).

The World Health Organisation (WHO) emphasises that the management of HCW is an intergral part of the national health care system (WHO, 2007). According to the South African National Department of Environmental Affairs and Tourism (SA DEAT), health care waste management in South Africa cuts across initiatives identified by the National Waste Management Strategy (NWMS) and comprises a third focal area of the 1999 NWMS implementation project. This third focal area is the overall objective of the strategy which is to reduce the generation of waste and thus the impact of all forms of waste on economic development, health and the quality of environmental resources (South Africa, 2009).

The WHO core principles for achieving safe and sustainable health care waste management provide the critical areas for improving strategies of HCW management in different countries (ISWA, 2011; WHO 2007), these principles require:

- waste management plans;
- human resource allocation for health care waste management;
- proper segregation of hazardous waste;
- appropritate storage, collection and transportation of waste;
- occupational health and safety programs; and
- training programmes and policies for health care waste management.

In addidtion to these strategies, there is a hierarchy of priorities in terms of waste management. The National Environmental Management, Waste Act (Act 59 of 2008)(Part 2, section 16) refers to this hierarchy as “general duties that apply to

all producers and holders of waste" (South Africa, 2008). These general duties include avoidance or reduction of waste, re-use and recycling, and responsible treatment and disposal of waste.

The development of the National Environmental Management, Waste Act (Act 59 of 2008) (SA NEMWA) and the NWMS was critical in addressing waste issues in the context of co-operative governance and enhancing the different spheres of goverment to identify their responsibilities in its implementation. After the promulgation of the Waste Act (SA NEMWA) in 2008, the South African National Department of Health (DoH) identified its role as a holder and generator of HCW and therefore was affected by the „general duty" and „polluter pays principles". The study that was conducted by the DEAT in 2008 indicated that there had been a reduction in the treatment capacity of HCW because of the closure of the regional HCW incinerators due to non-compliance in terms of air emission standards. At the same time, there was an increase in HCW generation that required further treatment and disposal (Otto and Clemens, 2008). The decommissioning of incinerators in 2005 by the DEAT in DoH facilities led to outsourcing of HCW management services throughout the country.

The focus of the study was to evaluate the HCW management practices and to compile a data base using the data recorded in the Department of Health in the Northern Cape. The purpose was to measure the Department`s compliance status in terms of international and national guidelines and legislation. In order to develop proper waste management strategies for hospitals, it is important to characterise volumes and compositions of the waste streams (Jang, Lee, Yoon and Hwidong, 2006). Moreover, to be able to make recommendations in termsof the appropriate management of infectious waste, data about the generation sources, and types and quantities of waste generated at each point or facility should be known (Alagoz and Kocasoy, 2008).

The map (Figure 3.1) is a visual presentation of the location of the various health care facilities in the Northern Cape.

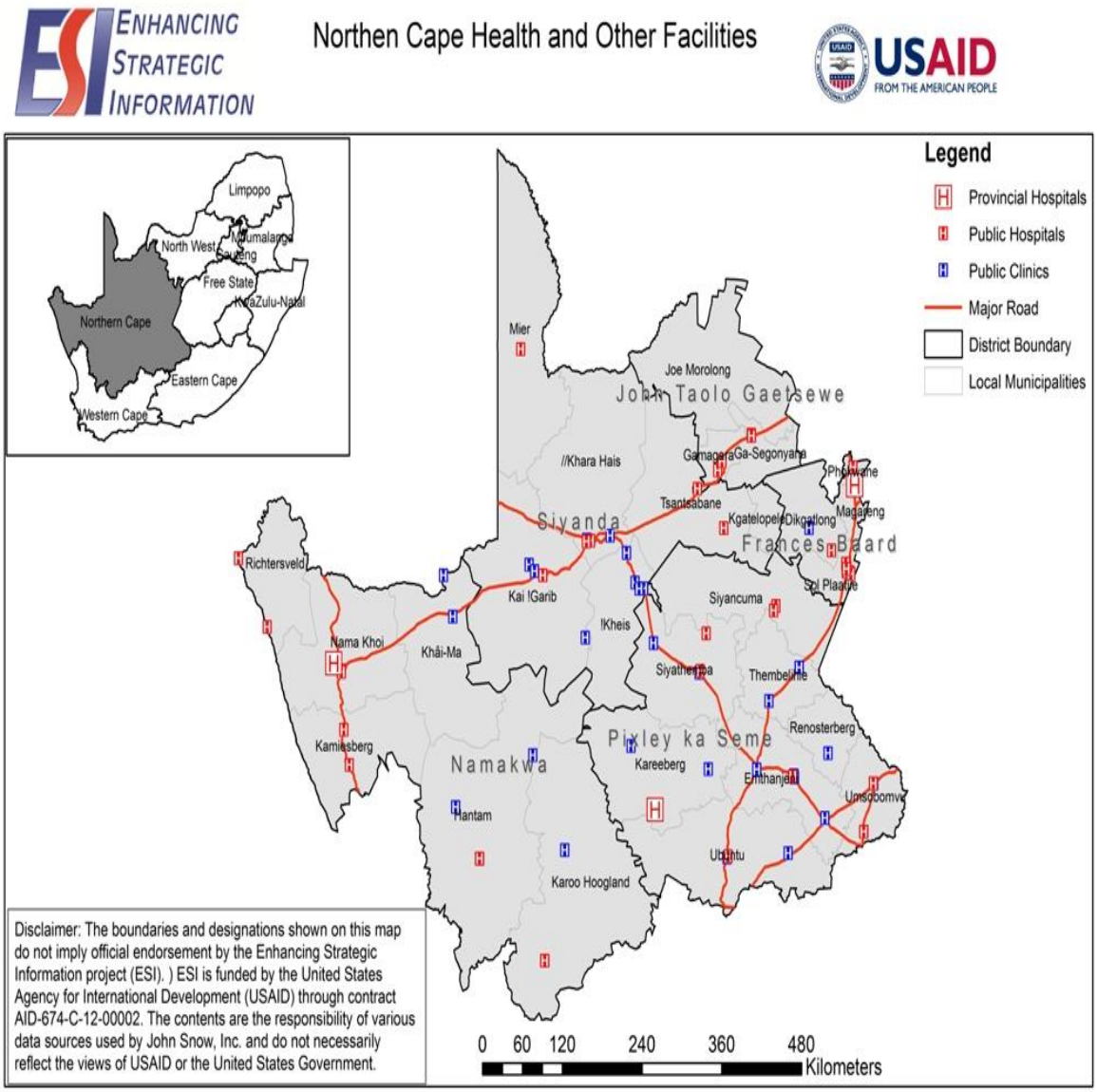

Figure 3.1: Location of health care facilities in the Northern Cape Province
(Source: ESI, 2012)

3.2. Methodology

The study utilised a descriptive, cross-sectional design. A cross-sectional study design is often conducted to estimate the prevalence of the outcome of interest for a given population, commonly for the purposes of public health planning. If a study is descriptive and is conducted in the form of a survey, it is sometimes carried out to investigate associations between risk factors and outcome of interest (Levin, 2006).

3.2.1 Study site and characteristics

The Northern Cape Department of Health (NC DoH) has a total of 179 health care facilities which include 129 clinics, 33 community health care centers and 17 hospitals within five districts. The facilities selected for the research included (A) a provincial tertiary hospital, (B) a day care hospital and (C) a mental hospital which are all situated in the Frances Baard district. The HCW facilities identified in the four districts in this study included hospitals (F) and (G) in the John Taolo Gaetsewe district, hospitals (D) and (E) in the Pixley Ka Seme district, hospitals (H) and (I) in the Namakwa district, and hospitals (J) and (K) in the ZF Mcgawu district. Frances Baard is the provincial head quarters of the province where legislature is located and where the tertiary hospital is situated.

Eleven of the 17 hospitals in the NC DoH were assessed. A simple stratified sampling method was used which was in line with the type of sampling required for modelling procedures when there are more than one element in a population. The product multi-nomial distribution was used to estimate a probability vector and its co-varience matrix. As the sample size was large, the probability vector was approximately normally distributed as a central limit theory (SAS, 2010). The sample (11 hospitals) constituted a 64.7% representation of the total population of the 17 hospitals.

A brief description of each hospital is provided:

Hospital A

Hospital A is a tertiary hospital which has the highest number of beds of all the hospitals in the province. Because the hospital is the largest hospital in the province, it has the capacity to attend to an average of 12011 patients per month. Hospital A is the referral point of all public health care facilities where all the specialised medical services are provided in the province. These specialised services include a renal dialysis unit, an intensive care unit, a paediatrics unit, a neonatal units, laboratory services, a chemotherapy unit, and surgical and radiology units. Non-specialised units located in this hospital and many other surveyed hospitals include medical units, surgical units, out-patient units, maternity units, dental units, and theatre and other general health care services.

Hospital B

Hospital B is a general hospital which specialises in termination of pregnancies in the Frances Baard district and provides other maternity services. This hospital is situated in close proximity to the private and tertiary hospitals. Because of its proximity to other hospitals, its patient turnover is low. A high rate of anatomical and infectious non-anatomical waste is regularly generated at this hospital.

Hospital C

Specialised services which include mental health services and tuberculosis (TB), multi drug resistant tuberculosis (MDR) and extreme drug resistant tuberculosis (XDR) treatments are the core business of hospital C, which is also situated in the Frances Baard district. It is the referral hospital for TB and mental patients in the province. It has a low generation rate of waste per bed which could be attributed to the type of patients which are regularly admitted to this hospital.

Hospital D

Hospital D was the smallest hospital included in the survey. It is situated within a population of about 16601 in the Pixley Ka Seme District Municipality (Local Government Handbook (LGH), 2013). This hospital provides general health care services and does not provide specialised services. Any complicated health care services requiring the attention of a specialist cannot be provided in this hospital; such patients are referred either to hospital E or hospital A.

Hospital E

Although it is the biggest hospital in the Pixley Ka Seme district and provides various services, this hospital is surrounded by a few smaller hospitals in other municipalities. It serves a population of at least 42 356 (LGH, 2013). Because of it being the biggest hospital in this district, it serves as a referral point for other smaller hospitals. Different health care services are rendered at this hospital.

Hospital F

Hospital F is one of the few hospitals in the John Taolo Gaetsewe district and it is situated close to the urban area, whereas Hospital G is situated in the rural part of

the district. The population surrounding this hospital is estimated at 93 652 (LGH, 2013). This hospital renders a few specialised services such as radiation and a theatre, and it has a state mortuary where post-mortem examinations are conducted, even for other nearby districts.

Hospital G

This hospital is situated in an area with an estimated population of 89530 (LGH, 2013). This hospital provides similar services to hospital B, meaning that it renders termination of pregnancies, circumcisions, and maternity services. The hospital renders other general health care services in the rural areas of the district.

Hospital H

This hospital is surrounded by a relatively small population estimated at 21 578 (LGH, 2013). This hospital is situated on the boundary of the province in the south of the Namakwa district and it is approximately 400 km from main centres such as Cape Town, Upington, Springbok and Beaufort West (LGH, 2013).

Hospital I

This hospital is the main service centre for health care services in the north west of the Namakwa district. It is a major health care centre for a population of approximately 47 041 in Namakwa (LGH, 2013). The hospital has a relatively small number of patients admitted on a monthly basis as compared to other bigger district hospitals in the province.

Hospital J

This is the second biggest hospital in the province. The hospital is situated in the centre of the province in the ZF Mgcawu district and the patients are transported from the furthest districts of the province to this hospital. The population around the hospital is estimated at 93 494 (LGH, 2013). Being one of the biggest hospitals in this district and in the province, it renders different general health care services and certain specialised services.

Hospital K

Hospital K is situated not far from other smaller hospitals in the ZF Mgcawu district in the north east of the Northern Cape Province. It is situated towards the border of John Taolo and ZF Mgcawu. The population in the surrounding municipal area is estimated at 35 093 and the hospital caters for both urban and rural communities as well as for miners working in the surrounding areas (LGH, 2013).

3.2.2 Survey method

A convenience sampling method was applied to ensure that a hospital in each district was used in the study to eliminate biased conclusions of the findings of HCW data in the districts. For the purpose of the study, a simple random sampling method was also used to select the various wards that would be surveyed in each hospital. Quantitative data were collected by making use of a structured multiple questionnaire developed to identify the quantities of waste generated and the waste management practices used in the different hospitals. Those persons responding to the questionnaire (i.e., the study respondents) varied between the Hospital Manager, Infection Control Nurse, Occupational Health Nurse and Ward Manager in each hospital. A walk-through survey was done to observe actual health care waste management practices, interviews were conducted with relevant staff members and workers, and a resources assessment was done.Data of the health care waste provided during collection from hospitals were recorded. HCW information data provided by the service provider were also used to capture the quantities and types of waste generated by the various hospitals. The questionnaire was developed based on the principles of the health care waste management guidance notes of the HNP discussion paper (Johannessen, Dijkman, Bartone, Hanrahan and Boje, 2000).

3.2.3 Analysis

Descriptive analysis was used by means of tables and graphs demonstrating different characteristics of the individually surveyed hospitals, and a descriptive narrative mode was employed in the evaluation of the results. The primary purpose of using the desciptive mode is to describe a person, place, or event so

that the topic can be clearly seen in the reader"s mind, whereas the narrative mode describe an experience, event, or sequence of events in the form of a story (Steel, 2007).

3.3 Results

3.3.1 Health care waste generation

The total number of patients who received treatment at the 11 hospitals in the Northern Cape province was 36 437. An average of 16 070 kg of HCW was generated each month. The total number of outpatients treated per month was 21 075 while the total number of inpatients was 15 362. Responces to question nine indicated the quantities of waste generated by these hospitals (Tables 3.1, 3.2 and 3.3).

Table 3.1: The monthly average HCW statistics of patients treated per hospital

Hospitals	A	B	C	D	E	F	G	H	I	J	K
Inpatients/ month	2119	296	2752	68	581	634	3700	258	40	4634	280
Beds/ month	850	19	225	26	51	64	159	51	40	180	30
Occupancy/bed/ month	2	16	12	3	11	10	23	5	1	26	9

The occupancy rate of the beds per hospital varied from one hospital to another. Being the tertiary hospital in the province, Hospital A had the highest bed allocation of 850 beds whereas a large academic hospital in Johannesburg has 947 beds (Ramokate, 2007). In one month, each bed was occupied at least twice in this hospital. Table 3.1 shows the difference between the smaller district hospital, hospital D, which had a three times higher bed occupancy rate per month when compared to hospital A. This comparison also applies to hospitals G and J which had more inpatients per month (3 700 and 4 634 respectively), but record a higher bed occupancy rate (23 and 26 respectively) each month.

The results recorded in the study indicated that the HCW generation rate for each hospital was inconsistentwith the number of patients and that there was no direct correlation between the number of inpatients and bed allocation with the quantities of health care waste generated as demonstrated in Table 3.2.

3.3.2 HCW generation per hospital

The monthly generation of health care waste was not proportional to the turnover rate of patients in any of the hospitals. The study also revealed that the HCW generation rate was not inter-dependent on the number of beds occupied per month. The hospitals with the highest number of inpatients were identified (i.e., hospitals A, C, G and J) and the HCW generated by these hospitals was calculated per kilogram per patient category per month as illustrated in Tables 3.1 and 3.2. respectively.

Table 3.2: The monthly HCW generated per hospital per kg per patient

Hospitals	A	B	C	D	E	F	G	H	I	J	K
Kg/inpatient /month	4.34	1.03	0.04	1.33	0.54	1.80	0.33	0.60	10.3	0.61	1.03
Kg/outpatient /month	0.93	0.46	0.34	0.24	0.34	0.93	0.35	0.12	0.46	2.78	0.29
Kg/bed/ Month	10.8	16.0	0.46	3.47	6.11	17.8	7.72	3.05	10.3	15.8	9.60

The results shown in Tables 3.1 and 3.2 indicate that the highest HCW generation rates depended on the number of inpatients treated and the number of beds occupied per month. When comparing the quantities of health care waste generation in Tables 3.1 and 3.2 and rating waste generation according to the values between one and four, one representing the highest value and four representing the lowest value in each category, the results are presented in descending order:

- Inpatients per hospital: J, G, C, A
- Beds per hospital: A, C, J, G
- Occupency rate per hospital: J, G, C, A
- Kg/inpatient/month: A, J, G, C and
- Kg/bed/month; J, A, G, C .

