A lifecycle evaluation of Health Care Waste Management by General Practitioners in South Durban.

This work is submitted in fulfilment for the degree of Master of Health Sciences: Environmental Health in the Faculty of Health Sciences at the Durban University of Technology

Litonya Boodhram

30 November 2018

Supervisor: Ms. E.J. Kistnasamy

Co-Supervisors: Dr. R. Baatjies and Mr. E. Euripidou

ABSTRACT

Health care waste management (HCWM) poses a major risk due to its hazardous and deleterious effects on the environment and communities. It is imperative that specific and correct strategies from generation to final disposal, are implemented at all health care facilities (HCFs). A search of the literature has shown that many incorrect HCWM procedures have been found in HCFs, especially in developing countries.

In South Africa, research on HCWM was mainly undertaken in municipal or government hospitals while it appeared to be non-existent in the private sector. This study therefore minimized this important gap in the private sector by investigating the lifecycle evaluation of HCWM by General Practitioners (GPs) in South Durban. The objectives included the following: 1) to assess the GPs' knowledge and practices of the hierarchy of waste principles; 2) to evaluate occupational risks associated with handling health care waste in GPs' surgeries and 3) to determine regulations utilized during the HCWM process in GPs' surgeries. GPs belonging to the Durban South Doctors Guild (DSDG) were assessed in a two staged interview process using a questionnaire and a regulations checklist.

Overall, the results indicated that private practicing GPs in the South Durban area do practice HCWM in a responsible manner. Age appeared to play a significant role in terms of knowledge and practices. The areas of compliance showed that correct segregation was practiced by 92% of the sample group and 100% of the GPs utilized accredited waste collection services. Areas of concern were that while regular HCWM seminars were convened by the DSDG, the response rate was poor. Additionally, there seemed to be a lack of knowledge regarding the definition of infectious waste as 18% of GPs noted that their facilities did not produce this type of waste. The occupational risks appeared to be minimal with only 6% of GPs experiencing needle-stick injuries. The GPs were knowledgeable and practiced HCWM according to appropriate South African legislation. In response to the areas of concern, seven recommendations are proposed.

This study established that HCWM in private practicing GPs surgeries in the South Durban area are being carried out correctly and in accordance with specific South

African regulations and policies. It would also be beneficial when undertaking future research to obtain more holistic outcomes by including GPs who:

a) are younger than the majority age group noted in this study;
b) have their surgeries in other previously disadvantaged and under-resourced communities;
c) are female and;
d) are of African, White or Coloured descent.

DECLARATION

The author hereby declares the content of this project is the author's own unaided original work, except where specific indication is given to the contrary (by reference). This work has not been previously submitted to the Durban University of Technology (DUT) or other University.

_____

L. Boodhram (Student number: 20925881)

BTech: Environmental Health

Date: 30 November 2018

DEDICATION:

I dedicate this thesis to:

My late grandfathers: Mr Boodhram Bissessar and Mr Girdarparsadh Baliram

My grandmother: Mrs. R. Bissessar

My parents: Ashwin and Serine Boodhram

My sister: Smriti Boodhram

My fiancé: Thuven Pillay

It is through your unconditional love, encouragement, patience, support and guidance that I attained the ability to derive my inspiration and success.

THANK YOU TO MY…

- Parents, my sister and grandmother, whose constant support and encouragement brought me to this point in my goal setting.
- Dad for being my personal chauffeur, confidant and pillar of strength through the tireless days of fieldwork.
- Mum for all the administrative assistance, love and inspiration.
- Sister for always lending an ear, encouraging and accompanying me through the late nights and long campus meetings.
- Fiancé for the tremendous amount of support, comfort and spurring me to never give up during testing times.

"IT ALWAYS SEEMS IMPOSSIBLE UNTIL IT'S DONE"

-Nelson Mandela

AND NOW… IT is DONE!

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation and gratitude to:

- God for allowing me the strength and determination to reach greater heights in my career.
- My research supervisor: Ms Emilie Joy Kistnasamy - your constant motivation, constructive critiques and sound feedback is what aided me to consistently persevere through these years especially with our long distance relationship we have shared to achieve this end goal.
- To my co-supervisors: Dr Roslynn Baatjies and Mr Rico Euripido for their support.
- Dr Deepak Singh: for statistical assistance.
- Mr Maharaj from the Phoenix Health department for assistance in providing data collection tools.
- Durban South Doctor's Guild (DSDG) administrator for assisting in the permission process.
- Dr Lalbadoor for granting permission to undertake this study with the DSDG.
- All GPs who chose to participate in this study.
- My uncle and aunt (Anil and Premilla Boodhram): thank you for the printing and organizing of my data collection instruments for the interviews.
- My dear friends: Ms Melishnee Ruthanam and Ms Savanna Moodley for all the assistance and valuable insight through this journey.

Table of Contents

LIST OF TABLES:

LIST OF FIGURES

LIST OF ANNEXURES

LIST OF ABBREVIATIONS

DOH	Department of health
DSDG	Durban South Doctor's Guild
GP	General Practitioner
HCE	Health Care Establishment
HCF	Health Care Facility
HCW	Health Care Waste
HCWM	Health Care Waste Management
HMC	Home Medical Care
HPCSA	Health Professional Council of South Africa
IOD	Injury On Duty
IREC	Institutional Research Ethics Committee
ISO	International Organisation for Standards
MWTA	Medical Waste Tracking Act
NEMA	The National Environmental Waste Act 59 of 2008
PPE	Personal Protective Clothing
RHDC	Research Higher Degrees Committee
WHO	World Health Organisation

CHAPTER 1: INTRODUCTION

1.1 Background

Health care waste (HCW) is waste generated by health care facilities, research facilities and laboratories (Mbongwe, Mmereki and Magashula 2008:226-227); noting that it also includes waste from homes where patient care is given. In South Africa, HCW is managed under an array of government Laws, Acts and Gazettes. Some of these major official documents include but are not restricted to: The Health Professionals Council of 2003, The National Environmental Management Waste Act 59 of 2008 (NEMA) and the eThekwini Municipality: Nuisance and Behaviour in public places by- law (Section:9). These legislation assist health care professionals to manage HCW efficiently and effectively (South Africa 2016:1-28), South Africa (2004:2-92), South Africa (2008:20) and South Africa (2015:36).

In most developing countries, health care waste management (HCWM) has posed a major risk due to its hazardous and deleterious effects on the environment and communities (Longe and Williams 2006:133). Many unsafe HCWM procedures were observed in health care establishments in countries like for example, Bangladesh (Hassan et al. 2008:2), Jordan (Bdour et al. 2007:751) and Nigeria (Longe, Williams 2006:135). Hence, and as argued by Hassan et al. (2008:2), specific management and treatment of HCW from its generation to final disposal was required. In South Africa, research on HCWM was mainly undertaken in municipal hospitals (Nemathanga, Maringa, Chimuka 2008:1241), while research in the private sector appeared to be non-existent.

1.2 Rationale for study

Both HCW and medical waste are generated at health care facilities including clinics, General Practitioner's (GPs) surgeries, hospitals and laboratories (South Africa 2014:4). HCW must be handled and disposed of in a manner that does not negatively impact on communities and the environment. In the South Durban area, research concerning HCWM appeared to be non-existent and anecdotal evidence suggested that there was indiscriminant disposal of HCW and its management leading to major concerns in the South Durban community (Leonard 2004:1). HCW was dumped and disposed of inappropriately and mixed with general waste which created a potentially highly contaminated environment. These indiscriminate actions could leave the community vulnerable to diseases and infections and would be detrimental to the environment (Leonard 2004:1). Therefore, it was important to assess the GPs knowledge and practices of the hierarchy of waste principles; evaluate occupational risks associated with handling health care waste and determine regulations utilized during the HCWM process in GPs surgeries. The outcomes of this study would assist in generating an understanding of how HCW was managed by GPs in South Durban.

Health care waste management (HCWM) was a growing global concern, particularly with a daily increase in human population; more clinics, general practitioners' (GPs) surgeries, hospitals and laboratories been opened (Longe, Williams 2006:133; Abdulla, Qdais, Rabi 2008: 451-453; Muluken, Haimanot, Mesafint 2013:318). These studies were undertaken on HCWM in health care facilities. However, a literature search has shown a paucity of research regarding HCWM in GPs surgeries in the Durban South area, situated in the eThekwini Municipality in Kwazulu-Natal, South Africa. Therefore, researching HCWM in private practicing GPs surgeries became an interesting research topic due to GPs having initial contact with HCW and the subsequent (mis)management thereof. Proper management or mismanagement could result in direct impacts on the GPs and their employees and indirectly, impact surrounding communities and the environment. It was anticipated that the results of this study would provide insight into the HCWM practices of GPs and thereby minimize the HCWM knowledge gap in South Durban, if this is shown by the study findings. Furthermore, recommendations would be

presented to help improve current practices where necessary while noting best practices. It would also be important to take cognizance of applicable legislation and how it could influence knowledge, practices and occupational risks in the South African context.

1.3 Aim of study

To evaluate the Health Care Waste Management lifecycle utilized by General Practitioners (GPs) in South Durban

1.4 Objectives of study

1. To assess the GPs knowledge and practices of the hierarchy of waste principles.
2. To evaluate occupational risks associated with handling health care waste in GPs surgeries.
3. To determine regulations utilized during the HCWM process in GPs surgeries.

1.5 Summary of Methodology

Study participants were recruited from the Durban South Doctors Guild (DSDG). GPs that belong to this Guild had surgeries within the following residential areas of: Bluff, Chatsworth, Clairwood, Isipingo, Overport, Merebank, Queensburgh, Reservoir Hills, Shallcross, Town Central and Umlazi.

A two-staged methodology was used to accomplish the study objectives:

1.5.1 Stage 1: Questionnaire

A validated 36-item questionnaire [(adapted from World Health Organisation, n.d : 60-84)] assessed the GPs knowledge and practices of the hierarchy of waste principles and evaluated their understanding of occupational risks associated with handling health care waste in his/her surgery.

Four sections were included in this questionnaire:

- Section 1: demographic data
- Section 2: knowledge on HCWM
- Section 3: practices of HCWM
- Section 4: occupational risks associated with HCWM.

1.5.2 Stage 2: Regulations Checklist

A Regulations Checklist, adapted from the KwaZulu-Natal Department of Health Environmental Health Legislation, Guidelines, Policies, Protocols and Strategies CD and in consultation with Environmental Health Practitioners from the Phoenix Health Department, was used to determine regulations utilized during the HCWM process in each participant's surgery.

In the next chapter, a critical evaluation of HCWM as related to the objectives above will be undertaken.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The World Health Organization (WHO) defined HCW as all waste that was generated by heath care facilities, research facilities and laboratories (Mbongwe, Mmereki, Magashula 2008:226-227). Also included was waste from homes where patients were cared for and that was known as waste from “scattered” or “minor” sources. HCW posed an occupational and community risk as diseases or infections could be contracted if the HCW was untreated and this probability had intensified over the years. (Mbongwe, Mmereki, Magashula 2008:226-227). Therefore, the management of HCW was of importance due to its potential to negatively impact on the environment and the possible risks to human health. HCWM was a growing global concern as there was a tendency for HCW to be mixed with general municipal waste and disposed of in general landfill sites (Jang *et al.* 2006:107).

Health care facilities such as General Practitioners’ (GPs) surgeries, clinics, hospitals, nursing homes, veterinary clinics and laboratories should dispose of HCW generated through medical care and medical treatment, in an environmentally sound manner. (Abdulla, Qdais. Rabi 2008:450). However, according to Caniato, Tudor and Vaccari (2015:93) in many facilities, globally, this was not the case as HCW practices vary significantly from country to country depending on each country’s socio-economic status, This included the level of education that the health care staff possessed, the heath care facilities and the available resources and treatment technologies.

A literature search showed a lack of research on HCWM in GPs’ surgeries from year 2000 to current. This was concerning as GPs surgeries are primary sites of HCW generation. Furthermore, these sites were mainly situated in residential or commercial areas and incorrect or a lack of proper HCWM can prove to be detrimental to the environment and the surrounding communities. Given the lack of literature about HCWM in GPs surgeries, the following sections will primarily focus on HCWM in health care facilities such as hospitals, clinics and laboratories.

An understanding of the HCWM process was critical when evaluating the practices of HCWM. This process looked into HCW from generation to disposal of the waste. The categories included: separation, collection, transport, treatment and the disposal of HCW and is further explained in Table 1 (Kaiser, Eagan, Shaner 2001:205).

2.1.1 The health care waste management lifecycle explained

Table 1: HCWM Process (Chartier, Emmanuel, Pieper, Prüss, Rushbrook, Stringer, Townend, Wilburn and Zghondi 2014:77-138).

STEP 1 SEPARATION	STEP 2 COLLECTION	STEP 3 TRANSPORTATION	STEP 4 TREATMENT	STEP 5 DISPOSAL
The process of waste segregation should be done at the point of generation.	Collection of waste should always be done at a set time allocated for collection and should be estimated at according to the filled waste bags.	During onsite transportation to the facilities central storage area, the trolleys should have a set route to prevent harm to the patients and staff.	HCW can be treated during the process of autoclaving; this is a steam based treatment which mainly requires heat for disinfecting, e.g. reusable sharps, anatomical or pathological waste.	This process concentrates on the remaining waste that cannot be treated or recycled.
The user should separate waste into sharps, Infectious waste, pathological waste and general	All sharp containers and waste bags to be collected when they are three quarter-filled.	Transportation should be routed from “clean” area into the dirty “area”. Waste from the most sensitive wards	This process occurs at temperatures from an estimate of 200˚C to 1000˚C.	The waste is then dumped in a landfill site.

waste.		should be collected first to prevent further infections.		
All containers should be colour coded to identify the different types of waste generated in that facility.	Each category of waste should always be collected separately. General waste is should not be collected with HCW.	Transport staff should at all times wear appropriate PPE.		Alternatively, waste can be incinerated to convert HCW to inorganic waste which reduces the amount of waste discarded and burnt openly. This happens if facilities do not have the finance to incinerate the HCW.

2.2 Knowledge and practices of health care waste management

2.2.1 Best practices of HCWM

2.2.1.1 Best practices in developed countries

The United Arab Emirates followed HCWM guidelines and policies appropriately (Shareefdeen 2012:1626). Sharps were placed in different puncture proof containers as compared to infectious and pathological waste. These were then labelled “Biohazard”, then sealed and disposed of. These water tight containers were uniformly coloured for easy identification. A yellow plastic bag was used to identify infectious waste that needed to be buried or incinerated. HCW was disposed in a red bag indicating that this type of waste needed to be autoclaved. The size of the storage container depended on the volume of waste and was not overfilled. (Shareefdeen 2012:1626).

In the United Kingdom, a further management step was initiated where all waste handlers were provided with the necessary personal protective equipment (PPE) for example, cut-resistant ballistic gloves, boots and heavy-duty poly-cotton uniforms (Blenkharn, Odd 2008:2). Further studies in Algarve, Portugal, indicated that all treatment rooms contained small appropriately labelled and colour coded waste containers to dispose their HCW. Boxes were used for “puncture wastes” ie. sharps and needle disposals. Moreover, collection and transportation of HCW was done differently in private and public hospitals. In public hospitals, a private company collected the waste from the various storage areas. In private hospitals, housekeepers performed all segregation operations before the waste was collected for final disposal (Ferreira, Teixeira 2010:2659).

An added step was that to continuously encourage and promote proper HCWM, a Spanish hospital undertook HCWM staff training which improved the hospitals’ HCWM status. The HCW was significantly reduced and in turn, this lowered HCW treatment costs (Makajic-Nikolic *et al* 2016:368). This showed that regular training was imperative as it improved the management of HCW. This progressive achievement resulted in accreditation with the International Organization for Standardization (ISO) 14001 (Mosquera *et al*.

2014:896-897). Additionally the disposal of sharps in Sydney, Australia showed that within the 26 health care facilities that were researched, almost all health care professionals stored their sharps in yellow Australian Standards approved sharps containers (Blundell *et al*. 2011:151), these containers were puncture proof, leak proof and waterproof.

This search in literature depicted good practices when managing HCW in developed countries but almost equally in a few developing countries, great efforts are also shown as noted below.

2.2.1.2 Best practices in developing countries

In Serbia for example, HCW was segregated and packed appropriately in demarcated containers for each type of HCW. The waste was then transported with special transportation for both treatment and final disposal (Makajic-Nikolic *et al* 2016:368). While in comparison to India (Gupta, Boojh, Mishra, Chandra 2009:816), predominantly poor HCWM practices were identified. However, in the area of Vivekananda, India; a polyclinic segregated HCW according to legislation. Also, collection of infectious and non-infectious waste was carried out by two teams of two individuals; the first set pulled filled carts for the collection and disposal while the others replaced them with clean carts. The HCWM colour coding segregation method was used to manage their waste in an efficient risk free method in accordance to the biomedical waste management and handling rules of 1998.This information not only indicates good practices in hospital based facilities but also in clinics; specifically in developing countries.

