COMPARISON OF ALKALINE HYDROLYSIS AND NEWSTER STERILIZING ALTERNATIVE TREATMENT TECHNOLOGIES AND CULTURAL BELIEFS ON PLACENTA MANAGEMENT IN GAUTENG, SOUTH AFRICA

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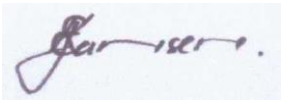
DECLARATION OF INDEPENDENT WORK

I, Kathie Elizabeth Jansen, student number , hereby declare that this research document submitted to the Central University of Technology, Free State, is my own independent work and that it has not been submitted to any institution by myself or any other person in fulfillment of any requirement for the attainment of any qualification.



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STUDENT SIGNATURE **DATE**

DEDICATION

This dissertation is dedicated to my late mother, Marie Elizabeth Lurie, whom I deeply miss. During the completion phase of this study, I walked the passages of many hospitals and always expected to hear the clicking of your shoes as you while caring for the sick and needy. I hope that you know that I have completed this task in honour of the person you were and will always be in my heart and memory.

ABSTRACT

The history and development of a health care risk management legal framework in South Africa has come a long way since the 1500s. A historical overview has shown that continuous development of legal requirements took precedence and that legislative promulgations were typically followed by systems development.

The aim of the study was twofold. First, the study aimed to compare the feasibility of two types of alternative technologies for the treatment of placentas, namely the Alkaline Hydrolysis treatment technology and the NEWster® steriliser system. Various concerns have been raised regarding the operational handling, management, maintenance, and optimal treatment efficiency of these two systems. It was found that the volumes of generated waste in terms of generation versus treatment play a role in the choice of the plant that should be installed. Moreover, based on a comparative evaluation of the two systems, it is evident that the NEWster®, which is the smaller of the two units, is more suitable for small scale operators such as district hospitals, clinics, and community health establishments. This is because the cycle time of the NEWster® is shorter, the space needed to install a unit is less, and the capacity of this unit in terms of generation rates is more in line with international requirements than that of the Alkaline Hydrolysis system.

The second study was to determine the prevalence of traditional beliefs in the management and disposal of placentas. Health professionals were recruited from health establishments in the Department of Health in Gauteng, South Africa. A quantitative investigation was conducted. A questionnaire was used to obtain the required data from health professionals in governmental hospitals in Gauteng. These professionals were selected from five categories, namely matron/nursing supervisor/operational manager, professional nurse, nursing assistant, medical practitioner (doctor), and health care risk waste officer/environmental health practitioner. The envisaged study site would have consisted of the obstetrics and maternity wards of 27 hospitals, but 15 hospitals were ultimately included in the

study. The highest district participation rate was from hospitals in the Tshwane district (50.7%), while the lowest participant rate was medical practitioners at 11.11%.

It was determined that the placentas of all the birth mothers (100%) were individually packed in small red plastic bags after giving birth. However, a splash risk was identified.

Differences in timeframes were detected for the placement of placentas after birth into Specicans due to theatre procedures, and this could take up to 30 minutes. The placentas were stored in freezers that were not equipped with a thermometer or mechanism to verify freezer temperatures. There was a 50% chance that a mother who was not aware of the procedures regarding her placenta would request it after it had already been disposed of in a Specican. Moreover, it was evident that health professionals were unsure which procedures to follow should various religious practices associated with a patient's right to take the placenta home needed to be addressed.

Family members generally collected patients using their own vehicles and it was reported that the placenta would be buried at home as quickly as possible. It is noteworthy that a small percentage of the respondents indicated that placentas would be given to traditional healers.

Taking religion (which is central to the cultural diversity discussion) into account, the most dominant group that tended to take the placentas home was the Indian group. The Zulu population group was the secondary most likely group to take the placenta home. The traditional rituals followed at home were not well defined or described by the participants, which suggests that many Health Professionals may not be aware of customs to dispose of placentas in the traditional manner.

It was also found that there was no standardised record form for placenta handling, and thus a trustworthy data base for placenta management procedures

was a challenge. Most of the health professionals (84.13%) had been trained. The study revealed that medical practitioners (i.e., doctors) felt that health care risk waste management was not their responsibility.

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Abbreviations

ABBREVIATION	DESCRIPTION
CCVM	Cornell College of Veterinary Medicine
CMWS	Compass Medical Waste Services
DEAFF	Department of Environmental Affairs, Fisheries and Forestry
EAP	Environmental assessment practitioner
GDoH	Gauteng Department of Health
GHCRWM	Gauteng Health Care Risk Waste Management
GHCRWR	Gauteg health care risk waste regulations, 2004
GWIR	Gauteng Waste Information Regulations, 2004
GWIS	Gauteng Waste Information System
HCI	Health Care Improvement
HCRW	Health care risk waste
HCRWM	Health care risk waste management
HEs	Health establishments
IWMP	Integrated Waste Management Plan
KOH	Potassium hydroxide
MWTA	Medical Waste Tracking Act
NaClO	Sodium hypochlorite
NGO	Non-governmental Organization
NHA	National Health Act, Act No. 61 of 2008
NIWMP	National Integrated Waste Management Plan
PCBS	Polychlorinated biphenyl
RWH	Royal Womens Hospital
SANS	South African National Standards
SAWIS	South African Waste Information System
SOP	Standing Operational Procedures
UK	United Kingdom
USA	United States of America
USAID	USA Agency for International Development
WHO	World Health Organisation
WM	Waste Management
MLW	Waste Management Licence

CHAPTER 1

INTRODUCTION AND GENERAL BACKGROUND

1.1 Introduction

As communities expand, waste is continuously and more voluminously generated as part of normal human activities. Although it represents a minor waste category, the volumes of health care risk waste (HCRW) have grown exponentially. In fact, problems associated with HCRW were recorded as far back as the beginning of civilization. In 2011, the United Nations special rapporteur on human rights and toxic waste warned the world that it was not paying attention to the problems caused by medical waste (Georgescu, 2011:1-21).

Health care risk waste is generated at health establishments (HEs) such as hospitals, clinics, community health centres, laboratories, research institutions, dental practices, emergency medical services, veterinary practices, old age homes, and forensic pathology services. According to the World Health Organisation (2005:2-3), the Gauteng Health Care Waste Management Regulations (2004a:6), and the Department of Environmental Affairs (2018:7-8), such waste can be divided into the following categories:

- laboratory waste
- anatomical/pathological waste
- genotoxic/cytotoxic waste
- infectious waste (including highly infectious or isolation waste)
- sharps waste
- sanitary waste
- nappy waste
- chemical waste
- low level radioactive waste
- pharmaceutical waste.

The bacterial contents of HCRW comprise contaminants that pose a risk to the immediate environment of HEs and communities, especially where such waste is indiscriminately dumped or poorly managed (Benmour, 1993:3; Harris, 2006:32; Shareedeen, 2012:1265-1268; Sharma, Jais, Gupta, Ansari, Lall, Debbarma & Kaur, 2016:8739-8740; Shepard & Burnie,1998; Stevens, 1989:1).

Pathological waste is deemed a category of HCRW by the Gauteng Health Care Waste Regulations (2004a:5) and is defined as follows:

> "[It comprises of] (a) deceased animals or animal parts infected with zoonotic diseases; (b) human and animal tissues, organs, body parts, blood, fluid, blood products and body fluids; (c) containers or equipment containing blood that is fluid or blood from animals known or suspected to be infected with any zoonotic disease; and (d) human foetuses; but excludes teeth, hair and nails."

It is stipulated that waste will only be classified as HCRW if the product comes into contact with human bodily fluids, and thus nails, teeth, and hair are in most cases not regarded as part of HCRW (University of Arizona, 2011; University of Minnesota, 2021; United States of America. Department of Energy National Laboratory, 2012; WHO, 2005:2-3 and 2018).

The World Health Organisation (2005:2) indicates that 80% non-infectious waste, 15% of pathological waste, 1% of sharps waste, 3% of chemical or pharmaceutical waste, and less than 1% of pressurised cylinders and broken thermometers constitute the estimated percentages of waste per total waste produced in primary HEs. The mean percentages of HCRW found at two hospitals in the Limpopo Province of South Africa were in the following decreasing order (Nemathaga, Maringa and Chimuka, 2008:1236-45): general waste (60.74%), medical waste (30.32%), and sharps (8.94%). The reported average HCRW generation rate is 0.60 kg per patient per day.

The management of HCRW in developing countries is a major concern and is considered poor (Nemathga et al.,2008:1236-45; Programme for the Implementation of the National Waste Management Strategy, 2000:1; World Health Organisation, 1985 and 2005:4-6). Olaniyi, Ogola and Tshitangano (2019:2199) corroborate this view, stating that that the average of 0.54 kg per patient per day was generated in his study.

1.2 Demographics of the Study Site

1.2.1 Demography

Figure 1.1 is a map of South Africa indicating its nine provinces and the geographic location of Gauteng Province in relation to the other provinces. Gauteng is South Africa's economic heart and has a population of 15.2 million people. With 25.8% of the population living here, it is the most heavily populated province (Britiannica, 2017; Businesstech, 2019; Statistics South Africa, 2019;).

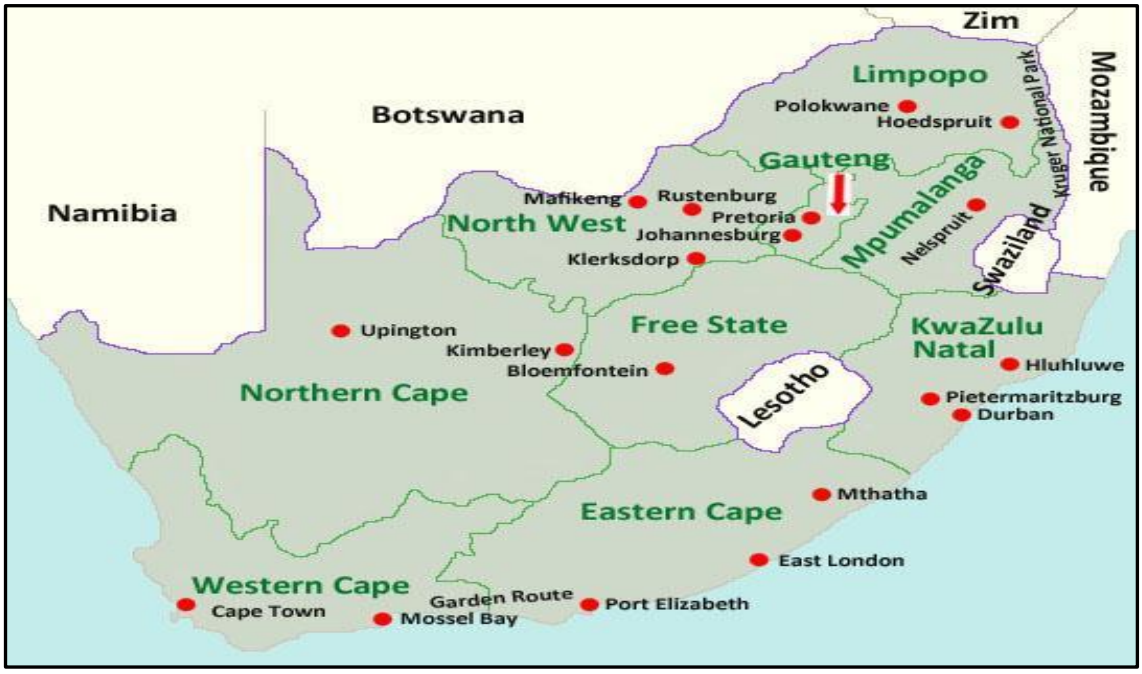

Figure 1.1: Map of the research area in relation to the other nine provinces of South Africa
Source: Facts about South Africa, 2008

The health establishments under study were situated in the Province of Gauteng (hereafter referred to as Gauteng) in South Africa (Figure 1.1). Gauteng is

situated in the north-eastern part of South Africa and it has four major cities: Johannesburg, Pretoria, Vereeniging, and Germiston. Pretoria is the administrative capital of the province. Despite Gauteng being the smallest of the provinces in South Africa, it contributes most extensively to mining, industrial, commercial, and financial activities that are at the heart of the vast mineral wealth of the province.

Two contracted HCRW service providers regularly serve the HEs of the Gauteng Department of Health (GDoH). The first is Buhle Waste Services, which operates in districts such as Sedibeng, Ekurhuleni and Johannesburg (Steve Biko Academic Hospital, Chris Hani Baragwaneth Hospital, Charlotte Maxeke Johannesburg Academic Hospital, and Doctor George Mukhari Academic Hospital). The second is Compass Waste which operates in districts in the Tshwane Metropolitan and West Rand areas. An annual HCRW generation rate of about 4.7 million kilograms is produced by health establishments in this province (Gauteng Department of Health, 2020:1-10).

Historically, the Gauteng Department of Health (GDoH) had incinerators on site at government hospitals for the treatment of HCRW. However, due to the promulgation of the Air Quality Act No. 39 of 2004 (South Africa, 2004b) that addresses the inability of government owned hospital incinerators to comply with the standards set by the National Environmental Management: Air Quality Act No. 39 of 2004 (South Africa,2004b), they were closed in all state-owned HEs.

1.2.2 Health care waste management and treatment technologies: incineration versus alternative technologies

The Gauteng Health Care Waste Regulations (2004a) do not preclude alternative treatment technologies from handling pathological waste, and thus this form of waste is still commonly treated in this province by incineration. Unfortunately, the Department of Environmental Affairs, Fisheries and Forestry (DEAFF) has not yet approved alternative treatment methods for pathological waste on site (South Africa, 2004a:26-28).

The management of alternative HCRW treatment technologies has been conducted by means of different systems or processes that have been available since 2001 (Emmanuel, Puccia and Spurgin, 2001: 1-44). The latter authors, who are involved in the registered company that manages these processes, summarise the associated requirements and operations as follows:

> "...throughput capacity, types of waste treated, microbial inactivation efficacy, environmental emissions and waste residues, regulatory acceptance, space requirements, utility and other requirements, reduction of waste volume and mass, occupational health and safety, noise and odour, automation, reliability, level of commercialisation, technology manufacturer, cost, and community and staff acceptance."

The Gauteng Health Care Waste Management Regulations, 2004document (South Africa, 2004a:8) defines the non-combustion treatment of health care waste as follows:

> "[It is] any method, technique or process designed to change the biological character or composition of any health care risk waste so as to sterilize such health care risk waste whereas treat and treated have a corresponding meaning."

Comparatively, the Colorado Department of Public Health and Environment (2012:1) in the USA classifies HCRW treatment technologies based on their method of rendering the waste non-infectious, such as the following:

- **Thermal:** These treatments include autoclaving, incineration, heat application, micro- or macro-waving, pyrolysis, and gasification;
- **Chemical:** For example chlorine or chlorine derivatives, ozone, enzymes, sodium hydroxide;
- **Irradiation:** For example ultraviolet, Cobalt 60, electron beam; and
- **Other mechanisms:** Some mechanisms designed for specific medical waste categories, for example gas/vapour sterilisation.

Generally, pathological or anatomical waste is treated globally by means of incineration. However, it has been argued that this treatment of pathological waste may not be effective due to air removal and lack of penetration success (Cleanroom Technologies, 2019). Emmanuel et al. (2001:1-44) mention that some alternative technologies are generally used for only a year or a limited period thereafter. It is evident that these processes are frequently changed due to continuous technological developments.