The study also showed that the largest contributor of waste streams was the tertiary hospital. Similar results were found in the capital city of Mongolia (Shinee, Gombojav, Nishimura, Hamajima and Ito, 2008). The results showed that more research is required to understand the contributing factors that influence the high generation levels of HCW in health care facilities.

3.3.3 HCW generation case in the Northern Cape (RSA) compared to that in El-Beheira Governorate (Egypt)

To confirm the question of HCW generation rates, a comparison was drawn between the current study in the Northern Cape Province and a study in Egypt that was conducted by El-Salam (2010). Three of the nine hospitals that were surveyed in the study conducted in Damanhour City, Egypt, were selected for comparison with this study. Three hospitals, numbers 3, 4 and 8, were selected for comparison with hospitals A, C and I of this study due to their similar charecteristics. Hospital 4 (general and teaching) and hospital A (tertiary) are the largest in their region, hospital C and hospital 3 are both specialised hospitals, and hospitals I and 8 both render general health care services and have the same number of beds (Table 3.2).

Table 3.3: Comparison of HCW generation rates between hospitals in NC DoH and hospitals in Egypt

Hospitals	Number of beds	Kg/bed /day
A	850	0.36
4	590	1.42
C	225	0.02
3	210	0.23
I	40	0.34
8	40	0.75

Table 3.3 was compiled to compare the recorded results of the HCW generation trends comparing hospitals in Egypt and in the Northern Cape. Hospital 4 in Egypt has fewer beds than hospital A in the Northern Cape, yet it generated more HCW kg/bed/day; whereas hospital 3,which generated more HCW than hospital C, has more beds. Hospital I in the NC DoH, with an equal number of beds to hospital 8, also generated less HCW.These contradictory results emphasise the need to conduct further research to determine the factors that influence HCW generation rates in hospitals.

3.3.4 Comparison of total HCW generation rates between all HCF`s and the selected hospitals

The quantities of HCW in kilograms generated by all (179) public health care facilities (PHCF) in the province were compared to the rates of HCW generated by the selected (11) hospitals. The purpose was to provide a broader view of the differences found in generation rates of HCW between the different health care facilities. This comparison was observed between March and June 2012. The results are presented in Table 3.4.

Table 3.4: Comparison of HCW generation between the hospitals and other PHCFs in the Northern Cape Province in the period March to June 2012 (weights expressed in kg)

Months	March	April	May	June
PHCF (n=179)	2 322 299	2 398 799	2 690 108	2 292 227
Hospitals (n=11)/kg	1 801282	1 794 618	1 958 570	1 795 947
Hospital waste %	77.6	74.8	72.8	78.3
PHCF %	22.4	25.2	27.2	21.7

Table 3.4 reveals that, expressed as percentages, there was minimal increase, yet some fluctuation, in the HCW generation rates for the sampled population and other public health care facilities as reported for the period March to June 2012.

The differences expressed as percentages show that HCW generation in hospitals increased in kg from April to May by approximately 9%. A sudden decrease of generation levels by approximately 8% from May to June. The generation rates in all health care facilities show a similar pattern where HCW generation from April to May increased by 12% and generation rates decreases from May to June by approximately 14%. This unexpected decrease which occurred from April to June presents a challenge which requires further research. The average HCW generation rate expressed as a percentage as observed in Table 3.4 was much higher for the 11 hospitals when compared to all other health care facilitites in the NC DoH. These selected hospitals generated an average of 75.9% of HCW compared to 24.1% recorded for the other health care facilities in this region. These results could influence decisions when the service provider and the hospitals develop route plans and collection schedules for HCW.

3.3.5 Collection frequency of HCW per hospital by service provider

The collection of health care waste in the selected hospitals was done by one service provider. In this study the assessment was carried out over a period of one month taking only five working days per week into consideration. This means that the data were collected over a period of concurrent 20 working days. All the vehicle registers of the hospitals were checked and verified against the collection schedules of the service provider. Question one of the questionnaire assessed HCW collection frequency as provided by the service provider (Figure 3.1).

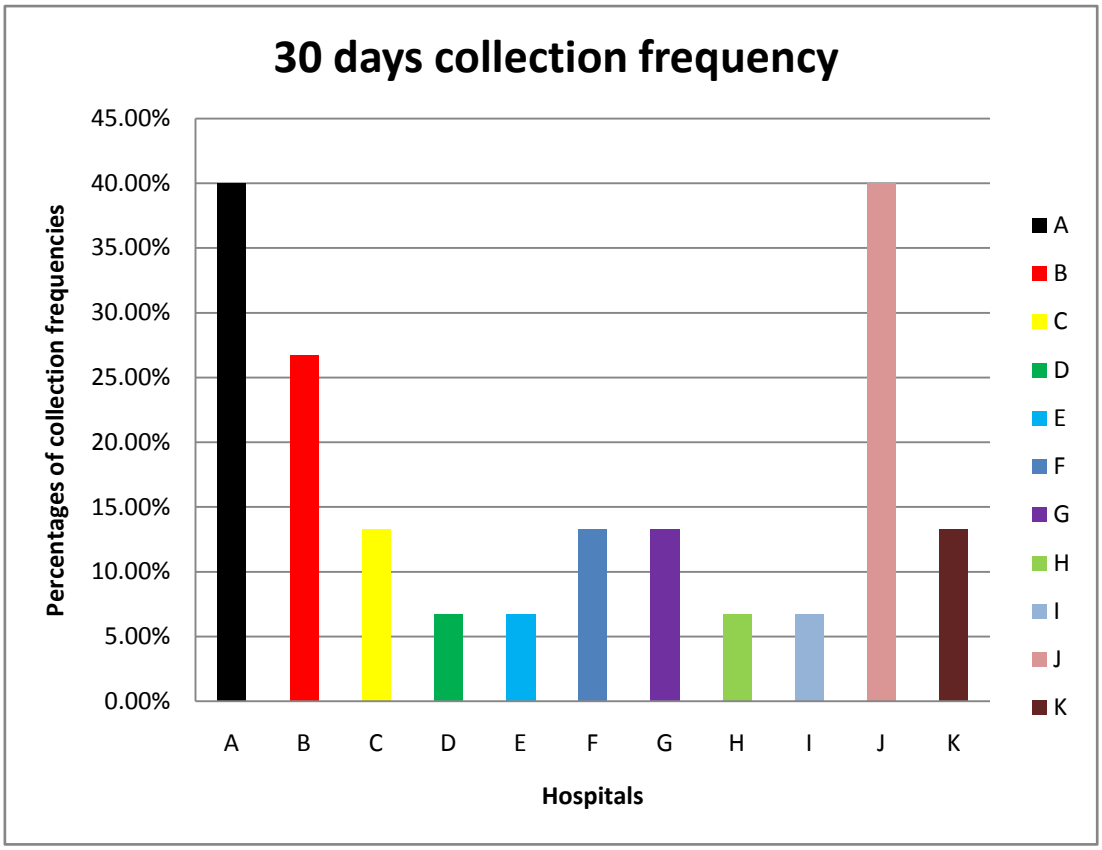

Figure 3.2: HCW collection frequency by an outsourced service provider

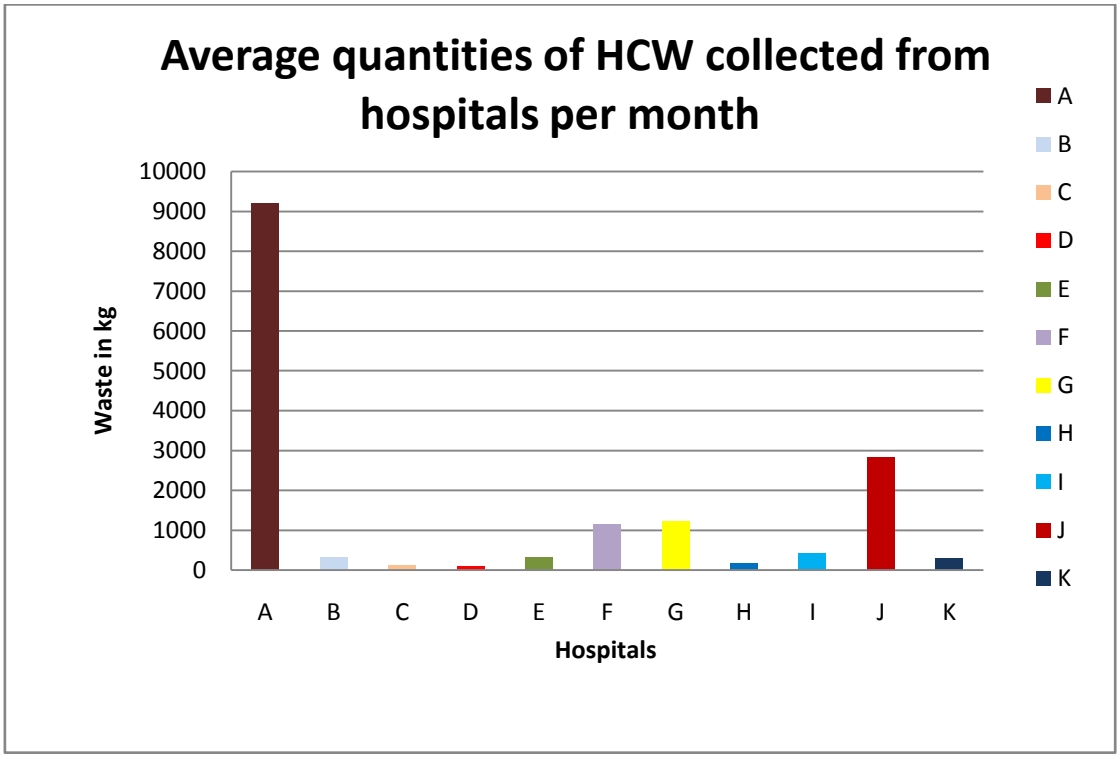

Figure 3.3: Average quantities of HCW collected from hospitals per month

The collection frequencies as indicated in Figures 3.1 and 3.2 show that the factor influencing the collection schedules of HCW in each hospital could be associated with the total HCW generation rates. The highest collection frequency occured at hospitals A and J with 12 out of the 20 working days of the month. The second highest collection frequency occurred at hospital B with eight days collection which differs from the rates at the rest of the hospitals. Most HCW collections were done twice (hospitals D, E, H and I) and four times (hospitals C, F, G and K) over the 20-day collection period.

These results revealed that the HCW collection frequencies in the Northern Cape hospitals adhered to the WHO guidelines but did not comply with the SANS codes and UNEP guidelines. The broad WHO guidelines stipulate that a HCW collection routine programme should be established as part of the HCW management plan (WHO, 1999:64), but these guidelines do not stipulate the frequency. Al-Khatib and Sato (2009) also conducted a study in the West Bank, Palestinian territory, and reported that solid health care waste was collected one to three times a week. However, the United Nations Environment Programme (UNEP) recommends that all categories of HCW should be collected every second day (UNEP, 2003:27). The time limits for storage of health care waste between generation and treatment as stipulatedin the South African National Standards are 24 hours for pathological waste, 72 hours for infectious waste, 90 days for sharps waste and 90 days for pharmaceutical waste (SANS, 2008:29). Any HCW maybe stored at -2 ºC for 90 days, according to SANS codes. Therefore, if HCW that contained pathological waste was only collected twice a week, it was in serious contravention of SANS.

3.3.6 Different types of HCW generated per hospital

It was observed that different types of health care waste were generated at the various hospitals. Most literature classify health care waste as “any waste generated at the health care establishments” (UNEP, 2003; WHO, 2004). Seven of the waste types or categories generated at health care facilities are sharps, general refuse, anatomical parts, infectious non-anatomical products, cytotoxic products, pharmaceutical products and radioactive products (SANS: 2008:29).

Question two of the questionnaire surveyed the types of health care waste generated in the NC DoH facilities.

Table 3.5: Types of HCW generated at each hospital under study

Waste Types	A	B	C	D	E	F	G	H	I	J	K
Infectious non-anatomical	X	X	X	X	X	X	X	X	X	X	X
Sharps	X	X	X	X	X	X	X	X	X	X	X
Anatomical	X	X		X	X	X	X	X	X	X	X
Pharmaceutical	X	X	X	X	X	X	X	X	X	X	X
Cytotoxic	X						X		X	X	
Radio Active	X						X		X	X	X
General Refuse	X	X	X	X	X	X	X	X	X	X	X

Table 3.5 indicates that hospitals A, G, I and J generated all seven health care waste types. Hospital K generated all HCW types excluding cytotoxic waste, whereas,hospitals B, D, F and H generated five types of HCW which excluded cytotoxic and radio-active waste. Hospital C generated only three types of waste which were sharps waste, general refuse and infectious non-anatomical waste. All the hospitals generated sharpswaste, infectious non-anatomical waste, and general refuse waste.

Thisstudy revealed that certain types of health care waste were not generated in large quantities and were not being handled on a day-to-day basis. These types of waste included cytotoxic and radio-active waste. Alagoz and Kocasoy (2008) report that generation of radioactive waste in Istanbul accounted for only 0.21% of the total quantity of HCW generation. The one type of waste which was not given any attention in the Northern Cape Province was general refuse because of the different collection systems and the final treatment it undergoes.

3.3.7 Four HCW types generated during different seasons

The predominant HCW types in this study were sharps waste, anatomical waste, infectious non-anatomical waste and pharmaceutical waste. These four types of waste make up large quantities of all health care waste which poses a threat to humans and the environment (WHO. 2004).

It was important in this study to understand the pattern that waste generation followed in seasonal terms. The holiday season was classified according to the shool calender; thus December and January are classified as holiday periods (peak season) and February and March are classified as low season when schools are fully operational (SA Calendar, 2012). Data were collected in the peak season from December 2011 to January 2012 and in the low season during February 2012 and March 2012. The results are presented in Table 3.6.

Table 3.6: HCW generation during and after holidays

Waste types	After holidays (kg) (low season)	During holidays (kg) (peak season)
Sharps	5953,7	5731.5
Infectious	55490,3	53571.3
Anatomical	5267.2	5405.2
Pharmaceuticals	1358.8	1694.3
Total	68070	66402

The results in Table 3.6 show an increase of 222.2 kg (3.8%) of sharps and 1 919 kg (3.6%) infectious non-anatomical waste generation respectively after the holidays. The results further indicate a decrease of approximately 138 kg (2.6%) anatomical waste and a significant decrease of 1668kg (19.8%) pharmaceutical waste after the holidays respectively. When comparing the seasons as depicted in Table 3.6, it indicates that there was an average increase of 1 668 kg (2.5%) of HCW after the holiday season. When assessing the period shown in the table, the assumption was that because there would be more movement of people from one area to another and because of accidents during holiday seasons, generation of HCW might increase drastically when compared to low season periods. However, the results (Table 3.6) revealed a different scenario. While the expectation was that an increase of HCW generation would occur during the holidays, the unexpected decrease of 2.5% HCW was a surprise. Despite the insignificant difference, further research may be necessary to determine the factors impacting this phenomenon.

3.3.8 HCW segregation

GroundWork (2006) defines waste segregation as a process of separating different types of waste at the point of generation and keeping them isolated from each other.

An important aspect of health care waste management involves understanding the classification of different waste types. Classifying waste correctly provides a better understanding of the need for different containers to be used for different waste types. In addition, the potential hazards related to the transportation and treatment of HCW also emphasises the importance of selecting the appropriate containers for particular waste types. It is important to take cognizance of all the issues related to waste segregation needs into account when appropriate waste management strategies are developed. This will provide new systems of reducing quantities of waste to be treated through a cost effective and efficient management system. Four segregation methods are highlighted in Figure 3.3, Table 3.7 and Table 3.8.