Clinics in Mauritius also played a vital role by practicing good HCWM (Bokhoree *et al*. 2014:38). These facilities adopted a three colour coding system for the disposal of different medical waste. This system included: yellow for soiled linen, red for hazardous medical waste and black for general municipal waste. This practice was similar to the one used in Serbia (Makajic-Nikolic *et al* 2016:368). The waste service staff were also provided with the necessary protective clothing when handling the HCW. Further research conducted in Malaysian hospitals also indicated the use of colour coded bags used to segregate waste into HCW and general waste making a huge

difference in their health care facilities (Omar, Nazli, Karuppannan 2012:138). Sharps were similarly being disposed of in separate puncture-proof sharp bins and infectious waste was disposed in light blue bags ready to be autoclaved. Similarly in Binzhou, China, research showed that in secondary and tertiary hospitals, special containers with bio-hazard markings were used to dispose of different HCW in their different categories (Rouyan *et al.* 2010: 248). Furthermore, all secondary and tertiary hospitals established a storage location area for HCW that had filled, sealed containers. Pest control and security measures were taken into consideration to ensure rodent infestation and theft were minimal. This also provided a barrier against accident spillages and leakages. Special tools for collection and transport together with time frames and routes were arranged and used to dispose their HCW. This efficient practice cut costs and minimised infections and injuries. It further provided an environmentally friendly facility for all patients, workers and visitors.

Ulaanbaatar in Mongolia, further demonstrated that hospitals generally exhibited good separation methods for HCW (Popp *et al.* 2014:3). The hospitals general waste was collected by the municipality waste sampling lorries. All HCW was collected 3 times a week by a method known as “Element” cars which are used to transport HCW to treatment facilities. Similarly in the South western region of Cameroon, nursing assistants and sanitation workers were both responsible for the collection and transportation of HCW in health care facilities (Manga *et al.* 2011:113). When HCFs were surveyed, waste bins were emptied at least once a day, typically in the morning and sharp containers were disposed of 2-3 times a week. This indicated a good movement of HCW. These health care facilities highlighted excellent HCWM practices and when management and staff worked together, a potentially risk-free environment could be maintained. However, challenges still existed and these are noted below.

2.2.2 Challenges concerning HCWM

2.2.2.1 Challenges experienced in developed countries

Contrary to the best practices noted previously, Udofia, Fobil and Gulis (2015: 252) and Winfeld and Brooks (2015:103) concentrated on Africa and the UK respectively and highlighted the common challenges experienced when managing HCW. These challenges included the inappropriate use of colour coded bags to segregate HCW, the lack of consistent training for staff in HCFs and the inappropriate vehicles used to transport the HCW. These practices and lack of training also had an effect in the Australian HCFs where sharps were stored in drinking bottles and used baby bacterial wipe containers (Blundell *et al*. 2001:151). Most storage containers were overflowing with sharps. Although in some cases, equipment was provided for HCWM in developing countries; training on how to use these different types of products was not given; resulting in the misuse of the equipment. This directly affected the patients and staff, exposing them to occupational hazards such as needle stick injuries and incurred added costs for the treatment and disposal of HCW.

2.2.2.2 Challenges experienced in developing countries

Developing countries like Nigeria and Jordan experienced poor HCWM on an ongoing basis (Longe, Williams 2006:133; Abdulla, Qdais, Rabi 2008: 451-453). This was primarily due to the cost and implementation associated with HCWM, vague regulations and the lack of HCWM awareness associated to the related risks. Further studies conducted in health care institutions in Jordan (AlMomani, Al-Zube, Al-Bataineh 2012: 323-332) showed that processes used to carry out HCWM were inefficient as the correct steps were not taken to manage HCW effectively. These processes and steps included: correct disposal, separation, labeling, containerization, collection, transportation and treatment of HCW. The government however, had given precedence to provide more attention to the handling and disposing of HCW in these institutes whereby a new protocol on HCW was released by the Minister of Health. Unfortunately these documents made no transformation

where HCW was concerned. This was as a result of the potential health effects related to HCW mismanagement on the environment and the community. These health effects included the spread of infectious diseases aided by inappropriate segregation of HCW and hazardous material been deposited into the environment. Some of these effects included needle stick injuries which resulted in the spreading of infectious diseases while chemicals also hindered the quality of water supply and caused air and soil pollution.

Likewise, evidence gathered in Gondar town, North West of Ethiopia showed that HCWM practices across a significant number of health care institutions indicated poor practice of HCWM by the health care workers (Muluken, Haimanot, Mesafint 2013:318). All health care workers were placed in direct danger of developing needle stick injuries and associated infectious diseases through the lack of proper HCW segregation. Additionally, poor waste segregation was also due to the insufficient supply of colour coded containers and the absence of HCWM guidelines. Consequently, in Ethiopia, staff attitude and commitment from health care workers were extremely negative where HCW segregation was concerned. With a total of 260 health care workers interviewed, 32.5% practiced HCWM, 93% were provided with gloves when handling HCW, 40.8% used sterilization when treating infectious waste before final disposal and only 31% segregated the waste at the point of generation while majority of the participants used normal waste bins to segregate their HCW.

Similar circumstances occurred in Tanzania where preference of proper waste segregation was given only to sharps, pathological and infectious waste (Kagonji, Manyele 2016:445). Those three categories of waste retained excellent HCWM while chemical, pharmaceutical and radioactive waste was neglected. Colour coding methods used for HCWM were nonexistent resulting in very poor practices. The transportation of HCW was done manually within the hospital to neglected storage sites which contained medium heated incinerators. Furthermore in Hawassa city, Ethiopia, HCFs displayed poor HCWM (Haylamicheal *et al.* 2010:3). From the nine health care facilities surveyed, 67% HCWM was absent, 22% of the surveyed individuals claimed to have segregated sharps from other HCW and only 11% were using the

appropriate practice to manage HCW. These practices included colour coding classifications of which yellow puncture proof containers were used for infectious waste; puncture proof safety bins for sharp waste and black for the general waste. Of these nine facilities, two of the facilities mixed sharp waste with general waste. This depicted a poor legislative framework and a lack of HCWM guidelines throughout the study areas.

In addition, Addis Ababa, another city in Ethiopia, showed poor HCW segregation among the researched hospitals (Debere *et al.* 2013:5). This mismanaged HCW was collected and transported in perforated plastic bins which were thereafter stored at a temporary storage site. In some hospitals the collected HCW was stored up to a month before transported to final disposal sites. These practices indicated a total absence of HCW segregation training. Lack of awareness concerning the importance of HCWM was highlighted as the main reason for poor HCW segregation in the above facilities. It should be noted that not only does HCWM awareness minimize infections concerning staff and patients but also helps the facility to cut back cost for autoclaving and the incineration of HCW.

Although in Mongolia, HCW was incorrectly separated and sharps were not being sterilized (Popp *et al.* 2014:3). The reasons for these poor practices were numerous and included: old non-functional sterilizers, incorrect installation and lack of funding. This therefore highlighted that financial resources were unvailable to upgrade and maintain their medical equipment as legislation required. Additionally studies conducted in Libya indicated that the solid wastes produced in the country's hospitals were collected by private transportation (Sawalem, Selic, Herbell 2009:1371-1372). After collection, waste was stored predominantly in black plastic bags and transported via an uncovered trolley to an on-site storage area in the hospital yard. This directly affected all patients, staff members and visitors exposing them to disease and bacteria filled contaminants. Sharps and the remaining HCW that were produced in the hospitals operating theaters were then collected and placed in closed plastic containers and plastic bags. Thereafter the waste was transported to nearby incinerators. While a 2001 case study in Dhaka, Bangladesh similarly showed practices of partial segregation in HCFs where

HCW was continuously being mismanaged during separation and thereafter transported to a temporary storage location (Patwary, O'Hare, Sarker 2011:1204). Even though training for these health care workers was not available on an ongoing basis, an effort to segregate HCW was made but the end result was ineffective.

Additionally, research done in Greece by Tsakona, Anagnosropoulou and Gidarakos (2007:914), noted the availability of HCWM guidelines for the segregation of HCW. These guidelines indicated that black and yellow containers are used to dispose infectious, municipal and sharp waste separately. This however was not practiced resulting in municipal and infectious waste often being mixed together. Additionally, flammable waste was not being handled in the appropriate manner leaving workers exposed to environmental health risks. Tsakona, Anagnosropoulou and Gidarakos (2007:914) went on further to note that the quality of waste bags placed in patient's rooms were of low resistance made from extremely thin materials. This coupled with poor segregation methods increased the chance of needle stick injuries to patients, staff and the waste handers.

HCW mismanagement continued in Allahabad in India (Shalini, Harsh, Mathur 2012:82-83). Here, hospital facilities and medical colleges indicated poor HCWM practices where all colour coded bags were incorrectly stored and bins were not covered by lids. Further, only 43% of the researched facilities segregation sites contained properly segregated HCW. Unqualified and untrained staff segregated HCW and only 30% of cleaners were given gloves.

It was also discovered that a multi-specialty tertiary hospital called Sri Ram-Murti Institute of Medical Sciences situated in India, depicted unsatisfactory HCWM practice which was similar to that of Allahabad. Even though the institutions are provided with colour coded bags and special protective equipment, segregation was still not practiced using the correct methods. This was primarily due to the lack of awareness concerning the health hazards relating to the mismanagement of HCW. This resulted in needles and sharps being burnt in open spaces while HCW did not have a separate structured

pathway for the transportation of waste out of the health care facility (Srivastav *et al.* 2010:46-49).

Similarly in Agra, Lakshmi and Kumar (2012:2) researched bio-medical waste management. The results indicated that out of 54 waste handlers, 23 had knowledge on the risks associated with the mismanagement of HCW, 12 health care workers received training on HCWM and 10 health care workers suffered needle stick injuries, punctures and infections in the past 6 months. These incidents were not reported to the higher authorities. As a result of the staff's lack of knowledge on HCWM, all workers in the facility were directly affected through needle stick injuries. Therefore training on HCWM needed to be emphasized.

For instance, Bangladesh's HCFs dispose of HCW in general waste bins as indicated by Hassan *et al.* (2008:2). Similarly, in Jordan, waste separation was absent at landfill sites. Often these types of practices occurred because the hospitals and waste management authorities did not have adequate supporting documentation for the composition and quantities of the generated HCW which then resulted in improper HCWM (Longe, Williams 2006:135; Bdour *et al.* 2007:751, Insa, Zamorano, Lopez 2010:1049).

In comparison to the above researched facilities, Indonesia developed an integrated health care waste management plan designed for 600 beds in the researched heath care facilities (HCF). Even so, this did not help the process of HCWM as the HCW was still being mismanaged. The government made strong efforts to solve HCWM only after major illegal recycling of possible hazardous waste made headlines. This then ensured regular inspections at health care facilities along with the implemented practice (Kuhling, Pieper 2012: 103). This therefore highlighted that facilities were only taking corrective measures when the situation had deteriorated and thereafter policies and mandates were still not being practiced. Daou, *et al.* (2015:3) similarly highlighted poor managed HCW in Lebanon where the majority of the clinics researched did not practice HCWM appropriately. This was because 28% of the total number of respondents (242) segregated sharp waste into the

appropriate puncture proof containers but all other waste was disposed of in one common municipal waste bag.

Additionally research conducted in Korea showed that HCW and municipal waste were being mixed and disposed of together at various landfill sites. In recent years though, segregation of HCW was being carried out more efficiently at HCFs. Moreover, these facilities were using colour coded bags and containers to segregate their waste. Human and animal tissues were placed in red containers (plastic, metal or paperboard container), while sharps and pathological waste were stored in yellow containers. All other waste was placed is orange containers. This showed the improved methods of HCWM management in Korea (Jang *et al.* 2006:107-110).

In Uludag, Turkey, a vocational school of health services showed that first year health services students had insufficient or no knowledge on HCW and the effects it had on the environment, while the fourth-year students were educated in the field of HCWM (Calis and Arkan, 2013:1474-1475). These fourth-year students explained they inherited this information over the years of studying the health services courses. They were also able to explain the classification of HCW and the process that should be applied when managing HCW. This study revealed that over the years of education, knowledge is gained on HCWM.

However, in countries like Brazil and Spain, research has shown that legal requirements are still unknown and not put into practice by both healthcare workers and the managers in primary healthcare centres (Insa, Zamorano, Lopez 2010: 1049; Moreira, Günther 2012:164). Management of waste produced in HCFs was usually assigned to laborers who are uneducated on the HCW disposal methods (Alogoz, Kocasoy 2007:1227). These laborers executed their daily duties without guidelines, training and the provision of appropriate protective equipment was lacking. Alternatively, Bokhoree *et al*. (2014:38) stated that in Mauritius, clinics adopted a three colour coding system for the disposal of different medical waste. This colour coding system included, yellow for soiled linen, red for hazardous medical waste, and black

for general municipal waste. Waste service staff were also provided with the appropriate protective clothing when handling the HCW.

While in Algeria and Mostaganem inappropriate practices were carried out, yellow bags were the only type of bags that were provided in the departmental hospitals and black plastic bags were used in public and private HCFs. Furthermore, HCW was being disposed in household bins and empty cardboard boxes without prior segregation (Bendjoudi *et al.* 2009:1386). Concerning the transportation of HCW, untrained cleaners were helping discard the produced HCW. (Bendjoudi *et al.* 2009: 1386).

Likewise a questionnaire survey was conducted in 144 hospitals in Tehran, Iran and addressed the different phases of the management of HCW together with the hygiene practices carried out in the hospitals (Malekahmedi, Yunesian, yaghmaeian, Nadafi 2014:2). The majority of the selected hospitals (84.7%), had experts in the field of environmental health to ensure all HCWM practices were carried out according to standards and guidelines but 15.3% of the researched hospitals showed poor HCWM strategies due to there being a lack of experts in the field of environmental health. Therefore guidance on disposal strategies were minimal but training on HCWM was readily available for HCFs, even so, only 52.78% of hospitals were involved in the training, while 47.22% had no training courses available to them. Therefore HCWM training should have been available to staff in all facilities, ensuring continuous best practice in HCW management.

Chinese HCFs were well equipped with the required tools for HCWM but poor service delivery impacted negatively (Rouyan *et al.* 2010: 248). Facilities were provided with the correct containers and tools used for separation, but these tools were not being delivered timeously. This resulted in the mismanagement of domestic waste and HCW during the separation and collection processes. The delivery of equipment was beyond the control of the health care facility, but in terms of the storage room, this contained all the suitable protective measures as the health care facility was only able to control this aspect

Similar practices of inappropriate HCW segregation at hospitals situated in Nanjing also located in China were experienced (Yong *et al.* 2009:1378).

Observations indicated that despite colour coding techniques used to segregate HCW, this was not being practiced effectively. All types of waste such as HCW and municipal waste were being mixed together in one bag and this was due to the absence of labels on the containers to indicate the different types of HCW placements. These challenges were again predominantly due to lack of service delivery which directly impacted on the management of HCW at certain HCFs.

Likewise, in El-Beheira Governorate, Egypt, poor HCWM was practiced. All researched hospitals had an existing segregation method, but none of them were effective and or practiced according to any guidelines or legislation. All waste which included HCW and general municipal waste were being disposed together in similar packages. Only sharps that were used in 87% of investigated hospitals were appropriately disposed in puncture proof containers. The balance of the hospitals used cardboard boxes as disposal containers. This on the contrary was due to staff mismanagement of HCW and not the service provider (El- Salaam 2010:621).

Similarly in Botswana, observations were made in consultation rooms in designated hospitals. These observations confirmed poor HCWM, the facilities were found to be keeping only red bags for all types of waste that was generated. This indicates that both HCW and general waste are being disposed of in one common “red” bag instead of separating general waste in separate black allocated bags. The HCW consisted of syringes, medications, glove sand packaging materials which were being neglected and mishandled (Mbongwe, Mmereki, Magashula 2008:227).

However health care facilities in Malaysian hospitals were lacking in segregation methods and were not adhering to appropriate standards and guidelines. Observations indicated that HCW was being deposited into yellow plastic bags which exceeded the required legal volume of HCW deposited in each plastic bag. Furthermore, incubation plates were also found to be disposed in sharp bins which increased the level of needle stick injuries accompanied by infection (Omar, Nazli, Karuppannan 2012:138).

While in Nigeria, tertiary HCFs was extremely poor where HCWM was concerned, yet this was not a major concern to these facilities. Abah and Ohimain (2011:102-103) deduced from direct observation at these HCFs, 63 disposal bins were examined, of these 63 disposal bins, 43 were found to be uncovered and left exposed to staff, patients and visitors in those areas and the only type of waste being segregated were sharp waste.

Where training was concerned, in management level, a total of 11.5% of staff had training on HCWM and 8% of the nurses and other staff collectively had seen the instructive posters displayed as continuous training on HCWM in their facility. In addition, there was no responsible trained person for the management of HCW at the health care facility. Sixty nine percent of the respondents indicated that HCW generated was being disposed by either burning on an open fire or burying the waste on site of the facility (Abah, Ohimain 2011: 102-103).

Similar research done in 12 hospitals located in Lassa, Nigeria, indicated only 1 of 12 hospitals had a trained waste handler and hindered training in the other 11 facilities. Respondents were unanimous with regards to protective clothing not being provided when carrying out their daily duties at the hospital. Fortunately the only protective clothing that was provided were rubber gloves and boots which was specifically given to gardeners. Furthermore, 8 hospitals confirmed that there were no existing national policies for HCWM on their premises while the injection safety posters were the only form of HCWM practices displayed in 5 of the facilities (Tobin *et al*. 2013:19).