Treatment plants for pathological waste in South Africa are registered on an internet-based South African Waste Information System (SAWIS) which is a country-wide registration system, but the Gauteng Waste Information System (GWIS) is only applicable to Gauteng. This system was created after the Gauteng Waste Information Regulations (GWIR) had been enacted in 2004, but not all provinces have their own registration system and it thus requires a national system to register (South Africa, 2005; South Africa, 2004c).

Although this study acknowledges the use of a variety of authorised treatment technologies in South Africa, it focused on the Alkaline Hydrolysis system which is currently used in the meat industry − especially in the abattoir environment in rural and semi-rural areas–and the NEWster® technology, which was imported from Italy and is in relatively new use in South Africa (NEWster, 2019).

1.3 Health Care Risk Waste Disposal Strategies

The Integrated Strategy and Action Plans for sustainable HCRW management of Gauteng that was developed by the National Department of Environmental Affairs, Fisheries and Forestry (DEAFF) was developed after wide consultation in 2004.This system encompasses a wide variety of topics that should be considered in the general management of HCRW. It was devised after the introduction of the Gauteng Waste Information Regulations (GWIR) in 2004, but not all provinces had their own system of registration and needed a national system, as was stated earlier (South Africa, 2004a; South Africa, 2004c).

Adherence to the above-mentioned policy is required to decrease waste, reduce the effect of waste on the environment, enhance occupational health and safety (OHS) practices, and improve effective cooperation between various spheres of government. This will also lead to the cost-effective treatment and disposal of HCRW, ensure a well-informed community, and facilitate the development of a well-defined regulatory structure that will provide training for the local community and health professionals in waste management (South Africa, 2000:i-iii).

1.4 Health Care Risk Waste Legal Framework

A regulatory system for waste management was established in 2000 and has been periodically updated in South Africa. This system addresses waste management, protection of the environment, and prevention of pollution. It also aims to govern the functions of different actors and integrate a multitude of related laws.

As far back as 2013, it was still citizens' right to possess human tissue (Mahomed, Nöthling-Slabbert and Pepper, 2013). However, the latter authors argue that it was a controversial issue in South Africa then and therefore needed more legal attention and legislative development. Pepper and Nőthling-Slabbert (2015) noted two years later that legislation relating to human tissue and stem cell research and therapy was exclusive to the South African National Health Act (NHA) No. 61 of 2003, which manages the legal control of human tissue to this day. However, this is an issue that presents serious problems in terms of the management of human tissue waste, particularly placentas (South Africa, 2003:16).

1.5 Traditional Placenta Management

The placenta is globally known as an example of a biodegradable human waste and a microbe rich HCRW product. It is also generally accepted that unique techniques and instructions are needed to dispose of the human placenta. A placenta is between 500 and 650 grams in weight with an average weight of 637 grams (Kerr, 2012). It is a tradition among many ethnic groups in and around South Africa to take the placenta home for burial or alternative disposal methods

after a child's birth. This means that pathological waste is transported by public or private transport to the patient's house, where it is then deposited in a shallow grave or hole in the ground or treated in other ways.

It is common practice to dispose of placentas in accordance with cultural and ceremonial traditions in many cultures across the globe. In Western culture, however, the human placenta is deemed nothing more than human waste. In Nigeria and Ghana, the cultural group referred to as the 'Iblo' views the placenta as the dead twin of the living child and it is thus ceremoniously buried. It is buried in a grave-like hole in some cultures, while others cover it with grass, bury it in the dirt floor of the family home, wrap it in a blanket and bury it by a tree, or wash it, dry it, and put it in a basket for burial by the father. These activities symbolise on-going life, fertility, the born child's wellbeing, a life-giving power, the twin or older sibling of the baby, the guardian of the baby during life, medical care, binding the child to its place of residence, and protection from evil spirits. In Mali, the Arabian Peninsula, North and South America, New Zealand, and all over Africa, such beliefs still prevail (Bradley, 2014).

Bradley (2014) also refers to the Capceco capsule which symbolises ‘birth to earth’. This is an environmentally friendly method for the disposal of the placenta and is popular in New Zealand among the indigenous people. The capsule is made of recyclable materials and the kit consists of a corn starch bag, a reusable carton capsule or box, a carrying bag, a keepsake record book, and a tag that records the infant's name and date of birth. The use of such parcels is an example of efforts to protect the placenta and the environment, but their use does not address concerns about the microbial load and/or potential spread of diseases and the potential for the release of heavy metal content, such as mercury, cadmium, and placental lead, into the environment. Mothers who wish to carry the placenta home are equipped with health and safety advice by the Royal Hospital for Women (RWH) in Australia. Here a legal form must be completed before the placenta is handed to the mother (Royal Hospital for Women,2014:1-

2; Esteban-Vasallo, Aragón's, Pollan, López-Abente andPerez-Gomez, 2012:1369-1377).

1.6 Rationale

Technology is emerging and evolving in our ever-changing environment, and so do new treatment technologies for health care waste. In the meat industry, for instance, technologies that have not developed in the field of health care risk waste are being used, and this prompted this comparative investigation into the Alkaline Hydrolysis treatment technology and the NEWster technology as the first part of this study.

The second part of this research study was undertaken to investigate the handling of placentas in HEs and the custom of taking placentas home to determine whether placentas, as pathological waste, were handled appropriately according to HCRW regulations.

1.7 Problem Statement

Apart from incineration, no alternative treatment technologies have been licensed in South Africa for the treatment of pathological waste. However, an alternative solution that is successful already exists in South Africa in the abattoir (or slaughter) industry, where pathological waste derived from carcasses is treated using the Alkaline Hydrolysis technology. This procedure is carried out in an alkaline atmosphere at high temperatures under high pressure and results in non-infectious by-products and brine (also known as hydrolysate). The strongest portion of the by-product is called 'cremains'. This procedure has been shown to be efficacious in the treatment of infectious carcasses at full-scale facilities. In July 2000, it was piloted at the Cornell College of Veterinary Medicine (CCVM) plant in Ithaca City, New York (Prinie, 2002:1320-006).

The NEWster® Group (NEWster, 2019) which was founded in 1996, created another alternative treatment method for HCRW. This technology was validated in Italy in 1998, the UK in 2012, Australia in 2013, and Turkmenistan in 2013. In

2014, Enviro Services validated this treatment technique in South Africa and published a systematic report on the NW10, which was tested at the Vergelegen Hospital Mediclinic in Somerset West, Cape Province. Efficacy requirements were tested, but the analyses were limited to sharps and general infectious waste. The list of materials that can be managed by NEWster® (NW10), Alloro Africa (Pty) Ltd, suggests that "teeth, small body parts, guinea pigs, and small rodents" can be treated and rendered unrecognisable. Making a part ‘unrecognisable’ means deconstructing its structure in such a way that it does not pose a threat to humans or the environment. ‘Unrecognizable’ can also be described as “very different to before, or changed very much, and therefore not able to be recognized” (Cambridge Dictionary, 2020).The placenta is a small part of the body and can therefore also be effectively treated by means of this procedure (NEWster, 2019; Bovetti, 2016).

However, the viability of the above technologies for the treatment of human pathological waste that is produced in HEs has been questioned. It is undeniable that the most important aspect of any such technology is its effectiveness in destroying pathogens and rendering the treated product unrecognisable. Questions about the handling methods of placentas at HEs and which traditional techniques should be used when taking a placenta home have also been posed. It is also important to determine the quantities of placentas that need to be disposed of, but a challenge was experienced in this regard as neither the hospitals under study nor the literature could verify the number of placentas generally taken home by mothers. This practice thus seems to be shrouded in mystery regardless of the pathological threat that the poor handling of placentas may pose, and this gap in the literature needed to be addressed.

1.8 Aim

The aim of the study was two-fold. First, the purpose of the study was to compare two types of technologies, namely Alkaline Hydrolysis and the NEWster® sterilizer, for the potential treatment of placentas at HEs. Secondly, the study aimed to investigate disposal methods of placentas with specific focus on the

nature of placenta home treatment methods and procedures. The study also focused on the expertise, training, and practices of health professionals responsible for human placenta management in selected HEs in the Gauteng Province.

1.9 Objectives

The objectives of the study were to:

- consider the Alkaline Hydrolysis and the NEWster® sterilisation methods and to compare their feasibility as alternative treatment systems for pathological waste in HEs in the GDoH;
- assess placenta management procedures against the legal framework at HEs in the study area;
- determine the prevalence and influence of traditional values and practices on placenta home management;
- determine the extent of health professionals' knowledge of placenta management and their perceptions of common practices and beliefs associated with traditional customs of placenta disposal;
- determine the training levels of health professionals in HCRW management;
- assess the position of health professionals and the degree to which they would accept responsibility for educating patients as new mothers about their human rights;
- establish a standard operating procedure for placenta management and subsequently create an information pamphlet for mothers and families who wish to take the placenta home.

1.10 Delimitations

- The study was limited to the Gauteng Province and focused only on maternity and obstetric wards in GDoH hospitals. However, as Health professionals in these sections of the hospitals were deemed the most knowledgeable of the topic under investigation, their participation was crucial.

- The envisaged sample of five categories of health professionals, and at least one of each category per hospital (matron/nursing supervisor/operational managers; professional nurses; nursing assistants; medical practitioners (doctors); and health care risk waste officers/environmental health practitioners) could not be achieved. However, the study still managed to target 15 hospitals of the envisaged 27 (55.5%) and 63 Health Professionals of the envisaged 75 (84.4%).
- The inquiry excluded the views of patients.
- A limitation was identified after the questionnaire design had been finalised and the questionnaires returned. This was that the line of responsibility in terms of realistic expectations of the task description of participating Health Professionals had not been considered before the standardised questionnaire was administered. In retrospect, some additional questions should have been posed to target each group of health professionals as this would have prevented medical practitioners from failing to see the need to participate. It would also have contributed to a better questionnaire return rate.
- A number of partly completed questionnaires may have influenced the findings. It was found that the respondents would rather leave a question blank than give a wrong answer or indicate that they did not know.

1.11 Methodology

This study was conducted in two phases.

First phase: A comparative study was conducted to assess two types of alternative HCRW technologies and select the best for implementation by the Gauteng Department of Health.

Second phase: A pilot-tested questionnaire was administered to five categories of Health Professionals in HEs in the Gauteng Department of Health. The questionnaire responses were descriptively calculated (raw data and percentages of responses per question were obtained) and analysed to assess

the data quantitatively. Among other things, the purpose of the questionnaire was to determine the Health Professionals' knowledge and practices of handling placentas in HEs in Gauteng, and to obtain these Health Professionals' understanding of the cultural beliefs of patients that impacted their handling of placentas when they took them home. The study was conducted in health care institutions (hospitals) among health care professionals in Gauteng government hospitals.

1.12 Thesis Outline

The document consists of an introductory chapter which includes, but is not limited to, a general background based on the literature review. Chapter 2 and Chapter 3 are presented in article format and thus contain duplication of certain sections in the introductions and abstracts. Each chapter comprises a discussion, conclusions, recommendations, and a list of references. The study report follows the following sequence:

Chapter 1:General Background

This chapter provides background information regarding the topic under investigation and introduces HCRW in the GDoH. The demographic background of the entire study site (Gauteng) is discussed and the two alternative technologies for HCRW that were investigated in this study are compared. The aims and objectives of the study are outlined and the impact of traditional beliefs on placenta management is briefly considered.

Chapter 2: Literature Review

A general historical background is given of the legislative framework, the development of legal and strategic documentation, and international legislative developments regarding health care risk waste (HCRW). This form of waste in the waste management chain is explained in depth with particular focus on the historical background of pathological waste. A desktop study was conducted and the findings regarding two different alternative HCRW treatment technologies,

namely the Alkaline Hydrolysis and NEWster® sterilizing technologies and their specifications, are discussed.

Chapter 3: A Holistic Approach to Placenta Management in Health Establishments in Gauteng

An assessment of traditional health care practices focusing on placenta management was undertaken at health establishments falling under the Gauteng Department of Health. This investigation focused specifically on the historical background of placenta management, the identification of major drivers of traditional beliefs among South African communities, and the custom of taking placentas home. The level of knowledge of Health Professionals in terms of placenta management in HEs was also explored. The results are discussed and conclusions are drawn based on the research outcomes.

Chapter 4: General Discussion

The general discussion and the conclusions that were reached are based on the results of the data presented in Chapter 3. The safe containment of pathological waste is discussed and an alternative treatment technology for possible placenta management by the GDoH is proposed.

Conclusion

The research was conducted in Gauteng and was restricted to hospitals in the GDoH. First, the study tested two alternative HCRW treatment technologies, namely the NEWster® and the Alkaline Hydrolysis alternative technologies. Both technologies use chemical thermal processes that were assessed to determine their suitability for the treatment and disposal of on-site HCRW produced HEs in the study area.

Secondly, the objective was to assess the extent of participation of health professionals in placental management and to examine the management of

placentas in- and outside hospitals. For the latter section, the respondents' answers regarding the beliefs and traditions associated with placentas and people's custom to take it home, their general awareness of HCWM, and the level of training for health care professionals were taken under the loop.

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CHAPTER 2

LEGAL FRAMEWORK FOR AND ALTERNATIVE TREATMENT TECHNOLOGIES IN THE HEALTH CARE RISK WASTE MANAGEMENT SECTOR

ABSTRACT

The management of pathological tissue as part of health care risk waste management (HCRW) is not a new phenomenon as it can be traced back to the 1500s. Alternative treatment technologies currently utilised in South Africa for this purpose are not widely used and thus require investigation. The treatment of pathological waste is not limited to the Gauteng Province, which was the main study area. This chapter, presented in article format for publication later, illustrates the diversity of medical waste treatment strategies determined by location throughout South Africa. Legal requirements in terms of alternative waste treatment plants are subject to the volume of waste treated and the type of activity that will activate a waste management licence procedure to ensure legal compliance. This means that an appropriate licence should be applied for and issued to operators when required. All treated health care risk waste must be declared on the appropriate available waste information systems and this information is utilised to determine the treatment capacity in South Africa. Various sets of legislation have been developed worldwide to guide the industry and to ensure compliance and South Africa is no exception.

Keywords: Alternative Technologies, health care risk waste treatment, NEWster, Alkaline Hydrolysis

2.1 Introduction

Both foreign and local alternative treatment technologies for HCW treatment and protein or meat production formed part of the investigation. Priority was given to available technologies that were already in use in South Africa and had delivered effective test results. In terms of protein conversion/digestion and rendering

treated placenta unrecognisable, the two technologies referred to in this study had the highest likelihood for application in Gauteng HEs.

The management of health care risk waste is highly regulated by different environmental, health and constitutional laws that underscore the fact that every person has the right to an environment that is not harmful (Du Toit & Bodenstein, 2014:14-15; Hangulu, 2016:69-71; South Africa. Department of Environmental Affairs, 2000:1-68& 2007:21).

The waste hierarchy consists of five levels and includes, but is not limited to, requirements for avoidance, reduction, reuse or recovery, recycling or composting, minimisation, energy recovery, and final disposal (Brits, 2011; Department of Environmental Affairs and Tourism, 2008a:10-15; Green industries, 2020:1-93; Gumbi, 2015:6-110; Matete and Trois, 2008:1480-14 Smale, 2017; USEPA, 2002:1-13:92). According to Smale (2017), resorting should take place before final disposal to ensure that the full life cycle of the product or waste type has been achieved.