3.3.9 Position of sharps waste containers

Most causes of needle prick injuries which occur in different hospitals and clinics, excluding poor segregation, can be attributed to the public gaining access to sharps containers shortages and inaccessibility by health care workers. The position at which sharps waste containers are placed is a contributing factor and plays an important role in decreasing or increasing needle pricks. The general placement criteria for sharps waste containers include accessibility, visualisation and obstacle avoidance (NIOSH, 1998). Three placement areas were identified in this study, which were the floor next to the bed, on the medication trolley, and inside the brackets mounted on the wall next to the bed. Responses to question eight identified the practices used in the hospitals selected in the study (Figure 3.3).

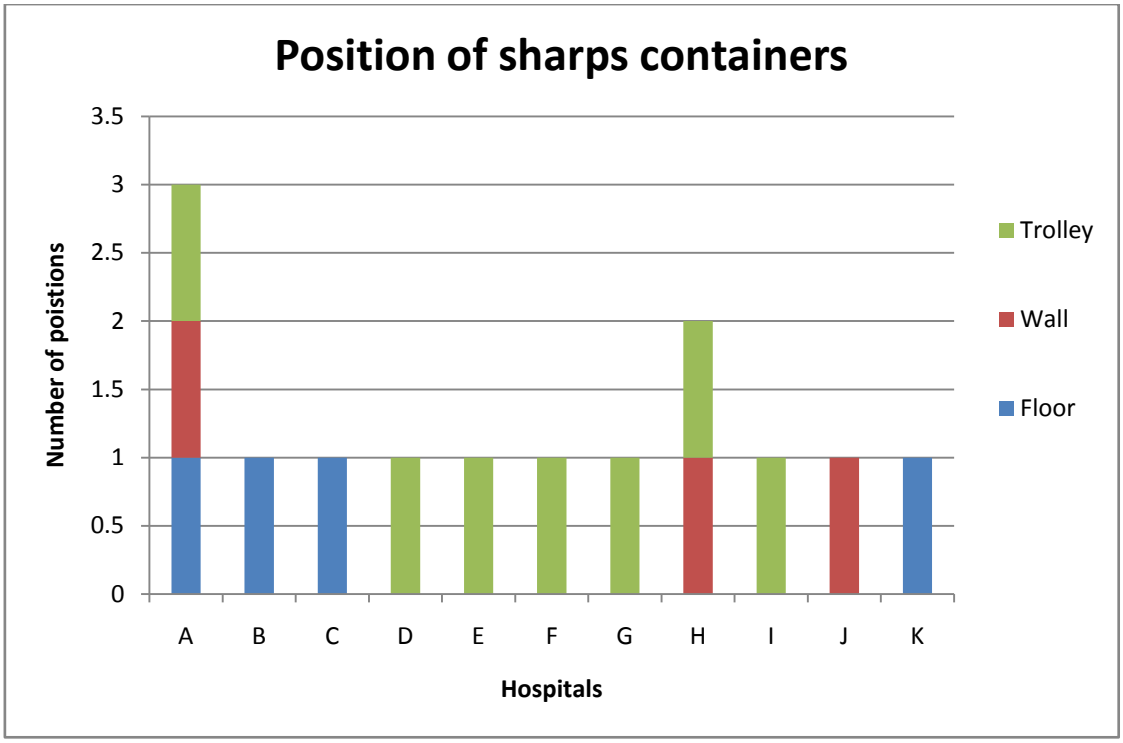

Figure 3.4: Position of sharps waste containers in hospitals

The results shown in Figure 3.3 indicate that in hospital A, the sharps waste containers were placed on the floor, on brackets on the wall and on trolleys. Hospital H placed the sharps containers on the floor and on trolleys, whilst hospitals B, C and K put the sharps containers on the floor next to the patients" bed. Hospitals D, E, F, G and I preferred medical trolleys and hospital J was the only hospital that preferred that the sharps containers be placed inside the brackets mounted on the walls next to the bed. The position of the sharps where sharps containers are placed after use is an important part of waste segregation and is integral in understanding the knowledge and practices of waste segregation. The National Institute for Occupational Safety and Health (NIOSH) propagates proper sharps disposal container location and placement, and it also provides guidelines to hospitals to ensure that containers are visible and within horizontal reach of the user (NIOSH, 1998).

Most national and international guidelines emphasise the importance of correct transportation of waste in hospitals and recommend carts and trolleys for HCW transportation. The Northern Cape hospitals did not comply with the safety measures as outlined in the NIOSH guidelines and this negligence exposed the

HCW handlers to risks associated with blood borne pathogens such as the Human Immuno Deficiency virus and the Hepatitis B and C viruses (UNEP, 2004:8).

3.3.10 Segregation practices per hospital

The results indicated that in all the hospitals included in the study, four types of waste were generated which included sharps waste, anatomical waste, infectious non-anatomical waste, as well as general refuse and pharmaceutical waste. The recorded responses to questions 11 to 14 assessed the segregation of sharps and pharmaceutical waste in these hospitals. A summary of the results is presented in Table 3.7.

Table 3.7: HCW segregation status of hospitals under study

Waste	Yes	No
Sharps n (%)	7 (63.6)	4 (34.4)
Infectious waste n (%)	7 (63.6)	4 (34.4)
General waste n (%)	7 (63.6)	4 (34.4)

(n=11)

Anatomical and pharmaceutical wastes were two of the waste types that were most commonly segregated at all hospitals in the study. All these hospitals generally segregated these two types of waste correctly. The responsibility of the management (segregation, containerisation and disposal) of pharmaceutical waste was vested with the pharmacists while anatomical waste was found mainly in the operation theatres and in the maternity wards was the responsibility of the theatre and maternity nursing staff. It was found that seven (63.6%) of the eleven hospitals complied with the SANS codes relating to segregation of sharps waste. General refuse and infectious waste was handled in the same efficient manner (Table 3.7).

A colour-coding system is important in the segregation of waste process and different national and international guidelines apply similar colour coding for similar waste types. The sharps waste container is a yellow puncture-proof

container marked “sharps”, the anatomical waste container is a yellow plastic bag or container, and the infectious waste container is yellow and marked “highly infectious”. The chemical and pharmaceutical waste container is brown and the general health care waste container is a black plastic bag (UNEP,2003 and WHO,1999). The South African National Standards recommend similar colours for HCW containers in South Africa, except for infectious waste where impermeable red colour containers are recommended, green containers are recommended for chemical and pharmaceutical waste (SANS, 2008:22). The assessment of the health care workers regarding the segregation of waste in colour-coded containers in the selected hospitals could not rated “poor” at 63.6% (Table 3.7). However, negative attitudes and shifting of responsibility from general workers to nurses and from nurses to doctors were identified as the main reasons for the finding of 34.4% non-compliance as shown in Table 3.7.

3.3.11 In-house storage areas

The in-house storage area referred to in this study included any area inside the hospital building where waste was temporarily stored before it was removed to an on-site storage area. Most hospitals used such sites because there was no personnel available to remove the waste to an on-site storage area. Some hospitals used in-house storage areas because on-site storage areas were not secured and as a consequence members of the public and rodents might gain access to them. The SANS 10248 code defines a storage area as “a suitable location or facility for the placement of waste” (SANS, 2008:28). Such storage areas are therefore temporary storage areas situated in an area where the risk of contamination of the main operations of that area and the medicines, foodstuffs, textiles, employees, patients and visitors are mininmised (SANS, 2008:28).

Question 15 assessed the compliance of hospitals in the Northern Cape with the provision of in-house storage areas for HCW.

Table 3.8: In-house storage areas

Facilities	Yes	No
Storage area n (%)	7 (63.6)	4 (36.4)

(n=11)

Results recorded in the study indicated that seven (63.6%) hospitals had in-house HCW storage areas (Table 3.8). The location and nature of these in-house storage areas differed from one hospital to the other. Some hospitals were found to use toilets as in-house storage areas whereas others used sluice rooms or space in a linen room, as a HCW storage room. The recorded results (Table 3.8) therefore indicated that hospitals in the Northern Cape Department of Health did not comply with the SANS codes in this regard. The United Nations Environmental Programme and World Health Organisation recommend the immediate removalof HCW containers when they are full to the on-site storage areas and discourage any accumulation of HCW at the point of generation (WHO, 1999:64; UNEP, 2004:15).

3.3.12 Proper labelling of HCW containers

The application of colour coding and labelling in waste management “aims to ensure an immediate and distinctive identification of the origin and hazards associated with the type of HCW that is handled or treated” (UNEP, 2004:14). One of the most important aspects of HCW management is the accountability and responsibility of hospital managers and staff for the correct handling of all types of waste. The policy and standard operational procedures are only followed when people accept responsibilities as outlined in their job descriptions. Proper management of HCW can be done if hospital staff in the various sections are able to identify or distinguish their own waste amongst other waste generated by other hospitals. The origin of particular waste can be determined through proper and approprate labelling or marking of waste containers. The system of labelling assists management to immediately identify incorrect practices and to identify areas and places which should be targeted for corrective measures and future development and planning. Question 16 assessed the labelling practices of the hospitals in the province.

Table 3.9: Container labelling per hospital

Facilities	Yes	No
Container labelling n (%)	6 (54.5)	5 (45.5)

(n=11)

The results recorded in the study (Table 3.9) indicated that only six (54.5%) of the eleven hospitals were labelling their HCW containers, even though details of labelling varied from one facility to the other. The colour coding and international hazardous or infectious signs and marking which indicate that waste containers should be handled with "caution" are some of the labelling properties required to comply with the recommendations for HCW by UNEP, SANS and WHO. The Regulations Governing Solid Waste (RGSW) (1999) stipulate the following to be included when labelling infectious waste:

- the name, address and business telephone number of the waste generator;
- an international hazard sign; and
- if it is pathological waste it should include information about the content of the container (RGSW, 1999).

The results as provided in Table 3.9 shows non-compliance with RGSW regarding proper labelling of HCW in the hospitals under study.

3.4 Discussion

It was revealed in this study that the generation quantities of health care waste from inpatients could not only be associated with the number of beds, as may have been thought. According to Jang *et al.* (2006) and Hassan, Ahmed, Rahman and Biswas (2008), quantities of medical waste depend upon several factors, such as the size of healthcare facilities, segregation programmes of medical waste, medical waste activities, the economy, social and cultural status of the patients, and the general conditions where the hospital is situated. In addition to other research findings, the assessment of the hospitals in the

Northern Cape Department of Health showed that HCW generation rates, especially in terms of inpatients,were not influenced by the number of beds in hospitals. A similar study by Tsakona, Anagastopoulou and Gidarakos *(*2006) found the generation of infectious waste of 1.9 kg/bed per day inhospitals in Greece in comparison with the generation of 3.37 kg/bed per day from selected hospitals in NC DoH. Based on these findings, it was concluded that there were no unconditional factors that indicated what the actual contributors to HCW generation rates at the hospitals under study were.

Health care waste generation was also assessed in this study by comparing the 179 other health care facilities" generation rates to those of the 11 selected sites. The results of the assessment showed that an average of 259 886 patients received treatment from all these other public health care facilities in a four-months period compared to 26 991 patients who were treated at NC DoH hospitals, according to the District Health Information System (DHIS) (South Africa, 2003). The analysis revealed that the 11 hospitals generated HCW quantities at a rate 75.8% more than the public health care facilities. A study done by Shinee *et al.* (2008) recorded similar results where the medical waste generation rate per day per kg/patient/day was higher in a tertiary hospital than in the secondary level health care facilities.

It is common practice to take the quantities of HCW generated into account when developing HCW collection schedules. The study showed that where there were larger quantities of waste generated, the service provider increased the collection frequency. Storage facilities are sized according to the volume of waste generated and the frequency of collection (UNEP, 2004:16). The collection frequency of HCW in the NC DoH hospitals was associated with the generation quantities.

It is acknowledged that all health care waste types in this study were classified according to WHO guidelines. However, further research is still required to assess other category or types such as radio-active waste and cytotoxic waste in terms of heath care waste generated in various facilities. Research conducted by Jang *et al.* (2006); Park, Lee, Kim, Lee, Seong and Ko (2009); Patil and Shekdar (2001) and Shinee *et al.* (2008) also concentrated mainly on four types or

categories of health care waste. These four types of HCW were sharps waste, anatomical waste, infectious non-anatomical waste and pharmaceutical waste, which were also evaluated in this study.

The study assessment of the NC DoH also investigated the pattern of health care waste generation in terms of different seasons. There was an increase of about 2.5% in the quantities of HCW generation after the holiday season. However, this increase may not require any special strategic planning in addressing unforeseen risks related to HCW generation activities, as the increase appeared to be minimal.

The hospitals under study in the Northern Cape Province all used the public health care facilities colour-coding system to identify containers for different waste types. This showed compliance with SANS (2008) which states that the packaging for health care risk waste should be clearly marked with appropriate colour codes and the appropriate international infectious hazard labels. The colour coding used in the study was according to the colour coding prescribed in the SANS (2004).Yellow colour is used for sharps disposal containers, black for general refuse, red colour-coded plastics for infectious non-anatomic use, red puncture proof containers for anatomical waste use, and green containers are used for pharmaceutical waste. The WHO (1999) recommends that brown is usedfor pharmaceutical waste containers and yellow for infectious waste containers. The international infectious hazard label or symbol has to be displayed on all containers. The study revealed that the NC DoH hospitals used the SANS (2004) colour coding system.

National Institute for Occupational Safety and Health (NIOSH) has identified several factors that increase sharps injuries (NIOSH, 1998). Inadequate design of the container and inappropriate placement of the sharps disposal containers were amongst these factors. The correct location of the sharps disposal containers (i.e. placement which should be clearly visible and be within easy horizontal reach of the user) is recommended. This study found that only one hospital complied with NIOSH recommendations in terms of the position of sharps waste containers.

Segregation of HCW is a key factor to ensuring effective health care waste management. The proper disposal of HCW can only be achieved when proper segregation has taken place. Personnel safety is also achievable and harming the environment is minimised as a result of segregation. Segregation of HCW ensures that few and appropriate resources are used during the recycling process (UNEP, 2003). Therefore, as only 63.6% of the hospitals in the NC DoH segregated the sharps waste correctly (Table 3.8), greater effort is still required to improve segregation practices in order to reduce the potential for harm to handlers, the general public and the environment.

In South African legislation, labelling is well defined in terms of the size, style and layout of the required signs (SANS, 2004). The responsibility of labelling containers does not only end with the manufacturer of the containers, but also resides with each health care worker. Over and above the container labels, facilities should develop mechanisms that will easily identify the source where the waste type was generated, the date on which the container was sealed, and the name of the responsible person for the particular ward or clinic should be written on the container. The study revealed that only 54.5% of the hospitals in the NC DoH labelled the waste containers according to the SANS(2004) recommendations.

3.5 Conclusion

The study showed that the majority of the HCW assessed per month was generated and collected at the hospitals, which was much more than that which was generated and collected from other primary health care facilities in the region. Therefore, the number of patients visiting health care centers such as clinics in the NC DoH had little influence on the total HCW generation levels produced in the province. It is therefore important that when the NC DoH attempts to improve the HCW management strategies, the focus should be on hospitals because of their high HCW generation levels. The study also highlighted an important fact about the waste generation patterns during different seasons. It was concluded that HCW management is important throughout the year and therefore attention to appropriate HCW management strategies should be equally distributed over 12 months of the year. Moreover, more attention

should be given to all the components of segregation of health care waste, and not to select few.

REFERENCES

Al-Khatib, I. and Sato C. 2009. Solid health care waste management status at health care centers in the West Bank – Palestinian Territory. *Journal of Waste Management,* 29: 2398-2403.

Alagoz, A.Z. and Kocasoy, G. 2008. Determination of the best appropriate management methods for the health-care wastes in Istanbul. *Journal of Waste Management*, 28: 1227-1235.

El-Salam, A.M.M. 2010. Hospital waste management in El-Beheira Governorate, Egypt. *Journal of Environmental Management*, 91:618-629.