While research indicated that the southeast area of Nigeria had knowledge of HCWM, this was much greater in the government hospitals rather than the private hospitals. From a sample size of 660, merely 71 participants attended HCWM training with 50 participants attending from the government sector as compared to 21 from the private sector. These results presented a lack of HCWM knowledge and interest among the health care professionals. Moreover this malpractice contributed significantly to the deficiency of HCW segregation, handling and disposal. It further displayed that the government

hospitals were much more equipped when enforcing HCW regulations then the private hospitals (Oli *et al.* 2016:85-87).

In comparison to Tanzania, research revealed that HCW is efficiently separated into categories of, infectious and non- infectious waste. However, where sharps were concerned, this type of waste was found to be mixed with general waste. This act was detected during the process of incineration. Despite the availability of the proper equipment for HCWM, segregation is not continuously taken seriously in health care facilities. The reason for this malpractice of segregation was due to lack of education and awareness as well as poor staff management (Manyele, Lyasenga 2010: 312).

In addition, South Africa also lacked training in HCWM; investigations were conducted in two hospitals located in the Limpopo province. This was an on-site investigation which observed the process of waste management. These observations revealed that HCW was not being separated according to its composition as different types of waste were being mixed together in one common area.

Moreover Kwa Zulu-Natal, South Africa, further indicated that 30 rural health care clinics were visited. In all 30 clinics a categorical segregation method was used where all waste generated in the facilities had to be separated into pharmaceutical, pathological, infectious, sharps and general waste. However observations indicated that their practices failed to authenticate the stipulated segregation methods (Gabela, Knight 2010:20), therefore, this gave rise to additional waste separation after collection was done. Additionally, the disposal of sharp waste was the only HCW stream that was predominantly stored in appropriate puncture proof containers. Further, pharmaceutical, chemical and infectious waste was put into red coloured bags and occasionally, would be mixed together during collection while all incineration residues were dumped close to the area where incineration took place. (Nemathanga, Maringa, Chimuka 2008:1241-1245). Note should be taken that HCW requires specific management and treatment from generation to final disposal (Hassan *et al*. 2008:2).

However, these types of practices would need for workers to manually clean up and separate harmful HCW at landfill sites which poses many associated occupational risks that can directly affect the workers' health and safety. practices of HCW directly affect all workers in health care facilities directly causing many associated occupational health and safety risks. The next section evaluates these risks together with the cause.

2.3 Occupational risks associated with health care waste management

Occupational risks is a major aspect to consider when managing HCW, therefore awareness and attention needs to be drawn to this aspect to help educate society which includes the private practicing GPs in the South Durban area on the harm this can cause to all individuals.

In order to minimize occupational risks, two federal resolutions in Brazil suggested initiating a Medical Waste Management Plan (MWMP) (Moreira, Günther 2012:162), this plan was said to report all external and internal procedures that were taken regarding waste management and it also took into consideration the risks involved when handling each type of waste generated. This was implemented to assist in the reduction of any occupational accidents that may occur together with the avoidance of environmental impacts, while also protecting the public at large (Moreira, Günther 2012:162).

Alternatively in Asia, Kazakhstan, the SEMA hospital revealed that in the department of outpatients, needle stick injuries were most predominant. These injuries were mostly related to improper disposal methods of the sharps as once the health care waste bags were being picked up, the workers were injured by these sharps. Sharps were being discarded in normal HCW bags and not the appropriate sharp containers that were allocated for contaminated sharps (Toraman *et al*. 2011:460).

However, in countries like Mauritius, clinics are provided with polyethylene bottles where sharps are disposed of. This type of bottle is said to be a much safer unit as compared to ordinary sharp containers. A sharp policy was developed at the clinic which states that once the bottle is filled up to two thirds, the bottle should then be replaced with another bottle. All medical

nurses abide by this rule. After the implementation of this rule in the clinics, there were no reported cases of sharp injuries (Bokhoree *et al.* 2014:38).

Unlike in Japan, certain homes with patients who require medical attention and care from nurses also generated HCW called Home Medical Care (HMC) waste. In this specific situation, the municipalities are responsible for collecting the general waste. However the smaller municipalities refused to collect this type of waste, due to general waste being mixed with the HMC waste. It is because of this malpractice, municipal workers had the fear of being infected and injured with the sharps that were placed in the general waste bags, but after a few years of not having their waste collected, the larger municipalities agreed to assist and collect the waste, provided proper HCW disposal guidelines are being followed (Ikeda 2014: 1330). Under no circumstances should exceptions be given to the waste producers as any mistake in HCWM in a home setting can result in being detrimental to the waste handlers as well as the nursing staff as they will be exposed to the infections from the sick.

In addition to the above, also occurred in Japan, an electronic review study done in the United Kingdom indicated that sharp injuries varied from 0.8 to five injuries for every hundred workers. Even though this was a burning issue among workers, needle stick injuries were not reported where patients and health care workers were concerned. Studies showed that a catheter stylets accounts for the highest rate of injuries in these health care facilities (Elder, Paterson 2006:571). Reporting these occupational incidents was not taken seriously by these facilities neglecting the safety of hundreds of workers.

While in Binzhou, China, training programmes on health and safety were provided for all workers who were actively involved in HCWM. Some components concerning HCWM training in various HCF differed from one another. In Primary health care facilities, new employees received introductory induction/orientation training, while in tertiary and secondary health care facilities, training programs were much more wide-ranged and on-going which kept all employees well-informed with different practices. Regular lectures were also provided as an extra form health and safety education training.

Vaccinations, health checks and the provision of protective measures in primary and secondary hospitals were found to be undersupplied (Rouyan *et al*. 2010:248).

Whereas in Nanjing, similarly situated China, workers handling HCW do so without the use of protective equipment placing themselves in direct risk of infectious diseases and needle stick injuries. Sharps are also being mismanaged and disposed in plastic bags. These waste bags, when being transported to the final disposal site are being punctured due to the disposed sharps putting the waste handlers in direct risk of needle stick injuries (Yong *et al*. 2009:1378). Additionally, similar practices were being carried out in Serbia, Europe, this study indicated injuries at the workplace which was the main cause for concern (Makajic-Nikolic *et al.* 2016:372), and this was deduced by retrieved data using an analysis program called Fault Tree Analysis (FTA).

Other challenges experienced were that protective equipment was not being used when handling and segregating HCW produced. In this situation, the necessity for the implementation of decision making and the improvements of HCWM cannot be over emphasised. Creating a register for the monitoring of risk activities carried out (for the use of protective equipment and occurrence of injuries at work) and training of HCWM would be a great help to the health care facilities in this area. This will give management to chance to monitor the workers and take note of the challenges experienced when handling HCW (Makajic-Nikolic *et al.* 2016:372).

Likewise in India, a premier tertiary hospital institute was investigated. Research at this particular hospital disclosed that HCW was being mishandled on a daily basis. As a result of this malpractice, 347 injuries occurred from needle stick injuries alone. The percentages however reduced from 69.2% in 1995 to 38.5% in 1996, these stats decreased after education on needle stick injuries were given to all staff (Sachin, Patel, Nischal 2012:2). This in particular highlights the importance of training and disseminating the correct information on HCWM. But in some areas in India as indicated below, HCWM training lacked significantly, in a city known as Allahabad similarly situated in

India, a lack of HCW training was reported. A total of 7% of the sweepers/ waste handlers were reported to have needle prick injuries over the last 6 months. Holistically segregation was poor as sweepers and cleaners where primarily the individuals in charge of segregating the produced HCW. (Shalini, Harsh, Mathur 2012:82-83). This clearly indicated that training is imperative at all health care facilities as it reduces the amount of risks from occurring when carrying out daily HCWM practices.

In addition, Tanzania's health care facilitates have many needle stick injuries because all sharps are not being collected and placed in correct safety deposit boxes. On some occasions when safety boxes are used, these boxes are being over loaded again, causing harm to HCW collectors. Some facilities were found to be disposing off their sharps in pit latrines by professional health care workers, this points back to the medical colleges as the curricula is said to be "scanty" (Manyele, Lyasenga 2010:306). Health care professionals such as GPs are the generators of sharp waste, therefore training on occupational health and safety concerning disposal methods of HCWM is required to be given either in orientation or at medical colleges.

Furthermore a risk assessment carried out in Portugal presented 44 injuries from HCWM in one of the three hospitals researched during the year 2008. These injuries included 5 cuts, 39 punctures (needle stick injuries) and 8 from bloods and body fluids splash. To add, a further 5 injuries were reported from handling HCW during the same year (2008) which resulted in needle stick injuries when preparing the needles for disposal. This was due to improper HCWM practices (Ferreira, Teixeira 2010:2661).

In Palestine a similar phenomenon was being carried out, 37 clinics were researched of which a total number of 45.9% of doctors were disposing sharps in ordinary plastic bags. 40.5% threw their needles in plastic bottles and 13.3% burnt their bottles containing needles by themselves in quiet isolated areas. Furthermore all infectious waste such as blood gauzes was being disposed together with municipal waste. This poses major occupational health and safety risk not only to the staff but also the patients placing them in direct risk of infections and diseases (Darwish, Al- Kartib 2006:219-220).

Patients and visitors especially are now being put at risk due to the improper waste segregation methods; this could eventually lead to hospital acquired infections from the risk of needle stick injuries in this instance.

Further research done in Ethiopia showed that needle stick injuries are a norm revealing a 42.1% of injuries in staff. The high risk areas were laboratories, on-site waste storage areas and the delivery rooms. This was due to sharp disposal containers not being closed properly due to overfilling. Needles were also being carelessly stored in sacks which are allocated for soft waste; this resulted in the bags being punctured by the sharps (Shiferaw, Abebe, Mihret 2012:1301).

Additionally in the North West of Ethiopia a lack of training and knowledge on HCW stood out at facilities, 49.1% health care workers received no training and safety instructions on HCWM at their place of work which contributed to a 25% needle stick injury in the year 2012. Of this amount, 9.6% of the injuries were caused during the process of handling HCW (Muluken, Haimanot, Mesafint 2013:318). Likewise a study was done in Hawassa City also located in Ethiopia. This study concentrated on nine health care facilities which were surveyed for the occurrence of needle stick injuries among waste handlers (Haylamicheal *et al.* 2010:7), these included cleaners and the waste collectors. 25%–100% of waste handlers said to have experienced needle stick injuries at least once in their life time.

All health care facilities stated that they had provided waste handlers with proper equipment. One of the nine hospitals provided plastic gloves alone, but the remaining eight reported that they provided gloves, aprons, masks and boots. However during the study observations it was indicated that none of these workers were wearing the provided protective equipment. In some instances workers were seen to be wearing surgical gloves when handling HCW due to the unavailability of appropriate gloves. Additionally HCW was being mixed with municipal waste which will add to needle stick injuries and expose the workers to occupational infections and diseases (Haylamicheal *et al.* 2010:7).

To add, the south western area of Cameroon located in Africa also presented poor HCWM practices. Workers at health care facilities did not use personal protective clothing and the appropriate equipment needed to handle HCW. As a result of this action workers were said to be at high risk to occupational and health hazards (Manga *et al.* 2011:113).

While in Botswana also located Africa, research displayed that healthcare workers were not aware of the severity of mismanaged hazardous waste (chemical waste, radioactive waste and pressurized containers in health care facilities) had on the environment and us, human beings. Training was also unavailable to new staff in certain health care facilities relating to HCWM. With regards to sharp disposal, health care workers did not have any knowledge on the risk of needle stick injuries and associated infections including the contraction of the HIV virus. (Mbongwe, Mmereki, Magashula 2008: 233).

In South African hospitals though, research has shown different practices of poor management of sharps by both doctors and nurses after these instruments have been used, for example, once sharps are used, it was placed on the patient's bed instead of discarding them into the designated containers. This then puts the patients in direct danger of a needle stick injuries. These are not practices advocated by the World Health Organisation, who noted that all health care risk waste is to be discarded in plastic bags and strong plastic containers for HCW and sharps respectively (Abor 2007:93).

These practices in South African hospitals also shows disregard for government's policy and regulations for the management of HCW whereas in countries such as Croatia, government policy is being correctly implemented and regulations enforced. Below a literature search of different countries guiding legislation and framework will be analysed.

2.4 Legislation used for health care waste management

According to the government policy in Croatia, all HCW is to be separated at the point of generation (Marinkovic *et al*. 2007:1050). Further, all waste should be appropriately packed into containers according to its composition; it should then be transported and treated before final disposal. Red coloured containers indicate infectious waste, pathological waste is indicated as red with a black

stripe, yellow indicates medical waste, green for pharmaceutical waste and black and blue indicates general waste with all waste clearly indicated as 'Hazardous Medical Waste'. While in Sao Paulo, Brazil, a study indicated that health care workers and the managers in primary healthcare centres were not familiar with the legal requirements (Moreira, Günther 2012:163). Negligence in health care centres and poor practice of HCWM of the documentation provided was the norm. In most government medical institutes, procedures were not appropriately practiced whereas in the private sector, more medical institutes complied with legal regulations.

Similarly, the HCWM in Turkey is carried out and practised according to the Turkish Medical Waste Control Regulations which was effectively implemented in 1993 (Alogoz, Kocasoy 2007:1228). This regulation explained all processes from collection to final disposal but with regards to the disposal of waste, the regulation was insufficient due to technological advancements and revisions were subsequently required.

Further, in the city of Mongolia, HCW is separated according to their composition, e.g. sharps, infectious waste, pathological waste, and pharmaceutical waste. However even though colour coding bags and containers are provided, not all the heath care facilities firmly follow these national regulations for the segregation and disposal of HCW. Some of the health care facilities store their HCW in plastic or paper bags and cardboard boxes which clearly indicates inefficient HCWM (Shinee *et al.* 2007:2-3). This indicates poor staff knowledge across all HCF in Mongolia, a uniform HCWM practice needs to be communicated via awareness's and trainings to keep up one common standard.

However in Lebanon, studies revealed that out of 242 surveyed clinics, 90% of the respondents were well aware of the HCWM's written plans and procedures, but only 64% of the respondents were in compliance with the local health and safety requirements; these requirements included the policy for sharp injuries and blood exposures. Another 45% of the totalled surveyed clinics were provided with protective equipment when collecting, treating or transporting the HCW (Daou, *et al*. 2015:3). This emphasises that more

training, education of guidelines and standards need to be relayed to all staff members.

In comparison, Indonesia has a population of 250 million people, yet research has shown there were no specific laws or regulations regarding HCWM in HCF's. There is only one guideline which is used and can be found in the Decree of the Minister of Health on the "Requirements of hospital health environment". In the year 2008 another set of legislation was released called The Solid Management Act18/2008 which also covered HCW (Kuhling, Pieper 2012:101). These are the only two pieces of standards and guidelines which is provided to this country to assist in the management of HCW.

While a study done China, Binzhou revealed that employment of a management system which was based on National Government regulations was different when comparing various health care facilities. Secondary and tertiary hospitals were seen to have been complying completely with the national regulations. While in contrast with primary health care facilities, numerous issues such as lack of equipment, poor waste separation, deficient protective measures, unsanitary storage locations and on-site disposal were the challenges observed (Rouyan *et al.* 2010: 249). This indicates that laws and regulations need to be enforced and monitored at primary health care facilities. This will assist to identify the challenges experienced. After which provisions need to be made to ensure all required protective clothing is available for all workers at these particular facilities.

Furthermore, health care facilities in Sydney Australia reflected that sharp waste disposal was not implemented appropriately and not taken as seriously as it should be, none of the researched health care facilities had a waste contractor for sharp disposal and incineration. The managers also had no knowledge of the Skin Penetration Regulations or their Code of Best practice (Blundell *et al*. 2011:151). This put all workers in direct occupational risk as legislation and guidelines needs to be enforced from management and relayed to all workers to abide by on a daily basis. These regulations and best practices should be readily available in all healthcare facilities.

Likewise in the City Sylhet located in Bangladesh, HCWM is a neglected topic at the health care centers as there were no administrative processes concerning the management of HCW. In addition the most important fact highlighted, was that there is an absence of well-defined regulations or guidelines for HCWM in this city. This indicates that there is no definition for hazardous waste and no regulations for the disposal or transportation of the HCW produced (Sarkar, Haque, Khan 2006:36).

Whereas in Agra, India, a questionnaire survey revealed that out of 569 respondents 189 (33.21%) health care workers were aware of the Bio-medical waste rules of 1998 (Lakshmi, Kumar 2012:2), while in the South East of Europe, Serbia, the national guidelines for safe medical waste management in the Republic of Serbia is the only piece of legislation that is practiced at these health care facilities, together a Rulebook called Medical Waste Management. These guidelines are what help the facilities in terms of definitions and segregation methods used for HCWM (Makajic-Nikolic *et al.* 2016:367).