Variations have been observed in the literature regarding the definition of human tissue, which is one of the most important and difficult types of HCRW to manage. Generally, it is stipulated that waste will only be classified as HCRW if the product came in contact with bodily fluids, and thus nails, teeth, and hair are not regarded HCRW. According to Ramírez and Gonzalez (2019:71-81), the European Union (EU) defines health care waste or medical waste in Chapter Eighteen of the European Waste Catalogue as “waste from human or animal healthcare or research”. He confirms that variations in definitions of health care waste exist in other parts of the world. The World Health Organization (WHO, 2014:1-242) labels HCRW as the wastes generated by healthcare activities and establishments such as used needles, syringes, soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices, and radioactive materials. Bdour, Altrabsheh, Hadadin and Al-Shareif (2007:746-759) group medical waste into pathological waste, sharps, and infectious waste.

According to Cheng, Sung, Yang, Lo, Chung and Li (2009:440-444), in Taiwan the classification of medical waste refers to two streams, namely infectious and general medical waste, but this classification is vague and lacks further detail. In Turkey, waste is only classified as municipal solid waste, hazardous waste, radio-active waste, and medical waste. In China, HCRW is categorised into tissue, infectious waste, and chemical and pharmaceutical waste (Bdour, Altrabsheh, Hadadin & and Al-Shareif, 2007:746-759; Cheng, Sung, Yang, Lo, Chungand Li, 2009: 440-444; Ramírez & and Gonzalez, 2019:71-81; United States of America. Department of Energy National Laboratory, 2012; United States of America. University of Arizona, 2011; United States of America. University of Minnesota, 2021; World Health Organization, 1985 & and 2014; Yonga, Gang, Guanxinga, Taoa & and Dawei, 2009: 1376-1382).

Pathological waste forms part of the health care waste stream at health establishments (HE) in South Africa. Recent reviews by groundWork (a non-profit NGO) indicated that the average HCRW in the Gauteng Province is 1.2 kg per patient per day (Leonord, 2019), and 1.5 kg per patient per day across South Africa (Motlatla, 2015:32; Olaniyi, Ogola & Tshitangano, 2018:34; Rogers *et al*., 2006).

The treatment of HCRW is done mainly in the provinces of Kwa-Zulu Natal (KZN), the Western Cape, and Gauteng, with the largest number of incinerators located in Gauteng Province (Motlatla, 2015:35-40; South Africa. Department of Environmental Affairs and Tourism, 2008b:4-7). Alternative treatment plants are currently available in Claysville (autoclave), City Deep (thermo-deactivation) and Somerset West (NEWster®), to name a few (Bovetti, 2016; South Africa. Gauteng Waste Information System, 2004).

The implementation of the Air Quality Act of 2004 (South Africa, 2004b) ended onsite treatment at health care establishments of HCRW generated in South Africa. In 2005, the Danish International Development Assistance (DANIDA) funded a project in association with the Department of Environmental Affairs

(DEA) to establish strategic strategies and a legislative framework to manage this waste type. Thereafter, tender specifications as well as a pilot project were developed for Gauteng (Leratong Hospital and Itreleng Clinic) where different systems were tested for sustainability and cost-effective management systems for containing and transporting HCRW. Resources locally and abroad were combined to establish the first set of regulations for South Africa, but these are applicable only in Gauteng. The regulations were published and enforced although enforcement resources remain limited (South Africa. Department of Environment and Tourism, 2008b:4).

After 15 years, the implemented GHCWR and the main treatment of pathological waste are still led by and regulated in Gauteng. This started with the involvement of three main companies in April 2000, namely Execumed, ClinX, and Sanumed. Sanumed was the holder of the government tender and accounted for more than 90% of the medical waste industry business (Mahlangu, 2001). However, several cases of inappropriate dumping were reported and the initial tender award in Gauteng was plagued by a lack of container provision. Sanumed lost the tender, a three-year contract which had commenced on 1 April 2000, to four companies. The contract was awarded to companies operating in five districts as follows: Wits and East Rand districts were awarded to Buhle Waste; Pretoria District (currently referred to as Tshwane District) was awarded to Phambili Services; West Rand District was awarded to Skip Waste; and D.S. Environment was awarded the Vaal region (referred to as the Ekurhuleni and Sedibeng regions). D.S. Environment subsequently lost the contract to Buhle Waste due to non-performance which did not contribute to the amicable management of HCRW. Several additional awards were made by the Gauteng Department of Health from 2003 to 2019 as listed in Table 2.1 (Gauteng. Agriculture, Conservation, Environment & Land Affairs, 2003:2-46; Leonard, 1996; Magallan Risk Services & Kobus Otto and Associates, 2009; Magner, 2014: 393-395; Mathebula, 2001).

Table 2.1: Summary of historical tender awards by the Gauteng Department of Health

Tender reference number	Contracted service providers
GT/GHD/102/2003	Phambili Wasteman, Buhle Waste, Evertrade (Evertrade became insolvent and Phambili Wasteman took over their contract), and Tshumisano Environmental Services were appointed to provide disposable containers, excluding cardboard boxes, for general infectious waste.
2006(not available)	Buhle Waste, Phambili Wasteman.
GT/GHD/30/2010	Buhle Waste, Phambili Wasteman, and Solid Waste Technologies.
GT/GHD/168/2013	Buhle Waste, Compass Waste, and Seane Waste.

Later, the introduction of transfer stations to act as depots for the collection of HCRW was recommended and implemented. The initial development of waste treatment plants was based on incineration technologies. The DEA reluctantly considered alternative treatment technologies due to the need for efficacy testing and green procurement, which had become requirements in the field of environmental management. The GHCRWM regulations do not prohibit the treatment of pathological waste by any other type of technology, but they limit treatment to the requirements as set out in terms of waste management licence authorisation (Gauteng Health Care Waste Management Regulations, 2004a: 19-20; South Africa. Department of Environment & Tourism, 2008a: 25-30; South African Waste Information System, 2019).

2.2 Clarifying the Concept of Health Care Risk Waste Management

The management of health care waste in developing countries is a big concern as it has been described as poor (Nemathga *et al.,* 2008). Developing countries are countries that do not achieve industrialisation in relation to their population ratio and where the basic standard of living is low. These countries are categorised by factors such as prevailing health risks, low access to safe water

and sanitation, and poor hygiene (Ansari, Ehrampoush, Farzadki & Ahmadi, 2019:1-18; Esculier, Le Noe, Barles, Billen, Créno, Garnier, & Tabuchi, 2019:1028-1045; Gumbi, 2015: 83-103; World Population Review, 2020; Yang, 2011:227-231). Table 2.2 lists the 10 lowest Gross Domestic Product (GDP)

Table 2.2: List of the per capita gross domestic product of the10 lowest developing counties in 2020

COUNTRY	GDP PER CAPITA	POPULATION 2020
South Sudan	$254 (R3957.69)	11193725
Malawi	$377 (R5874.21)	19129952
Burundi	$393 (R6123.51)	11890784
Niger	$460 (R7167.47)	24206644
Gambia	$494 (R7697.24)	2416668
Mozambique	$495 (R7712.82)	31255435
Madagascar	$503 (R7837.47)	27691018
Sierra Leone	$509 (R7930.96)	7976983
Somalia	$532 (R8289.34)	15893222
Yemen	$598 (R9317.71)	29825964

Source: Adapted World Population Review, 2020

earners per capita from the list of 126 countries, where South Africa is listed as 96th, with an income of $6606 (R102931) as per currency converted on 9 November 2020 as 1$=R15.58 and a population of 59308690 (OANDA,[1] 2019; World Population Review, 2020).

Caniato, Tudor and Vaccari (2015) report that broad efforts have been made to raise interest and awareness at various levels (public authorities, health care providers, supporting role players, etc.) to promote the debate on the implementation of policies and the difference in terminologies. Various socio-economic conditions in 15 years (2000 to 2015) showed some improvement in

[1]OANDA is a currency converter company

governance structures, policies for HCRW, and a focus on best practice at local, national, and international levels. Shannon and Woolridge (2011) refer to improvements in education, resources, treatment technologies, capacity building, and best management practices in developing countries. However, differences in management structures, especially in middle- and low-income countries, remain a concern, especially in terms of the development of policies and legal frameworks. Caniato *et al.* (2015) particularly raised this concern, as legislative frameworks are usually used as a basis to evaluate compliance for HCWM. In a recent assessment done by Ansari *et al*. (2019) they mentioned that several studies were done in developing countries and that in countries such as India, China, Pakistan, Brazil and Iran, they had found more evidence of poor health, economic, and environmental management in hospital solid waste than in other developing countries (Ansari, 2019:1-18). This comment was corroborated by Dehghaniab, Ahrami, Nabizadeh, Heidarinejad and Zareif (2019).

Several local and international studies focused on the management of HCRW as well as the quantification of the generated waste. In six (representative of 20%) of the clinics included in a KZN study, it was found that HCRW was still being burnt by and buried at these clinics. One response indicated that placentas were disposed of in a pit latrine (Gabela, 2007:1-25). Abor and Bouwer (2008) reported that some HCRW in Southern African hospitals were still being disposed of as part of general waste, which means that this waste was disposed of on landfill sites, which posed the threat of contamination of water sources (Abor & Bouwer, 2008:356-364; Aung, Luan & Xu, 2019:733-745: Gabela, 2007:1-25;).

The ‘cradle-to-grave’ management approach in HCWM should incorporate a life cycle assessment. A life-cycle assessment (LCA) is a system based on environmental accounting and management that takes all aspects of resources used and environmental releases into account. Such a system was already in use in the 1960s. If it is employed, careful consideration should be given to costing and performance. Other approaches such as environmental design, impact, or risk assessment and cost benefit analysis should be applied and are described

in the ISO 14040 (1997) guidelines as depicted in Figure 2.1 (Bhatt, Bradford & Abbassi, 2019:98-109; Krishna & Manickam, 2017:1-664; United States of America. Environmental Protection Agency, 2006; Widheden & Ringström, 2007:37-48).

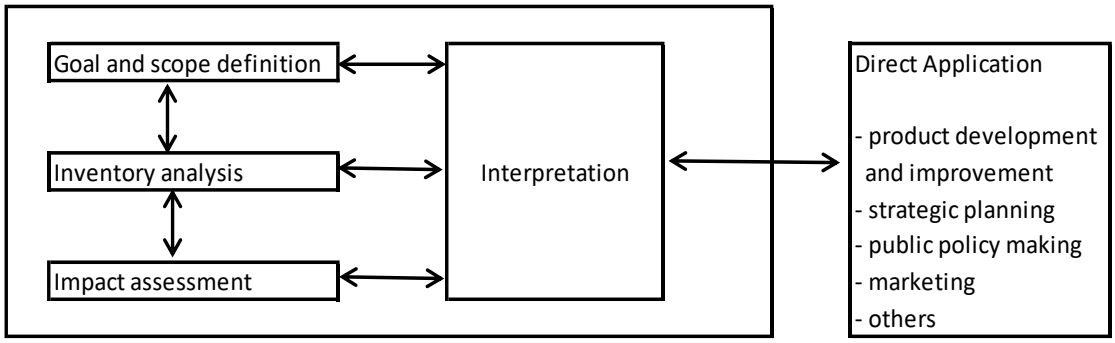

Figure 2.1: The life cycle assessment framework as described in ISO 14040 guidelines
Source: Bureau of Indian Standards, 2009 (ISO 14040:2006)

In legislative terms, the 'cradle-to-grave' management principle means a system that tracks waste from its collection to its treatment or final disposal point.

2.3 The History and Prevalence of Pathological Waste

Since the dawn of civilization, human beings have had to manage waste. In modern legislation, the term 'hazardous waste' is used as a descriptive term under which all categories of HCRW reside. It can be described as waste that contains organic or inorganic elements that, due to their inherent physical, chemical or toxicological components, have a negative or detrimental impact on the health of humans and/or the environment (Australia. Department of Agriculture, Water & the Environment, 2020; EPA, 2019; Hazardous Waste Management, 2019; Intrakamhaeng, Claviera & Townsenda, 2020; Saleh, 2016; SAWIS, 2005; United States of America. University of California, 2021).

In Europe, the word 'waste' resonates with the French word 'vastum', which means empty or desolate. The term is also used to describe wasteful expenditure and relates to the French word 'déchet', which has been in use since the

15th century. Barles (2005) also mentions that waste has historically been linked to both wellbeing and sanitation in urban spaces and has included the management of urban excreta. Barles (2005) studied the history of waste between the 1870s and the 1960s and observed that medical practitioners were the first to correlate the effect of air pollution, water, sanitation, and environment with illness and disease. Various authors such as Allen (2003), Esculier, Le Noe, Barles, Billen, Créno, Garnier and Tabuchi (2019), and all agree that recycling is important and will contribute to the wellbeing of the population and improved sanitation.

The first reports in the United States of America regarding the proper management of pathological waste occurred early in 1988 when medical waste washed out on several east coast beaches. This event prompted the United States of America Congress to develop regulations to manage medical waste. These regulations were promulgated on 24 June 1989 in New York, New Jersey, Connecticut, Rhode Island, and Puerto Rico (United States of America. Environmental Protection Agency (EPA), 2017). According to Pépin, Chakra, Pépin, Nault and Valiquette (2014), a population increase of 13% was witnessed from 2000 to 2010, and they argue that the spread of diseases can be linked to the use of unsafe syringes in this period when the number of HIV and HCV infections was reduced from 87% to 83% respectively.

Kazazaki (2016) describes the first development of legal documentation to manage hazardous waste in the United States of America (USA). In California, specific legislation was developed and promulgated in 1972 which directed the transportation and disposal requirements of hazardous waste. Although the development of legal guidelines is a positive contribution to hazardous waste management, it does not prevent problems from occurring due to non-compliance issues.

2.4 Local and International Incineration Practices

The Gauteng Health Care Waste Regulations (2004) do not prohibit the treatment of pathological waste by incineration, and therefore such waste is generally still treated by incineration in this province. Moreover, alternative pathological waste treatment methods had not been authorised for health care risk waste by 2020 by the Department of Environmental Affairs, Fisheries and Forestry (DEAFF) for the treatment of pathological waste on site (Gauteng Health Care Waste Management Regulations, 2004a:26-28).

HCRW disposal methods in South Africa are mainly incineration and the use of alternative technologies such as thermo-deactivation, NEWster® heat sterilisation, pyrolysis, gasification, and autoclaving (Nkosi, Muzenda, Zvimba & Pilusa, 2013:303-308). Three alternative technologies (e.g., pyrolysis, steam sterilisation, and chemical disinfection) were investigated to determine their economic impact and their effectiveness by means of a life cycle assessment (Hong, Zhan, Yu, Hong & Qi, 2018:65-73). The latter authors propose that steam sterilisation and chemical disinfection have the highest overall environmental and lowest economic impacts due to differences in energy consumption. All other costs are due to investment, labour, electricity, and occupational health and safety measures. Moreover, the latter authors argue that environmental burden is derived from energy and chemical production processes. Hydrogen emissions are relatively low, but the direct hydrogen chloride emission is higher for waste pyrolysis than it is from municipal solid waste and industrial hazardous waste incineration. Lower emissions have been noticed for mercury. They propose that measures that have to be considered for the reduction of environmental impacts are the improvement of electricity and diesel consumption and a reduction in the use of chemicals such as sodium hydroxide, lime, and chlorine oxide. Reference is also made to the selection of cleaner energy and energy recovery where incineration processes are used. Other effective measures such as optimising labour, investment cost, and electricity should be considered for more viable economic technologies (Hong, Zhan, Yu, Hong &Qi,

2018: 65-73). It was evident from the above studies that several issues should be considered before commissioning or establishing alternative technologies.