Enhancing Strategic Information Project (ESIP). 2012. GIS mapping applications.USAID and John Snow Inc. Available from:http://www.jsi.com/JSInternet/IntHealth/project/display.cmf?ctid (Accessed 12 May 2012).

GroundWork. 2006. The international POPs elimination project, Available from: http://wwww.ipen.org//pepweb1/library/ipep/ (Accessed 23 May 2012).

Hassan, M.M., Ahmed A.S., Rahman, K.A. and Biswas T.K. 2008. Pattern of medical waste management: existing scenario in Dhaka City, Bangladesh. *Journal of BioMed Central Public Health*, 471:471-2458-8-36.

International Solid Waste Association (ISWA). 2011. Health-care waste. Technical policy no 11,. Available from: http://www.iswa.org (Accessed 07 April 2012).

Jang, Y.C., Lee C., Yoon, O.S. andHwidong, K. 2006. Medical waste management in Korea. *Journal of Environmental Management*, 80:107-115.

Johannessen, L.M., Dijkman, M., Bartone, C., Hanrahan, D., Boyer, M.G. and Chandra, C. 2000. Health care waste management guidance notes. Health nutrition and population. Washington:International Bank for Reconstruction and Development, World Bank.

Levin, K.N. 2006. Study design III: cross-sectional studies. *Journal of Evidence-Based Dentistry*, 7: 24-25.

Local Government Handbook (LGH). 2013. A complete guide to municipalities in South Africa, Available from: http://www.localgovernment.co.za/districts/view/37 (Accessed 19 September 2012).

National Institute for Occupational Safety and Health (NIOSH). 1998. Selecting, evaluating, and using sharps disposal containers. DHHS (NIOSH), Publication No. 97-111.

Otto, K. and Clemens, J. 2008. Survey of generation rates, treatment capacity and minimal costs of health care waste in the nine provinces of RSA, Department of Environmental Affairs and Tourism. Available from: http://www.sawic.org.za/documents (Accessed 12 March 2012).

Park, H., Lee, K., Kim, M., Lee, J., Seong S.Y. and Ko, J. 2009. Detection and hazard assessment of pathogenic microorganisms in medical wastes. *Journal of Environmental Science and Health*, 44:995-1003.

Patil, A. and Shekdar, V. 2001. Health care waste management in India. *Journal of Environmental Management*, 63:211-220.

Ramokate, T. 2007. Knowledge and practices of doctors and nurses at a large academic hospital in the Gauteng Province about management of health care waste. Dissertation. Faculty of Health Sciences,Medical School niversity of Witwatersrand, Johannesburg: 19-23**.**

Regulations Governing Solid Waste (RGSW). 1999. Special waste management, section 11. Available from: http://www.epa.gov/solidwaste/nonhaz/industrial/medial/mwpdfs/deleware/1-pdf (Accessed 20 March 2013).

Shinee, E., Gombojav,E., Nishimura, A., Hamajima, N. and Ito K. 2008. Health care waste management in the capital city of Mongolia. *Journal of Waste Management* 28:435-441.

South Africa.National Environmental Management Act. 2008. *Waste Act No. 59 of 2008 (NEMWA). Government Gazette. No. 32000.*Cape Town. Government Printers*.*

South Africa. National Department of Environmental Affairs and Tourism (DEAT). 2009. *A framework for the national waste management strategy (NWMS),* Cape Town. Government Printers*.*

South Africa. National Department of Health (DoH). 2003. District health information system (DHIS). Available from: http://doh.gov.za/nhis (Accessed 17 March 2012).

South African Calendar. 2012. Available from: http://wwww.kwathabeng.co.za/travel/SouthAfrica/destinations.html (Accessed 17 February 2012).

South African National Standards (SANS). 2004. *Management of health care waste,* SANS10248, Pretoria. Standards South Africa (division of SABS).

South African National Standards (SANS). 2008*. Management of health care waste, Part 1: management of health care risk waste from a health care facility* SANS10248-1, Pretoria. Standards South Africa (division of SABS). .

Statistical Analytical Software (SAS). 2013. SAS/Stat (R) 92 users‟ guide (2nd ed.). Available from http://www.support.sas.com/en_us/software/analytics.html (Accessed 21 May 2013).

Steel, K. 2007. Definitions/purposes for the modes of writing. Available from http://www.kimskorner4teachertalk.com/writting/modes/definitions.html (Accessed 13 June 2012).

Tsakona, M., Anagastopoulou, E. and Gidarakos, E. 2006. Hospital waste management and toxicity evaluation: a case study. *Journal of Waste Management*, 27:912-920.

United Nations Environmental Programme (UNEP). 2003. *Technical guidelines on the environmental sound management of biomedical and health care waste (Y1:Y2).* Secretary of the Basel Convention International Environmental House, Switzerland. United Nations Environment Programme.

United Nations Environmental Programme (UNEP). 2004. *Preparation of national health care waste management plans in Sub-Saharan countries: guidance manual.* Secretary of Basel Convention and World Health Organisation, Switzerland. United Nations Environment Programme.

World Health Organisation (WHO). 1999. *Safe management of wastes from health care activities.* Geneva. World Health Organisation.

World Health Organisation (WHO). 2004. Safe healthcare waste management, policy paper. Available from: http://www.healthcarewaste.org (Accessed 7 May 2012).

World Health Organisation (WHO). 2007. *WHO core principles for achieving safe and sustainable management of health care waste*. Report on the international meeting on health care waste held in Geneva 20-22 June 2007, Prepared by Jorge Emmanuel for World Health Organisation, Switzerland. World Health Organisation.

CHAPTER 4

HEALTH CARE WASTE MANAGEMENT TEAMS AND ON-SITE STORAGE AREAS IN THE NORTHERN CAPE DEPARTMENT OF HEALTH

ABSTRACT

A comprehensive HCW baseline audit or assessment is important and should be first priority in all hopitals and health care facilties. The HCWmanagement asessments forms the basic steps towards a turn-around strategy for every hospital or health facility in pursuing public and workers‟ safety, as well as environmental and occupational safety.

The aim of the study was to determine the current HCW management performances in the Northern Cape Department of Health in terms of safety, efficiency, environmental impact assessment and regulatory compliance with available waste storage areas for selected hospitals.

The investigation was conducted in 11 hospitals of the Northern Cape Department of Health. Interviews were conducted with relevant personnel using structured questionnaires. The respondents consisted of Hospital Managers, Occupational Health Nurses, Infection Prevention and Control Nurses and Hospital Ward Managers. HCW management practices were also observed during walk-through surveys as one of the data collection tools utilised in this study.

The results showed that none of the eleven (11) selected hospitals had appointed all four categories of personnel responsible for HCW management on a full-time basis. It was noteworthy that none of them appointed Waste Management Officers. Training for HCW handlers occured at three (27.3%) of the hospitals and HCW management plans were developed by five (45.5%) of the hospitals. The survey showed that Occupational Health Services, which included four basic services, were not fully compliant with as these basic services were categorised under OHS in only four (37.4%) hospitals. Moreover, the designated storage areas did not comply with the legislation governing storage of HCW as only one hospital complied with five basic requirements recommended for storage areas.

Shortfalls within the Northern Cape Department of Health which impacted negatively on the annual Auditor General`s (2010/2011) report were also recorded. It is important to ensure that personnel responsible for health care waste management are included at the highest decision making level where HCW issues should be elevated and prioritised. Integration of and collaboration among different programmes when physical structures such as hospitals are designed are very important in ensuring that those aspects which may be ommited as a result of ignorance are considered and applied, for example conditions relating to compliant designated storage area.

Keywords: Health care waste, storage areas, safe, occupational health services

4.1 Introduction

This chapter focusses on the resources that should be available for health care waste (HCW) management. Every generator of HCW, especially hospitals, is required to have a comprehensive HCW management plan (UNEP, 2004). A HCW management plan assists the management of a health facility in identifying shortfalls relevant to their specific institution. Facility managers can identify training needs relevant to HCW when management plans are in place and these plans should be reviewed frequently by the HCW management team. Clear allocation of responsibilities is imperative in attaining complete health care waste management. Appointed personnel and a nominated HCW committee responsible for the day-to-day management of HCW are important. Occupational health and safety in the management of HCW is crucial in matters such as exposure to sharps in all health care institutions. For example, the use of correct PPE when handling HCW and when vaccinating patients against the Hepatitis virus can only be effectively handled when sound occupational health services (OHS) are provided (WHO, 1999). The public must be protected from any hazards associated with HCW by ensuring that HCW storage areas are not accessible to everyone other than assigned staff. All storage areas should be suitably sited, lockable, should be kept under hygienic conditions, and should disply international hazard signs posted on their doors or walls (ISWA, 2007).

4.2 Methodology

The investigation was designed as a descriptive cross-sectional design. A cross-sectional study design is often conducted to estimate the prevalence of the outcome of interest for a given population, commonly for the purposes of public health planning. If the study is descriptive and is conducted in the form of a survey, it is sometimes carried out to investigate associations between risk factors and outcome of interest (Levin, 2006).

4.2.1 Study site and characteristics

The Northern Cape Department of Health (NC DoH) has a total of 179 health care facilities which include 129 clinics, 33 community health care centers and 17 hospitals within five districts. The facilities selected for the research included (A)

a provincial tertiary hospital, (B) a day care hospital and (C) a mental hospital which are all situated in the Frances Baard district. The HCW facilities identified in the four districts in this study included hospitals (F) and (G) in the John Taolo Gaetsewe district, hospitals (D) and (E) in the Pixley Ka Seme district, hospitals (H) and (I) in the Namakwa district, and hospitals (J) and (K) in the ZF Mcgawu district. Frances Baard is the provincial head quarters of the province where legislature is located and where the tertiary hospital is situated.

Eleven of the 17 hospitals in the NC DoH were assessed. A simple stratified sampling method was used which was in line with the type of sampling required for modelling procedures when there are more than one elements in a population. The product multi-nomial distribution was used to estimate a probability vector and its co-varience matrix. The sample size was large and the probability vector was approximately normally distributed as a central limit theory (SAS, 2010). The sample (11 hospitals) constituted a 64.7% representation of the total population of 17 hospitals.

A brief description of each hospital is provided:

Hospital A

Hospital A is a tertiary hospital which has the highest number of beds of all the hospitals in the province. Because the hospital is the largest hospital in the province, it has the capacity to attend to an average of 12 011 patients per month. Hospital A is the referral point of all public health care facilities where all the specialised medical services are provided in the province. These specialised services include a renal dialysis unit, an intensive care unit, a paediatrics unit, a neonatal units, laboratory services, a chemotherapy unit, and surgical and radiology units. Non-specialised units located in this hospital and many other surveyed hospitals include medical units, surgical units, out-patient units, maternity units, dental units, and theatre and other general health care services.

Hospital B

Hospital B is a general hospital which specialises in termination of pregnancies in the Frances Baard district and provides other maternity services. This hospital is situated in close proximity to the private and tertiary hospitals. Because of its

proximity to other hospitals, its patient turnover is low. A high rate of anatomical and infectious non-anatomical waste is regularly generated at this hospital.

Hospital C

Specialised services which include mental health services and tuberculosis (TB), multi drug resistant tuberculosis (MDR) and extreme drug resistant tuberculosis (XDR) treatments are the core business of hospital C, which is also situated in the Frances Baard district. It is the referral hospital for TB and mental patients in the province. It has a low generation rate of waste per bed which could be attributed to the type of patients which are admitted regularly to this hospital.

Hospital D

Hospital D was the smallest hospital included in the survey. It is situated within a population of about 16 601 in the Pixley Ka Seme District municipality (Local Government Handbook (LGH), 2013). This hospital provides general health care services and does not provide specialised services. Any complicated health care services requiring the attention of a specialist cannot be provided in this hospital; such patients are referred either to hospital E or hospital A.

Hospital E

Although it is the biggest hospital in the Pixley Ka Seme district and provides various services, this hospital is surrounded by a few smaller hospitals in other municipalities. It serves a population of at least 42 356 (LGH, 2013). Because of it being the biggest hospital in this district, it serves as a referral point for other smaller hospitals. Different health care services are rendered at this hospital.

Hospital F

Hospital F is one of the few hospitals in the John Taolo Gaetsewe district and it is situated close to the urban area, whereas Hospital G is situated in the rural part of the district. The population surrounding this hospital is estimated at 93 652 (LGH, 2013). This hospital renders a few specialised services such as radiation and a theatre, and it has a state mortuary where post-mortem examinations are conducted, even for other nearby districts.

Hospital G

This hospital is situated in an area with an estimated population of 89 530 (LGH, 2013). This hospital provides similar services to hospital B, meaning that it renders termination of pregnancy, circumcision, and maternity services. The hospital renders other general health care services in the rural areas of the district.

Hospital H

This hospital is surrounded by a relatively small population estimated at 21 578 (LGH, 2013). This hospital is situated on the boundary of the province in the south of the Namakwa district and it is approximately 400 km from main centres such as Cape Town, Upington, Springbok and Beaufort West (LGH, 2013).

Hospital I

This hospital is the main service centre for health care services in the north west of the Namakwa district. It is a major health care centre for a population of approximately 47 041 in the north west regionof Namakwa (LGH, 2013). The hospital has a relatively small number of patients admitted on a monthly basis as compared to other bigger district hospitals in the province.

Hospital J

This is the second biggest hospital in the province. The hospital is situated in the centre of the province in the ZF Mgcawu district and the patients are transported from the furthest districts of the province to this hospital. The population around the hospital is estimated at 93 494 (LGH, 2013). Being one of the biggest hospitals in this district and in the province, it renders different general health care services and certain specialised services.

Hospital K

Hospital K is situated not far from other smaller hospitals in the ZF Mgcawu district in the north east of the Northern Cape Province. It is situated towards the border of John Taolo and ZF Mgcawu. The population in the surrounding municipal area is estimated at 35 093 and the hospital caters for both urban and

rural communities as well as for miners working in the surrounding areas (LGH, 2013).

4.2.2 Survey method

A convenience sampling method was applied to ensure that each hospital in each district was used in the study to eliminate biased conclusions of the findings of HCW data in the districts. All the storage areas in the selected hospitals were identified and assessed for compliance with national and international guidelines. A random sampling method was also used to select different wards for the purpose of this study in each hospital. Quantitative data were collected by making use of a structured multiple questionnaire developed to identify the quantities of waste generated and the waste management practices used in the various hospitals. The participants responding to the questionnaire varied between the Hospital Manager, Infection Control Nurse, Occupational Health Nurse and Ward Manager in each hospital. A walk-through survey and interviews were also conducted during the study, and observations of the health care waste management practices and resources assesment were done. Data of the health care waste strategies observed and provided during the questionnaire data collection process at each hospital were recorded. The HCW information data provided by the service provider was also used to capture the quantities and types of waste generated in the different hospitals. The questionnaire was developed based on the principles of the health care waste management guidance notes of the HNP discussion paper (Johannessen, Dijkman, Bartone, Hanrahan and Boje, 2000).

4.2.3 Analysis

Descriptive analysis was used in the form of tables and graphs demonstrate different characteristics of the individually surveyed hospitals, and a descriptive narrative mode was employed in the evaluation of the results. The primary purposeof using the descriptive mode is to describe a person, place, or event so that the topic can be clearly seen in the reader"s mind, whereas the narrative mode describe an experience, event, or sequence of events in the form of a story (Steel, 2007).

4.3 Results

4.3.1 Staff allocation for HCW management

Proper management of HCW requires a well structured organogram in any health care facility (SANS, 2008). The HCW management team consists of the Hospital Manager, the heads of different wards, a Waste Management Officer, an Infection Control and Prevention Nurse, an Occupational Health Nurse, a HCW management representative and, in some instances the Head of Maintenance (WHO, 1999; UNEP, 2004 and SANS, 2008). To determine if the hospitals under investigation complied with the international standards as stipulated by WHO,UNEP and SANS requirements, questions one to five of the questionnaire explored the staff allocation responsible for HCW management in each hospital.