Likewise in Northern Jorden, 21 hospitals endured a comprehensive inspection survey which indicated the following results, 29% of hospitals had health care waste management systems, 38% indicated that they were verbally informed about national regulations, while another 38% informed staff in a written manner, 24% did not notify staff at all on any regulations or guidelines while only 10% of the surveyed hospitals have formal existing guidelines that were being practiced. All the surveyed hospitals were mindful of the HCWM regulations but only 67% of the total number of hospitals surveyed had a copy of the regulatory requirements (Abdulla, Qdais. Rabi 2008:453).

Moreover hospitals in Oregon situated in Washington reported a low rate of waste segregation despite the state law which requires that all health care facilities must segregate their waste at the point of generation. The reason for this low rate of HCW segregation is that 72% of the hospital use private waste haulers to transport their HCW to off- site treatment facilities. These companies are said to provide supplementary services such as HCW

segregation and repackaging, therefore the hospitals in this area depend on these waste haulers to carry out the health care facilities segregation. Neither the private waste haulers nor the health care facilities comply with disposal regulations and guidelines but this was the common way used to get rid of their waste generated (Klangsin, Harding 1998:520).

While in the United States, recent research revealed that medical waste was highly regulated by the Medical Waste Tracking Act (MWTA) of 1988. This Act came into practice after the 1980's when large amounts of HCW were indecorously disposed. This waste was found washing out on the shores of the United States causing major public outrage. It was because of that negative exposure presently the management of HCW is being carried out with much consideration (Winfeld, Brooks 2015:101). HCWM should always be taken seriously and not only after extensive damage been done. Therefore this matter cannot be over emphasized as many people's lives could be at risk.

Yet in the United Kingdom for example, HCW was received and collected in colour- coded bags which were compliant according to the United Nations transport of dangerous goods (UN 3291). Sharp waste was also in compliance with the British Standards institute 1990 (BS 7320: 1990) and collected in tamper- proof, puncture resistant containers. This indicated that the researched hospitals were following the appropriate legislation and guidelines for suitable HCWM (Blenkharn, Odd 2008:282).

While in 1998 the country of Mongolia in the city Ulaanbaatar new interventions were being implemented, after a raging transition from a centralized economy, the Mongolian Government developed a regulation on HCW classification, collection, storage, transportation and disposal. After 4 years, in 2002 this regulation was then updated, the regulation thereafter was used to emphasize non- burning technology when managing HCW to help reduce air pollution from incineration methods used to terminate HCW (Popp *et al.* 2014:2).

Additionally in the South Western region of Cameroon, regulations on HCWM also fell into the category of protecting the public health, the two main

legislation used to carry out HCWM is 1964 law on Conservation of a public Health and the 1996 Framework Health Law. These two pieces of legislation acts as a guiding policy for HCWM and to reduce the risk of infection and disease to medical staff in health care facilities (Manga *et al.* 2011:111).

In comparison to the Government of Botswana they too developed a set of practices, this was called the Clinical Waste Management of Practice in 1996 which was developed to help health care professionals understand the management of HCW. However research conducted in two districts in Botswana stated, majority of the health care workers were not aware of this code of practice even though this specifies colour coding instructions for the different types of HCW generated in health care facilities (Mbongwe, Mmereki, Magashula 2008:228). Again this indicates the lack of access to legislation for those who are in direct contact with HCW.

While in the North West of Ethiopia, out of 260 researched health care workers, 252 respondents had no access to none of the country's national guidelines or documents regarding HCWM, in addition 138 health care workers did not receive the appropriate training for the management of HCW at these health care facilities (Muluken, Haimanot, Mesafint 2013:318).

Likewise in Lagos, Nigeria, the HCWM effectiveness in four hospitals was measured against a three principal criteria in the National Guidelines for management of medical waste (Longe, Williams 2006:136). This included the presence or absence of a tracking programme, testing and monitoring programme, along with the presence or absence of a medical waste management plan. Results showed an absence of all three criteria in both private and public hospitals. Government laws and legislation shows to be ignored and taken casually, more enforcement and practice should keep the HCW handlers well prepared at all times on the various segregation methods.

Whereas in South Africa, legislation such as The Health Professionals Council of South Africa (HPCSA) Regulations, The National Health Act of South Africa (no. 61 of 2003), The National Environmental Management Waste Act 59 of 2008 (NEMA) and the eThekwini Municipality: Nuisance and Behaviour in public places by- law (Section: 9) are provided for all health care facilities to

adhere to at all times. These legislative documents provide a step by step, cradle to grave approach on how waste should be segregated and disposed of effectively. Some of the segregation practices include green for pharmaceutical waste, red liner for health care waste, clear liners for general waste and yellow puncture proof containers for sharps which should be labelled with a start date and end date. This indicates how long the sharps container was opened for which is not more than 3 months. (South Africa (2016:1-28), South Africa (2004:2-92), South Africa (2008:20) and South Africa (2015:36)).

In Gauteng, South Africa studies showed that all regulations according to the WHO and together with the National Conservation and Environmental Act (1989) and the Gauteng health care waste management policy were being adhered to. Majority of the health care professionals showed good knowledge on the local hospital policies, but research revealed that nurses had a much better understanding of the policies and legislation than the doctors ($p< 0.01$) (Ramokate, Basu 2009:444).

Therefore GPs may need to be educated on the appropriate ways to manage HCW, inclusive of a knowledge and implementation of appropriate legislation. They should be encouraged to be directly involved in the process especially when the HCW is being primarily generated by their practices.

2.5 Conclusion

This chapter has summarised literature as relating to the objectives under study but with specific reference to HCFs as there was a dearth of information regarding these relationships to GPs. However, all GPs should be aware that inappropriate HCWM causes various types of environmental pollution. It also causes harm to waste pickers and all directly involved in the collection and transportation of the HCW. It can act as a reservoir for communicable disease agents such as, HIV/ AIDS, Hepatitis A and B, Typhoid and Cholera. HCW is an extremely hazardous constituent and if not treated correctly can pose a major risk which can result in fatal diseases to all people in contact with HCW. Therefore the understanding of HCWM and control techniques cannot be over emphasized (Shareefdeen 2012:1628). A universal effort involving both

developed and developing countries should be strengthened and renewed and sustainable systems developed for HCWM (Caniato, Tudor, Vaccari 2015:100).

The next chapter will indicate methods used to evaluate the HCWM lifecycle utilized by GPs in South Durban.

CHAPTER 3: METHODOLOGY

3.1. Introduction

This chapter provides a detailed description of the research methodology used to undertake this study and includes the strategy, plan and structure of how this investigation progressed over the data collection period.

3.2. Overview

This study focused on the knowledge and practices of HCWM at GPs private surgeries in the South of Durban as well as identified the occupational health and safety risks that were associated with the HCWM practices. Additionally, a legislation checklist was answered regarding the legislation used for HCWM.

3.3. Study Design

This cross-sectional study was chosen to observe and analyse data that has been collected from the study population i.e. GPs, in order for the study to yield appropriate results.

3.4. Study Area

Study participants were recruited from the Durban South Doctors Guild (DSDG). This organisation is situated at the Chatsmed Garden Hospital in Woodhurst, Chatsworth. According to the Guild's records, their members' surgeries are within the following residential areas: Bluff, Chatsworth, Clairwood, Isipingo, Overport, Merebank, Queensburgh, Reservoir Hills, Shallcross, Town Central and Umlazi. These stated areas belong to the South Durban district in KwaZulu- Natal.

3.5. Sampling Strategy

3.5.1. Population

The population comprised doctors who belonged to the DSDG which in total N=70. These doctors are General Practitioners (GPs) who practise from their own private surgeries in various areas in the South of Durban, KwaZulu-Natal. This study included all qualified GPs, male and female irrespective of race.

3.5.2. Sample size

Using the method of simple random sampling and a programme called Raosoft Statistical Software (a sample size calculator), a minimum of n=60 i.e. 85% of the DSDG was determined as the appropriate sample size. However, on completion of visiting all GPs, only 50 GPs chose to participate in this study. Approval was sought and granted from the Durban University of Technology's research committees to reduce the sample size to n=50.

3.6. Inclusion and Exclusion Criteria

3.6.1. Inclusion Criteria

- All GPs that belong to the DSDG.
- All GPs practicing privately in South Durban, i.e. doctors who are not hospital based.

3.6.2. Exclusion Criteria

- All GPs that do not belong to the DSDG.
- All GPs who are not practicing privately in South Durban.

3.7. Data Collection

The DSDG was approached to obtain permission to undertake this study using the data collection tools noted below (Annexure 1). Permission was subsequently obtained from the DSDG Chairperson (Annexure 2). After permission was granted, a meeting with the DSDG secretary was scheduled to attain all the details of the GPs who would be invited to participate in this study. These details included: names of GPs, email addresses, telephone numbers and practicing addresses. All study instruments were provided in English which was the spoken language of the sample group. All potential participants were contacted telephonically or by email to set up an appointment at his/her convenience.

At the pre-determined appointment, the study was then explained by the researcher in a face-to-face interview with the GP concerned and with the use of a letter of information (Annexure 3). This discussion helped the participant understand the context of the research study, its potential outcomes, knowledge of the research team and with an outline of study procedures. Since participation was voluntary, should the participant consent to participate in this study, a consent form was given to the participant to read, sign and date (Annexure 4). This enlightened the participant on the nature, benefits and risks of this study. A copy of the information letter and signed consent form was given to the participant for his/her records.

The interview process took approximately 30-45 minutes per participant and included the two-stage process below.

STAGE 1: QUESTIONNAIRE (Annexure 5)

This validated 36-item questionnaire [(adapted from World Health Organisation (n.d : 60-84)] assessed the GPs knowledge and practices of the hierarchy of waste principles and evaluated occupational risks associated with handling health care waste in his/her surgery.

Four sections were included in this questionnaire:

- Section 1: demographic data
- Section 2: knowledge on HCWM
- Section 3: practices of HCWM
- Section 4: Occupational risks associated with HCWM

Some of the questions included in the questionnaire were as follows:
Section: 2: Knowledge on HCWM:

- On average how much of health care waste is generated per day at your practice?
- Is the health care waste stored according to specific regulations?
- Does your surgery have a waste management plan?
- Do you know where the health care waste generated from your surgery, is disposed of?

Section: 3: Practices of HCWM:

- Are protective masks being worn when handling different types of health care waste?
- Into which categories is health care waste separated?
- How full are your HCW bags before replenishing with a new one?
- Have you had any challenges in managing your health care waste appropriately and as per regulations?

Section: 4: Occupational risks associated with HCWM:

- Which personal protective equipment is used by your staff that handles health care waste?
- How many cases of needle stick injuries have occurred in the past 12 months in your surgery?
- Was all the needle stick injury cases reported?
- Do you have a copy of the injection safety policy/ recommendations issued by your health service?

STAGE 2: REGULATIONS CHECKLIST (Annexure 6)

A Regulations Checklist, adapted from the KwaZulu-Natal Department of Health Environmental Health Legislation, Guidelines, Policies, Protocols and Strategies CD and in consultation with Environmental Health Practitioners from the Phoenix Health Department, was used to determine regulations utilized during the HCWM process in each participant's surgery. This checklist consisted of a list of legislation that related to HCWM in private practice where each participant was required to tick the legislation that they utilised at their surgeries.

3.8. Data Management and Analysis

All data collected was recorded and captured in Excel. Thereafter data was coded, cleaned and analyzed using the statistical software SPSS version 24.0. With the assistance of a statistician, descriptive statistics using frequency and cross-tabulation tables, correlations and graphs (including pie & bar charts) were determined. This information was then used to evaluate the inferential statistics using Pearson's and/or Spearman's correlations at a significance level of 0.05 which revealed differences and similarities. Chi-square test was used to evaluate the association between bivariate variables. Relationships were treated as per the objective of the study using confounding variables of interest (e.g.: location, gender, etc.). The independent variables of this study were age, gender, time and frequency of patients while the dependent variables were segregation practices, amount of waste generated and storage of waste.

3.9. Ethical considerations

Following approval from the Departmental Research Committee, the research protocol was then submitted to the Faculty of Health Sciences Research Higher Degrees Committee (RHDC) for approval. Thereafter, the Durban University of Technology's Institutional Research Ethics Committee (IREC) granted ethics clearance (IREC no: 125/16) (Annexure 7). Once full ethical approval was obtained, the fieldwork then commenced as discussed above,

noting that all participants' ethical issues were considered e.g. confidentiality and voluntary withdrawal from the study with no penalty involved. In addition to certify the reliability and validity of the study, the researcher conducted the fieldwork by herself. Validated data collection instruments were used. The legislation checklist also acted as a triangulation tool for the questionnaire. e.g: where the practices did not correspond with the appropriate legislation chosen. Furthermore, to ensure confidentiality and integrity of the data that was received from this study, all collected information was safely stored and locked away and will only be subsequently destroyed the stipulated post examination time frame.

In the next chapter, results arising from the research will be presented.

CHAPTER 4: RESULTS

4.1. Introduction

This chapter presents the results that depicted the findings obtained from the data collection tools used in this study. Descriptive statistics in the form of graphs cross tabulations and other figures for the quantitative data collected are presented. Inferential techniques include the use of correlations and chi square test values; which are interpreted using the p-values.

The questionnaire was divided into 4 categories and consisted of 36 items, with a level of measurement at a nominal or an ordinal level. These categories were:

- Demographical Data
- Knowledge of Health Care Waste Management
- Practices of Health Care Waste management
- Occupational risks associated with Health Care Waste Management

Additionally, a Regulations Checklist was used to determine which of the main legislation was practiced when managing HCW.

4.2. Demographical data of private practicing GPs who belong to the Durban South Doctors Guild (DSDG)

Demographic information of participants is summarized in Table 4.2.1. Overall, from a total of 50 participants, 40% of GPs were >60 years old. Most of the GPs (86%) were male and 98% of the total number were Indian ($P< 0.001$). Forty percent of all participating GPs attained their qualification between the years of 1982-1992 and 44% were practicing for 22-37 years, which also showed a significant difference indicating there are not many GPs qualifying in recent years ($P< 0.001$). Furthermore, significantly more practices were opened since 1982 ($P = 0.008$).

Table 4.2.1: Demographic information

	n	%
Age (years) (n=50)		
25-35	3	6
36-46	12	24
47-57	10	20
57-60	5	10
60 and older	20	40
Gender (n=50)		
Male	43	86
Female	7	14
Race (n=50)		
Coloured	1	2
Indian	49	98
Attained Qualification (n=50)		
1960-1970	2	4
1971-1981	12	28
1982-1992	20	40
1993-2003	12	24
2004-2016	4	8
Years Practicing (n=50)		
1-15	10	20
16-21	11	22
22-37	22	44
38-53	7	14
When did you open your surgery in the area (n=49)		
1960-1970	1	2
1971-1981	7	14
1982-1992	15	30
1993-2003	12	24
2004-2014	14	28
Keeping up to date with conferences on HCW (n=50)		
Yes	33	66
No	17	34
Keeping up to date with literature on HCW (n=50)		
Yes	39	78

No	11	22

4.3. Knowledge of HCWM among private practicing GPs who belong to the DSDG

The Table 4.3.1 below indicates the knowledge of HCWM among private practicing GPs who belonged to the DSDG. Sixty-two percent of GPs gained information and updates on new emerging hazards from seminars. From their surgeries: 82% generated infectious waste, 62% generated hazardous waste and 92% generated general waste. Ninety-eight percent of their HCW was stored in a safe and secured environment and 82% of the GPs were knowledgeable of where their HCW was disposed.

According to research findings below, 92% of GPs segregated waste according to its composition. The amount of HCW generated by 48% of GPs per day added up to 1.5kg. Furthermore 100% of the sample group used accredited waste services in their surgeries.

Table 4.3.1: Knowledge of HCWM among private practicing GPs who belong to the DSDG

	n	%
Is infectious waste generated in your surgery (n=50)		
Yes	41	82
No	9	18
Is Hazardous waste generated in your surgery (n=50)		
Yes	31	62
No	19	32
Is general waste generated in your surgery (n=50)		
Yes	46	92
No	3	6
Unsure	1	2
Is HCW segregated in your surgery (n=50)		
Yes	50	100

Is HCW separated according to its composition (n=50)		
Yes	48	96
No	2	4
How much HCW is produced a day (n=50)		
1.5kg	24	48
3.5kg	4	8
4kg	1	2
Other	21	42
Is HCW stored according to specific regulations (n=50)		
Yes	49	98
No	1	2
Does your surgery have a WMP (n=50)		
Yes	47	94
No	3	6
Do you know where your HCW is disposed (n=50)		
Yes	41	82
Unsure	4	8
No	5	10
Do you use an accredited waste service (n=50)		
Yes	50	100

4.4. Practices of HCWM among private practicing GPs who belong to the DSDG

The table below (Table 4.4.1) shows the practices of HCWM among private practicing GPs who belonged to the DSDG. Forty-eight percent of the participants used personal protective equipment (PPE) when handling HCW whilst 44% did not wear PPE. All GPs separated sharps from other HCW while 86% separated the infectious waste produced at their surgeries, 94% separated chemical waste and 58% separated pharmaceutical waste from other HCW.

Separate disposable of syringes were used by 100% of GPs. Sixty-eight percent disposed of their HCW bags when it was three quarter full. Additionally, the most common PPE used when handling HCW was gloves

being 88%. With regards to Department of Health (DOH) monitoring, only 70% of surgeries were currently being assessed.