In the United States of America, the health care system has been ravaged by fraud, high testing costs, unclear procedures, and the high cost of waste treatment (Hoffer, 2019:1129-1132). The latter author's study also revealed the prevalence of malpractices and the loss of revenue in the health care waste industry in this country. He posits that the cost of all aspects involved in health care should be reduced before improvement in waste management will be achieved.

Aung *et al.* (2019) mention that, in Myanmar, disposal still consists of open burning, incineration, and uncontrolled dumping. Various insufficiencies were identified in waste collection, storage, and transportation where a lack of both onsite and offsite treatment facilities for government hospitals was experienced. The latter author emphasises the urgent need for medical waste management laws and regulations, technologies, expert knowledge, and funding to improve HCWM in Myanmar.

Ghasemi and Yusuff (2015) state that incineration is a worldwide engineered process that uses thermal treatment through oxidation at high temperatures between 900- and 1200ºC to destroy HCRW. Olaniyi, Ogola and Tshitangano (2018) also mention that incineration is the common denominator in the disposal of HCRW in South Africa where it contributes to air pollution through toxic emissions into the atmosphere as well as pollution of the soil and surface water. The study posits that the consequences of incineration disrupt the human hormonal, immune, and reproductive systems and can cause cancers. The study corresponds the lack of adequate equipment with the indiscriminate dumping of a large quantity of HCRW at illegal sites and burning it on-site. The authors reason that a lack of effective practices, capacities, and policies in dealing with medical waste management contributes to many countries, especially in developing countries, to poor waste management practices.

Since 1995, the phasing out of incineration in various countries such as Greece, Germany, Japan, Malaysia, and the United States of America has been recommended in a groundWork (2006) report. According to the Environmental Protection Agency (EPA), waste that does not burn completely is released as stack gases and toxic chemicals that cannot be destroyed (groundWork, 2006:1-35; United States of America. Environmental Protection Agency,1990). The advantages and disadvantages of incineration are listed in Table 2.3.

Reasons for not using incineration or thermal treatment processes vary greatly but include the following:

- Growing public pressure, calls for a green economy, and international trends are moving away from incineration.
- Capacity does not always ensure legal treatment of HCRW.
- Disposal of ash is expensive and must be done at highly hazardous landfill sites.
- Logistical challenges exist, for example transport distances.
- Maintenance is intensive and expensive and requires frequent down time.
- Specialised knowledge and experience are required. The HCRW management sector has been plagued with several illegal dumping cases that are summarised in Table 2.4.

  (Chen, Ding, Yang, Peng, Xu & Feng, 2013:1237-1244; Gautam & Thapar, 2010:191-192; Ho & Ding, 1989; IJgosse, 2019:1-24; Roberts, 2020; Washburn, Brainard & Harris, 1989:181-198; Zhao *et al.,* 2009:114-121).

Table 2.3: Advantages and disadvantages of incineration

Advantages	Disadvantages
Alternative to ash	Ash waste can potentially harm people and the environment
Converts heat generated by the combustion process into electricity or steam	Concerns linking to public health, occupational safety and the environment
Less material going to landfills	Difficult to operate

Eliminates harmful germs and chemicals	Flame temperatures are high, leading to high NOx formation and overheating.
Prevents the production of methane gas	Flue gas scrubbings generate other hazardous wastes apart from the dioxins, dibenzofurans, organohalides, and other pollutants discharged by the smoke stacks
Incinerators have filters for trapping pollutants	Hospitals in South Africa have closed incinerators down as air emissions standard requirements could not be met.
Provides better control over odour and noise	In South Africa, the ash must be reclassified when made available for alternative product use.
Incinerators operate in any weather	It is expensive.
Production of heat and power	Pollutes the environment
It has a computerised monitoring system	The possibility of long-term problems exists.
Can avoid the release of polychlorinated dibenzo-p-dioxins/dibenzofurans	
Decreases quantity of waste	
Effective metal recycling	
Reduction of pollution	
Saves on transportation of waste	

Source: Chen, Ding, Yang, Peng, Xu & Feng, 2013:1237-1244; Conserve Energy Future, 2021; Emmanuel, Puccia & Spurgin, 2001:1-10; Gautam & Thapar, 2010:191-192; Ho & Ding,1989; Roberts, 2020; Washburn, Brainard & Harris,1989:181-198; Zhao, van der Voet, Huppes & Zhang, 2009:114-121).

2.5 Issues Associated with Local and International Health Waste Management

Several reports indicate that the health care risk waste management industry is a bone of contention and that legal framework development does not always succeed in preventing the occurrence of illegal dumping or mismanagement of health care risk waste. Table 2.4 is a summary of reports on illegal dumping of HCRW in South Africa.

Table 2.4: Summary of illegal dumping of health care risk waste in South Africa

Article Title	Year	Place	Reference
Medical waste offers insights into South Africa's use of pharmaceuticals	17 February 2020	Buffalo City municipality, Eastern Cape Province, South Africa	*News24*, 2020
Medical waste illegally dumped near primary school in Pietermaritzburg	14 February 2019	Pietermaritzburg, KwaZulu-Natal, South Africa	*The Citizen*, 2019
The security risk associated with illegal dumping of medical waste on dump sites in South Africa	9 September 2017	Not applicable	*Nkwana*, 2017
Medical waste adds to ire over illegal dumping at Springfield dump	13 June 2016	Springfield Park, Durban	*Northglen News*, 2016
The mystery medical waste washing up on Durban beaches	20 May 2016	Durban, South Africa	*France24.The Observers*, 2016
Pikitup cleans up medical waste in Jo'burg hospital	15 February 2010	Johannesburg, Gauteng, South Africa	*Sowetan Live*, 2010
Dumped medical waste could pose health risk	29 November 2009	Welkom, Free State, South Africa	*Independent Online*, 2009
Medical waste disposal crisis	28 February 2001	Cape Town, South Africa	*News24*, 2001

treatment capacities, and minimal costs of health care waste in the nine provinces of South Africa. This survey was conducted on behalf of the Department of Environmental Affairs and Tourism (2008b) and revealed that the total operational commercial incineration capacity was approximately 5770 tons per year. The study projected that approximately 6810 tons of generated waste per year would

be reached in 2008, but a major shutdown of treatment capacity was experienced which necessitated the Gauteng Department of Health to landfill all generated HCRW at Holfontein. This is a highly hazardous (H:H) site as no alternatives to the treatment capacity of incinerators are available (Costley, 2020; Mokoena, 2007; Power & Maker, 2007:5; South African Waste Information System, 2019).

2.6 Global Legislative Framework for HCRWM

Olaniyi, Ogola and Tshitangano (2018) propose that the development and enforcement of a national policy for the management of medical waste should be directed by governmental structures. In South Africa, this should be the National Department of Health and the National Department of Environmental Affairs, Forestry and Fisheries, as they are the appointed enforcement authorities for waste management. Policies regarding the classification and management of HCRW categories should be clear and should also emphasise the importance of training and the provision of equipment to ensure standardised practices across all regions or provinces (Bassey, Benka-Coker & Aluyi, 2006:58-63; Maseko, 2014:34-45; WHO, 2015).

2.6.1 The European Union

The European Union (EU) is comprised of 28 nations (Great Britain has recently withdrawn) that amalgamated in Europe just after World War II (World Population Review, 2019). An alphabetical list of these countries is presented in Table 2.5.

Table 2.5: Membership dates of countries forming part of the European Union

COUNTRY	DATE	COUNTRY	DATE
Austria	January 1, 1995	Italy	March 25, 1957
Belgium	March 25, 1957	Latvia	May 1, 2004
Bulgaria	January 1, 2007	Lithuania	May 1, 2004
Croatia	July 1, 2013	Luxembourg	March 25, 1957
Cyprus	May 1, 2004	Malta	May 1, 2004
Czech Republic	May 1, 2004	Netherlands	March 25, 1957

Denmark	January 1, 1973	Poland	May 1, 2004
Estonia	May 1, 2004	Portugal	January 1, 1986
Finland	January 1, 1995	Romania	January 1, 2007
France	March 25, 1957	Slovakia	May 1, 2004
Germany	March 25, 1957	Slovenia	May 1, 2004
Greece	January 1, 1981	Spain	January 1, 1986
Hungary	May 1, 2004	Sweden	January 1, 1995
Ireland	January 1, 1973	United Kingdom	Withdrew 31 December 2020

Source: World Population Review, 2019

The document titled *Summaries of EU legislation* contains short, easy-to-understand explanations of the main legal acts passed by the EU and is intended for a general, non-specialist audience. The European Union's sets of legislation consist mostly of directives, regulations, and decisions. Additionally, there are also references to international agreements. It can mainly be summarised into thirty two policy areas namely agriculture, audio-visual and media, budget, competition, consumers, culture, customs, development, economic and monetary affairs, education, training, youth, sport, employment and social policy, energy, enlargement, enterprise, environment and climate change, external relations, external trade, fraud and corruption, food safety, foreign and security policy, humanitarian aid and civil protection, human rights, information society, institutional affairs, internal market, justice, freedom and security, maritime affairs and fisheries, public health, regional policy, research and innovation, taxation, and transport (European Commission, 2019; Głuszyński, n.d.; Luga, 2016:161).

Under environment and climate change, the waste management topics can be divided into five aspects such as general framework, hazardous waste, waste from consumer goods, waste from specific activities, and radio-active waste and substances. Głuszyński (n.d.) observes that there is a lack of legislation and policies in the field of health care waste and that there are different sets of legislation in member states that include requirements for waste classification and

disposal. The latter study also refers to the establishment of circular economy requirements in 2015 by the European Commission and describes the shift of focus as a change from a linear economy to a circular approach. This concept follows the approach from the extraction of virgin materials to design, production, use, recovery, and recycling when it becomes waste (secondary raw material) as illustrated in Figure 2.2. This approach should strengthen and contribute to a rational implementation of compliance in product policy, industrial emission requirements, consumer protection, and waste legislation.

Figure 2.2: Typical circular economy cycle

Source: Australia, 2018

Perrin (2018) explains that there are three ways to measure the circular economy, namely in terms of economic growth, material flows (inputs, losses, outputs, and leakages), and greenhouse gas accounting (production versus consumption). These aspects, when investigated, should form the basis of any business enterprise.

2.6.2 Africa

HCRWM in various African countries started with the development of legislative requirements and guidelines. Various references were made to the importance of research and the major contribution of research in terms of the responsible

management of generated health care waste (Gabela, 2007:1-25; Hassan & Rahman, 2019:1767-1739; Motlatla, 2015:20-25; Olaifa, Govender & Ross, 2018:137-145; Olaniyi, Ogola & Tshitangano, 2018:34; Yazie, Tebeje & Chufa, 2019:285).

The African continent is the second largest geographic area and the second highest populated continent in the world. A summarised list of the countries on this continent is presented in Table 2.6.

Table 2.6: List of all African countries

COUNTRIES			
Algeria	Equatorial Guinea	Malawi	Senegal
Angola	Eritrea	Mali	Seychelles
Benin	Ethiopia	Mauritania	Sierra Leone
Botswana	Gabon	Mauritius	Somalia
Burkina Faso	Gambia	Mayotte	South Africa
Burundi	Ghana	Morocco	South Sudan
Cameroon	Guinea	Mozambique	Sudan
Cape Verde	Guinea Bissau	Namibia	Tanzania
Central African Republic	Ivory Coast	Niger	Togo
Chad	Kenya	Nigeria	Tunisia
Comoros	Lesotho	Republic of The Congo	Uganda
Djibouti	Liberia	Reunion	Western Sahara
Democratic Republic of Congo (DRC)	Libya	Rwanda	Zambia
Egypt	Madagascar	Sao Tome and Principe	Zimbabwe

Source: World Population Review, 2019

Motlatla (2015) observed that the legislative frameworks that inform waste management policies in countries such as Nigeria, Egypt, Tanzania, Botswana, Ethiopia, Cameroon, and South Africa were mostly developed from 1965 to 2011. A list of legislation provided by Motlatla (2015) was updated and is summarised in Table 2.7.

Table 2.7: Recent developments in legislation, policies, and guidelines in African countries

Country	Legislation/Policy/Guideline	Source
South Africa	• Waste Classification and Management Regulations, Norms and Standards for Assessment and Disposal of Waste to Landfill, 2013 • Regulations for the Control of Import or Export of Waste, 2017 • National Waste Information Regulations, 2012 • Regulations regarding the control of the import or export of waste, 2019 • Norms and standards regulations applicable to different categories of health establishments, 2017 • Proposed Health Care Waste Management Regulations, 2018	South Africa. SAWIS, 2019; Open Gazettes South Africa, 2016
Nigeria	• The Constitution of the Federal Republic of Nigeria, 1999 • National Environmental Standards and Regulations Enforcement Agency (NESREA) Act, 2007 • Environmental Impact Assessment Act, 1992 • The Land Use Act, 1979 • Harmful Waste (Special Criminal Provisions) Act 1988 • Nuclear Safety and Radiation Protection Act 1995	Environmental Law Research Institute, 2011
Egypt	Egyptian Environmental Affairs Agency's mandate as a coordination entity under the following sets of legislation: • Environmental law (Law 4/1994) 1994 • Executive regulations (ER) 1995	Ramadan and Nadim, 2006

Tanzania	• The Environmental Management Act No. 20 of 2004 • World Health Organization (WHO). 2014.Safe Management of Wastes from HealthCare Activities. Edited by Y. Chartier, J. Emmanuel, U. Pieper, A. Prüss, P. Rushbrook, R. Stringer, W. Townend, S. Wilburn, R. and Zghondi, WHO,Geneva, Switzerland, 2nd edition. • Public Health Act No. 1of 2009	Kuchibanda and May 2015; WHO, 2014; Ministry of Environment, 2004; Government of Tanzania, 2004
Botswana	• Botswana's Waste Management Strategy 1998 • Waste Management Act 1998 • Air Pollution (Prevention) Act 1971 • Public Health Act 1981 • Guidelines for the Disposal of Waste in Landfills 1997 • Environmental Impact Assessment (EIA) and the 2012 EIA regulations • Botswana Municipal Recycling Guidelines2012 • Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal • Stockholm Convention on Persistence of Organic Pollutants 2001	Mmereki, 2018; Republic of Botswana, 1998a
Ethiopia	• Environmental Policy Review 2011 • Solid Waste Management Proclamation No. 513 of 2007 • Constitution of Ethiopia,1995 • Environmental policy,1997 • Environmental Protection Authority (EPA) • Solid Waste Management Proclamation No. 513 of 2007 • Environmental Pollution Control Proclamation No. 300 of 2002	Cleever, 2012
Cameroon	• Environmental Management Act No. 96 of 1996 • National Environmental Management Plan,1996 • Installation of Classified Establishments Act No. 98/15of 1998	Manga, Forton and Read, 2008

- National Waster Code: Law No. 98/005 of 14/04/1998
- New Urban Strategy,1999

Table 2.7 clearly indicates that vast developments in the WM sphere have taken place in Africa where the development of legislative frameworks and guiding documentation for officials are available to carry out their duties in alignment with other countries and overall global WM requirements. Standardisation and circle economy aspects are also raised and implemented, and this aligns with first world countries' visions.