4.3.2 HCW management team per hospital

Data collection by means of a questionnaire focused on only four staff categories, namelyHealth Care Waste Management Officer (HCWMO), the Infection Control and Prevention Nurse (ICPN), HCW representatitve (HCWR), and the Occupational Health Nurse (OHN).

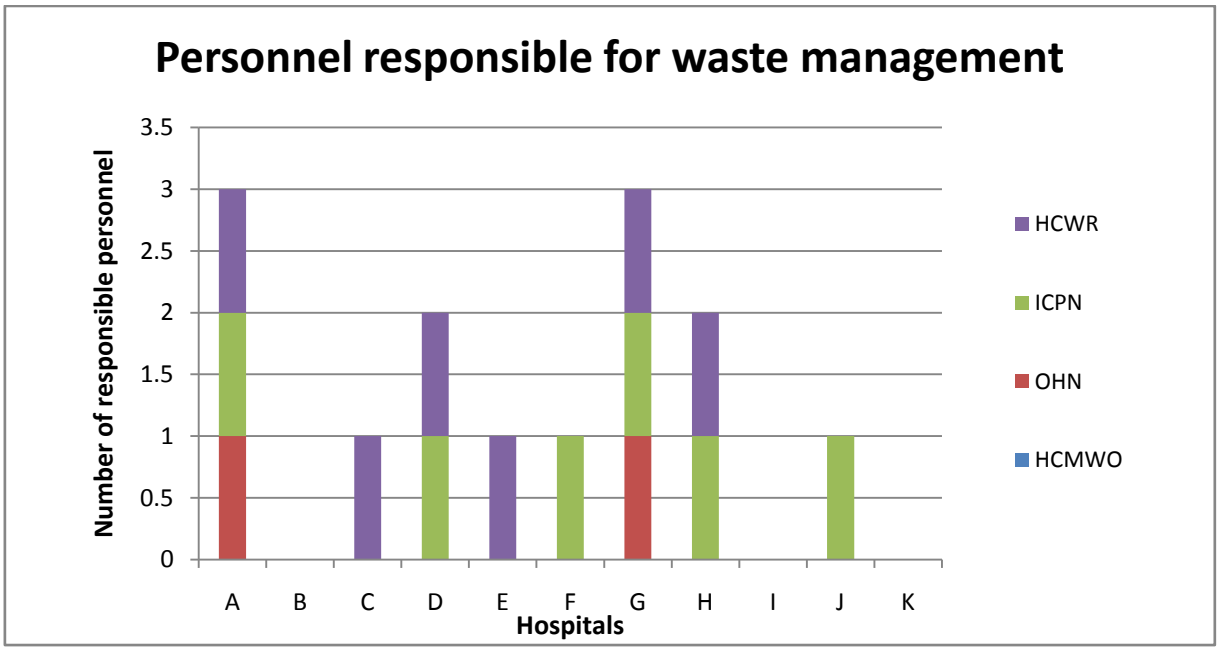

Figure 4.1: Allocation of staff responsible for the implementation of HCW management

The results presented in Figure 4.1 show that none of the eleven hospitals employed all four categories of the required staff members as stipulated by the SANS codes. The study found that no Waste Management Officer was employed by any of the hospitals. Hospitals A and G employed an Infection Control and Prevention Nurse, Occupational Health Nurse and HCW representative in their staff complement. Hospitals B, I and K did not have any appointed HCW management staff. Hospitals D and H each had a HCW representative and an Infection Control and Prevention Nurse. The remaining hospitals (C, E, F and J) either had a HCW representatives or Infection Control and Prevention Nurses. The three staff categories Waste Management Officer, Occupational Health Nurse and the Infection Control and Prevention Nurses are employees who require specialised formal training, whereas the representative is nominated, appointed and inducted after being identified. A major requirement in terms of staff responsible for HCW management according to regulations relating to the management of HCW in health establishment is the designation or appointment of appropriate officials by the owner or person incharge of the facility. Such appointees may be an Infection Control and Prevention Nurse, Occupational Health Nurse, Quality Control Nurse or Environmental Health Practitioner (South Africa, 2003).

Figure 4.1 shows non-compliance not only with national regulations, but also with WHO reccommendations. Similar studies conducted in the south-western region of Cameroon revealed that sanitation workers and nursing assistants were responsible for the collection and transportation of waste from the hospitals in the pubic sector (Manga, Forton, Mofor and Woodard, 2011). Although the staff complement for HCW management in the Northern Cape Department of Health was not fully compliant with WHO and UNEP reccommended standards, in comparison with the practices used in the south-western region of Cameroon, the hospitals in the Northern Cape performed better.

4.3.3 HCW management training per hospital

The overall aim of training is to develop awareness of the health, safety and environmental issues relating to health care waste and how this can affect employees in their daily work (WHO, 1999). It is important for every member

serving in the HCW management team to understand their individual roles. The HCW representative is a nominated position or is appointment and no specific qualification is required. The responsibility bestowed on those nominated members requires on-going training. Question six investigated whether HCW representatives nominated in the hospitals under study had been trained in HCW management issues.

Table 4.1: Training of HCW representatives

Job description	Yes	No
Trained handlers n (%)	3 (27.3)	8 (72.7)

(n=11)

Table 4.1 shows of the 11 hospitals under study, only three (27.3%) provided health care waste management training for their staff. The summerised results presented in Table 4.1 reflect poor HCW management by the NC DoH regarding health, safety and environmental issues affecting employees. All employees should be trained in HCW management and separate training activities that focus on the four main categories of HCW management personnel shoud be designed (WHO, 1999).

4.3.4 HCW management plans

An intergrated waste management system is an important tool to ensure a well functioning health care waste management, and the process of developing this system is achieved through waste management planning (DEAT, 2009). Waste management planning is functional only if the HCW management team has been established. The HCW management team should carry out a needs analysis of the facilities they are responsible for. The needs analysis will include priorities such as training programmes, resource allocation, procurement procedures,waste collection schedules and disposal and treatment strategies (SANS, 2004). The objectives of the plan are two-fold. According to the International Solid Waste Association, such a plan should provide an overview of existing waste management practices andshould further provide strategies for future programmes (ISWA, 2011).

Question seven to eleven investigated the availability and accessibility of a waste management plan in each hospital under study.

Table 4.2: HCW management plans per hospital

Facilities	Yes	No
HCW management plans n (%) (n=11)	5 (45.5)	6 (54.5)

Table 4.2 shows that five (45.5) of the 11 hospitals had developed HCW management plans; however, during the interviews, respondents indicated that these planswere not accessible to all staff members. he Northern Cape Department of Health thus did not comply with the reccomended standards for the development of HCW management plans as outlined by UNEP (2004) and the regulations pertaining to management of HCW in South Africa (South Africa, 2003). The HCW management plan also helps with the development of norms and standards for employee health and safety.

4.3.5 Occupational health services

Health care waste management policies or plans should make provision for the continuous monitoring of workers" and handlers" health and safety. Implementing occupational health and safety measures ensures that correct handling, treatment, storage, and disposal procedures are being adhered to (WHO, 1999). Occupational health services have an important role in WHO management. Poor HCW management has direct implications for the presence of bacteria thatare resistant to antibiotics and disinfectants in the health care establishments (WHO, 1999). The South African National Department of Health requires that all health care waste handlers be vaccinated against the Hepatitis B virus (South Africa, 2007). It is also important that all cases of needle prick injuries are well captured in the employee health records. In case of needle pricks, counselling services have to be provided to the exposed staff members and prophylactic treatment should commence within one to two hours of accidental needle prick or exposure (South Africa, 2004).

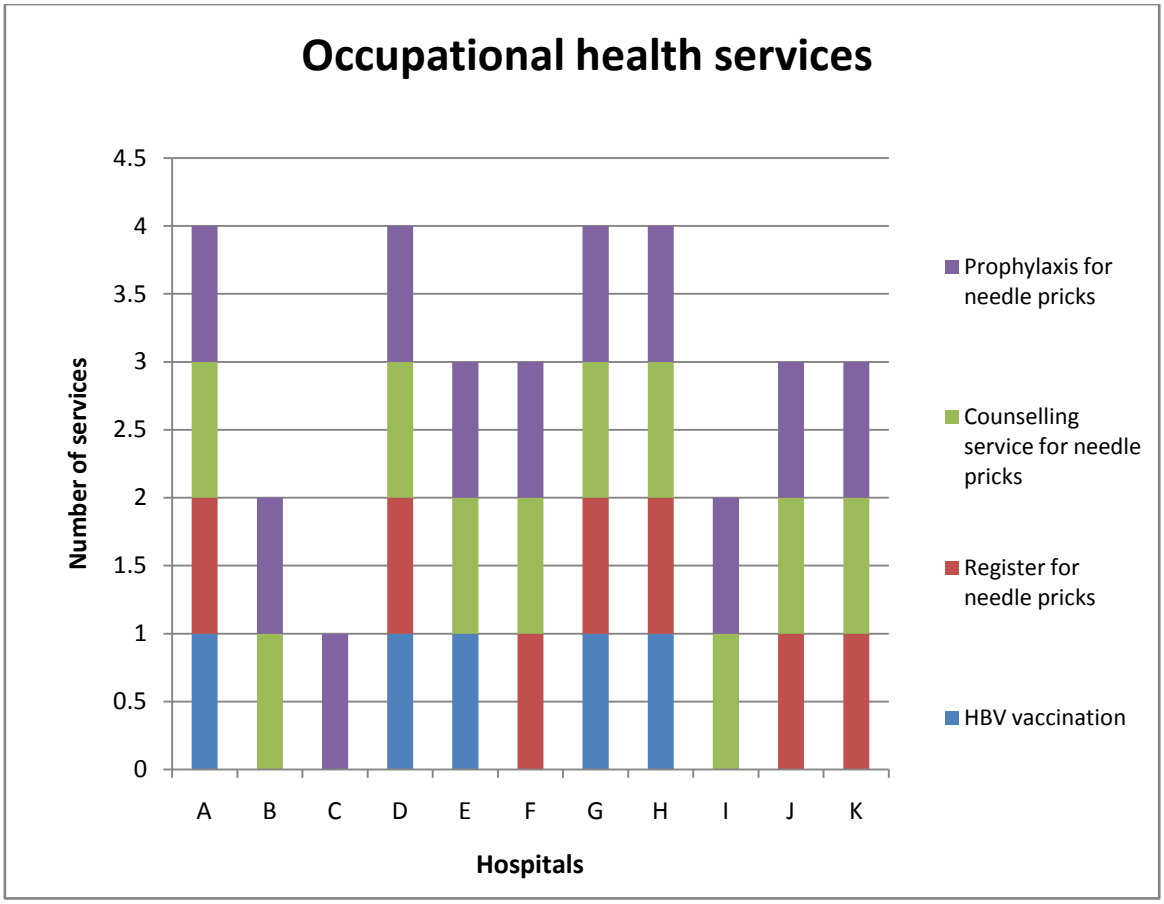

Figure 4.2: Occupational health services per hospital

Figure 4.2 shows that all the hospitals provided prophylaxis treatment for accidental needle prick victims. Five (45.5%) of the eleven hospitals had a Hepatitis B virus vaccination programme for personnel. Seven (63.6%) of the eleven hospitals had registers for needle prick injuries and the majority of the hospitals, 90.9% (10) provided counselling for accidental needle pricks injury victims.

Quality control measures require that all the four health and safety, infection control programmes should be in place all the time. The national policy and strategy on infection prevention and control in South Africa ensures a programme for national uniformity on issues such as; employee vaccination programmes, baseline employee health assessment, routine testing, post exposure prophylaxis and other related aspects (South Africa, 2007). However, poor compliance with national policy and strategy objectives in the Northern Cape hospital was evident, as depicted in Figure 4.2 .

4.3.6 On-site storage areas

Most of the hospitals had designated on-site HCW storage areas, which is a measure that is recommended for the storage of waste on a temporary basis. This waste then has to be retrieved, removed and transported to allocated treatment and disposal sites. These storage areas may not have been originally designed for purposes other than what they are used for. However, some of these areas were previously maintenance workshops, old incinerator areas and hospital records file storage areas. In some instances the walk-through survey revealed that old toilets were used for storing HCW. The study revealed that there were few facilities with properly designed designated storage areas. The United Nations Environment Programme advises authorities to have a dedicated storage area for HCW that is lockable with no possibility of animals/ insects gaining access (UNEP, 2004:16).

Question one to four determined whether the hospitals in this study were compliant with issues such as visually displayed hazard signs, lockable on-site storage areas, correctly demarcated waste storage areas, and whether these storage areas were under full-time supervision.

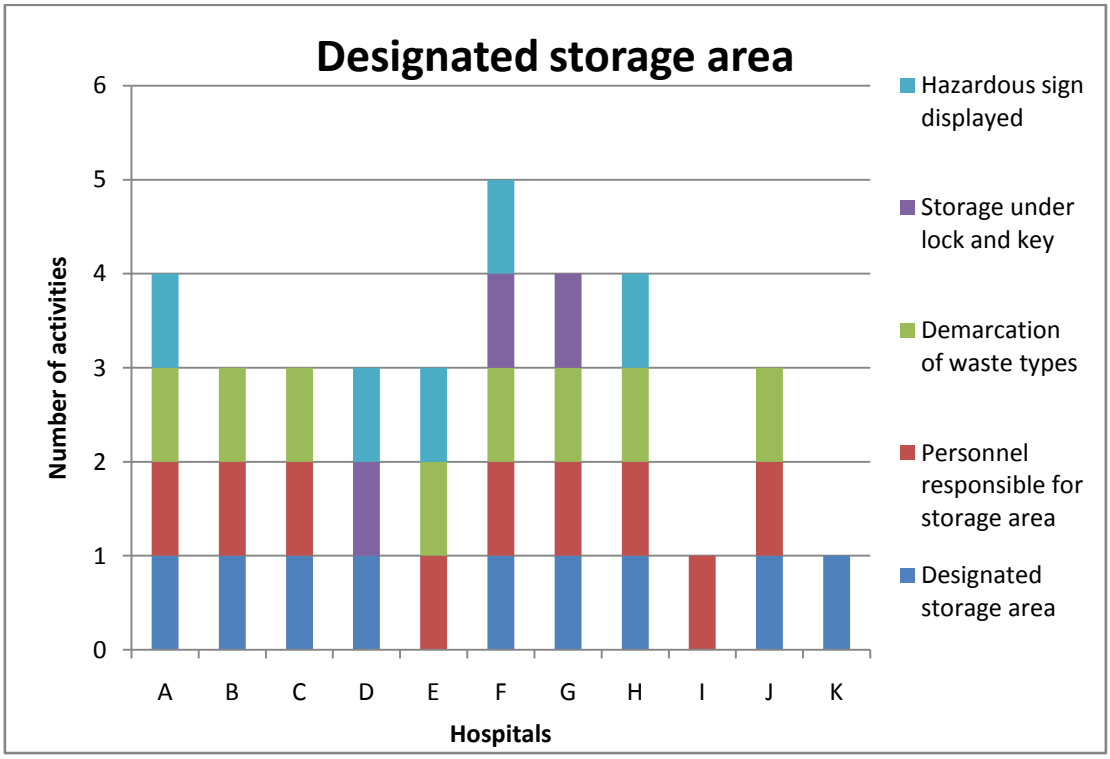

Figure 4.3: On-site storage facility per hospital

The responses relating to the on-site storage areas at the various hospitals (Figure 4.3) revealed that most hospitals had established a designated area for the storage of waste. The results indicated that at least nine (81.8%) of the hospitals (A, B, C D, F, G, H, J and K) had designated areas for waste storage; however, only five (45.5%) (A, D, E, F and H) of the hospitals included in the study,displayed international hazards signs. Both the responces to the questionnaire and walk-through observations indicated that eight (72.7%) (A, B, C D, F, G, H and J) of the hospitals had demarcated areas for different waste categories, but only three (27.3%) (D, F and G) of these hospitals ensured that the health care waste storage areas were securely locked. The nine hospitals (A, B, C D, F, G, H, J and K) that had designated on-site storage areas had a nominated person to manage the waste storage area. Alagoz and Kocasoy (2008) reported that most of the health care institutions in Istanbul had no temporary storage rooms or containers, and the Istanbul institutions that had storage rooms had rooms which were not constructed or operated according to the required regulations.In the Northern Cape hospitals in South Africa there was also non-compliance with regards to the storage facilities as required by the UNEP recomendations (Figure.4.3).