Table 4.4.1: Practices of HCWM among private practicing GP who belong to the DSDG

	n	%
Are protective clothing worn when handling HCW (n=50)		
Yes	24	48
Unsure	4	8
No	22	44
Are sharps separated from other HCW (n=50)		
Yes	50	100
Is infectious waste separated from other HCW (n=50)		
Yes	43	86
No	7	14
Is chemical waste separated from other HCW (n=50)		
Yes	3	6
No	47	94
Is pharmaceutical waste separated from other HCW (n=50)		
Yes	29	58
No	21	42
What type of syringes do you use (n=50)		
Disposable	50	100
How full is HCW bags before replacing it with a new one (n=50)		
Three quarter full	34	68
Half-filled	6	12
Completely filled	10	20
Are the bags kept in safe secured environment (n=50)		
Yes	48	96
Unsure	2	4

Are there any DOH monitoring in your surgery (n=50)		
Yes	35	70
Unsure	8	16
No	7	14
Type of PPE used when handling HCW (n=49)		
None	2	4
Gloves	44	88
Aprons	1	2
Other	2	4

4.5. The prevalence of Occupational risks concerning HCWM among private practicing GP who belong to the DSDG

Table 4.5.1 depicts occupational risks associated with HCWM. Seventy-four percent of GPs administered more than 11 injections on a weekly basis and 98% of GPs disposed this waste in plastic sharp containers. Needle stick injuries over the previous 12 months were absent in 94% of GPs with the remaining 6% been self-treated cases. In addition, 42% of surgeries did not have an injection safety policy while 48% had the occupational health and safety policy present.

Table 4.5.1: Occupational risks associated with HCWM among private practicing GP are who belong to the DSDG

	n	%
Number of injections given per a week (n=50)		
1-5	4	8
6-11	9	18
Other	37	74
Are plastic containers used to dispose sharps (n=50)		
Yes	49	98
No	1	2
Are metallic containers used to dispose sharps (n=50)		
No	50	100

Are cardboard containers used to dispose sharps (n=50)		
No	49	98
Unsure		
How many needle stick injuries occurred in the past 12 months (n=50)		
1-5	2	4
6-11	1	2
Other	47	94
Were these cases reported (n=50)		
Unsure	2	4
No	1	2
N/A	47	94
Was this self- treated (n=50)		
Yes	3	6
N/A	47	94
Do you have a copy of the injection safety policy (n=50)		
Yes	16	32
Unsure	13	26
No	21	42
Do you have a copy of the occupational health policy (n=50)		
Yes	24	48
Unsure	8	16

4.6. Legislation utilized during the HCWM process in GPs surgeries

Tables 4.6.1–4.6.3 indicates the most frequently used legislation among private practicing GP who belong to the DSDG. Table 4.6.4 highlights that the majority of the GPs (80%) abided by and practiced the Occupational Hazard and Health Act under the HPCSA Policy guidelines. Also 96% practiced segregation of waste and 80% have in-house control measures when managing HCW. High percentages (88%) adhered to closure and bagging of waste-holding plastic bags while only 54% use the colour-coding method to segregate HCW.

Table 4.6.1: HPSCA Policy Guidelines practiced among private practicing GP who belong to the DSDG

	n	%
Occupational Hazards and Health Risks (n=50)		
Yes		
No	10	20
Segregation of waste (n=50)		
Yes	40	80
No	2	4
In-house control (n=50)		
Yes	4	80
No	10	20
Closure and bagging of waste-holding plastic bags (n=50)		
Yes	44	88
No	6	12
Intermediate and final storage areas (n=50)		
Yes	32	64
No	18	36
Movement of waste (n=50)		
Yes	42	84
No	8	16
Maintenance of cleaning operations (n=50)		
Yes	39	78
No	11	22
Spill or accidents clean-ups (n=50)		
Yes	34	68
No	16	32
Specific provisions for dealing with the different types of health care waste (n=50)		
Yes	41	82
No	9	18
Summary of colour-coding/labelling requirements (n=50)		
Yes	27	54
No	23	46

In Terms of the Department of Health legal requirements, Table 4.6 shows that 81% adhered to HCW regulations. Seventy-six percent use packaging and labelling of HCW to identify the different types of HCW.

Table 4.6.2: Department of Health: National Health Act (No. 61 of 2003)

	n	%
Regulations relating to the health care waste management in health establishments (n=50)		
Yes	41	81
No	9	18
Health care waste management plans (n=49)		
Yes	34	68
No	15	30
Requirements applicable to health establishments (n=50)		
Yes	37	74
No	13	26
Packaging and labelling of HCW (n=50)		
Yes	38	76
No	12	24
HCW storage facility (n=50)		
Yes	39	78
No	11	22

In terms of NEMA, Table 4.6.3 below shows that 50% of GPs practiced the National Waste Management Strategy, norms and standards while 44% had waste management strategies in their surgery.

Table 4.6.3: NEMA: Waste Act 59 of 2008

	n	%
National waste management strategy, norms and standards (n=50)		
Yes	25	50
No	25	50
Waste management strategies (n=50)		
Yes	22	44
No	28	56

Table 4.6.4 indicates that only 26% of GPs were aware of the Nuisance and Behaviour By-Law 2015 (a particularly recent by-law).

Table 4.6.4: Nuisance and behaviour by-law 2015 (n=50)

	n	%
Nuisance and Behaviour By-Law 2015 (n=50)		
Yes	13	26
Unsure	14	28
No	23	46

4.7. Relationship between Variables

4.7.1. Age VS Gender

Overall, Table 4.1.7 depicts the ratio of males to females is approximately 9:1 (86.0%: 14.0%). Within the age category of >60 years, 90% were male. Within the category of males (only), 41.9% were between the ages of >60 years. This category of males between the ages of >60 years formed 36% of the total sample. It is noted below that, the distributions by age and gender were significantly different ($p < 0.05$). This is reflected in the table below.

Table 4.7.1: Age VS Gender

			Gender		Total
			Male	Female	
Age (in years)	25 - 35	Count	1	2	3
		% within Age (in years)	33.3%	66.7%	100.0%
		% within Gender	2.3%	28.6%	6.0%
		% of Total	2.0%	4.0%	6.0%
	36 - 46	Count	9	3	12
		% within Age (in years)	75.0%	25.0%	100.0%
		% within Gender	20.9%	42.9%	24.0%
		% of Total	18.0%	6.0%	24.0%
	47 - 57	Count	10	0	10
		% within Age (in years)	100.0%	0.0%	100.0%
		% within Gender	23.3%	0.0%	20.0%
		% of Total	20.0%	0.0%	20.0%
	58 - 60	Count	5	0	5
		% within Age (in years)	100.0%	0.0%	100.0%
		% within Gender	11.6%	0.0%	10.0%
		% of Total	10.0%	0.0%	10.0%
	> 60	Count	18	2	20
		% within Age (in years)	90.0%	10.0%	100.0%
		% within Gender	41.9%	28.6%	40.0%
		% of Total	36.0%	4.0%	40.0%
Total		Count	43	7	50
		% within Age (in years)	86.0%	14.0%	100.0%
		% within Gender	100.0%	100.0%	100.0%
		% of Total	86.0%	14.0%	100.0%

4.7.2. Year qualification attained vs HCW segregation

Table 4.7.2 below shows the majority number of respondents attained their qualifications between the years 1982-1992; this was a total of 40% of the respondents. In addition this category of GPs also practised the correct HCWM methods in their respective private practices.

Table 4.7.2: Year qualification attained vs HCW segregation

			In which year did you qualify as a Doctor?					
			1960 - 1970	1971 - 1981	1982 - 1992	1993 - 2003	2004 - 2016	Total
Is health care waste segregated from general waste?	Yes	Count	2	12	20	12	4	50
		% within Is health care waste segregated from general waste?	4.0%	24.0%	40.0%	24.0%	8.0%	100.0%
		% within In which year did you qualify as a Doctor?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	4.0%	24.0%	40.0%	24.0%	8.0%	100.0%

4.7.3. Segregation of HCW from general waste VS Age (in years)

Table 4.7.3 below indicates all GPs in all age groups (25-60 years old) in the table below shows the segregation of HCW in their practices. This is a total of 100% practicing segregation of waste.

Table 4.7.3: The table below depicts: Health care waste segregated from general waste VS Age (in years)

			Age (in years)					
			25 - 35	36 - 46	47 - 57	58 - 60	> 60	Total
Is health care waste segregated from general waste?	Yes	Count	3	12	10	5	20	50
		% within Is health care waste segregated from general waste?	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%
		% within Age (in years)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%
Total		Count	3	12	10	5	20	50
		% within Is health care waste segregated from general waste?	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%
		% within Age (in years)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%

4.7.4. Segregation of waste according to its composition VS Age (in years)

In the table below, 38% of respondents >60 years old segregated their waste according to its composition while 4% of respondents were unsure of whether their waste was being separated accordingly.

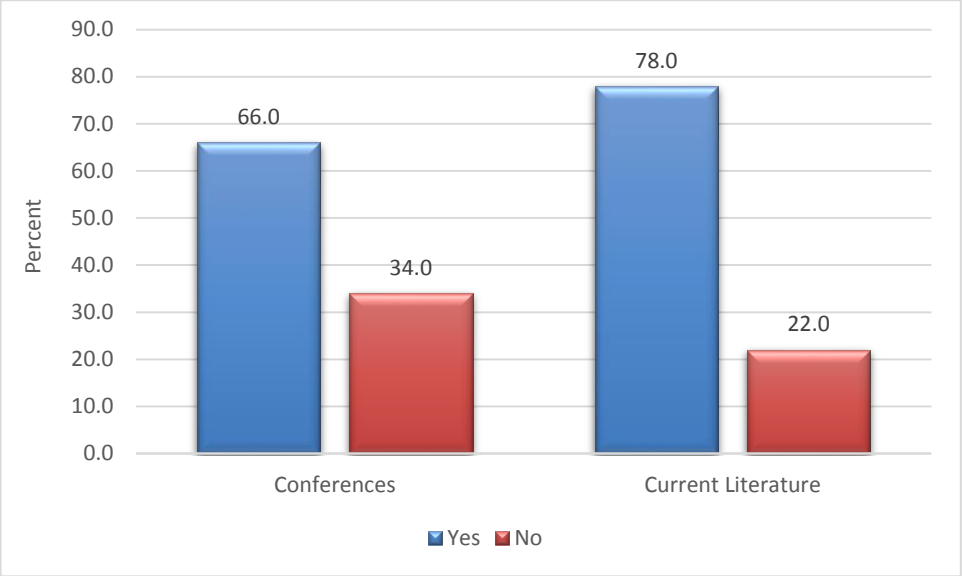
Table 4.7.4: Is all waste generated in your surgery segregated according to it's composition VS Age (in years)

			Age (in years)					
			25 - 35	36 - 46	47 - 57	58 - 60	> 60	Total
Is all waste generated in your surgery segregated according to its composition?	Yes	Count	3	11	10	5	19	48
		% within Is all waste generated in your surgery segregated according to its composition?	6.3%	22.9%	20.8%	10.4%	39.6%	100.0%
		% within Age (in years)	100.0%	91.7%	100.0%	100.0%	95.0%	96.0%
		% of Total	6.0%	22.0%	20.0%	10.0%	38.0%	96.0%
	Unsure	Count	0	1	0	0	1	2
		% within Is all waste generated in your surgery segregated according to its composition?	0.0%	50.0%	0.0%	0.0%	50.0%	100.0%
		% within Age (in years)	0.0%	8.3%	0.0%	0.0%	5.0%	4.0%
		% of Total	0.0%	2.0%	0.0%	0.0%	2.0%	4.0%
Total		Count	3	12	10	5	20	50
		% within Is all waste generated in your surgery segregated according to its composition?	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%
		% within Age (in years)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%

Figure 1: Ways in which GPs keep abreast of new information.

In the table below two thirds of the respondents below kept abreast via conferences (*P*=0.024), whilst three quarters used current literature (*P*< 0.001), both the comparisons yield a significant difference where the p-value is < 0.05.

Figure 1: How do you keep up to date with health care waste management issues



4.7.5. Segregation of HCW from general waste VS Conferences attended

The table below shows 66% of respondents, who attended conferences to keep abreast with HCW matters, segregated the HCW produced in the surgery from other waste. A further 34% did not attend the conferences but continued to segregate their waste giving a 100% response to appropriate waste segregation.

Table 4.7.5: Is health care waste segregated from general waste *VS* Conferences attended

			Do you attend conferences		
			Yes	No	Total
Is health care waste segregated from general waste?	Yes	Count	33	17	50
		% within Is health care waste segregated from general waste?	66.0%	34.0%	100.0%
		% within Conferences	100.0%	100.0%	100.0%
		% of Total	66.0%	34.0%	100.0%
Total		Count	33	17	50
		% within Is health care waste segregated from general waste?	66.0%	34.0%	100.0%
		% within Conferences	100.0%	100.0%	100.0%
		% of Total	66.0%	34.0%	100.0%

4.7.6. Segregation of hazardous waste from general waste VS Conferences attended

The table below indicates 80% of the respondents separate hazardous waste from the general waste produced in their surgery, while 75.8% of 80% within hazardous waste separation attend conferences on HCWM.

In addition 22% of the total sampled population segregated hazardous waste from general waste but did not attend conferences.

Table 4.7.6: Is hazardous waste separated from general waste VS Conferences attended

			Do you attend conferences		
			Yes	No	Total
Is hazardous waste separated from general waste?	Yes	Count	25	6	31
		% within Hazardous waste separation	80.6%	19.4%	100.0%
		% within Attends conferences	75.8%	35.3%	62.0%
		% of Total	50.0%	12.0%	62.0%
	No	Count	8	11	19
		% within Hazardous waste separation	42.1%	57.9%	100.0%
		% within Attends conferences	24.2%	64.7%	38.0%
		% of Total	16.0%	22.0%	38.0%
Total		Count	33	17	50
		% within Hazardous	66.0%	34.0%	100.0%
		% within Conferences	100.0%	100.0%	100.0%
		% of Total	66.0%	34.0%	100.0%

4.7.7. Relationship between doctor's who attend conferences and hazardous waste segregation

The chi-square statistical test table below was done to assess if attending conferences influenced hazardous waste segregation in the GPs surgery. This table depicted a significant relationship *(P<* 0.05) between segregation of hazardous waste and conferences attended.

Table 4.7.7: Relationship between GPs who attend conferences and hazardous waste segregation.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	7.797[a]	1	0.005	0.007	0.007	
Continuity Correction[b]	6.174	1	0.013			
Likelihood Ratio	7.777	1	0.005	0.012	0.007	
Fisher's Exact Test				0.012	0.007	
Linear-by-Linear Association	7.641[c]	1	0.006	0.007	0.007	0.006
N of Valid Cases	50					

4.7.8. Segregation of waste according to its composition VS Year qualified as a Doctor?

The table below depicts respondents who qualified between the years 1982-1992, segregated waste according to their composition by 40% leaving 4% in the remaining age groups, i.e. 2% in years 1960-1970 and 2% in years 1993-2003 unsure of their waste segregation.

Table: 4.7.8: Segregation of waste according to its composition VS Year qualified as a Doctor?

			In which year did you qualify as a Doctor?					
			1960 - 1970	1971 - 1981	1982 - 1992	1993 - 2003	2004 - 2016	Total
Is all waste generated in your surgery segregated according to its composition?	Yes	Count	2	11	20	11	4	48
		% within Is all waste generated in your surgery segregated according to its composition?	4.2%	22.9%	41.7%	22.9%	8.3%	100.0%
		% within In which year did you qualify as a Doctor?	100.0%	91.7%	100.0%	91.7%	100.0%	96.0%
		% of Total	4.0%	22.0%	40.0%	22.0%	8.0%	96.0%
	Unsure	Count	0	1	0	1	0	2
		% within Is all waste generated in your surgery segregated according to its composition?	0.0%	50.0%	0.0%	50.0%	0.0%	100.0%
		% within In which year did you qualify as a Doctor?	0.0%	8.3%	0.0%	8.3%	0.0%	4.0%
		% of Total	0.0%	2.0%	0.0%	2.0%	0.0%	4.0%
Total		Count	2	12	20	12	4	50
		% within Is all waste generated in your surgery segregated according to its composition?	4.0%	24.0%	40.0%	24.0%	8.0%	100.0%
		% within In which year did you qualify as a Doctor?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	4.0%	24.0%	40.0%	24.0%	8.0%	100.0%

4.7.9. Storage of HCW according to specific regulations VS Age (in years)

In Table 4.7.9, majority of respondents (40%) aged >60 are storing HCW in the appropriate regulated way. The additional 58% are scattered between 25-60 years of age, and the remaining 2% are unsure if regulations are being used when storing HCW.