2.6.3 Asia

In the context of India, six broad categories were reviewed in terms of the development of a strategy for HCWM at primary level for West Bengal. These consisted of the following:

> "General guidelines, country experiences, legal and administrative directives, state experiences, hospital experiences, training modules, and accreditation" (Society for Direct Initiative for Social and Health Action, 2005).

The review was an overview of documents that address various strategic points of HCRWM. The final recommendation is to establish a standardised accreditation system and to clarify different categories of waste generated at different health units (Society for Direct Initiative for Social and Health Action, 2005).

2.6.4 Australia

All territories in Australia have health care risk waste management legislation and governmental health agencies enforce the legal framework. The latest sets of legislation that have been developed address of the classification and disposal of used needles, syringes, domestic waste and litter, as well as general pollution provisions, public health provisions, provisions for the possession of needles and syringes, national sharps provisions, enabling or authorisation legislation, and local government policies. These sets of legislation differ from region to region

that can basically be divided into eight territories. Local governments have the power to develop their own by-laws, which are summarised in Table 2.8.

Table 2.8: Demographic breakdown of leading waste management legislation in Australia

Area	Legislation
Australian Capital Territory	Australian Capital Territory (Self Government) Act 1988
New South Wales	Local Government Act 1993
Northern Territory	Local Government Act2008
Queensland	Local Government Act 2009
South Australia	Local Government Act 1999
Tasmania	Local Government Act 1993
Victoria	Local Government Act 2019
Western Australia	Local Government Act 1995

Source: Australia, 2005

In Western Australia, the main set of legislation is the Environmental Protection Act of 1989 and its related regulations. All health establishments must also comply with requirements as stipulated by the Environmental Protection and Control Waste Regulation of 2004, which refers to standards in transportation and the disposal and control of waste. It also applies to health establishments that are both generators and holders of clinical waste from the point of generation until final disposal, irrespective of who may be the contracted service provider. All radio-active waste is covered by the requirements as set out in the Radiation Safety Act of1975 and the Poison Act of 1964 (Western Australia, 2016).

As depicted in Table 2.9, it is recognised that the Western territory of Australia has well developed legislation and related documents that outline the requirements for health establishments in terms of HCRW.

Table 2.9: List of Australian waste legal frameworks

List of Health Care Waste Related Legislation	Related Documentation
Environmental Protection Act No. 29 of 1986	Operational Directive 0500/14 - Use of macerator machines for the disposal of human waste in western Australian health care facilities
Environmental Protection (Controlled Waste) Regulations, 2004	Operational Directive 0398/12 - Release of human tissue and explanted medical devices
Radiation Safety Act No. 044 of 1975	Operational Procedure 1961/05 - Safe handling of cytotoxic drugs: Guide to hospitals on the appropriate and safe handling of drugs used in cancer treatment
Medicine and Poisons Act No. 70 of1964 and amended up to Reprint 6: The Poisons Act 1964on 10 September 2004	Operational Directive 0492/14 - Management of Schedule 8 and Restricted Schedule 4 oral liquid medicines
Radiation Safety (General) Regulations, 1983	
Radiation Safety (Qualifications) Regulations, 1980	
Radiation Safety (Transport of Radioactive Substances) Regulations, 2002	
Occupational Safety and Health Act No. 101 of 1984 and amended to the Occupational Safety and Health Amendment Act No. 16 of 2018	
Occupational Safety and Health Regulations, 1996	

Source: Western Australia, 2016

2.6.5 New Zealand

The Human Tissue Act (New Zealand,2008), and more particularly section 20, describes the requirements for collection of waste generated for specific purposes such as post-mortems and donor analysis. It also addresses consent

for the collection and use of tissue from living people in section 34 of the Act, and emphasises respect for the cultural and spiritual needs, beliefs, and values of the immediate family of the individual whose tissue is collected in section 42 of the Act.

In general, the New Zealand legislative framework is well developed and consists of various sets of legislation as listed in Table 2.10.

Table 2.10: Legislative waste framework of New Zealand

Legislative Framework	International Agreements
Waste Minimisation Act,2008 Local Government Act,2002 Resource Management Act,1991 Litter Act, 1979 Climate Change Response Act, 2002 Health and Safety at Work Act, 2015 Hazardous Substances and New Organisms Act,1996 Ozone Layer Protection Act,1996	The Montreal Protocol: Substances that deplete the ozone layer are addressed by the Ozone Layer Protection Act of 1996 and the Ozone Layer Protection Regulations of 1996.

Source: New Zealand, 2018

Waste management and minimisation planning legislation are based on the following three sets of legislation: The Waste Minimization Act of 2008, the Local Government Act of 2002, and the Resource Management Act of 1991. All this legislation were developed within the parameters of the circular economy approach (New Zealand, 2018:).

2.6.6 United States of America (USA)

In the USA, medical waste is mainly regulated by state environmental and health departments. The State Environmental Protection Agency is the enforcement agent. Concerns regarding the health hazards posed by medical waste were first acknowledged in the 1980s. This prompted Congress to establish the Medical

Waste Tracking Act (MWTA) in 1988, which was a two-year Federal program for the promulgation of regulations for the management of medical waste. It was successfully piloted in June1989 and shortly thereafter implemented in four states, namely New York, New Jersey, Connecticut, and Rhode Island. Puerto Rico also adopted this programme. After the MWTA had expired in 1991, each state developed its own set of regulations for medical waste management referred toas 'Model Guidelines for State Medical Waste Management'. The development of all such regulations is undertaken under the auspices of the USA Environmental Protection Agency (USA EPA). The regulations are categorised in sets of legislation according to the following topics: air, cross-cutting issues, emergency management, land and clean up, pesticides, toxic substances, waste, and water (United States of America. Environmental Protection Agency, 2017).

All regulations are coded in the Code of Federal Regulations and consist of permanent rules that are published in a Federal register by different departments and agencies of the Federal Government. They are then compiled by the Office of the Federal Registrar and published by the government publishing office. Under the heading 'Protection of Environment', thirty-seven titles are listed for different programmes such as Ambient Air Quality (Title 1) and Engine and Vehicle Testing Procedures (Title 37). Part 266 –titled 'Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities' −addresses pharmaceuticals and residues in empty bottles. Title 47 (Part 172) refers to the specific provisions for infectious waste under the headings Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans. Part 62 contains provisions for the approval and promulgation of state plans for designated facilities and pollutants, whereas sub-section HHH contains Federal plan requirements for hospital/medical/infectious waste incinerators constructed on or before 1 December 2008. Part 61 contains procedures for implementing the National Environmental Policy Act, and Appendix F to Part 61 addresses Federal Bureau of Investigation (FBI)procedures relating to the implementation of the National

Environmental Policy Act. In the latter section, the integration of environmental considerations are discussed and environmental sustainability and planning activities are encouraged. This section ensures that environmental requirements are included in Federal orders, directives, and policy guidelines. It is notable that there is a well-developed legal framework in the USA for all forms of waste management (United States of America. Electronic Code of Federal Regulations, 2020).

2.6.7 Namibia

Formally known as South West Africa, Namibia borders South Africa on the north-western side of the African continent. German rule ended here in 1915 when South African forces fighting for Germany were defeated. In 1920, at the end of World War I, South West Africa was colonised into South Africa, but gained independence from South Africa on 21 March 1990 following the Namibian War of Independence. The country was then renamed Namibia (Namibia gains independence, 1990; Namibia, 2020; Silver and Groenewald, 2003:1-366). Table 2.11 provides a list of WM-related legal frameworks that exist in Namibia.

Table 2.11: List of waste management-related legal frameworks for Namibia

List of Legislation	Reference
• The Atmospheric Pollution Prevention Ordinance No. 11 of1976 • Offensive Trades Regulations, 1959 • Local Authorities Act No. 6 of 1992 (Amended as Labour Act No. 11 of 2007) • Mineral Prospecting and Mining Act No. 33 of1992 • Environmental Management Act No. 7 of 2007 • Public Health Act No36 of 1919 • Regulations Relating to the Health and Safety of Employees at Work promulgated under the Labour Act 1992 (amended in 2007) • Hazardous Substance Ordinance Act No. 14 of 1974 • Road Traffic and Transport Act No.22 of 1999 • Medicines and Related Substances Control Act No. 13 of 2003 • Marine Resource Act No. 7 of 2000	Republic of Namibia, 2010

- Water Act No. 56 of 1956
- Hazardous Substance Ordinance Act No.14 of 1974 (as amended)
- Constitution of Namibia Act No. 1 of 1990 (with amendments)

Policies and Other Documents

- National Waste Management Policy, 2010
- National Solid Waste Management Strategy, 2017
- Namibian Waste Management and Pollution Control Policy, 2003
- Namibian Integrated Health Care Waste Management Plan, 2011

References

Republic of Namibia, 2010;
Republic of Namibia, 2003 and 2017;
Republic of Namibia,2011

Agreements

- Basel Convention: Adopted in 1989.
- Rotterdam Convention: Adopted in 1998, enforced on 24 February 2004.
- Stockholm Convention: Adopted in 2001, enforced on 17 May 2004

Reference

Republic of Namibia, 2010

The Namibian National Integrated Waste Management Plan (NIWMP) is a detailed, specific, and comprehensive guide for health establishments and provides information that allows health structures to establish a good HCW management system that is aligned with the legislative framework of Namibia. The IWMP was developed with support from the USA Agency for International Development (USAID) and its Bureau for Global Health, Office of Health and Mission in Namibia. Support was provided under the USAID Health Care Improvement (HCI) Project in compliance with the regulatory requirements of Namibia. Challenges in terms of HCW management were identified as bad attitudes, lack of knowledge and risk identification, poor decision making, low prioritising of health care waste management, and lack of basic direction such as a plan for HCW management and training. The NIWMP document is comprehensive and includes recommended practices for waste segregation, minimisation, handling, collection, storage, transport, treatment, and disposal, as well as contingency planning (Republic of Namibia, 2011).

2.6.8 South Africa

In South Africa, remarkable advances have been made since 2000 in the development of a regulatory framework for waste management. The Department of Environmental Affairs developed several sets of legislation pertaining to waste management, environmental conservation, and pollution prevention. However, Mahomed, Nöthling-Slabbert and Pepper (2013) argue that the right of ownership in terms of human tissue is still a contingent issue in South Africa and they urge further legal development.

Waste in South Africa is governed by the implementation of several acts and regulations such as the following:

- South African Waste Information System, 2019
- The Constitution of the Republic of South Africa Act No. 108 of 1996
- Hazardous Substances Act No. 5 of 1973
- Health Act No. 63 of 1977
- Environmental Conservation Act No. 73 of 1989
- Occupational Health and Safety Act No. 85 of 1993
- National Water Act No. 36 of 1998
- The National Environmental Management Act No.107 of 1998
- Municipal Structures Act No. 117 of 1998
- Municipal Systems Act No. 32 of 2000
- Mineral and Petroleum Resources Development Act No. 28 of 2002
- Air Quality Act No. 39 of 2004
- National Environmental Management: Waste Act No. 59 of 2008
- National Environmental Management: Waste Amendment Act No. 26 of 2014.

Several regulations and legislative updates have been promulgated under these acts. They are not limited to HCRW, but include the broader waste integrated approach (South African Waste Information System, 2019):

- Withdrawal of Integrated Industry Waste Tyre Management Plan, 2017

- Waste Tyre Regulations,2009
- Waste Tyre Regulations, 2017
- Waste Classification and Management Regulations: Norms and Standards for Assessment and Disposal of Waste to Landfill, 2013
- Regulations to phaseout the use of polychlorinated biphenyl (PCBS) materials and polychlorinated biphenyl (PCBS) contaminated materials, 2014
- Regulations regarding the planning and management of residue stockpiles and residue deposits and the amendments to the waste management activity list, 2014
- Regulations regarding the phasing out and management of ozone-depleting substances, 2014
- Regulations for the control of import or export of waste,2017
- Regulations regarding plastic carrier bags and plastic flat bags, 2003
- Compulsory specification for plastic carrier bags and flat bags,2003
- National Waste Information Regulations,2012
- Date of Effect of Waste Tyre Regulations, 2009
- Regulations for the prohibition of the use, manufacturing, import and export of asbestos and asbestos containing materials, 2008
- Regulations regarding the control of the import or export of waste,2019
- Amended National Waste Tyre Regulations, 2016.

The Hazardous Substance Act of 1973 classifies hazardous waste according to its inherent risk to human health, whereas general waste is deemed waste that does not pose a significant risk to the environment and human health. This Act was published under the auspices of the National Department of Health. Currently, stringent environmental legislation such as the National Environmental Management: Waste Act of 2008 and the Environmental Conservation Act of 1989, which have several regulations promulgated under them, direct the South African waste industry. One of these regulations is the Gauteng Health Care Waste Regulation of 2004, which stipulates that, if pathological waste is treated

in any manner, it must comply with the requirements for either combustion or non-burn alternative technologies (Environmental Conservation Act of 1986:10,18,21; Gauteng Health Care Waste Regulations, 2004a:9). National Environmental Management: Waste Act of 2008a:76-77; South Africa South Africa. Hazardous Substance Act of 1973:2).

According to Pepper and Nőthling-Slabbert (2015), the National Health Act, specifically Chapter 8, manages the legal regulation of human tissue. The promulgation of the afore-mentioned Act in effect repealed the Human Tissue Act (Act No.5 of 1983) which regulated human tissue management. Most of the content of the Human Tissue Act now forms part of the Health Act under Chapter 8 (control of use of blood, blood products, tissue, and gametes in humans). Currently, the DEAFF and the National Department of Health (NDoH) have prepared two sets of regulations, but their promulgation was halted due to disputes in terms of regulatory bodies and enforcement. The HCW industry has been plagued by sporadic dumping of medical waste and this resulted in a total outage of treatment plants in 2008, which left the whole of South Africa without any functional treatment plants. For instance, special authorisation by the DEAFF was required to landfill HCRW generated in Gauteng (South Africa, 2003; South Africa,1983).

The Integrated Strategy and Action Plans for Sustainable Health Care Risk Waste Management in Gauteng (2004c) were developed through consultation and concluded in 2003.This Strategy proposes that a wide variety of factors should be considered in the general management of HCRW. It is mainly applicable for implementation by the DEAFF, the National Department of Health (NDoH), and private and public bodies dealing with the management of HCRW.

According to the Gauteng Health Care Risk Waste Management Strategy (2004c:1-3), the vision of the Gauteng HCWM strategy is to:

> "Facilitate the establishment of an integrated, environmentally sustainable, occupationally healthy and safe, financially viable, institutionally feasible and

> operationally practical, comprehensive cradle-to-grave management system for HCW in Gauteng, covering all HCW generators in the province, and addressing the short-, medium- and long-term needs."

This strategy aims to minimise generated waste, reduce environmental impact, improve occupational health and safety (OHS), enhance communication in different spheres of government, and ensure cost effective treatment and disposal of waste. When correctly implemented, it will ensure a well-informed community and promote the development of a legal framework that includes directives for the training of communities and employees and the establishment of an enforcement authority (Gauteng Health Care Risk Waste Management Strategy, 2004c:1-3).

2.7 Types of Alternative Health Care Risk Waste Treatment Technologies used in South Africa

Treatment technologies can be classified based on their method of rendering waste non-infectious, for example:

- thermal (e.g., autoclaving, incineration, heat application, micro- or macro-waving, pyrolysis, gasification);
- chemical (e.g., the use of chlorine or chlorine derivatives, ozone, enzymes, sodium hydroxide);
- irradiation (e.g., ultraviolet, Cobalt 60, electron beam); and
- other mechanisms designed for specific medical waste categories (e.g., gas/vapour sterilisation) (United States of America. Colorado Department of Public Health and Environment, 2012).