4.3.7 On-site storage conditions

When designing the on-site storage areas for healh care waste, it is important to consider several building requirements. The International Committee of the Red Cross (ICRC) alludes to the fact that if the storage times for HCW were extended under poor environmental conditions such as high temperature, humidity, lack of sunlight and minimal presence of disinfectant and organic substrates, health care waste will become a source of pathogenic micro-organisims (ICRC, 2011:19). Pathogenic micro-organism will create serious health risks in the hospitals and impact negatively on patient and health care workers (Park, Lee, Kim, Lee, Seong and Ko, 2009). Ventilation is important in improving air circulation and control of odours. Ventilation in the storage area can be provided by the inserting windows and air-bricks in the structure or installing a ventilator where necessary. Provision of natural light from the sun as well as artificial lighting becomes a requirement when constructing a storage area to ensure the safety of waste handlers and collectors. Smooth, light painted plastered walls provide easy cleaning with

disinfectant which prevents microbial growth on wall surfaces. Smooth, well paved floors with a drainage system provide an easy cleaning and spillage control system (SANS, 2008:28). The structure of the roofing of a health care waste storage area must be water-proof to ensure that boxes and plastic containers are not damaged. Such damage may cause tearing and difficulty when handling waste containers. All structures should prevent rodent access (SANS, 2008:28). Some facilities may have full brickwalls from bottom to top, whereas others may consist of half brick walls with wire mesh on top.

Question five assessed the storage conditions of the dedicated HCW areas in the hospitals under study.

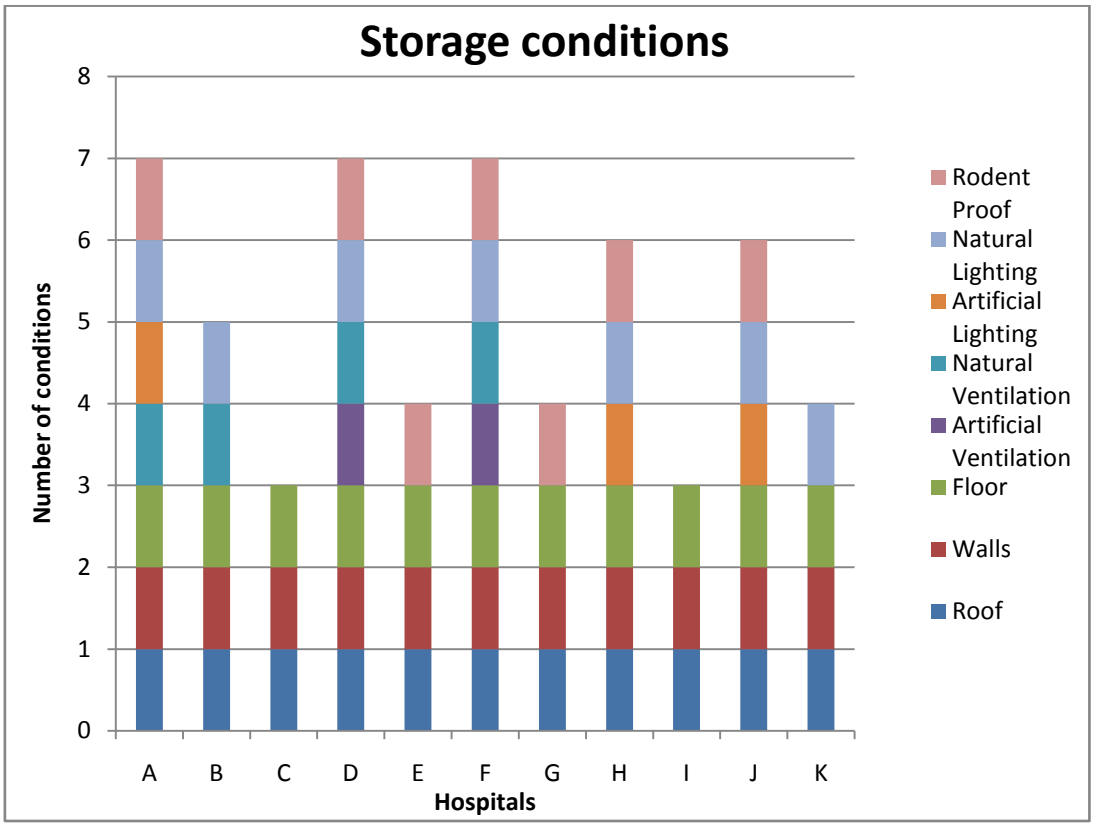

Figure 4.4: Conditions of on-site storage facilities per hospital

Figure 4.4 shows that the HCW storage areas in all hospitals had safe non-leaking roofing and they also had smooth plastered and painted walls with smoothly paved floors. Seven (63.6%)(hospitals A, B, D, F, H, J and K) of the eleven storage areas had natural lighting. Three (27.3%) (hospitals A, H and J) of the storage areas had artificial lighting. Only two (18.2%)(hospitals D and F) of the eleven storage areas had ventilators. Four (36.4%) storage areas

(hospitals A, B, D and F) had air bricks and openable windows for natural ventilation. Seven (63.6%) storage areas (A, D, E, F, G, H and J) were rodent proof.

The results shown in Figure 4.4 indicate that the storage areas for health care waste in the hospitals which falls under the auspices of the NC DoH did not fully comply with recommendations of SANS, WHO and UNEP.

4.3.8 Knowledge of HCW management

The knowledge of individual respondents in the study was assessed by means of a questionnaire using a rating system. Each hospital was represented by one respondent. The respondents were requested to indicate how they rated their knowledge and understanding of the concepts of HCW management. The following scale was provided, with knowledge ranging from very low (1) to very good (5).

- Rate1 = Very low
- Rate2 = Low
- Rate3 = Average
- Rate4 = Good
- Rate5 = Very Good

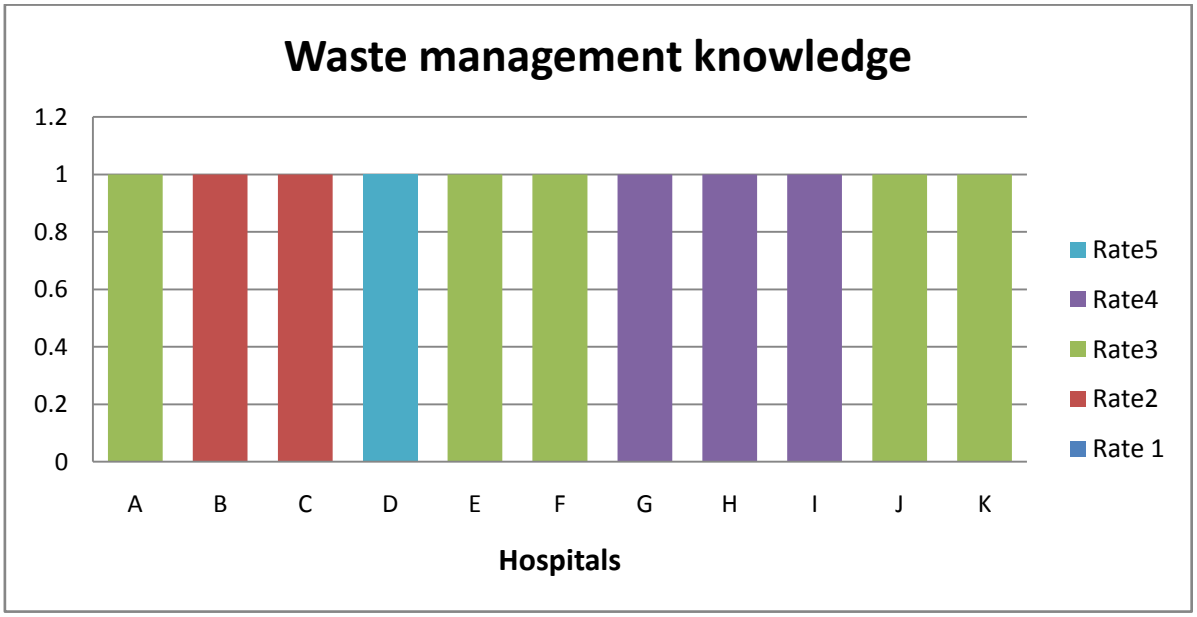

Figure 4.5: Personal knowledge rating of HCW management by staff

None of the respondents in any of the hospitals (Figure 4.5) rated their knowledge on health care waste management as very low, whilst the respondents in two hospitals (B and C) rated their general knowledge as low. The respondents in five hospitals (A, E, F, J and K) believed that their knowledge is average, while three respondents in three hospitals (G, H and I) rated themselves above average which is classified as good. Only one respondent (D) rated their knowledge of HCW management as very good.

4.4 Discussion

Health care waste management is firstly a management issue before being a technical one and is therefore completely dependent on the commitment of the entire hospital staff complement (UNEP, 2004:7). The results of the study showed that there was a lack of management support with regards to HCW management particularly because the allocation of personnel responsible for handling HCW management issues was inadequate. The appointment of HCW Management Officers, Infection Control and Prevention Nurses, Occupational Health Nurses and the nomination of HCW representatives in health care facilities is important and their roles should be seen as inter-dependent. Proper management of biomedical and health care waste is largely dependent on good administration and organisation (UNEP, 2003:40), which were both lacking in this study.

In addition to the provision of personnel protective equipment (PPE), broad occupational health and safety measures should be considered and the necessary preventative measures must be put in place in all health care facilities. Procedures which include HCW waste spillage protocols, emergency evacuation protocols, decontamination procedures, HBV vaccination, incidence report procedures, registers for needle prick injury, counselling procedures, post exposure prophylaxis treatment protocols and compensation for injuries on duty proceedures must be adhered to at all times. According to WHO (1999: 140-143) essential health and safety measures include;

- Proper training of health care workers
- Provision of equipment and clothing for personnel, and

- Establishment of an effective occupational health programme that includes immunisations, post-exposure prophylactic treatment, and medical surveillance.

This study showed that 81.8% of the selected hospitals had designated on-site storage areas for HCW. However, most of these storage areas had not originally been designated for the purpose of storing waste but had been converted to function as waste storage areas. It was also evident that many of the facilities failed to display international hazard symbols. The conditions of these storage areas differed from one hospital to the other because of their primary original design. A HCW storage facility cannot be situated next to food stores and preparation areas, access should be limited to authorised personnel only, it should be easy to clean, have good lighting and ventilation and be designed to prevent rodents, insects and birds from entering (SANS, 2008:28; UNEP, 2004:16). The walk-through survey observation indicated that 72.7% of the storage areas was demarcated according to waste categories, but that only 27.3% ensured that the HCW storage areas were securely locked. The storage areas of hospitals under study may be accessible to the public and other unauthorised staff members thereby exposing them to infectious materials. The observation revealed that the conditions of the on-site storage did not comply with SANS (2008).

4.5 Conclusion

The findings regarding HCW waste management practices in the hospitals under study revealed that there was was a general lack of support from management to provideefficient human resources for HCW management purposes. A structured HCW management team which should include HCW management officers, OHS nurses, IPC nurses and appointed HCW representatives was absent in the majority of the facilities. The omission impacted negatively on, among others, the training of workers and handlers of HCW.

On-site development of new hospitals and revitalisation programmes for old facilities should include well designed HCW storage areas. Efficient waste management strategy development can be achieved when there is a strong buy-

in of HCW management programmes by senior managers. The development of HCW management plans in all hospitals should be prioritised. Training of all health care waste handlers should be provided and the responsibilities of HCW representatives should be emphasised. The development of policies and procedures regarding HCW management and the implementation of these policies should be a priority and regarded as a critical matter.

REFERENCES

Alagoz, A.Z. and Kocasoy, G. 2008. Determination of the best appropriate management methods for the health care waste in Istanbul. *Journal of Waste Management*, 28: 1227-1235.

International Committee of the Red Cross (ICRC). 2011. Medical waste management. Available from: http://www.icrc.org/spa/assets/files/publications/icrc-002-4032.pdf (Accessed 9 April 2013).

International Solid Waste Association (ISWA). 2007. Health care waste :technical policy No 11. Available from:http://www.iswa.org (Accessed 12 March 2012).

Johannessen, LM., Dijkman, M., Bartone, C., Hanrahan, D., Boyer, M.G. and Chandra, C. 2000. Health care waste management guidance notes. Health nutrition and population. International Bank for Reconstruction and Development. Washington. World Bank.

Local Government Handbook (LGH). 2013. A complete guide to municipalities in South Africa. Available from: http://www.localgovernment.co.za/districts/view/37 (Accessed 19 September 2012).

Manga, E.V., Forton, O.T., Mofor, L.A. and Woodard, R. 2011. Health care waste management in Cameroon: a case study from the South Western Region. *Journal of Resource Conservation and Recycling*, 57: 108-116.

Park, H., Lee, K., Kim, M., Lee, J., Seong,S.Y and Ko, J. 2009. Detection and hazard assessment of pathogenic microorganisms in medical wastes. *Journal of Environmental Science and Health*, 44:995-1003.

South Africa.National Department of Health (SA DoH). 2003. National Health Act. Act No 61 of 2003. R375. Regulation relating to HCW management in health establishment. Pretoria, Available from: http://www.gpwonline.co.za/docs/legislation-f.html (Accessed 17 July 2014).

South Africa. National Department of Health (SA DoH). 2004. National antiretroviral treatment guidelines. Available from http://www.southafrica.usembassy.gov.medic/2004.doh.art.guideines (Accessed 13 May 2013).

South Africa. National Department of Health. 2007. National infection prevention and control policy and strategy, Available from: http://www.doh.gov.za/docs/legislatio-f.html (Accessed 8 March 2012).

South African National Standards (SANS). 2004. *Management of health care waste, SANS10248*, Pretoria. Standards South Africa (division of SABS).

South African National Standards (SANS). 2008. *Management of health care waste, Part 1: management of health care risk waste from a health care facility* SANS10248-1, Pretoria. Standards South Africa (division of SABS).

Statistical Analytical Software (SAS). 2013. SAS/Stat (R) 92 users‟ guide (2nd ed.). Available from http://www.support.sas.com/en_us/software/analytics.html(accessed 21 May 2013).

Steel, K. 2007. Definitions/purposes for the modes of writing. Available from http://www.kimskorner4teachertalk.com/writting/modes/definitions.html (Accessed 13 June 2012).

United Nations Environmental Programme (UNEP). 2003. *Technical guidelines on the environmental sound management of biomedical and health care waste (Y1:Y2)*. Secretary of the Basel Convention International Environmental House, Switzerland. United Nations Environment Programme.

United Nations Environmental Programme (UNEP). 2004. *Preparation of national health care waste management plans in Sub-Saharan countries: Guidance Manual.* Secretary of Basel Convention and World Health Organisation, Switzerland. United Nations Environment Programme.

World Health Organisation (WHO). 1999. *Safe management of wastes from health care activities,* Geneva. World Health Organisation.

CHAPTER 5

GENERAL DISCUSSION

5.1 Introduction

Some local and international documents are referred to in this chapter to comparecurrent HCW practices of the Northern Cape Department of Health with those in other countries. This chapter provides an overview of total health care waste management concepts that form the background for the conclusions and recommendations based on the study. The latter are presented in order to address weaknesses in HCW management as identified during the assessment of HCW management practices in 11 hospitals in the Northern Cape Province.

The basic principles governing the „cradle to grave" system of HCW management are the following:

- Segregation of HCW at the source;
- Internal collection of HCW and on-site storage;
- Occupational Health Safety programme;
- Training and policy documents related to HCW management;
- Health care waste management plans; and
- Allocation of human resources for health care waste management in health care facilities.