Table 4.7.9: Is HCW stored according to specific regulations VS Age (In years)

			Age (in years)					
			25 - 35	36 - 46	47 - 57	58 - 60	> 60	Total
Is HCW stored according to specific regulations?	Yes	Count	3	11	10	5	20	49
		% within Is HCW stored according to specific regulations?	6.1%	22.4%	20.4%	10.2%	40.8%	100.0%
		% within Age (in years)	100.0%	91.7%	100.0%	100.0%	100.0%	98.0%
		% of Total	6.0%	22.0%	20.0%	10.0%	40.0%	98.0%
	Unsure	Count	0	1	0	0	0	1
		% within Is HCW stored according to specific regulations?	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
		% within Age (in years)	0.0%	8.3%	0.0%	0.0%	0.0%	2.0%
		% of Total	0.0%	2.0%	0.0%	0.0%	0.0%	2.0%
Total		Count	3	12	10	5	20	50
		% within Is HCW stored according to specific regulations?	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%
		% within Age (in years)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%

4.7.10. PPE used when handling HCW VS Age (In years)

In the table below results show gloves are the predominantly used PPE, 22.4% of the respondents aged 36-46 years old and 34.7 aged >60 years old are using gloves during the handling of HCW.

Table 4.7.10: PPE used when handling HCW VS Age (In years)

			Age (in years)					
			25 - 35	36 - 46	47 - 57	58 - 60	> 60	Total
Which PPE is used by your staff that handles HCW?	None	Count	0	0	1	0	1	2
		% within Which PPE is used by your staff that handles HCW?	0.0%	0.0%	50.0%	0.0%	50.0%	100.0%
		% within Age (in years)	0.0%	0.0%	10.0%	0.0%	5.3%	4.1%
		% of Total	0.0%	0.0%	2.0%	0.0%	2.0%	4.1%
	Gloves	Count	3	11	9	4	17	44
		% within Which PPE is used by your staff that handles HCW?	6.8%	25.0%	20.5%	9.1%	38.6%	100.0%
		% within Age (in years)	100.0%	91.7%	90.0%	80.0%	89.5%	89.8%
		% of Total	6.1%	22.4%	18.4%	8.2%	34.7%	89.8%
	Apron	Count	0	1	0	0	0	1
		% within Which PPE is used by your staff that handles HCW?	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
		% within Age (in years)	0.0%	8.3%	0.0%	0.0%	0.0%	2.0%
		% of Total	0.0%	2.0%	0.0%	0.0%	0.0%	2.0%
	Other	Count	0	0	0	1	1	2
		% within Which PPE is used by your staff that handles HCW?	0.0%	0.0%	0.0%	50.0%	50.0%	100.0%
		% within Age (in years)	0.0%	0.0%	0.0%	20.0%	5.3%	4.1%
		% of Total	0.0%	0.0%	0.0%	2.0%	2.0%	4.1%
Total		Count	3	12	10	5	19	49
		% within Which PPE is used by your staff that handles HCW?	6.1%	24.5%	20.4%	10.2%	38.8%	100.0%
		% within Age (in years)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	6.1%	24.5%	20.4%	10.2%	38.8%	100.0%

4.7.11. Frequency of needle stick injuries in the past 12 months? VS year qualified as a Doctor?

Four percent of the respondents who qualified between the years 1982-1992 experienced needle stick injuries while 94% of the respondents in the same year category chose “None” as an option.

Table 4.7.11: Frequency needle stick injuries in the past 12 months? VS In which year did you qualify as a Doctor?

			In which year did you qualify as a Doctor?					
			1960 - 1970	1971 - 1981	1982 - 1992	1993 - 2003	2004 - 2016	Total
How many needle stick injuries have occurred in the past 12 months?	1 - 5	Count	0	0	2	0	0	2
		% within How many needle stick injuries have occurred in the past 12 months?	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%
		% within In which year did you qualify as a Doctor?	0.0%	0.0%	10.0%	0.0%	0.0%	4.0%
		% of Total	0.0%	0.0%	4.0%	0.0%	0.0%	4.0%
	6 - 11	Count	0	0	0	1	0	1
		% within How many needle stick injuries have occurred in the past 12 months?	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
		% within In which year did you qualify as a Doctor?	0.0%	0.0%	0.0%	8.3%	0.0%	2.0%
		% of Total	0.0%	0.0%	0.0%	2.0%	0.0%	2.0%
	None	Count	2	12	18	11	4	47
		% within How many needle stick injuries have occurred in the past 12 months?	4.3%	25.5%	38.3%	23.4%	8.5%	100.0%
		% within In which year did you qualify as a Doctor?	100.0%	100.0%	90.0%	91.7%	100.0%	94.0%
		% of Total	4.0%	24.0%	36.0%	22.0%	8.0%	94.0%
Total		Count	2	12	20	12	4	50
		% within How many needle stick injuries have occurred in the past 12 months?	4.0%	24.0%	40.0%	24.0%	8.0%	100.0%
		% within In which year did you qualify as a Doctor?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	4.0%	24.0%	40.0%	24.0%	8.0%	100.0%

4.7.12. Needle stick injuries reported VS Age (in years)

In table below a further 4% of the respondents who experienced needle stick where unsure if these cases were reported while 96% of the respondents, needle stick injuries were not applicable.

Table 4.7.12: Needle stick injuries reported VS Age (In years)

			Age (in years)					
			25 - 35	36 - 46	47 - 57	58 - 60	> 60	Total
Were all needle stick injuries reported?	Unsure	Count	0	0	2	0	0	2
		% within Were all needle stick injuries reported?	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%
		% within Age (in years)	0.0%	0.0%	20.0%	0.0%	0.0%	4.0%
		% of Total	0.0%	0.0%	4.0%	0.0%	0.0%	4.0%
	No	Count	0	1	0	0	0	1
		% within Were all needle stick injuries reported?	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
		% within Age (in years)	0.0%	8.3%	0.0%	0.0%	0.0%	2.0%
		% of Total	0.0%	2.0%	0.0%	0.0%	0.0%	2.0%
	NA	Count	3	11	8	5	20	47
		% within Were all needle stick injuries reported?	6.4%	23.4%	17.0%	10.6%	42.6%	100.0%
		% within Age (in years)	100.0%	91.7%	80.0%	100.0%	100.0%	94.0%
		% of Total	6.0%	22.0%	16.0%	10.0%	40.0%	94.0%
Total		Count	3	12	10	5	20	50
		% within Were all needle stick injuries reported?	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%
		% within Age (in years)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%

4.7.13. Self-treated needle stick injuries VS Age

In Table 4.7.14 below 4% of the respondents who experienced needle stick injuries in the age group 47-57 years old were self –treated after the injury.

Table 4.7.13: Were all needle stick injuries self - treated VS Age

			Age (in years)					
			25 - 35	36 - 46	47 - 57	58 - 60	> 60	Total
Were all needle stick injuries self- treated?	Yes	Count	0	1	2	0	0	3
		% within Were all needle stick injuries self- treated?	0.0%	33.3%	66.7%	0.0%	0.0%	100.0%
		% within Age (in years)	0.0%	8.3%	20.0%	0.0%	0.0%	6.0%
		% of Total	0.0%	2.0%	4.0%	0.0%	0.0%	6.0%
	No	Count	3	11	8	5	20	47
		% within Were all needle stick injuries self- treated?	6.4%	23.4%	17.0%	10.6%	42.6%	100.0%
		% within Age (in years)	100.0%	91.7%	80.0%	100.0%	100.0%	94.0%
		% of Total	6.0%	22.0%	16.0%	10.0%	40.0%	94.0%
Total		Count	3	12	10	5	20	50
		% within Were all needle stick injuries self- treated?	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%
		% within Age (in years)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%

4.7.14. Possession of a copy of the injection safety policy/ recommendations issued by your health service VS Age (in years)

In the table below, 42% of the respondents did not have the copy of the injection safety policy or the recommendations for injection safety.

Table 4.7.14: Do you have a copy of the injection safety policy/ recommendations issued by your health service VS Age (in years)

			Age (in years)					
			25 - 35	36 - 46	47 - 57	58 - 60	> 60	Total
Do you have a copy of the injection safety policy/ recommendations issued by your health service?	Yes	Count	2	4	2	1	7	16
		% within Do you have a copy of the injection safety policy/ recommendations issued by your health service?	12.5%	25.0%	12.5%	6.3%	43.8%	100.0%
		% within Age (in years)	66.7%	33.3%	20.0%	20.0%	35.0%	32.0%
		% of Total	4.0%	8.0%	4.0%	2.0%	14.0%	32.0%
	Unsure	Count	0	1	3	2	7	13
		% within Do you have a copy of the injection safety policy/ recommendations issued by your health service?	0.0%	7.7%	23.1%	15.4%	53.8%	100.0%
		% within Age (in years)	0.0%	8.3%	30.0%	40.0%	35.0%	26.0%
		% of Total	0.0%	2.0%	6.0%	4.0%	14.0%	26.0%
	No	Count	1	7	5	2	6	21
		% within Do you have a copy of the injection safety policy/ recommendations issued by your health service?	4.8%	33.3%	23.8%	9.5%	28.6%	100.0%
		% within Age (in years)	33.3%	58.3%	50.0%	40.0%	30.0%	42.0%
		% of Total	2.0%	14.0%	10.0%	4.0%	12.0%	42.0%
Total		Count	3	12	10	5	20	50
		% within Do you have a copy of the injection safety policy/ recommendations issued by your health service?	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%
		% within Age (in years)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	6.0%	24.0%	20.0%	10.0%	40.0%	100.0%

In the next chapter, the results will be discussed.

CHAPTER 5: DISCUSSION

5.1. Introduction

This study highlighted that there was a paucity of research that has been undertaken regarding health care waste management by GPs. In the South African context, there appeared to be no published research to date. Therefore, published literature relating to other institutions where health care waste was generated, were considered in writing up this chapter.

This chapter will discuss the GPs knowledge and practices of the hierarchy of waste principles. Occupational risks associated with handling health care waste in their private surgeries will also be highlighted. Additionally, the regulations utilized during the HCWM process in these surgeries were determined. Validated data collection instruments consisted of a questionnaire and regulation checklist. These were administered at the surgeries. The population of N=70 GPs belonged to the DSDG and were invited to participate in this study. The final sample size was n=50. In the next section, a demographical analysis of the sample group will first be discussed.

5.2. Demographical analysis of the sample group

Demographical results showed that 70% (n=35) of the sample group opened their surgeries for practice during the apartheid era between the years 1960-1993. It was also significant that not many GPs of other races or of the female gender belonged to the DSDG as results showed that Indian males (84%; n=42) were dominant. This could be attributed to GPs of other races not opening their surgeries in the democratic era in the residential areas noted as it may be considered to be an over-saturated with preference then given to the previously disadvantaged areas (Hangulu and Akintola, 2017:3).

Age appeared to play a significant role in terms of knowledge and practices. When further comparing gender and race, results yielded 86% (n=43) of the sample size were male and 98% (n=49) were Indian ($P<0.001$). Furthermore, the distribution between age and gender was also found to be significant ($P<0.05$) with nearly 40% (n=20) of these GPs >60 years of age. Therefore,

the key variable that was chosen to be highlighted in the bivariate analyses was age. Age together with experience were continuously highlighted where for example, the majority of GPs opened their surgeries between the years 1982-1992 and where HCWM practices were compliant and in line with legislation as listed in the legislation checklist.

5.3. Knowledge and practices of HCWM

5.3.1. Areas of Compliance

In the private sector in the South Durban area, the researched GPs did practice appropriate HCWM guided by the various Acts such as The Health Professionals Council of 2003, The National Environmental Management Waste Act 59 of 2008 (NEMA) and the eThekwini Municipality: Nuisance and Behaviour in public places by- law (Section: 9). These legislation assist health care professionals to manage HCW efficiently and effectively (South Africa (2016:1-28), South Africa (2004:2-92), South Africa (2008:20) and South Africa (2015:36).

Segregation of waste

Ninety- two percent (n=46) of the sample group showed to have segregated their HCW correctly and according to its composition. Having practiced for many years, these GPs would have been aware of the possible consequences arising from non-compliance. Similarly in Tanzanian hospitals, good HCW segregation methods were practiced (Kagonji, Manyele 2016:448).

The lifecycle evaluation of HCWM

Hundred percent (n=50) of the GPs regularly used accredited waste collection services. Similarly in Tanzania, research undertaken in two hospitals showed that both hospitals used privately owned, regular waste collection services (Kagonji, Manyele 2016:451-452). Furthermore, accredited disposal containers for sharp waste indicating opening and closing dates of the sharp containers which according to the requirements of legislation were also used by GPs (100%; n=50). This does confirm that the cradle-to-grave method of HCWM was been used where the following was applied:

- separation of waste was done successfully indicating type of waste and date;
- collection was undertaken by accredited HCW collection services as per legislation requirements and;
- Transportation was reliable and safe with vehicles compliant with the requirements of legislation.

However, In terms of the treatment and disposal processes, the GPs considered this an area of concern as they were unaware of where their generated waste was being treated or disposed of. It was taken for granted that the correct methods were followed as the collection services were accredited.

Since these surgeries in urban areas were privately owned by the GPs themselves, extra care was taken where housekeeping and HCWM was concerned. This further indicated that the financial backing of private practicing GPs was more than sufficient to ensure a safe and compliant environment. Studies done in India also indicated that in urban areas awareness of HCWM is significantly higher (Hanumantha 2016:300), as compared to the public sector where funding is scarce and resources limited. This is noted for example in Brazil where the public sector have very poor HCWM practices due to poor managerial and implementation skills and inadequate economic resources (Da Silva, Hoppe, Ravanello and Mello 2005:602-603).

5.3.2. Areas of Concern

Training sessions on the lifecycle of HCWM

Sixty-two percent (n=31) of the sample group had the capacity of keeping themselves informed of any new information on HCW by attending related seminars and conferences. These seminars and conferences were readily available to all GPs that belonged to the DSDG. The remaining one third of respondents used current literature as sources of information. This in comparison, yielded a p-value of <0.05 showing significance as the literature

and seminars/conferences were ways in which GPs kept themselves informed of new developments concerning HCWM and emerging hazards. However, there is cause for concern. These monthly seminars, convened by the DSDG had a poor response rate, with some GPs attending these sessions occasionally whilst others did not attend at all. This poor response rate could be influenced by the working hours of a GP and that they have to generate an income.

Generation of infectious waste

According to Chartier *et al* (2014: 41), infectious waste is defined as waste that can contain traces of pathogens which also may pose a risk of transmission of disease: this is waste that is contaminated with blood and/or bodily fluids. However, the results in this study indicated that 18% of the GPs stated that their surgeries did not generate infectious waste. This then is cause for concern as it indicated a lack of understanding and knowledge regarding categories of waste generated in the HCE. Similarly, healthcare workers at two hospitals in Tanzania, were seemingly unaware of this differentiation (Kagonji, Manyele 2016:453)

5.4. Occupational risks associated with handling HCW in GPs surgeries

Practicing the correct methods of occupational health and safety from the point of generation to final disposal can prevent individuals from life-threatening diseases, injury and associated financial costs. Some of these diseases included Typhoid, Cholera and HIV (Hangulu, Akintola 2017:1). With appropriate training on what PPE should be worn and the correct legislation followed, this could play a major role in the minimization of occupational injuries (Hangulu, Akintola 2017:1-5).

Results from this study indicated that within the past 12 months, there were no needle stick injuries present in 94% (n=47) of the sampled GPs. This is contrary to for example, Ethiopia where there was a high rate of needle stick injures amongst staff working in laboratories and on-site waste storage areas (Shiferaw, Abebe, Mihret 2012: 1301). The remaining 6% (n=3) of GPs aged between 36-57 years old, experienced needle stick injuries which were all

self-treated. Consequently there were no official record of the occurrence. This lack of record keeping makes it difficult to address any concerns that may arise from needle stick injuries in the sample group. It also poses an occupational health and safety risk not only to the GP, but also the patients being treated by the injured GP. In these instances, GPs also placed themselves in direct danger if the proper treatment was not administered appropriately and or timeously when treating these injuries by themselves. Similarly, with regards to record keeping of needle stick injuries, in the city of Allahabad in India, injury reporting was extremely poor or absent as health care professionals did now have any record of reported health care injuries that occurred among all the researched HCF (Mathur *et al*. 2012: 143-145).

The South African Department of Public Service and Administration (2011:6-7) outlines the procedure for needle stick injuries as follows:

- If the health care worker is injured in their line of duty, the injured, in this case needs to fill in a report of accident describing how the injury occurred.
- After which the injured will visit a doctor for consultation where a medical report will be filled in by the doctor himself.
- The injured will then be given a 28-day course of medication.
- All forms should be submitted to Human Resources or an occupational health nurse designated to the body (DSDG in this case) or to whomever is assigned to process injury on duty (IOD) for the facility.
- The injured has to go in for further testing by consulting a doctor after 6 weeks and again after 4 months where the doctor will fill in a final report to submit to a laboratory.

Where PPE was concerned, 48% (n=24) of the sample group used PPE when handling HCW. The most suitable PPE used by 100% (n=50) of the respondents were gloves and face masks. The possible reason for this was that a GPs surgery has minimal staff and it may be considered impractical and expensive to wear every piece of PPE required. This response was also noted in a study undertaken on community health workers in Kwa-Zulu Natal where they were knowledgeable of HCWM and the associated implications and

considered the use of gloves an imperative part of PPE to avoid any form of infections or diseases associated with HCW management (Hangulu, Akintola 2017: 5). Furthermore, hospitals in Tanzania also highlighted that 80% of the health care workers used gloves as compared to other provided PPE (Kagonji, Manyele 2016:454). Moreover, taking into consideration that GPs surgeries generally do not have heavy machinery which needs to be moved, safety shoes were not considered a necessity. However, of concern was that 48% (n=24) of the GPs do not possess a hardcopy on site of the Occupational Health and Safety Policy.