Waste treatment can be defined as:

> "...any method, technique or process that is designed to alter the biological or chemical composition and physical characteristics of healthcare risk waste or reduce the hazardous or toxicity nature of [such waste]" (Gauteng Health Care Risk Waste Regulations, 2004a).

Treatment methods are generally described as thermal, chemical, irradiative, biological, and mechanical (Emmanuel *et al.*, 2001:1-10; Jiang, Ren, Tian & Wang, 2012:257-265; Maamaria, Mouaffak, Kamel, Brandam, Lteifa & Salameha, 2016:462-468). Table 2.12 is a simplified summary of alternative technologies as discussed by Emmanuel *et al*., 2001.

Some of the issues to consider in waste treatment technologies are consistency, temperature, and penetration success. Globally, general treatment practices are dominated by incineration, especially of pathological or anatomical waste. Emmanuel *et al.* (2001) state that some of these alternative technologies only exist for about a year after development and that they are frequently changed due to continuous technological development. Ansari (2019) compiled a table with the types of health care solid waste disposal methods that are used in developing countries (Table 2.13). It is evident that the most common type of treatment in developing regions is incineration, while autoclaving is the major treatment technology used in developed countries.

Non-incinerator medical waste treatment technologies are alternative systems or processes for waste treatment, many of which were already available by 2011. Emmanuel, Puccia and Spurgin (2001) argue that the factors that should be considered for use of these technologies include: throughput capacity, types of

Table 2.12: Alternative treatment technologies for medical waste

Category	Technology
Low heat thermal processes	Autoclave or retort Several technologies that make use of combinations of vacuum, streaming, compaction, shredding, steam-mixing, drying, pre-mixing, fragmenting, mixing and or chemical. Microwave Electro deactivation Dry heat Reverse polymerisation

Medium heat thermal processes	Thermal depolymerisation
High heat thermal processes	Pyrolysis oxidation Plasma pyrolysis Induction based pyrolysis Laser based pyrolysis Superheated steam reforming Advanced thermal oxidation
Chemical processes	Sodium hypochlorite hammer mill Sodium hypochlorite shredding Chlorine dioxide shredding and grinding Ozonation Electro-catalytic wet oxidation 'Stericid' shredding and mixing Dry inorganic chemical addition and shredding Peracetic acid addition and grinding Alkaline hydrolysis
Irradiation processes	Electron beam and shredding
Biological processes	Enzyme-based treatment or extrusion

Source: Emmanuel *et al.*, 2001

waste treated, microbial inactivation efficacy, environmental emissions and waste residues, regulatory acceptance, space requirements, utility and other requirements, reduction of waste volume and mass, occupational health and safety, noise and odour, automation, reliability, level of commercialisation, technology manufacturer, cost, and acceptance by communities and health professionals.

Table 2.13: Summary of the types of alternative health care waste treatment methods used in developing countries

Botswana	Incineration, open dumping, landfilling
Nigeria	Hydrovlaing, incineration
Palestine	Incineration, landfilling
Pakistan	Landfilling, incineration, open dumping
Ethiopia	Incineration

Brazil	Incineration, autoclaving, microwaving, anitary landfilling, ditching, open-air dumping
Jordan	Autoclaving, chemical disinfection, incineration, landfilling
China	Incineration, burning on-site
Turkey	Landfilling, incineration, autoclaving
India	Autoclaving, hydroclaving, microclaving, incineration, landfilling, pit burial, vermiculture pyrolysis/gasification
Bangladesh	Autoclaving, dumping in open spaces
Algeria	Incineration, chemical disinfection, on-site burial
South Africa	Incineration, autoclaving, open dumping, landfilling

Source: Ansari, 2019

In Northern Carolina in the USA, pathological waste is treated by using an alternative treatment method known as the Sanitec microwave treatment (Devine *et al*, 2007:79-84). This method is dependent on specialised knowledge regarding these types of plants and huge infra-structure and capital investments are required for their operations. The economic viability of such plants in South Africa, particularly in dealing with health care waste in rural and urban areas, is a matter of concern. The main constraints currently are demographics and distances between generation points and the actual treatment locations for waste products.

2.8 Waste Classification and Licencing/Authorisation Requirements

A guideline document titled 'Waste Classification and Management Regulations' was developed in 2013 due to the shortfalls in the minimum requirements for the handling and disposal of waste, such as the disposal of waste to landfill. These regulations were developed to:

- improve efficient classification and management of hazardous waste;
- ensure safe and appropriate handling, storage, reuse, recycling, recovery, treatment, and disposal of waste;
- ensure accurate reporting on waste generated;
- ensure correct classification of waste as appropriate, including:
    - pre-identification

  - testing and analysis
  - classification of waste
  - further analyses if required
- direct management options by aligning them with the waste management hierarchy;
- support and promote recovery of resources and diversion of waste from landfill; and
- encourage separation of waste at source (Kneale, n.d; South Africa. Guidelines for the Development of Integrated Waste Management Plans, 2009:3; South Africa. Waste Classification and Management Regulations, 2013.).

2.8.1 Waste classification

Annexure 1 (Chapter 7) of the Waste Classification and Management Regulations of 2013, as promulgated under the National Environmental Management: Waste Act of 2008, indicates that HCRW does not require classification or assessment in terms of the South African National Standards (SANS)code 10234 (2008) (South Africa, 2013; South Africa, 2008a, SANS,2008). This latter code standardises the system of classification and labelling of chemicals in line with global standards. The regulation document refers to mixed waste and classifies some requirements in Annexure 1(2)(b) under hazardous waste, stating that mixed chemical hazardous waste from laboratories and academic institutions in volumes less than 100 litres do not have to be classified and assessed. It does, however, specify that all agencies must ensure that the waste they generate is classified in accordance with SANS 10234:2008 within 180 day of generation. In section 5, it is stated that waste that was treated must be re-classified in terms of sub-regulation (2). Re-classification should be done every five years when HCRW was treated by a contracted service provider who must ensure that classification meets all the approved standards for microbial inactivation (South Africa. Waste Classification and Management Regulations, 2013:6,19-21; South African National Standards, 2008:3-81). Such waste must be deposited at a Class B

landfill site, but the landfill site may refuse to accept the waste due to operational reasons.

2.8.2 Licencing/authorisation of treatment plants for health care risk waste

According to the National Environmental Management Waste Act of 2008 (South Africa, 2008a:54-68), a license/authorisation/permit and registration of operators are required for the following waste management agents/activities:

- generator
- storage
- re-use, recycling, and recovery
- treatment
- waste management operators
- waste transporters
- waste recyclers
- waste processors
- all those trading in waste.

Chapter 5 of the National Environmental Management Waste Act (South Africa, 2008a) outlines the licensing of different waste management activities and their requirements according to a systematic approach. In the current review, only the procedures for basic waste management licence application will be discussed. Section 19(1) of the Act indicates that a waste management licence is required in accordance with section 20(b) of the National Environmental Management: Waste Act of 2008and the Environmental Impact Assessment Regulations of 2014 (amendments published in 2017). A category A activity requires a basic assessment, whereas a category B activity requires a scoping and environmental impact reporting process (South Africa. Environmental Impact Assessment Regulations, 2014:229-230; South Africa. National Environmental Management Waste Act,2008a:4-7,54-68; South Africa. List of Waste Management Activities, 2012:4-8).

Basic assessment is required for small-scale operators and any operator that intends to apply for a waste management licence is required to appoint an independent environmental assessment practitioner (EAP). A fee structure is available on the SAWIS web page to guide intended applicants. However, there is no reference to the requirements for alternative treatment technologies for lower treatment volumes. Amending this shortcoming will not be an overnight exercise but will require a medium- to long-term project plan.

The following list of incinerators (Table 2.14) was compiled by the researcher from information retrieved from the SAWIS web page to illustrate the location and quantity of waste incineration sites currently operating in Gauteng.

Table 2.14: List of registered incineration treatment plants in Gauteng Province

Province	Municipality	Licence Number	Facility Name	Waste Classification	Facility Type	Date Awarded
Gauteng	Emfuleni	12/9/11/L170/3/V1	A-thermal retort technology	Hazardous	Incineration	2013-02-20
Gauteng	Emfuleni	12/9/11/L615/3	ArcelorMittal Hazardous waste storage, treatment, and remediation	Hazardous	Incineration	2013-09-23
Gauteng	City of Tshwane	12/9/11/L625/3	Bon Accord Hydroclave HCR	Hazardous	Incineration	2012-08-23
Gauteng	City of Johannesburg	12/9/11/P9	Clinical medical waste incinerator	Hazardous	Incineration	2007-12-05
Gauteng	Emfuleni	12/9/11/P71	ClinX	Hazardous	Incineration	2009-02-05
Gauteng	City of Johannesburg	12/9/11/L1138/3	Eastern Cape Incineration	Hazardous	Incineration	2013-05-30
Gauteng	City of Johannesburg	12/9/11/P89	Enviroserve Waste Management (Pty) Ltd	Hazardous	Incineration	2009-05-16
Gauteng	Ekurhuleni	12/9/11/L180604114809/3	Lonmin Platinum Incinerator	Hazardous	Incineration	2018-12-06
Gauteng	Sedibeng	12/9/11/L314/3	Luipaardsvlei	Hazardous	Incineration	2010-07-02
Gauteng	City of Tshwane	12/9/11/L609/3	Remade Waste Management Facility	Hazardous	Incineration	2011-10-27

Gauteng	City of Johannesburg	12/9/11/L1445/3	Solid Waste Technologies SOUTH AFRICA	Hazardous	Incineration	2014-05-28
Gauteng	Ekurhuleni	12/9/11/L301/3/V1	Thermopower Process Technology	Hazardous	Incineration	2013-03-07

Source: SAWIS, 2019

Some alternative treatment plants (Table 2.15) are required by SAWIS to declare their treatment volumes. They are not licensed under waste management licence (WML) requirements due to their low daily treatment volumes (below 500 kg). Costley (2019) argues that their operations are based on the design or type of technology used and, as such, the actual daily volumes treated are less than the technical specification of the technology type illustrating the projected volume that the technology can treat. Alternative treatment plants are listed by various authors such as Costley (2019), Mokoena (2007), Power and Maker (2007:5), and South Africa Waste Information System (2019). It has been observed that several treatment plants utilise more than one treatment technology which may include incineration as well as alternative treatment technologies.

Table 2.15: List of alternative treatment plants in South Africa

Province	Facility	Type
Easter Cape	CMWS Berlin	Non-burn
Gauteng	Averda City Deep	Non-burn
Gauteng	BioMed	Incinerator and non-burn
Gauteng	Cecor Allied	Non-burn
Gauteng	ClinX	Incinerator and non-burn
Gauteng	CMWS Clayville	Non-burn
Gauteng	Sterilatics	Non-burn
Gauteng	Tech4Green	Non-burn
KwaZulu-Natal	CMWS Westmead	Non-burn
KwaZulu-Natal	Ecocycle	Non-burn
Limpopo	Buhle Limpopo	Non-burn
Western Cape	Averda Killarney Gardens	Non-burn

Source: Costley, 2019

2.9 Comparison of NEWster® and Alkaline Hydrolysis

In South Africa, no alternative treatment technology to treat human pathological waste other than incineration exists. It is also the only measure that is authorised. However, an alternative method is already available in South Africa that has been used successfully in the abattoir industry where pathological waste derived from carcasses is treated. This treatment is known as Alkaline Hydrolysis technology. This type of treatment is done at high temperatures, under high pressure, and in an alkaline environment which renders non-infectious by-products and brine-like wastewater, also referred to as hydrolysate non-infectious waste. The solid part of the by-product is known as 'cremains'. This type of treatment has demonstrated its effectiveness in the treatment of infectious carcasses at full scale installations and was piloted in July 2000 at the Cornell College of Veterinary Medicine (CCVM) plant in Ithaca, New York (Prinie, 2002:1320-006).

An alternative treatment process for HCRW treatment was also developed by the NEWster®Group. The NEWster®Group was founded in 1996 and their technology was first validated in Italy in 1998. It was also validated in the United Kingdom (UK) in 2012, Australia in 2013, and Turkmenistan (a sovereign country in Central Asia) in 2013. In South Africa, this treatment strategy was validated by Enviro Services in 2014 and was supported by a comprehensive report. The NEWster® (NW10) was tested at the Vergelegen Mediclinic Hospital in Somerset West, Western Cape Province. The unit was tested for efficacy requirements, but the testing was limited to sharps and general infectious waste. The materials list that indicates which types of material can be treated by the NW10 that was issued by Alloro Africa (Pty) Ltd indicates that "teeth and small body parts" and "guinea pigs and small rodents" can be treated and rendered unrecognisable. The placenta is deemed a small body part and may thus be treated successfully using this technology (NEWster, 2019; Bovetti, 2016).

A survey of HCW generation rates, treatment capacities, and minimal costs of health care waste in the nine provinces of South Africa was done for the Department

of Environment and Tourism (2008b). This survey found that the total operational commercial incineration capacity is approximately 5770 tons per year. The study projected that 6810 tons of generated waste per year would be reached in 2008. The study also estimated that pathological HCRW generation in South Africa would amount to approximately 37400 tons per annum. Estimating a 5% incineration requirement, it was calculated that pathological HCRW would amount to 1 867 tons per year. This was deemed to be less than the available capacity of approximately 5770 tons per year (South Africa. Department of Environmental Affairs and Tourism, 2008b; South African Waste Information System, 2005).

In 2008, a major shutdown of treatment capacity was experienced which necessitated the Gauteng Department of Health to use the Holfontein landfill facility to dispose of all HCRW. This facility is a highly hazardous (H:H) site but no alternatives for the treatment capacity of incinerators were available (Costley, 2020; Mokoena, 2007; Power & Maker, 2007:5). The question was posed whether alternative treatment technologies could be used for the treatment of human pathological waste generated in HEs. It was argued that the most important aspect to consider was the effectiveness of destroying pathogens and rendering the product unrecognisable. The two technology types that were evaluated will be discussed in greater detail.

2.9.1 NEWster® Machine Model NW10

The NEWster® (NW10) is the second smallest unit of the NEWster® products on the market for the treatment of HCRW. The process is based on frictional heat treatment (FHT) technology. It is basically heat generated by impact and friction of the waste and is controlled through a programmable logic controller (PLC). The residue is sterilised, finely shredded and ground, dried, and reduced in weight and volume. The technology has been tested, patented, and internationally certified. The technology is known for its ability to drastically reduce volumes of HCRW (up to 70%) and is also known to reduce environmental impacts as it reduces environmental emissions and risks arising from the transport of infectious waste. The technology increases hygiene quality and improves the safety of personnel,

and the agents provide a supportive service such as training, maintenance, and placement requirements (NEWster, 2020).

Figure 2.3:The NEWster® Machine Model NW10

Source: NEWster, 2020; van Wyngaard, 2015

The treatment of HCRW is commenced by loading the HCRW into the chamber, closing the lid, and activating he NW10by pressing the start button. The waste is treated in five phases as listed in Table 2.16.