5.2 Proper segregation of HCW

The principle behind waste segregation is to reduce quantities of waste generated during the patient care process and to reduce exposure to injuries as a result of hazardous materials found in waste. Moreover, it adresses issues of compliance with environmental and waste regulations to ultimately reduce the cost of treatment of special types of waste (ICRC, 2011:43). Segregation is done at the point of generation and the treatment of the waste further requires containerisation, storage, transportation, treatment and final disposal. The Technical Guidelines on Environmentally Sound Management of Biomedical and Health Care Waste (Y1;Y2) indicate that average biomedical and health care waste streams contain less than 10% of materials that could be considered „potentially infectious" (UNEP, 2003). Segregation that is done at the source is

safer and more cost effective. Proper segregation in the storage facilities using correct labelling systems is also effective and safe for health care waste handlers.

Segregation of health care waste in health care facilities is defined in a similar way, globally and in South Africa, although not word for word. SANS 10248 defines „sharps" as needles, syringes, blades or clinical glass, that are capable of causing cuts, abrasions or puncture wounds (SANS, 2004), whilst the World Health Organisation (WHO) gives examples of „sharps" as all types of needles, broken glassware, ampules, scalpel blades, lancets and vials without contents (WHO, 1999). According to the WHO, infectious waste is waste with blood contaminated with HIV, viral hepatitis, brucelloses, Q fever, faeces from patients infected with typhoid fever, enteritis, cholera, respiratory tract secretions from patient infected with TB, anthrax, rabies and poliomyelitis (UNEP, 2004:8; WHO, 1999:3).

The South African National Standards document defines infectious non-anatomical waste as "that which contains or is suspected to contain pathogens, bacteria, viruses, parasites or fungi in sufficient concentrations or quantities to cause disease in susceptable hosts" (SANS, 2004:11; SANS, 2008:8).

Anatomical waste according to the World Health Organisation includes tissue waste, removed organs, amputated body parts and placentas, whereas the South African National Standards document describes such waste as "waste that contains tissues, organs, body parts blood and body fluids from patients, foetuses and animal carcasses, but excludes teeth and hair" (SANS, 2004:6; SANS, 2008:7; WHO, 1999:3).

Pharmaceutical waste according to the World Health Organistion includes expired, unused, split and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required and thus need to be disposed of appropriately. SANS defines such waste as"unused medicines, medications and residues of medicines that are no longer usable as medication" (SANS, 2004:11; WHO, 1999:3). The four catergories of health care waste that were the main categories on which this research concentratedform an integral part of HCW segregation systems. A part of the segregation focuses on the colour coding associated with the different types of waste and labelling of waste containers.

This study, which was conducted in 11 hospitals in the Northern Cape, Department of Health, revealed that 63.6% of the surveyed hospitals segregated waste correctly, while a study that was done by Mudau (2007) in hopitals in the central district municipality of North West Province revealed that even though appropriate HCW containers were available, there was poor segregation of health care waste in these hospitals. Thus, when comparing HCW segregation practices in the NC DoH hospitals with those in the North West Province, it became evident that the Northern Cape Department of Health hospitals had better segregation of waste strategies, although they were not practised a 100% correctly.

5.3 Internal collection and on-site storage areas

The study focused only primarily on the internal collection of waste and the identification of the manner in which the waste handlers handled the waste from the consultation area point of origin or wards to the onsite storage areas.

The practices observed regarding the handling of HCW included labelling of waste containers before being delivered to the storage area, the position in which the sharp containers were placed, the levels to which the containers were filled, and the temporary storage areass inside the facility before the waste was taken out to on-site storage areas.

The Environmental Health and Safety Guidelines for health care facilities compiled by the International Finance Corporation recommend the following practices in terms of handling, collecting, transporting and storing HCW;

- The waste bags should be sealed and containers must be replaced when they are approximately three quarters full.
- Waste has to be transported to storage areas on designated trolleys/carts which should be cleaned and disinfected regularly.
- Waste storage areas should be located within the facility and sized according to the quantities of the waste generated. Such areas should have the following design considerations:
  - hard impermaeble floors with drainage, and designed for cleaning /disinfection with available water supply;

- secured by locks with restricted access;
- protected from the sun and inaccesable to animals/rodents;
- equipped with appropriate lighting and ventilation;
- segregated from food supplies and preparation areas; and
- equipped with supplies of protective clothing and spare bags/containers (WBG, 2007).

This study found that internal transportation of HCW inside the hospitals was done differently by the individual facilities in the Northern Cape Department of Health. Most practices observed in these hospitals employed waste handlers to remove waste by hand from the wards to the on-site storage areas. Protection against injuries to personnel is very important and, if not complied with, the safety of the personnel can be compromised. Personnel protective equipment (PPE) such as overalls, industrial aprons and heavy duty gloves should be used all the time.

Maximum storage time should not exceed 24 hours within the health care facility (UNEP, 2004), but this requirement is not adhered to at the hospitals included in the study. The study shows that highest collection frequency occured at hospitals A and J with 12 out of the 20 working days of the month, therefore the storage period of heath care waste was more than 24 hours in all the surveyed hospitals.

The National Health Care Waste Management Plan forsub-Saharan Countries, recommends the following:

> "the collection of waste must follow a specific route through the health care facility to reduce the passage of loaded carts through wards and other clean areas. The carts should be easy to load and unload, should have no sharp edges that could damage waste bags or containers and be easy to clean" (UNEP, 2004:15).

The location of sharp containers is very critical in the prevention of injury and cross infection. The most common position for sharps containers in the hospital is mounting of sharps containers on the wall next to the patient`s bed. This position provides easy access for the health care worker and prevents access by children (NIOSH, 1998). In the NC hospitals similar results were only observed in two

hospitals (A and J), and the most common position for sharps containers were found to be placing them on the trolley and on the floor next to the patients bed.

5.4 Occupational health and safety programme

In addition to the PPE required for the handling and transportation of waste, general occupational health and safety measures should also be considered. Necessary preventative measures must be put in place in the health care facilities. Procedures which include HCW spillage protocols, emergency evacuation protocols, decontamination procedures, HBV vaccination, incidence report procedures, registers for needle prick injury, counselling procedures, prophylaxis treatment protocols and compensation for „injuries on juty"" (IOD) procedures must be correctly followed (South Africa, 2007). The hospitals under study in the Northern Cape Department of Health showed compliance in terms of provision of prophylaxis treatment during accidental needle pricks to all health care workers. The recorded results indicated that 45.5% of the hospitals had a vaccination programme for their personnel handling HCW (HBV) and 63.6% of the surveyed hospitals had registers for needle pricks injuries. As HCW management requires 100% compliance with legislation and regulations, these figures revealed serious omissions in HCW management in the hospitals under study, and thus drastic and urgent measures are required by the managers of these health facilities to address the problem.

5.5 Training of HCW workers and handlers and policy documents on HCW management

Training programmes for personnel handling HCW and knowledge of the policies governing HCW management are very important in ensuring complete and functional health care waste management systems.

According to (WHO, 1999:160-161), different methods are used to capacitate health care workers dealing with HCW management. Such methods include:

- on-site inspection training or one-on-one information sharing;
- orientation programmes for newly recruits;
- structured workshops or seminar by outsiders or experts; and

- short courses during staff meetings and information sharing through posters and pamphlets.

The hospitas under study showed that only three hospitals trained their HCW handlers on correct health care waste management principles and proceedures. The NC DoH hospitals did not comply with the recommendations as stipulated by WHO.

Health care waste management plans must have detailed training schedules for facilities (WHO, 2004). The plan should identify and incorporate the training needs for different categories of workers. Aspects which have to be included in the training of individual groups are, for example:

- All health care povіders training should focus on safe needle and vaccination procedures and recording, prophylaxis and counselling requirements;
- proper segregation principles involving containerisation, labelling, colour coding, types of containers and classification of hazardous/infectious materials; and
- procurement of HCW consumables and individuals` responsibilities.

Basic training courses on HCW management (handling, loading and unloading of waste from carts or trolleys and lifting of waste conatiners) should include:

- identification of the categories of waste and their storage areas/containers;
- management of storage facilities;
- policies and procedures on health care waste management principles; and
- safety practices which include PPE and emergency response to spillage and accident procedures.

Training in health care facilities is the responsibility of the manager of the facility who appoints infection control and waste management officers to develop relevant training programmes (UNEP, 2003). Training of health care workers at the selected NC DoH hospitals was very poor at only 27.3%. If urgent attention is not given to this matter, the safety and health of HCW handlers may be severely compromised.

5.6 Health care waste management plans

In South Africa the only national regulatory mandate that requires the development of an Industrial Waste Management Plan is the National Environmental Management, Waste Act 59 of 2008. The following is stipulated under part 7 section 28(1):

> „„Where any activity results in the generation of waste that affects more than one province or where such activity is conducted in more than one province, the Minister may by written notice require such a person or by notice in the gazette require a category of a person or an industry that generates waste to prepare and submit an industrial waste management plan to the Minister for approval"" (South Africa, 2008).

Chapter 3 (section 12) of the Gauteng Health Care Risk Waste Regulations (GHCRWR) of 2004, promulgated under the Gauteng Department of Agriculture, Conservation and Environment, requires that a major generator of health care risk waste who starts operating after the date of these regulations must have an approved health care waste management plan before it may start to provide the service. This law applies to all those generators that operate within the jurisdiction of the Gauteng Province (GHCRWR, 2004).

The Western Cape Draft Health Care Risk Waste Regulations (WC) of 2011 (section 17(1)) promulgated under the Western Cape, Department of Local Government, Environmental Affairs and Developmental Planning, stipulate that a generator must prepare a health care waste management plan within 12 months after commencement of these regulations. This regulation includes an annexure of what should be included and what is expected in the Waste Management Plan (WC DoLGEADP, 2011)

The South African National Standards document, section 5, recommends that a waste management team shall make an assessment of all the health care waste generated in a health care facility before the development of a waste management plan (SANS, 2008).

The Gauteng HCRW regulations classify major generators as those facilities generating 20 kg of HCRW per day. Facilities are classified as a generator of

waste according to the National Waste Information Regulations (Notice 625 of Government Gazette 35583) (South Africa,2008)

The International Solid Waste Association"s ISWA (2007), Technical policy No 11 requires a waste management plan for the management of HCW. It is also stipulated that a responsible, properly trained and competent waste manager be appointed at each facility and that the plan be reviewed regularly (ISWA, 2007). This study indicated that 45.5% of the hospitals in the Northern Cape had developed health care waste management plans for the individual facilities. The plans developed by these facilities were derived from the provincial health care waste management plan.

5.7 The allocation of human resources for HCW management

Poor human and financial resources allocation will impact negatively on the control of environmental pollution and health improvements. Without specific dedicated financial resources, it is impossible to ensure sustainable improvement in the management of health care waste (WHO, 2004).

In conjunction with the allocation of financial resources, it is important to ensure adequate allocation of human resource to handle waste management. In many instances, the responsibility of health care waste management in the hospitals in the Northern Cape Department of Health rested with the Infection Control and Prevention nurses. None of the hospitals in the study, appointed Waste Manangement Officer.

South African National Standards (2004) recommend the establishment of management teams in each health care facility that are comprises of the following personnel:

- Occupational Health and Safety Officer
- Heads of Departments
- Infection Control Officer
- The Chief Pharmacist
- The Radiation Officer
- The Senior Nursing Nurse

- The Maintainance Engineer (where possible)
- Appointed Waste Management officers.

However, this study found that most of the personnel appointed in designated posts as recommended by SANS had not been appointed for HCW management exclusively, in the hospitals under study in the Northern Cape Department of Health. The personnel who were identified in the study were running other parallel programmes in the hospitals as well. For instance, an Infection Prevention and Control Nurse would be managing infection control while also managing the surgical ward. Six of the eleven hospitals which were included in the study had appointed Infection Prevention and Control Nurses appointed while only two hospitals had Occuptional Health Nurses.

No Waste Management Officers had been appointed at any of the hospitals, including the tertiary hospital which generates high levels of health care waste.Only three hospitals in the provincial Department of Health had prioritised the appointment of waste management officers.

REFERENCES

Gauteng Health Care Risk Waste Regulations (GHCRWR). 2004. Available from: http/www.gdard,gpg.gov.za/Services/Documents/CertifiedHCWMregulations (Accessed 2 March 2010).

International Committee of the Red Cross (ICRC). 2011. Medical waste management. Available from:http://www.icrc.org/spa/assets/files/publications/icrc-002-4032.pdf (Accessed 9 April 2013).

International Solid Waste Association (ISWA). 2007. Health care waste:Technical policy No.11. Available from: http/www.iswa.org/inex.php (Accessed 23 February 2012).

Mudau, S. 2007. Towards environmentally sound health care waste management in the central district municipality of the North West province.Dissertation. School of Animal, Plant and Environmental Studies, Faculty of Science University of Witwatersrand, Johannesburg, South Africa: 63-69.

National Institute for Occupational Safety and Health (NIOSH). 1998. *Selecting, evaluating, and using sharps disposal containers*. DHHS (NIOSH), Publication No. 97-111.

South Africa. National Department of Health (DoH). 2007. National Infection Prevention and Control Policy and Strategy, Available from: http://www.doh.gov.za/docs/legislatio-f.html (Accessed 8 March 2012).

South Africa. National Environmental Management Act. 2008. *National Environmental Management*: Waste Act No. 59 of 2008 (NEMWA). Government Gazette. (No. 32000).

South Africa National Environmental Management Act. 2008. R625 National Environmental Management. Waste Act 59 of 2008: National Waste Information Regulations (2012). Available from: https://www.environment.gov.za/.../nemwa-waste information regulations (Accessed 24January 2013).

South African National Standards (SANS). 2004. *Management of health care waste*, SANS 10248, Pretoria. Standards South Africa (division of SABS).

South African National Standards (SANS). 2008. *Management of health care waste*, Part 1: Management of health care risk waste from a health care facility SANS10248-1, Pretoria. Standards South Africa (division of SABS).

United Nations Environmental Programme (UNEP). 2003. *Technical guidelines on the environmental sound management of biomedical and health care waste (Y1:Y2*). Secretary of the Basel Convention, International Environmental House, Switzerland. United Nations Environmental Programme.

United Nations Environmental Programme (UNEP). 2004. *Preparation of national health-care waste management plans in Sub-Saharan countries:*

*guidance manua*l. Secretary of Basel Convention and World Health Organisation, Geneva, Switzerland. United Nations Environmental Programme.

Western Cape Department of Local Government, Environmental Affairs and Developmental Planning (WC LoGEADP). 2007. Western Cape health care waste management Act. Available from: http/www.westerncape.gov.za/other/2011/6/pn126e (Accessed 2 March 2010).

Western Cape Draft Health Care Risk Waste Regulations (WC). 2011. Draft health care waste management regulations, Available from: http/www.westerncape.gov.za/other/2011/6/pn126e (Accessed 2 March 2010).

World Health Organisation (WHO). 1999. *Safe management of wastes from health care activities*, Geneva. World Health Organisation.

World Health Organization (WHO). 2004. Safe health care waste management, policy paper, Available from: http://www.healthcarewaste.org (Accessed 7 May 2012).

World Bank Group (WBG). 2007. Environmental, health and safety guidelines for health care facilities. Available from: http/www.ifc.org/ehsguidelines(Accessed 7 May 2012).

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter summarises the most important findings of the study and highlights some outstanding issues identified in the assessment. It focuses on the current HCW practices of hospitals in the Northern Cape Department of Health and aligns these practices to national and international requirements with regards to HCW management.

The conclusions further map out future developmental projects that can be undertaken to address the identified shortfalls that were found in South Africa and in particular in the Northern Cape Department of Health.

6.2 Conclusion

The study evaluated various aspects of health care waste management, specifically in hospitals in the NC Doh. These aspects that were investigated included health care waste generation rates, types of health care waste generated, frequency of collection of waste by a contracted service provider, types of waste containers used, segregation systems used in the various hospitals, human resources structure for health care waste management in the hospitals, and occupational health and safety programmes. Legislation and other relevant documents were used to verify whether the HCW management practices in the hospitals complied with national and international requirements for HCW management.