Where accredited service providers were concerned, 100% (n=50) of the GPs did use accredited waste collection services who followed the Occupational Health and Safety Standards stipulated for their type of job. These service providers provided the appropriate PPE to their employees. This assisted with the reduction of occupational health and safety associated injuries that could have arisen during the waste collection process. This also highlighted that GPs in the private sector were able to afford these quality waste collection services due to their economic stability and financial viability.

5.5 Legislation, Acts and Policies utilized during the HCWM process

A knowledge, understanding and implementation of legislation and policy is important and cannot be over-emphasized as these guide and are vital for the efficient and appropriate management of HCW. For this study, the legislation noted below were used to determine if GPs were practicing HCWM from generation till final disposal accordingly:

- The Health Professionals Council of South Africa (HPCSA) Regulations,
- The National Health Act of South Africa (no. 61 of 2003),
- The National Environmental Management Waste Act 59 of 2008 (NEMA) and
- eThekwini Municipality: Nuisance and Behaviour in public places by-law (Section: 9)

Furthermore, the above legislation was available for use by all GPs that belonged to the DSDG. These were noted to be absent in some surgeries. However, 80% (n=40) of GPs abided by the Occupational Hazard and Health Act under the HPCSA guidelines and a further 96% (n=48) practiced the segregation of waste. The Department of Health: National Health Act (No. 61 of 2003) was also one of the popularly adhered to legislation as 81% (n=41) of GPs used these guidelines. In terms of NEMA, 50% (n=25) of the GPs practice these norms and standards while only 26% were aware of the newly introduced Nuisance and Behavior by-law of 2015. This indicated that some GPs in the sample group were not keeping abreast of new available by-laws and this could have a negative impact on their HCWM. Knowledge of these by-laws and legislation would assist GPs to have a holistic view of HCWM and contribute to keeping their practices environmentally- and community-friendly. Given that GPs have limited time and staff capacities, they may also be unable to keep abreast of any new or available legislation updates. A recommendation from a Sudanese study, suggested that awareness campaigns should be conducted to educate health care professionals on non-compliance (Hassan, Tudor and Vaccari 2018:8).

Hundred percent (n=50) of the GPs attained their qualification between the years 1982-1992 and displayed excellent HCWM as they did abide by the required legislation for the segregation of the generated HCW. Taking into consideration that 90% of the GPs were over the age of 60 years, this may be a contributory factor to compliance showing that responsibility came with experience. This is substantiated by research undertaken in Gauteng that indicated that GPs do have knowledge on HCWM and the National Conservation and Environmental Act (1989) and the Gauteng Health Care Waste Management policy with nurses however, having a better sense of the implementation process (Ramokate, Basu 2009: 444).

The responsibility of the Department of Health (DoH) seemed to be lacking regarding enforcement of legislation. Only 70% (n=35) of the surgeries were currently being assessed and inspected. This lack may be due to either the DoH being under-resourced or dedicated time is not allocated for the

inspections of surgeries. According to The National Health Act of South Africa (no. 61 of 2003) Norms and standards (2013:45), 100% of the surgeries should be assessed and inspected at least once a month.

According to the Occupational Health and Safety Act, facilities should be inspected to maintain a common compliant standard. As a result of the DoH not inspecting 30% (n=15) of the surgeries, this could also have implications for example, as to why 32% (n=16) of the GPs HCW bags are being filled more than 3 quarter before being disposed of. Implications of this poor practice can be detrimental to the waste service company as occupational injuries are then most likely to occur.

5.6. Conclusion

Overall, the results indicated that private practicing GPs in the South Durban area do practice HCWM in a responsible manner. However, a key concern lies with the absence of reporting structures regarding needle stick injuries and the absence of hardcopies of legislation in certain surgeries as there is no guidance should a major injury occur. Going forward these procedures need to be addressed to ensure proper records are kept and methods followed when information is required.

In the next chapter, implementable recommendations will be explored to negate the areas of concern identified above.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

HCW has the potential to contain many different pathogens that can be detrimental to the human body. Therefore, any HCF including GPs' surgeries must have a method(s) in place to segregate and dispose of all HCW in an appropriate and compliant manner (Insa, Zamorano, Lopez 2010: 1048). This study established that HCWM in private practicing GPs' surgeries in the South Durban area was undertaken correctly. Additionally, it was done in accordance with the specific South African regulations and policies. It is commendable that the study findings did not reveal major non-compliance. It would also be beneficial when undertaking future research to obtain more holistic outcomes by including GPs who:

a) are younger than the majority age group noted in this study;
b) have practices in other previously disadvantaged and under-resourced communities;
c) are female and;
d) are of African, White or Coloured descent.

6.2. Recommendations

This section will suggest recommendations that can assist the DSDG and DoH in improving HCWM and minimize occupational health and safety risks in this context.

- A national HCWM policy should be implemented by the appropriate government ministries for all private sector HCFs to follow as it will assist in correct practice of the lifecycle of HCWM. This is possible to do with the backing and support of an active intervention driven by government (Chartier et al. 2014:41).

- All GPs who belong to the DSDG should have regular training on Health and Safety together with HCWM. This could be combined with briefings and further training on all new legislation that may impact on the GPs practice and legal compliance. DSDG should be encouraged to have updated information posted on various forms of social media. Given that GPs may be unable to attend these training sessions due to work commitments, it may be beneficial to the organization and its members to implement alternative online and web-based media strategies so that GPs can be enlightened in their own time, space and convenience. Additionally, the legal knowledge gap could be enhanced by workshops or courses being offered for points for Continuing Professional Development.

- Policy documents and legislation further form an important part for the guidance of the HCWM lifecycle and occupational health and safety practices. These documents have numerous benefits when followed and abided by appropriately. Hence, every surgery should contain the necessary hardcopies of policy documents and legislation to help assist make small differences in big ways.

- GPs need to have a copy of the Injection Safety Policy and the Occupational Health and Safety Policy at their surgeries so referrals to these can be made whenever required. This will assist in avoiding non-compliance in their surgeries and provide guidance where needed. This enables all employees at the surgery to have access to these documents in the event of a patient or staff member being injured. Information on precautionary steps to take to avoid and treat future mishaps will be readily available.

- A reporting structure for needle stick injuries should be implemented by the DSDG to:
  a) keep abreast with the needle stick injury cases;
  b) establish proper protocol for the reporting of needle stick injuries and;

c) provide training on how to report the injury on duty.

- Recycling of certain non-infectious medical equipment should be promoted, for example: glass tubes, vials, plastic and metal elements found in the syringes. This will assist in the reduction of waste and help GPs to financially spend a little less on HCW collection (Jang *et al.* 2006:107-115).

- Purchasing equipment that is easily recyclable will also assist in long term saving as well as have a positive effect on the environment to help reduce the rates of incineration (Jang *et al.* 2006:107-115).

- The DoH should ensure that GP's surgeries are inspected on a regular basis i.e. once a month in order to ensure compliance.

6.3. Strengths

This study:

- appears to be the first conducted among privately practicing GPs situated in the South Durban who belong to a doctor's guild.
- fills a significant research gap regarding the HCWM practices in GPs private practices. A search of the literature revealed that most HCWM research undertaken, concentrated on the public sector i.e. hospital facilities and clinics.
- highlights concerns where further training may be needed.
- will help raise awareness about HCWM amongst GPs.

6.4. Limitations

This study:

- concentrated on GPs who belonged to a single organization i.e. DSDG situated in the South Durban area.
- considered one municipality.

REFERENCES

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

Abdulla, F., Qdais, H.A. Rabi, A. 2008. Site investigation n medical waste management practices in northern Jordan. *Waste Management,* 28: 450- 458.

Abor, P.A. 2007. Medical waste management practices in a Southern African Hospital. *Journal of applied Science and Environmental Management,* 11(3): 91- 96.

Alogoz, A.Z., Kocasoy, G. 2007. Determination of the best appropriate management methods of the health- care waste in Istanbul. *Waste Management.* 28: 1227- 1235.

Almomani, T.D., Al-Zube, L.A., Al-Bataineh, O.M. 2012. Assessment of medical waste management protocols in Jordanian healthcare institutions. *International journal of Environmental Waste Management,* 323- 334.

Bdour, A., Altrabsher, B., Hadadin, N., Al-Sharif, M. 2007. Assessment of medical wastes management practice: A case study in northern part of Jordon. *Waste Management*, 27:746- 759.

Bendjoudi, Z., Taleb, F., Abdelmalek, F., Addou, A. 2009. Healthcare waste management in Algeria and Mostaganem department. *Waste Management,* 29: 1383- 1387.

Bokhoree, C., Beehary, Y., Makhoondlall- Chadee, T., Doobha, T., Soomary, N. 2014. Assessment of Environmental and Health Risks Associated with the Management of Medical Waste in Mauritius. *Asia-Pacific Chemical, Biological & Environmental Engineering Society*, 9: 38-41.

Blenkharn, J.I., Odd, C. 2008. Sharps Injuries in Healthcare Waste Handlers. *The Annals of Occupational Hygiene,* 52(4): 281- 286.

Blundell, L., Cains, T., Ressler, K.A., Ferson, M.J. 2011. Compliance with sharps waste standards by a sample of Sydney Acupuncture premises. *NSW Public Health Bulletin*, 149- 153.

Calis, S., Arkan, B. 2013. The views of the nursing students about the medical wastes and their effects on the environment and human health. *Procedia-Social and Behavioral Sciences,* 116:1472-1476.

Caniato, M., Tudor, T., Vaccari, M. 2015. International governance structures for health-care waste management: A systematic review of scientific literature. *Journal of Environmental Management,* 153: 93- 107.

Chartier, Y., Emmanuel, J., Pieper, U., Prüss, A., Rushbrook, P., Stringer, R., Townend, W., Wilburn, S and Raki Zghondi. ed. 2014. Safe management of wastes from health-care activities. 2nd Edition. Malta: WHO Library Cataloguing-in-Publication Data.

Da Silva, C. E., Hoppe, A. E., Ravanello, M. M., Mello, N. 2005. Medical waste management in the south of Brazil. *Waste Management,* 25: 600- 605.

Daou, M.H., Karam, R., Khalil, S., Mawla, D. 2015. Current status of dental waste management in Lebanon. *Environmental nanotechnology, monitoring and management*, 4: 1- 5.

Darwish, R.O., Al- Kartib, I.A. 2006. Evaluation of dental waste management in two cities in Palestine. *Eastern Mediterranean Health Journal,* 12(2): 217-222.

Debere, M.K., Gelaye, K.A., Alamdo, A.G., Trifa, Z.M. 2013. Assessment of health care waste generation rates and its management system in hospitals of Addis Ababa, Ethiopia, 2011. *BMC Public Health,* 13(28): 1- 9.

Elder, A., Paterson, C. 2006. Sharps injuries in UK health care: a review of injury rates, viral transmission and potential efficacy of safety devices. *Occupational Medicine,* 56: 566- 574.

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

Ferreira, V., Teixeira, M. R. 2010. Heath care waste management practices and risk perceptions: Findings from hospitals in the Algarve region, Portugal. *Waste Management,* 30: 2657-2663.

Gabela, S.D, Knight, S.E. 2010. Healthcare waste management in clinics in a rural health district in KwaZulu-Natal. *South African Journal of Epidemiology and Infection, 25(1): 19- 21.*

Gupta, S., Boojh, R., Mishra, A., Chandra, H. 2009. Rules and management of biomedical waste at Vivekananda Polyclinic: A case study. *Waste Management,* 29: 812- 819.

Hangulu, L., Aktinola, O. 2017. Health care waste management on community- based care: experiences of community health workers in low resource communities in South Africa. *BMC Public Health,* 17: 1-10.

Hanumantha, P., R. 2008. Report: Hospital waste management- awareness and practices: a study of three states in India. *Waste Management and Research,* 26: 297-303.

Hassan, A. A., Tudor, T., Vaccari, M. 2018. Healthcare waste management: A Case Study. *MDPI,* 5:1-16.

Hassan, M.M., Ahmed, S.A., Rahman, K.A., Biswas, T.K. 2008. Pattern of medical waste management: Existing scenario in Dhaka City, Bangladesh. *Journal of Biomedical Central of Public Health,* 8(36): 1-10.

Haylamicheal, I.D., Dalvie, M.A., Yirsaw, B.D., Zegeye, H.A. 2010. Assessing the management of healthcare waste in Hawassa City, Ethiopia. *Waste Management and Research,* 1- 10.

Ikeda, Y. 2014. Importance of patient education on home medical care waste disposal. *Waste Management,* 34: 1330-1334.

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

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

Kagonji, I.S., Manyele, S.V. 2016. Analysis of Health Workers' Perceptions on Medical Waste Management in Tanzanian Hospitals. *Scientific Research Publishing,* 8: 445- 459.

Kaiser, B., Eagan, P.D., Shaner, H. 2001. Solutions to Health Care Waste: Life-cycle thinking and 'Green' purchasing. *Environmental health perspectives*, 3 (109): 205- 207.

Klangsin, P., Harding, A. K. 1998. Medical waste treatment and disposal methods used by hospitals in Oregon, Washington, and Idaho. *Journal of the air and waste management association, 1047-3289(48)*:516- 526.

Kuhling, J.G., Pieper, U. 2012. Management of health care waste: Developments in Southeast Asia in the twenty-first century. *Waste Management and Research,* 30(9):100- 104).

Lakshmi, B.S., Kumar, P. 2012. Awareness about Bio-Medical waste management amoung health care personnel of some important medical centers in Agra. *International Journal of Engineering Research and technology,* 1(7): 1- 5.

Leonard, L. 2004. *Managing hospital waste: A guide for Southern African Health Care Institutions*. First Edition. Durban: Groundwork.

Longe, O.E., Williams, A. 2006. A preliminary study of medical waste of medical waste management in Lagos Metropolis, Nigeria. *The Iran Journal of Environmental Science Engineering*, 3(2): 133- 139.

Makajic-Nikolic, D., Petrovic, N., Belic, A., Rokvic, M., Radakovic, J.A., Tubic, V. 2016. The fault tree analysis of infectious medical waste management. *Journal of cleaner production,* 113: 365-373.

Malekahmedi, F., Yunesian, M., yaghmaeian, K., Nadafi, K. 2014. Analysis of health care waste management status in Tehran hospitals. *Journal of Environmental Health Science*, 12(116): 2-3.

Manga, V. E., Forton, O. T., Mofor, L. A., Woodard, R. 2011. Health care waste management in Cameroon: A cases study from the South western Region. Resources, Conservation and Recycling, 57: 108-116.

Marinkovic, N., Vitale, K., Holcer, N. J., Dzakula, A., Pavic, T. 2007. Management of hazardous medical waste in Croatia. *Waste Management,* 28: 1049- 1056.

Manyele, S.V., Lyasenga, T.J. 2010. Factors affecting medical waste management in low-level health facilities in Tanzania. *African Journal of Environmental Science and Technology, 4(5)*: 304- 318.

Mbongwe, B., Mmereki, B.T., Magashula, A. 2008. Healthcare waste management: Current practice in selected healthcare facilities, Botswana. *Waste Management*. 28: 226-233.

Moreira, A.M.M., Günther, W.M.R. 2012. Assessment of medical waste management at a primary health-care center in São Paulo, Brazil. *Waste Management*. 33: 162- 167.

Mosquera, M., Anders-Prado, M.J., Rodriguez-Caravaca, G., Latasa, P., Mosquera, M.E.G. 2014. Evaluation of an education and training intervention to reduce health care waste in a tertiary hospital in Spain. *American Journal of Infection Control, 42*: 894- 897.

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

Nemathanga, F., Maringa, S., Chimuka, L. 2008. Hospital solid waste management practices in Limpopo: A case study of two hospitals. *Waste Management,* 28: 1236- 1245.

Oli, A.N., Ekejindu, C.C., Adje, D.U., Ezeobi, I., Ejiofor, O.S., Ibeh, C.C., Ubajaka, C.F. 2016. Health care waste management in selected government and private hospital in Southeast Nigeria. *Asian Pacific Journal of Tropical Biomedicine,* 6(1): 84- 89.

Omar, D., Nazli, S.N., Karuppannan, S.A.L. 2012. Clinical waste management in district hospitals of Tumpat, Batu Pahat and Taiping. *Procedia Social and Behavioural Science,* 68*:* 134- 145.

Patwary, M.A., O'Hare, W.T., Sarker, M.H. 2011. Assessment of occupational and environmental safety associated with medical waste disposal in developing countries: A qualitative approach. *Safety Science,* 49: 1200-1207.

Popp, W., Jigjidsuren, A., Badrach, U., Uyanga, T., Ross, B., Zorigt, K., Spors, J., Bodart, C. 2014. Waste Management in Mongolian hospitals. *International Journal of Infection Control,* (1996-9783): 1-5.