Table 2.16: Process phases for the NEWster® Machine Model NW10

PHASE	ACTION	DESCRIPTION
1	Loading and starting	Waste is loaded into the sterilisation vessel. The lid is closed, and the treatment process is started by pressing the start button. The rotor, fitted with stainless steel blades, grinds the material while the temperature increases to 60℃. The electrical valve opens, and water is introduced into the cooling columns. There are two speed rotation levels until

		the rotor has pulverised the contents into small particles. The evaporation phase will start.
2	Evaporation of liquids	When 96 -100°C is reached, the temperature is maintained until evaporation has finished.
3	Achievement of sterilisation	After all the water has evaporated, the temperature is increased up to 150°C.At this point the rotor reduces speed to the first setting and resistance and turns off.
4	Cooling	Cooling is achieved by short sprays of water until the temperature has decreased to 95°C.
5	Unloading	The process cycle is now complete. The vessel is opened, and the contents are deposited in the stainless-steel integrated waste collector, ready for transportation to the waste collection bin for landfilling or use as an alternative fuel.

Source: NEWster, 2020

The process is automatically monitored and provides a printout of the process cycle parameters which the operator should attach to cycle reports (NEWster, 2020).

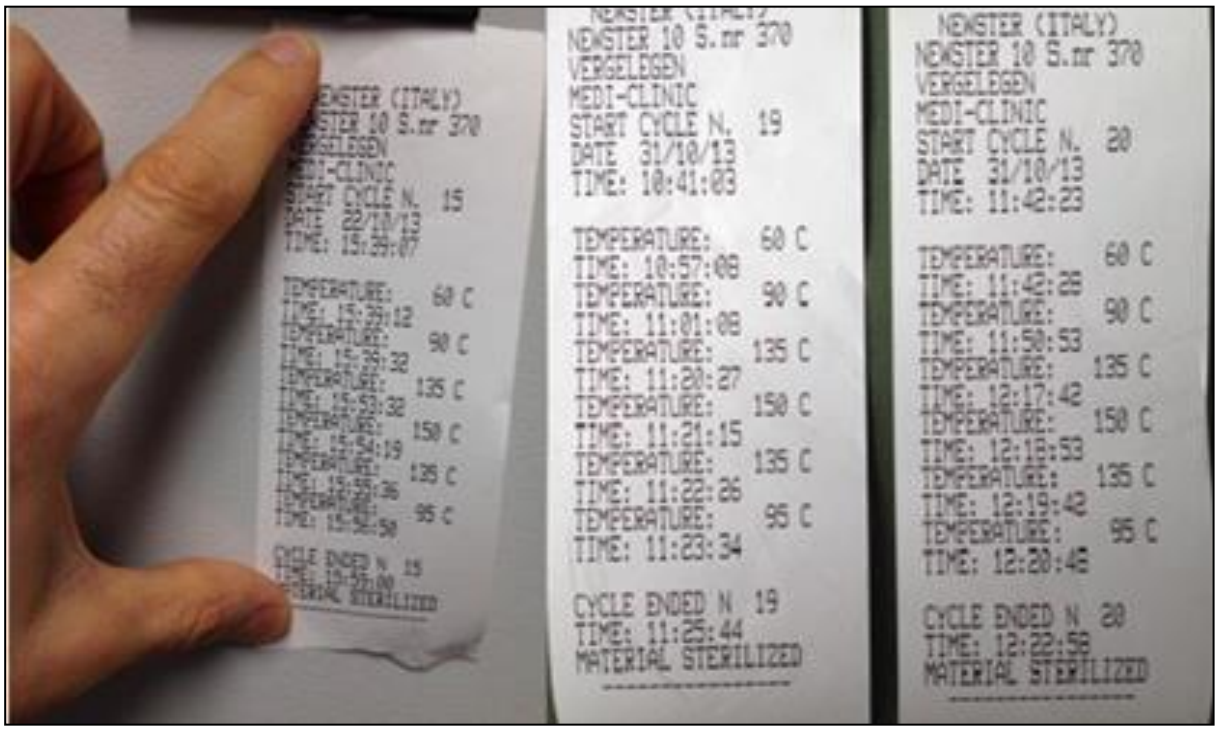

Figure 2.4: Photo of print-out as evidence of process cycle in a report by the Vergelegen Mediclinic in Somerset West

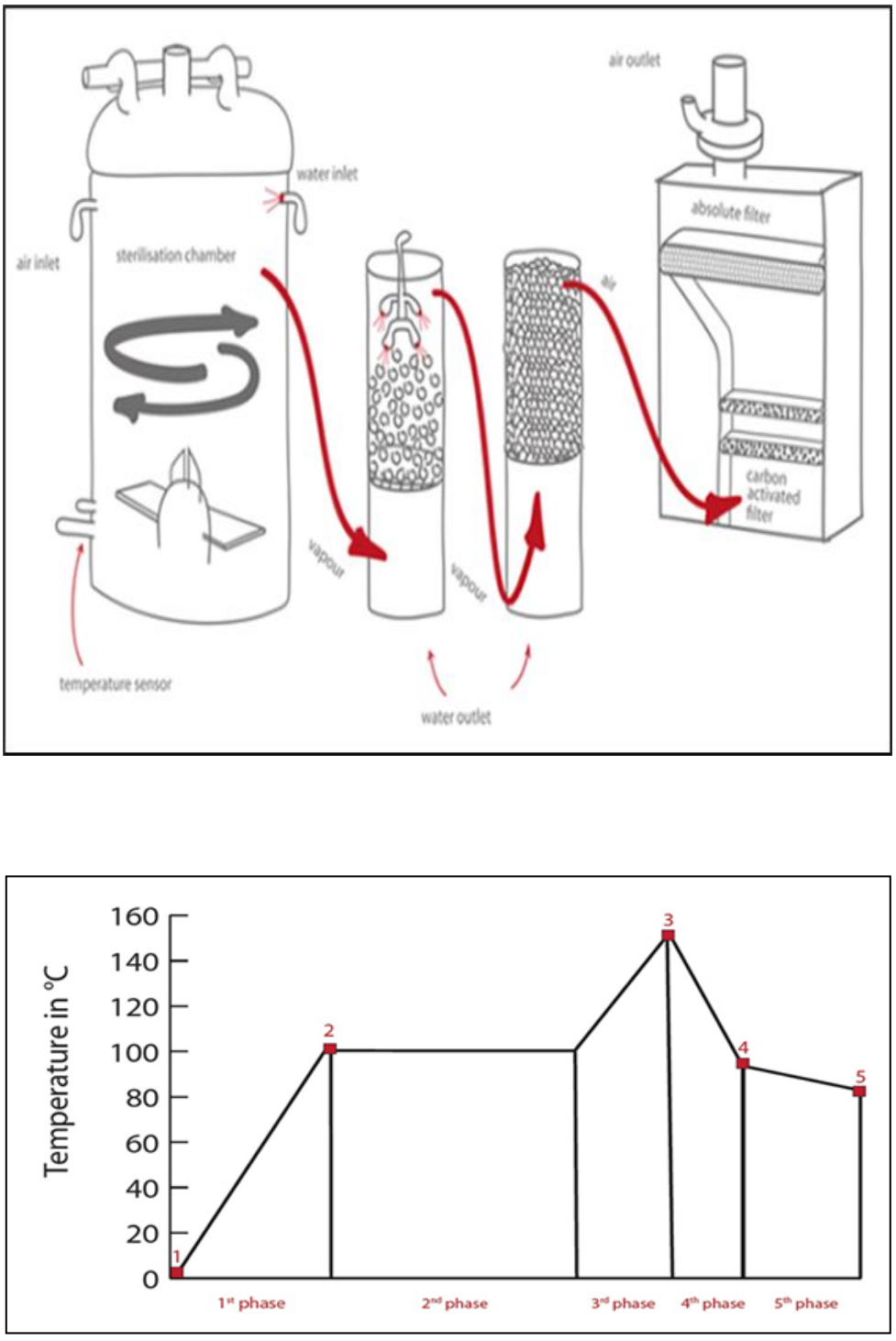

Figure 2.5: NEWster® treatment process graph indicating temperature optimisation and schematic process flow

Figure 2.5 illustrates the temperature of each phase in the NW10 treatment cycle of HCRW. The equipment can be manufactured according to the needs of each HE

and can be installed in a small room. It does need electricity connection, water supply, and access to a sewer system. Additional equipment such as weighing and bin cleaning systems can be added to the baseline assembly. Training of an operator is also included in the installation costs and maintenance staff can be provided and/or trained by the manufacturer. The process reduces the volume of the treated waste by 75% and its weight from 25% to 40%, depending on the moisture of the treated waste. A significant reduction of the cost of waste disposal was found in installations in Italy ranging from 50% to 70%. The product is a sterilised medium that can be used as a waste-to-energy medium in a waste-to-energy plant. The final product can also be disposed at landfill sites such as a GLB+ site. Materials that cannot be treated are organic waste and inorganic residues (broth, oil, sewage, washing, etc.) and organic residues with water content above 30%, radioactive waste and/or isotopes, compact metal masses heavier than 100 grams, gas containers and tanks, chemicals, flammable materials, explosive materials, stones, timber, carcasses of large animals, bed sheets, blankets, and pillowcases (NEWster, 2020; Bovetti, 2016).

2.9.2 Alkaline Hydrolysis

Alkaline Hydrolysis is a low-pressure tissue digester system. This system is currently used to manage condemned abattoir waste but has been tested for the treatment of animal tissue as well. A tissue digester is equipment that, through a catalysed thermo-chemical mechanism, breaks down specific organic material, thereby effecting a predetermined degree of hydrolysis of the different individual constituents that once made up such organic material (Pinho, Nunes, Lobo-da-Cunha & Almeida, 2015:51-56; Wang, Wu, Yi & Qi, 2016:366-374).

This is a process that uses alkali, high temperatures, and high pressure to dissolve pathological tissue into a sterile solution (also referred to as hydrolysate) and some bone residues (European Commission, 2002; Pinho, Nunes, Lobo-da-Cunha & Almeida, 2015:51-56; Prinie, 2002:1320-006; Wang, Wu, Yi & Qi, 2016:366-374).

Figure 2.6: Illustration of system requirements of the Waste Resolution Technologies (Pty) Ltd. MAAP Multi- processor process
Source: Waste Resolution Technologies (Pty) Ltd, 2020

The process consists of the following seven steps (some are illustrated in Figure 2.6):

- Step one: Load tissue
- Step two: Add catalyst
- Step three: Add water
- Step four: Hydrolyse the tissue
- Step five: Discharge tissue processor
- Step six: Recover fat or tallow
- Step seven: Recover or recycle the hydrolysed protein.

The tissue introduced into the system ends up as a liquid mixture of amino acids, peptides, sugars, nutrients, and soap. Also present is calcium phosphate (derived from teeth and bones). This process also destroys the protein membranes of viruses. The peptide bonds of protein-based infectious microorganisms are broken down and the destruction of infectious organisms occurs. The residual liquids and solids are pathogen free due to process time, temperature, alkalinity, and the homogenisation of protein-based materials. The process cannot digest materials such as plastics, synthetic polymers (e.g., nylon, polyethylene, polyester, Teflon, epoxy) and metals. The duration of the hydrolysis process is between 12 to 24 hours and is controlled by a PLC system that does not necessitate human intervention. An operational requirement is the use of an overhead crane to lower the basket containing the material or waste into the vessel. Thereafter, the lid is lowered and clamped on to the vessel and, when the system has cooled off, the lid needs to be removed so that the basket and the bone debris can be removed, which is a labour-intensive process (Gelfand Centre, 2021; UNEP, 2012:1-236; Waste Resolution Technologies (Pty) Ltd, 2020). The technology is available in two different design types, namely the dumpster type tissue digester and the centrifugal tissue digester. There are different models available that are summarised in Table 2.17.

Table 2.17: Summary of different designs and models of Waste Resolution Technologies (Pty) Ltd digesters

Dumpster Type	Centrifugal Tissue Digesters
Model DD500	Model DDR1000
Model DD1000	Model DDR2000
	Model DDR4000

The models differ in volumetric capacity and vary from 1700 litres to 12700 litres (Waste Resolution Technologies (Pty) Ltd, 2020). A two-litre digester was used in a research project by Wange *et al*. (2016), who illustrated the diversity of sizes and adaptability of the alkaline hydrolysis design. Figure 2.7 shows one of the current designs available in South Africa.

Figure 2.7: Example of the Waste Resolution Technologies (Pty) Ltd MAAP Multi-processor Technology
Source: Waste Resolution Technologies (Pty) Ltd., 2020

The benefit of the alkaline hydrolysis processes is that it can be adjusted to achieve what is required. Wang, Wu, Yi and Qi (2016) reported that the process had been tested to address four parameters, namely treatment time, temperature, concentration of alkali solution, and the ratio of alkali and tissue. Tests were carried out at temperatures of 80℃, 100℃, and 110℃. The study concluded that, by using *Bacillus stearothermophilus* spores, it could positively illustrate the successful treatment of animal tissue. The authors also argued that alkaline hydrolysis could be used as a safe method to treat infected animal tissue, particularly as no *Bacillus stearothermophilus* spores' growth could be detected in the test vials. Similar results were obtained by Kaye *et al.* (1998) at lower temperatures (110^0C to 120 ^{0}C for 18 hours).

2.9.3 Technical evaluation and comparison of the NEWster® Machine Model (NW10) and the Alkaline Hydrolysis Model DD500 (Waste Resolution Technologies (Pty) Ltd.)

When evaluating the Alkaline Hydrolysis and the NEWster® technologies, consideration was given to the most common denominators, namely: best available technology (BAT), best environmental practice, economic aspects, social acceptability, and administrative thoroughness (Ginters, Barkane & Vincent, 2010:357-363; Jiang, Ren, Tian & Wang, 2012:257-265). When looking at different assessment tools used to differentiate between types of technologies used in HCRWM and other types of technology, it is evident that thorough modelling and evaluation should be used when considering these types of alternative technologies.