The study revealed that health care waste generation was very high in the NC DoH hospitals and that these facilities generated more HCW than at any other health care facility in the province. However, the standards of the HCW management practices were found to be below par, as not any of the facilities under investigation fully met either national or international standards for best practices in HCW management. For this reason, it is recommended that more emphasis be placed on the health care waste management services provided at the hospitals to ensure better standards of waste management systems in the province.

A particular area that requires attention from the NCDoH is the human resources allocation structure. The study showed that the health care waste management

personnel structure in the hospitals was not given the priority it requires as none of the hospitals in the province had a Waste Management Officer.

The assessment of waste storage facilities in the province revealed that some specific requirements need urgent attention. Most of the hospitals did not have proper designated health care waste storage facilities. In many instances waste storage areas identified in the study were found to be rooms in the hospitals that were meant to be used for other purposes.

Training of health care waste handlers was found to be lacking as shown in the assessment of the hospitals. Periodic training programmes on health care waste management must be introduced at the health care facilities as a matter of urgency. Moreover, tailored training programmes to handle waste must be developedfor different staff categories.

A need for the development of HCW management plans is emphasised. The results revealed that only 45.5% of the selected facilities had developed HCW management plans. In comparison with other departments of health in South Africa such as the DoH in the Gauteng Province, the study revealed that the NC DoH had many shortfalls in terms of guidelines governing HCW management. Although appropriate legislation and some guidelines seemed to be in place, shortcomings were identified with regards to the implementation of these policies and guidelines.

6.3 Recommendations

6.3. 1 Reduce HCW generation at the source

The process of reducing waste at the source requires dedication and discipline from those health care practitioners who are at the first phase of patient care. It is crucial that strict monitoring systems be developed to ensure that HCW is correctly segregated into appropriately marked and correct containers.

6.3.2 Develop HCW policies and procedures

It is recommended that the NC DoH review its policies and procedures on a regular basis to keep abreast of developments in HCW management occurring at national and international levels.

6.3.3 Establish a well-structured HCW management team

It is important to emphasise a multi-sectoral approach towards health care waste management programmes. A task team comprising various specialists from different units or departments should be established in each health care facility. Such a task team should contribute towards complete and efficient health care waste management is very important.

6.3.4 Appoint Waste Management Officers at NC DoH hospitals

One of the key strategies in ensuring that health care waste management receives the attention it deserves is the appointment of a Waste Management Officer(WMO) at each hospital. Every official in each department of the hospital has aresponsibility which requires his/her undivided attention as outlined in the job description. The appointment of a Waste Management Officer will reduce the workload of other officials in terms of waste management issues and will facilitate special attention to HCW management by an expert.

6.3.5 Improve Occupational Health Service programmes at hospitals

Provision of correct PPE and education of handlers on correct lifting practices of waste containers will reduce injuries on duty as well as infection transmissions challenges. Shared responsibility between HCW, IPC and OHS by a common representative will ensure a safe working environment for all. Implementation of needle prick injury and post exposure procedures will enhance productivity and an immediate prophylaxis treatment in all health care facility programmes is essential.

6.3.6 Improve training programmes for HCW handlers

Periodic training by the service provider and internal experts which should include tailor-made programmes for different categories of HCW handlers is important. Some programmes require contact sessions for especially the lower level group of workers,for example general workers. Other categories of personnel can be trained through non contact sessions which will help in managing poorly resourced health care facilities (for example in the General Practitionersprogramme). Improved training will develop awareness of the many

health, safety and environmental issues that occur in health care waste management.

6.3.7 Improve HCW management plans

A waste management plan forms an integral part of complete health care waste management. A needs assessment interms of HCW management in the particular health care facility should be thoroughly outlined in the plan. Moreover, strong and weak points of the management are identifiable if a HCW management plan is developed and reviewed on a regular basis. Training programmes and steps to improve on health care waste management should also be identifiable in the plan.

6.3.8 Improve resource allocation for HCW management

As HCW management is an integral part of the health care system, it is important that all health care facilities budget adequately for all their needs. Budget calculations and allocations must be done at local facility, regional as well as provincial levels.

6.3.9 Establish compliant on-site HCW storage areas at hospitals

It is crucial to establish on-site HCW storage areas in each health care centre. Designated waste storage areas should be constructed according to national and international standards and signs indicating hazardous/infectious material should be displayed. Provision should be made inside these areas for compartments in which different waste categories can be separated. These designated areas will help to reduce accidents and prevent mixing of different categories of waste during collection.

6.3.10 Establish a central HCW storage facility for the province

A licensed central health care waste storage facility which is controlled and managed by the Department of Health is important in the province. This facility will allow storage of large quantities of HCW health care waste for reasonable periods during service disruptions.

6.3.11 Develop a provincial waste management strategy

Collaboration between the Northern Cape Department of Health and the Northern Cape Department of Environment, Nature and Conservation should lead to the development of a sound and efficient provincial health care waste management strategy.

6.3.12 Establish an alternative treatment facility for HCW in the province

The principle of „proximity" which requires that the treatment and disposal of hazardous waste take place at the closest possible location to its source in order to minimize the risks involved during transportation, should be considered. Through consideration of alternative treatment systems, the NC DoH will become compliant with international agreements on hazardous substances.

6.3.13 Conduct further research on HCW management status of all health care facilities

It is important to determine the national status of health care waste management in all health care facilities. Such investigations should not only include provincial departments of health, but also the private health care sector. This type of research will enhance standardisation of practices across the country and will provide accurate information relating to quantities of health care waste generated and processed in South Africa.

ANNEXURE 1: HCW MANAGEMENT QUESTIONNAIRE

CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE

FACULTY OF HEALTH AND ENVIRONMENTAL SCIENCES

HEALTH CARE RISK WASTE MANAGEMENT QUESTIONNAIRE

The aim of this study is to identify the current practices in the Northern Cape Department of Health regarding HCRW from cradle to grave processes and to review the non-compliant systems by developing well researched complying systems from national and international legislative perspective. Another aim is to monitor the HCRW systems used by contracted service provider in handling and treating health care risk waste and compare it to minimum requirements as stipulated by the relevant national legislations.

The purpose of this questionnaire is to review health care waste management practices in the Department of Health, Northern Cape Province. To establish health care workers and management level of understanding regarding principle of health care waste management and developing the corrective measures for non-compliant methods.

I, Mr MF Motlatla, ID number, 750824 5391 086 declare that I am a MTech student at the above-mentioned institution and that the information received from the questionnaires will only be used for the purpose of the study and all names and contact details will be used for verification purpose and published.

1. The questionnaire to be completed is not a test but contains questions to determine the perceptions, behaviour, and knowledge of health care workers and management towards health care waste management practices.
2. There are no rights and wrong answers.
3. To unsure the best value from the results, you should answer the questionnaire truthfully and as accurately as possible.

PERMISSION:

I, ...in my capacity of ....., hereby give permission for information gained by the completion of the questionnaire to be used in the study.

..... **.....**

Signature **Date**

Mark the applicable box with an x or write appropriate answer in the space provided

Official Use

Questionnaire number:

SECTION A : BIOGRAPHICAL INFORMATION

Name of the interviewer:.....

Name of the Health District

Frances Baard District	**1**		**1**
Siyanda District	**2**		
Namakwa District	**3**		
John Taolo Gaetsewe District	**4**		
Pixley Ka Seme District	**5**		

Name of the health care facility:

Kimberley Hospital	**1**		**2**
West end Hospital	**2**		
Galeshewe Day Hospital	**3**		
Victoria West Hospital	**4**		
Central Karoo Hospital	**5**		
Kuruman Hospital	**6**		
Tshwaragano Hospital	**7**		
Abraham Esau Hospital	**8**		

Springbok Hospital	**9**	
Gordonia Hospital	**10**	
Postmansburg Hospital	**11**	

What is your position at the facility:

Chief Executive Officer	**1**	
Matron/Supervisor	**2**	
Infection Control Nurse	**3**	
Occupational Health Nurse	**4**	
Chief Medical Officer	**5**	
Waste Management Officer	**6**	

☐ **3**

Number of beds(Specify the number next to the box ticked)

0-50	**1**	
51 to100	**2**	
More than 101 to150	**3**	
151 and more	**4**	

☐ **4**

Number of outpatients per month

0-50	**1**	
51 to 100	**2**	
More than 101 to 150	**3**	
More than 151	**4**	

☐ **5**

Number of inpatients per month

0-50	**1**		**6**
51 to 100	**2**		
More than 101 to 150	**3**		
More than 151	**4**		

Number of Medical Doctors

0 - 10	**1**		**7**
11 to 20	**2**		
More than 21 to 30	**3**		
30 and more	**4**		

Number of Nursing Staff

0 - 10	**1**		**8**
11 to 20	**2**		
More than 21 to 30	**3**		
31 and more	**4**		

Amounts of health care waste in (kg) collected monthly

0 – 100kg	**1**		**9**
101 to 200kg	**2**		
More than 201to 300kg	**3**		
301kg and more	**4**		

SECTION B: PLEASE INDICATE APPROPRIATE NUMBER FOR CORRECT ANSWER AS APPLICABLE TO YOUR KNOWLEDGE/ OTHERS MARK ON YES, NO OR DON`T KNOW AS RELEVENT TO YOUR KNOWLEDGE.

Question1: How frequent is health care waste collected from the facility?

Once a day	**1**			**10**
Once a week	**2**			
Twice a week	**3**			
Once a month	**4**			
Twice a month	**5**			
Other: (specify) how often:	**6**			

Question 2: What type of health care waste is generated at the facility?

Sharps, syringes, scalps, rasers and bottles or any other sharp material	**1**			**11-17**
General refuse	**2**			
Pathological /anatomical	**3**			
Blood soiled gloves, cottons, bandages (infectious non-anatomical	**4**			
Pharmaceuticals	**5**			
Radioactive	**6**			
Cytotoxic/genotoxic/laboratory	**7**			

Question 3: What type of container is used for sharp waste?

Yellow Container	**1**			**18**
Red Liner and Box	**2**			
Red Specibin	**3**			
Green Container	**4**			

Blue liner	**5**	
Black liner	**6**	

Question 4: What type of container is used for anatomical/pathological waste?

Yellow Container	**1**		**19**
Red Liner and Box	**2**		
Red Specibin	**3**		
Green Container	**4**		
Blue liner	**5**		

Question 5: What type of container is used for pharmaceutical waste?

Yellow Container	**1**		**20**
Red Liner and Box	**2**		
Red Specibin	**3**		
Green Container	**4**		
Blue liner	**5**		

Question 6: What type of container is used for cytotoxic/genotoxic or laboratory waste?

Yellow Container	**1**		**21**
Red Liner and Box	**2**		
Red Specibin	**3**		
Green Container	**4**		
Blue liner	**5**		

Question 7: What type of container is used for infectious non-anatomical waste?

Yellow Container	1		22
Red Liner and Box	2		
Red Specibin	3		
Green Container	4		
Blue liner	5		

Question 8: Where is sharps container situated?

Mounted on the wall	1		23
On the trolley	2		
On the bed side	3		
On the floor	4		
Other (specify).....	5		

Question 9: Up to what level is sharps container filled?

Quarter filled	1		24
Half filled	2		
Three quarter filled	3		
Fully filled	4		

Question 10: Is a container for disposal readily available in the facility?

Yes	1		25
No	2		
Do not know	3		

Question 11: Is a sharp segregated/sorted at source?

Yes	**1**		**26**
No	**2**		
Do not know	**3**		

Question 12: Is general waste segregated/sorted at source?

Yes	**1**		**27**
No	**2**		
Do not know	**3**		

Question 13: Is anatomical/pathological waste sorted at source?

Yes	**1**		**28**
No	**2**		
Do not know	**3**		

Question 14: Is pharmaceutical waste sorted at source?

Yes	**1**		**29**
No	**2**		
Do not know	**3**		

Question 15: Is temporary storage facility available within the premises?

Yes	**1**		**30**
No	**2**		
Do not know	**3**		

Question 16: Are containers from different wards properly marked for tracking purposes?

Yes	**1**		**31**
No	**2**		
Do not know	**3**		

Question 17: Is there facility for freezing of pathological/anatomical waste available?

Yes	**1**		**32**
No	**2**		
Do not know	**3**		

Question 18: Is there any health care waste educational material displayed in the premises?

Yes	**1**		**33**
No	**2**		
Do not know	**3**		

Section C: MARK APPROPRIATE BOX NEXT TO CORRECT ANSWER WITH AN (X)

Question 1: Does the facility have an appointed waste management officer?

Yes	**1**		**34**
No	**2**		
Do not know	**3**		

Question 2: Is there an occupational health nurse on duty daily?

Yes	**1**		**35**
No	**2**		
Do not know	**3**		

Question 3: Is there an infection control nurse on duty daily?

Yes	**1**		**36**
No	**2**		
Do not know	**3**		

Question 4: Is there an appointed health care risk waste representatives in the facility?

Yes	**1**		**37**
No	**2**		
Do not know	**3**		

Question 5: Is the health care risk waste handlers get training in waste handling?

Yes	**1**		**38**
No	**2**		

Do not know	**3**	

Question 5: Is there a health care risk waste plan for the facility?

Yes	**1**		**39**
No	**2**		
Do not know	**3**		

Question 6: Is the health care risk waste plan displayed?

Yes	**1**		**40**
No	**2**		
Do not know	**3**		

Question 7: Are health care personnel handling waste vaccinated against Hepatitis B?

Yes	**1**		**41**
No	**2**		
Do not know	**3**		

Question 8: Is there a register/file for needle prick injuries?

Yes	**1**		**42**
No	**2**		
Do not know	**3**		

Question 9: Is there a counselling service for needle prick occurrence?

Yes	**1**		**43**
No	**2**		
Do not know	**3**		

Question 10: Is there any prophylaxis for needle prick?

Yes	**1**		**44**
No	**2**		
Do not know	**3**		
Type of phrophylaxis:.....	**4**		

Question 11: Is there a prophylaxis protocol for needle prick?

Yes	**1**		**45**
No	**2**		
Do not know	**3**		

Section D: MARK APPROPRIATE BOX NEXT TO CORRECT ANSWER WITH AN (X)

Question 1: Is there a designated storage area for health care waste at the facility?

Yes	**1**			**46**
No	**2**			
Do not know	**3**			

Question 2: Is there a designated personnel working in the storage area?

Yes	**1**			**47**
No	**2**			
Do not know	**3**			

Question 3: Is the storage area demarcated for different types of waste?

Yes	**1**			**48**
No	**2**			
Do not know	**3**			

Question 4: Is the storage area locked at all times?

Yes	**1**			**49**
No	**2**			
Do not know	**3**			

Question 5: Conditions of the storage area (yes for satisfactory and no for not satisfactory)

Roofing	**Yes**	**1**		**50**
	No	**2**		
Walls	**Yes**	**1**		**51**
	No	**2**		
Floor paved	**Yes**	**1**		**52**
	No	**2**		
Artificial ventilation	**Yes**	**1**		**53**
	No	**2**		
Natural ventilation	**Yes**	**1**		**54**
	No	**2**		
Natural lighting	**Yes**	**1**		**55**
	No	**2**		
Artificial lighting	**Yes**	**1**		**56**
	No	**2**		
Spillage kit available?	**Yes**	**1**		**57**
	No	**2**		
Hazard signs displayed?	**Yes**	**1**		**58**
	No	**2**		
Rodent proof	**Yes**	**1**		**59**
	No	**2**		

Question 6: Do you think that health care waste is handled in the manner prescribed by legislation?

Always	**1**		**60**
Sometimes	**2**		
Never	**3**		
Do not know	**4**		

Question 7: How do you rate your knowledge of the waste disposal practices in operation at this facility on a scale of 1-5 (1 being low, 5 being very knowledgeable?)

Low						High
	1	2	3	4	5	

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THANK YOU FOR YOUR CO-OPERATION

ANNEXURE 2: APPROVAL LETTER NC DoH