Ramokate, T., Basu, D. 2009. Health care waste management at an academic hospital: knowledge and practices of doctors and nurses. *South African Medical Journal.* 99(6): 444- 445.

Republic of South Africa.2014. *The National Health Act 61 of 2003*. Cape-Town: Government Gazette.

Rouyan, G., Lingzhong, X., Huijuan, L., Chengchao, Z., Jiangjiang, H., Yoshihisa, S., Wei, T., Chushi, K. 2010. Investigation of health care waste management in Binzhou District, China. *Waste Management,* 30: 246-250).

Sachin, R., Patel, M.L., Nischal, A. 2012. Assessment of the knowledge, attitude and practices regarding Biomedical Waste Management amongst the Medical and Paramedical Staff in Tertiary Health Care Centre. *International Journal of Scientific and Research Publications, 2(7)*: 1- 6.

Sarkar, S.K.A., Haque, M.A., Khan, T.A. 2006. Hospital waste management in Sylhet City. *ARPN Journal of Engineering and Applied Sciences,* 1819 (1): 32-40.

Sawalem, M., Selic, E., Herbell, J.D. 2009. Hospital waste management in Libya: A case study. *Waste Management*, 29: 1370- 1375.

Shalini, S., Harsh, M., Mathur, B.P. 2012. Evaluation of bio-medical waste management practices in a government medical college and hospital. *National Journal of Community Medicine,* 3(1): 80- 84.

Shareefdeen, Z.M. 2012. Medical s management and control. *Journal of Environmental Protection,* 3: 1625- 1628.

Shiferaw, Y., Abebe, T., Mihret, A. 2012. Sharp injuries and exposure to blood and bloodstained body fluids involving medical waste handlers. *Waste Management and Research,* 30(12): 1299: 1305.

Shinee, E., Gombojav, E., Nishimura, A., Hamajima, N., Ito, I. 2007. Health care waste management in the capital city of Mongolia. *Waste Management,* 1- 6.

Srivastav, S., Kariwal, P., Singh, A.K., Shortriya, V.P. 2010. Evaluation of biomedical waste management practices in multi-speciality tertiary hospital. *Indian Journal of Community Health,* 21(2): 46- 50.

South Africa. Department of health.2013. *National Norms and Standards relating to Environmental health in terms of the National Health Act ,2003 (Act no 61 of 2003*). No: 36849: 20 September. Gauteng: Department of Health.

South Africa. 2016. Health Profession Council of South Africa. Pretoria. Health Professions Council of South Africa.

South Africa.2015. eThekwini Municipality: Nuisance and behavior in Public places By- Law (online). Available: https://openbylaws.org.za/za-eth/act/by-law/2015/nuisances-behaviour-public-places/chapter/4/ (Accessed: 23 May 2017).

South Africa. 2008. National Environmental Management Waste Act 59 of 2008. Kwa-Zulu Natal. Kwa- Zulu Natal provincial Gazette.

South Africa. 2004. National Health Act no. 61 of 2003. Government Gazette number 32000: 10 March.

Tobin, E.A., Ediagbonya, T.F., Asogun, D.A., Oteri, A.J. 2013. Assessment healthcare waste management practices in primary health care facilities in a Lassa fever local government area of Edo state, Nigeria. *AFRIMEDIC Journal*, 4(2): 16- 23.

Toraman, A.R., Battal, F., Ozturk, K., Akcin, B. 2011. Sharps Injury Prevention for Hospital Workers. *International Journal of Occupational Safety and Ergonomics*. 17(4): 455- 461.

Tsakona, M., Anagnosropoulou, E., Gidarakos, E. 2007. Hospital waste management and toxicity evaluation: A case study. *Waste Management,* 27(7): 912- 920.

Udofia, E.A., Fobil, N.F., Gulis, G. 2015. Solid medical waste management in Africa. *African Journal of Environmental Science and Technology. 9(3)*:244-254.

Winfeld, E.S., Brooks, M.S. 2015. Medical waste management- A review. *Journal of Environmental Management.* 163: 98- 108.

Yong, Z., Gang, X., Guanxing, W., Tao, Z., Dawei, J. 2009. Medical waste management in China: A case study of Nanjing. *Waste management,* 29: 1376-1382.

LIST OF ANNEXURES

Annexure	Title
1	Letter of information
2	Permission granted
3	Letter of information
4	Consent form
5	Questionnaire
6	Regulation checklist
7	Acceptance letter- IREC No: 125/16

ANNEXURE 1

RE: REQUEST TO CARRY OUT A QUESTIONNAIRE SURVEY WITHIN THE DOCTORS GUILD IN THE DURBAN SOUTH AREA.

To: Dr Lalbadoor

My name is Litonya Boodhram. I am an MHSc student at the Durban University of Technology. I am currently carrying out a study on "*A lifecycle evaluation of Health Care Waste Management by General Practitioners in South of Durban*.*".*

The view and opinions of the private practicing doctors of the Guild will be needed as it will play a vital role in this study. Therefore I would appreciate it if you grant me the permission to pursue my research by interviewing the respective doctors.

This study will assist the concerned area in determining the knowledge, attitudes and practices regarding the management of health care waste in private GPs surgeries. It will also highlight occupational risks associated with the handling of Health Care Waste (HCW) as well as to determine the regulations utilized when the HCWM process. This will help provide the community and those concerned with in depth knowledge on the importance of proper management of health care waste.

I will also ensure that the provided information will be confidential and participants remain anonymous. The information will only be used for research purposes by myself and my supervisor concerned. If you require further information please contact my research supervisor Ms Joy Kistnasamy on email: joyK@dut.ac.za or 031 373 2249.

Yours Faithfully

Ms. L. Boodhram

Contact no: 0842895795 or *E-mail*: litonya.boodhram@gmail.com

ANNEXURE 2

Durban South Doctors' Guild

P.O. Box 101935
Chatsworth
4030
Tel: (031) 4598061
e-mail: dsdg@mweb.co.za

80 Woodhurst Drive
Chatsworth
4092
Fax. (031) 4013 598

22nd June 2016

Dear Miss L. Boodhram,

Permission is hereby granted to you to carry out a questionnaire survey within the Durban South Doctors Guild in the Durban South area.

It is understood that you will ensure that the provided information will be confidential and participants remain anonymous. The information will only be used for research purposes by yourself and your supervisor concerned.

Yours faithfully

DR R. LALBADOOR
(Chairperson)
DSDG

ANNEXURE 3

LETTER OF INFORMATION

Title of the research Study: A cross sectional study is being carried out to determine the knowledge, attitudes and current practices on a lifecycle evaluation of Health Care Waste Management by General Practitioners in South of Durban.

Principal Investigator/s/researcher: Litonya Boodhram [(BTech: Environmental Health (Cum Laude)]

Supervisor: Ms E. J. Kistnasamy (M-Tech; Environmental Health, B. Comm).

Co-Investigator/s/Supervisor/s: Dr. R. Baatjies (PhD, MPH, MTech) and Mr. E.R Euripidou (MSc: Environmental epidemiology and policy).

Outline of procedure:

I personally will arrive at your private surgery accompanied with this document you are currently reading, this needs to be signed by you the interviewee. A questionnaire will be used in this interview and all questions must be answered accordingly, a regulations checklist will also be attached to the questionnaire which also needs to be answered accordingly. This interview process will take approximately half an hour to 45 minutes.

Risks or Discomforts to the participant:

There will be no harm done to you and it will be greatly appreciated that you answer all questions asked by the interviewer.

Benefits:

This study will highlight and elaborate knowledge, attitudes and practices on managing health care risk waste of each individual General Practitioner. It will also express each person opinion and holistic view of their experiences and challenges while working on a daily basis.

This will benefit the population of the South Durban area giving them a safe and healthy environment to live in. It will provide a quality healthcare that is required while cutting cost and saving our environment. It will also help reduce climate change and build a greener environment for this community.

Reasons why the participant maybe withdrawn from the study:

If for some reason you feel you cannot continue to answer the questionnaire at any point, you may stop. There will be nothing held against you.

Remuneration:

There will be no remunerations given to any persons involved in this study.

Costs of the study:

There will be no cost involved for participating in this study.

Confidentiality:

The questionnaire that is used in this interview will be totally confidential and only accessible by the interviewer and my supervisor.

Research-related injury:

There will be no payments made to the participants as no injury will be caused for the duration of this study.

People to contact if the event of any queries:

Miss Litonya Boodhram Tel (Mobile): 0842895795

Ms. J. Kistnasamy Tel: (+27) 31 373 2808

Potential participants must be assured that participation is voluntary and the approximate number of participants to be included should be disclosed. A copy of the information letter should be issued to participants. The information letter and consent form must be translated and provided in the primary spoken language of the research population e.g. isiZulu.

ANNEXURE 4

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, (name of researcher), about the nature, conduct, benefits and risks of this study – Research Ethics Clearance Number:_____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature/Right -Thumbprint**

I, _____(name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Full Name of Researcher	**Date**	**Signature**
Full Name of Witness (If applicable)	**Date**	**Signature**
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

ANNEXURE 5

GUIDELINES / REGULATIONS CHECKLIST OF HEALTH CARE WASTE MANAGEMENT IN GP's PRIVATE SURGERIES.

Please read which regulations below and tick (√) the regulations that are being practiced in your surgery.

HPCSA Policy Guidelines:

- OCCUPATIONAL HAZARDS AND HEALTH RISKS (4.1 & 4.2) ☐
- SEGREGATION OF WASTES ☐
- IN-HOUSE CONTROL ☐
- CLOSURE AND BAGGING OF WASTE-HOLDING PLASTIC BAGS ☐
- INTERMEDIATE AND FINAL STORAGE AREAS ☐
- MOVEMENT OF WASTE ☐
- MAINTENANCE AND CLEANING OPERATIONS ☐
- SPILL OR ACCIDENT CLEANUPS ☐
- SPECIFIC PROVISIONS FOR DEALING WITH THE DIFFERENT TYPES OF HEALTH CARE WASTE ☐
- SUMMARY OF COLOUR-CODING/LABELING REQUIREMENTS ☐

Department of Health: National Health Act (No. 61 of 2003)

- REGULATIONS RELATING TO HEALTH CARE WASTE MANAGEMENT IN HEALTH ESTABLISHMENTS ☐

- HEALTH CARE WASTE MANAGEMENT PLANS ☐
- REQUIREMENTS APPLICABLE TO HEALTH ESTABLISHMENTS ☐
- PACKAGING AND LABELLING OF HEALTH CARE WASTE ☐
- HEALTH CARE WASTE STORAGE ☐

NEMA: Waste Act 59 of 2008

- NATIONAL WASTE MANAGEMEN T STRATEGY, NORMS AND STANDARDS ☐
- WASTE MANAGEMENT STRATERGIES ☐

Nuisance and Behaviour in Public Places By-Law 2015

- Are you aware of the new Nuisance and Behaviour in Public Places By-Law 2015 (Section: 9- Litter)? **(√ Tick appropriate box)**

  ☐1 Yes

  ☐2 Unsure

  ☐3 No

Thank you for your time.

This Regulations Checklist was adapted from the KwaZulu-Natal Department of Health Environmental Health Legislation, Guidelines, Policies, Protocols and Strategies CD and in consultation with the Phoenix Health Department.

ANNEXURE 6

Good day, my name is Litonya Boodhram (20925881), I am an MHSc student at Durban University of Technology carrying out a research project, if you could kindly co- operate during this questionnaire process as it will be highly appreciated.

NOTE:

1. The information gained in this questionnaire is **strictly** for use at Durban University of Technology. This study **will not** reveal names of respondents who wish to **remain anonymous**, nor will the information reveal the identities of respondents in an insolent manner.
2. This is a **Master's study** and will therefore require information on awareness, participation in the management of health care waste, knowledge, attitudes and practices towards recycling for a better environment.

QUESTIONNAIRE TO DETERMINE THE MANAGEMENT OF HEALTHCARE WASTE IN PRIVATE GENERAL PRACTITIONERS SURGERIES IN THE DURBAN SOUTH AREA.

Section: 1:

Demographical information

1. **Name:**
(You may remain anonymous)

_____

2. **Age:**

_____

3. **Gender:** **(√ Tick appropriate box)**

☐ 1 Male

☐ 2 Female

4. **Race:** **(√ Tick appropriate box)**

☐ 1 African

☐ 2 Coloured

☐ 3 White

☐ 4 Indian

☐ 5 Other (Please specify) _____

5. In which area is your facility located? (√ Tick appropriate box)

☐ 1 Chatsworth	☐ 2 Umlazi	☐ 3 Shallcross
☐ 4 Clairwood	☐ 5 Merebank	☐ 6 Isipingo
☐ 7 Reservoir Hills	☐ 8 Overport	☐ 9 Queensburg
☐ 10 Town Central	☐ 11 Bluff	

☐ 7 other (Please specify) _____

6. Which year did you qualify as a GP?

_____

7. How many years have you been practicing as a GP in the Durban South Doctor's Guild?

_____

8. When did you open up your private practice?

_____

Section:2:

Knowledge of Health Care Waste Management

9. What type of waste is generated in your facility? (√ Tick appropriate box/s)

☐ 1 Infectious	☐ 2 Hazardous	☐ 3 General

☐ 4 other (Please specify) _____

10. Is Health care waste segregated from general waste? (√ Tick appropriate box)

☐1 Yes

☐2 No

☐3 Not sure

11. Is all waste generated at your surgery segregated according to its composition? **(√ Tick appropriate box)**

☐1 Yes

☐2 Unsure

☐3 No

12. On average how much of waste is generated per day at your practice?

☐ 1 1.5kg ☐2 3.5kg ☐3 4kg

☐ 4 other (Please specify) _____

13. Is the waste stored according to specific regulations? **(√ Tick appropriate box)**

☐1 Yes

☐2 Unsure

☐4 No

14. Does your surgery have a waste management plan? **(√ Tick appropriate box)**

☐1 Yes

☐2 Unsure

☐5 No

15. Do you know where waste generated from your surgery is disposed? **(√ Tick appropriate box)**

☐1 Yes

☐2 Unsure

☐3 No

16. What is the name of the waste collection service used by your surgery?

Section:3:

Practices of Health Care Waste Management

17. **Are protective masks being worn when handling different types of waste?** **(√ Tick appropriate box)**

☐1 Yes

☐2 Unsure

☐3 No

18. **Into which categories is waste separated?** **(√ Tick appropriate box)**

☐1 Sharps ☐2 Infectious waste ☐3 Chemicals

☐4 Pharmaceutical waste ☐5 Other (Please specify) _____

19. **What type of syringes do you use?** **(√ Tick appropriate box)**

☐1 Disposal ☐2 Sterilized ☐3 Safety syringes

☐5 Other (Please specify) _____

20. **How full is you HCW bags before replenishing with a new one?** **(√ Tick appropriate box)**

☐1 ¾ filled ☐2 half-filled ☐3 completely filled

☐4 other (Please specify) _____

21. **Are these bags stored in a safe place until it is disposed?** **(√ Tick appropriate box)**

☐1 Yes

☐2 Unsure

☐3 No

Section:4:

Occupational risks associated with Health Care Waste Management

22. **Which equipment does staff handling waste use?** **(√ Tick appropriate box/s)**

☐1 None ☐2 Gloves ☐3 Boots

☐4 Apron ☐5 Masks

☐6 Other (Please specify) _____

23. How many injections are given per a week on average? (√ Tick appropriate box)

☐1 1 – 5 ☐2 6 - 11

☐6 Other (Please specify) _____

24. What type of containers do you use to dispose used sharps? (√ Tick appropriate box)

☐1 Plastic ☐2 Metallic ☐3 Cardboard

☐4 Other (Please specify) _____

25. How many cases of needle stick injuries occurred in the past 12 months? (√ Tick appropriate box)

☐1 1 – 5 ☐2 6 - 11

☐6 Other (Please specify) _____

26. Where all the needle stick injury cases reported? (√ Tick appropriate box)

☐1 Yes

☐2 Unsure

☐3 No

27. Do you have a copy of the injection safety policy/ recommendations issued by your health service? (√ Tick appropriate box)

☐1 Yes

☐2 Unsure

☐3 No

28. Do you have a copy of the occupational health policy/ recommendations regarding exposure to sharps? (√ Tick appropriate box)

☐1 Yes

☐2 Unsure

☐3 No **Thank you for your time.**

Annexure 7

Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

13 October 2015

IREC Reference Number: **REC 125/16**

Ms L Boodhram
364 Silverglen Drive
Chatsworth
Durban
4092

Dear Ms Boodhram

A lifecycle evaluation of Health Care Waste Management by General Practitioners in South Durban

I am pleased to inform you that Full Approval has been granted to your proposal REC 125/16.

The Proposal has been allocated the following Ethical Clearance number **IREC 108/16**. Please use this number in all communication with this office.

Approval has been granted for a period of two years, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's. In addition, you will be responsible to ensure gatekeeper permission.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

Professor J K Adam
Chairperson: IREC

DUT DURBAN UNIVERSITY OF TECHNOLOGY
2016 -10- 13
INSITUTUTIONAL RESEARCH ETHICS COMMITTEE
P O BOX 1334 DURBAN 4000 SOUTH AFRICA