The following evaluation criteria were used to evaluate both types of technologies as a desktop study (Table 2.18):

Table 2.18: Comparison between the NEWster® Machine Model NW10 and Alkaline Hydrolysis Waste Resolution Technologies (Pty) Ltd Digester DD500

Process Name	NEWster Machine Model NW10	Digester DD500
Type of technology	Chemical thermal treatment	Chemical thermal treatment
Level	Sterilisation	Sterilisation
Maximum quantity	370	500
Volumetric capacity (kg/cycle)	10-25	350
Chamber capacity (m^3)	0.13	1.8
Water use per cycle (m^3)	0.15 – 0.3	0.1
Steam use per cycle (kg)	0	0

Energy use per cycle (kWh)	0.6	0.25
Chemical use per cycle (kg)	0.3 – 0.5 (14% – 15%) NaClO (Sodium hypochlorite)	11% of mass, at minimum weight of mass of 50 kg (Potassium hydroxide) (KOH)
Cycle time (per min.)	15-25	1080
Shredder	Yes	Agitator
Chamber unload	Automatic	Mechanical lift
Waste temperature right after process (^{o}C)	± 90^{0}C	±95^{0}C
Installation dimensions (length x width x height [m])	1.2 x 0.8 x 1.4	1.2 x 1.2 x 2.4
Installation mass (kg)	1100	1100 (316 stainless steel)
Power supply type (V)	3 x 380	3 x 380
Power (kW)	30	0.025
Does price include all equipment?	Yes	Yes
Price net (excluding VAT) per unit	Unknown	R 850 000 If high pressure is used: R1850 000
Term of guarantee (months)	12	12
Installation time	Unknown	Production: 12 weeks, Installation: 6 hours.
Alternative additions (renewable energy conversions, etc.)	Unknown	Steam coil conversion with dedicated LFP or coal boiler. Can compost and connect to an energy converter
Local and international pilot	Yes	Not for HCWM
Certification	Yes	Not for HCWM

Sterilisation test for micro-organisms	• Total cfu (total coliforms) • Faecal coliforms • Streptococcus • *Escherichia coli* • *Staphylococcus aureus*; • *Pseudomonas aeruginosa*; • Yeasts and moulds • *Geobacillus stearothermophilus* as indicated in the Enviro Services Evaluation report of February 2014 (Bovetti, 2016)	• *Staphylococcus aureus* • *Mycobacterium fortuitum* • *Candida albicans* • *Bacillus subtilis* • *Pseudomonas aeruginosa* • *Aspergillus fumigatus* • *Mycobacterium bovisBCG* • MS-2 bacteriophage • *Giardia muris (*Kaye et al., 1998:43-46; UNEP, 2012:1-236:)
Log	• Sterility in all and *Geobacillus stearothermophilus* sterile up to 10^7as indicated inthe Enviro Services Evaluation report of February 2014 (Bovetti, 2016)	• "No growth was reported for any of the indicator organisms, corresponding to $\log_{10}$ reductions ranging from 7 to 9, except for Giardia and Aspergillus 157H." • "Aspergillus had a reduction corresponding to about 3 $\log_{10}$. Intact Giardia cysts could not be detected except for small fragments of what appeared to be cyst wall" (Kaye *et al.,* 1998: 43-46; UNEP, 2012:1-236)

Sources: Kaye, Weber, Evans & Venezia, 1998; Kruger, 2020; United Nations Environment Programme (UNEP), 2012; Waste Prevention Association, 2003

Both systems that were evaluated utilise chemical thermal processes. It is apparent that the capacity per load differs between the two systems and varies from 10 kg to 350 kg per cycle. A small difference in the percentage chemical usage per cycle is noticeable (between 11% to 15%). The cycle time per unit is also significantly different: from 15 minutes up to 1080 minutes. Test results of the NEWster unit displayed full compliance with the requirements set out in Schedule 4(3) where three organisms, including *Geobacillus stearothermophilus* (ATCC 7953), were used for test purposes, although a minimum of one is required as mentioned in the Gauteng Health Care Waste Regulations (2004). It is noteworthy that the testing organisms listed in Table 2.17for the DDR500 digester were in line with abattoir test requirements, but that the minimum organism levels as per HCRW treatment requirements were present, such as *Staphylococcus aureus, Mycobacterium bovis (BCG),* and *MS-2 bacteriophage*. This demonstrated this technology's compliance with requirements as set out in the Gauteng Health Care Waste Management Regulations (2004).

2.10 Responsibilities of Health Care Risk Waste Generators

South African legislation divides waste generators into two categories. First, a major generator generates more than 20 kg of waste per day, and a minor generator generates less than 20 kg per day. Although the regulations require a generator to establish a suitable HCW management plan, this is only applicable to the major generator. The major generator must register on the registration site of the Gauteng Department of Agriculture and Rural Development (GDARD), whereas the minor generator must register with the local government in whose area it operates (Gauteng Health Care Risk Waste Management Regulations, 2004:8-12; GWIS, n.d.). No formal registration authority for local governments could be traced.

All generators are responsible for the 'cradle-to-grave' management of waste by providing physical proof of collection, transportation, treatment, and final disposal through manifest documents and destruction certificates. Strict rules also apply in terms of container markings and documentation management. The generator remains responsible for the waste until finally landfilled (for example ashes), or

where alternative technologies are used for treatment. All shredded waste must be de-classified, and proof of final disposal must be kept. Prosecutions can lead to substantial fines or even imprisonment.

2.11 Conclusion

Both the history and development of a health care risk waste legal framework have come a long way since the 1500s. Constant development of legal requirements is evident and it was clear that system development usually followed legislative promulgations. Several alternative treatment plants for waste are available in South Africa, some of which do not necessarily activate a waste management licence procedure, but operators are always mandated to declare the volumes of waste they treat and dispose of. Alternative treatment technologies used in other sectors, such as Alkaline Hydrolysis and the NEWster® sterilising units, were tested and may be considered for the treatment of pathological waste, but they will still have to be specified in the waste management licence authorisation document in accordance with the National Environmental Management: Waste Act of South Africa (South Africa, 2008a).

The operational management of these systems plays an important role in the consideration of alternative treatment technologies for waste. Such technologies should be investigated in terms of risk rating and occupational health and wellness outcomes before purchasing them. The volumes of waste generated versus treatment capacity also play a role in the choice of the most suitable technology. It is evident that concerns exist regarding the operational handling, management, maintenance, and optimal treatment efficiency of both systems. However, a comparative evaluation made it clear that the smaller unit, namely the NEWster® (NW10), is more suitable for small-scale operators such as district hospitals, clinics, and community health establishments, particularly as the cycle time is less than that of the Alkaline Hydrolysis system and the capacity of the unit versus generation rates is more in line with the set requirements.

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CHAPTER 3

PLACENTA MANAGEMENT IN HEALTH ESTABLISHMENTS IN GAUTENG PROVINCE

ABSTRACT

The aim of this phase of the study was to determine the prevalence of traditional belief systems and customs among patients admitted to health facilities in Gauteng Province, with specific reference to their beliefs regarding the handling and disposal of the placenta. A simple random sampling technique was used to recruit participants in hospitals falling under the Gauteng Department of Health, Gauteng Province. The investigation was limited to government hospitals in this province and was conducted at 15 hospitals (of an original sample of 27) that were representative of various levels of health care services, with special focus on obstetric and maternal services. Interviews were conducted using a structured questionnaire which focused on the following areas of interest: demographic information of respondents, patient and birth information, placenta management at the hospital, Health Professionals' views on the prevalence of traditional belief systems, Health Professionals' general knowledge of placenta management, and their training in this regard. Five categories of professional officials were targeted, namely matrons, supervisor/operational managers, professional nurses, nursing assistants, medical practitioners, and health care risk waste officers/environmental health practitioners.

The results showed that medical doctors did not associate their role with health care waste management. Administrative requirements in terms of placenta registers, weighing and weight recording, separating lining, provisioning of sufficient Specicans and liners for the disposal of placentas, and manifest documents were in place. The requirement of a safe disposal certificate for placentas was also adhered to. However, appropriate refrigeration requires attention as temperatures were not frequently monitored in the hospitals under study. It was also found that uncertainty prevailed in terms of the management of placentas according to

traditional beliefs and customs and particularly when birth mothers and their families requested to take the placentas home. The Indian population group was the group that predominantly requested to take the placenta home, followed by the Zulu population group. Formal in-service training programmes were not attended by the surveyed professionals and this requirement should thus be reviewed to ensure compliance. A marketing strategy to encourage best practice in placenta disposal and home treatment should be developed.

Keywords: Placenta, pathological waste, health care risk waste, traditions, belief, culture, health professionals.

3.1 Introduction

As communities expand, waste is continuously generated and waste disposal, which is part of the normal human way of life, should be continuously taken under review. Although health care risk waste (HCRW) represents a minor waste category in terms of volume, it grew exponentially and associated problems have been recorded since the dawn of civilization. In 2011, the United Nations Special Rapporteur on human rights and toxic waste warned the world that it was not paying enough attention to the problems caused by medical waste (Medical waste is posing a growing problem worldwide, 2011).

Health care risk waste is generated at health establishments (HE) such as hospitals, clinics, community health centres, laboratories, research institutions, dental practices, emergency medical services, veterinarian practices, old age homes, and forensic pathology services. The focus of the study was to evaluate management practices associated with placenta disposal (Gauteng Health Care Waste Management Regulations, 2004:3-7; South Africa. Department of Environmental Affairs, 2012:10-18; World Health Organisation, 2005).

Pathological waste is described as a category of HCRW and is defined in the Gauteng Health Care Waste Regulations (2004:6) as:

> "...(a)deceased animals or animal parts infected with zoonotic diseases; (b)human and animal tissues, organs, body parts, blood, fluid blood products and body fluids; (c)containers or equipment containing blood that is fluid or blood from animals known or suspected to be infected with any zoonotic disease; and (d) human foetuses; but excludes teeth, hair and nails."

In the USA, it is stipulated that waste will only be classified as HCRW if the product comes into contact with human bodily fluids and thus nails, teeth and hair are in most cases not regarded as a part of HCRW (United States of America. Department of Energy National Laboratory, 2012; United States of America, University of Arizona, 2011; United States of America. University of Minnesota, 2021; WHO, 2005 & 2018).

South Africa is rich in cultural beliefs and the traditional management of placentas places it in different categories of health care waste. Not only are there uncertainties about what exactly these traditions are, but there is also a lack of uniformity in terms of how placentas are transported and disposed of should the mother/family wish to take them home. The safeguarding of families partaking in this practice and their home environments, as well as the safety of the public and the environment during the transportation and disposal of placentas, are issues of great concern.

In the Western world, the human placenta is regarded as nothing more than human waste. However, according to Bradley (2014), placentas are ceremonially handled and disposed of by many cultures around the world, and South Arica is no exception. The tradition that prevails in South Africa that the placenta is disposed of at home by the family means that pathological waste maybe transported by public or private transport to a patient's home where it may then be buried in a shallow grave or a hole in the ground.

In Nigeria and Ghana, the 'Iblo' treats the placenta as the dead twin of the living child and it is therefore ceremonially buried. Traditional ways of placenta disposal range from burial to covering it with grass, burying in dirt floors of the family house, wrapping it in blankets and burying it near a tree, and washing it, drying it, and

placing in a basket for burial by the father. These beliefs variously symbolise on-going life, fertility, the health of the born child, a life-giving force, the baby's twin or older sibling, the baby's guardian throughout life, medicinal support, binding the child to his or her place of residence, and protecting it from evil spirits. These beliefs are still prevalent in Mali, the Arabic Peninsula, North and South America, New Zealand, and all over Africa (Bradley, 2014).

Littlejohn (2011) describes the customary disposal of the placenta by the San people in South Africa as follows:

> "San women bite the cord off with their teeth and bury the placenta after giving birth, before walking back to the settlement. It is seen as her duty to return the placenta to Mother Earth. It also connects the infant to the territory of a particular group of Bushmen [the San people] as well with the birth among the Bantu people that is said that an older woman such as a grandmother or a traditional birth assistant traditionally attends to the person that is in labour. After birth, the mother is kept in her hut with the baby until she stops bleeding. The cord and placenta are buried and when the cord falls off, it is believed that the new-born belongs to the whole community and not just to the mother. An animal is slaughtered, and the skin of the animal is given to the baby as protective clothing or as a sleeping mat."

A device referred to as the "birth to Earth's Capceco capsule" (Bradley, 2014) has been used in New Zealand for the so-called 'planting' of placentas in an environmentally friendly manner. These capsules are manufactured from recyclable materials and the pack consists of a corn starch bag, a recycled cardboard capsule/box, a carry bag, a keep sake record book, and a tag to record the child's name and birth date. Such a pack is an example of efforts to safeguard the placenta and the environment, but the practice does not address concerns regarding the microbial load and/or potential spread of illnesses.

Vast population births give rise to high quantities of wet pathological waste such as placentas in the waste treatment system. It was against this backdrop that questions were posed by health workers regarding the handling of placentas as a cultural dilemma. Aspects like packaging, transportation, treatment, and/or the burial of placentas are only a few unknowns in this field. The safety of the home environment

and the health of families partaking in this practice, as well as that of the public that may be exposed to infectious waste on public transport, is of great concern.

A placenta weighs 0,637 kg on average (Kerr, 2012). Considering that the estimated number of births between 1 July 2018 and 30 June 2019 was1171 219, it was calculated that an estimated minimum weight of 746 066 kg of placenta was derived from birth placentas as a by-product of a natural occurrence. The population growth rate was1.4% for the period 2018 to 2019. Thus, an expected additional 10444 kg of pathological waste was generated. This calculation did not take immigrants, illegal immigrants, foreign visitors, or cross boundary emergencies from neighbouring states into account, as they do not form part of South African statistics (Statistics South Africa, 2019).

The focus of this study was to evaluate the practices in HEs in terms of:

- placenta management;
- the prevalence of traditional beliefs and practices associated with placenta management;
- the level of knowledge of Health Professionals regarding placenta management and traditional belief systems;
- the level of training of Health Professionals in HCRW management and clarity of their role regarding their responsibility for educating patients regarding their human rights.

3.2 Study design, selection of the sample, and sampling technique

3.2.1 Study population and sample

The sample comprised of 15 provincial hospitals in the Gauteng Province. The demographic location of each of the study sites is presented in Figure 3.1 (of the 27 targeted HEs, only the 15 participating hospitals are indicated):

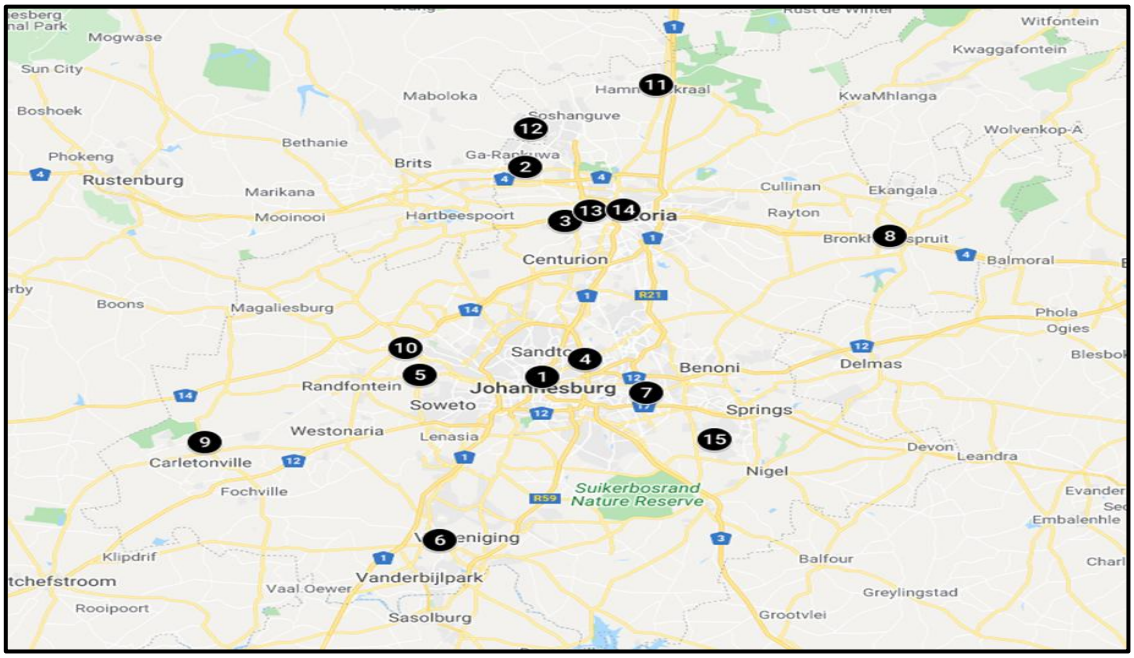

Figure 3.1: Demographic location of the sample sites

Source: Google Maps Application, 2019

The study population was all the health professionals associated with maternity wards and health care waste management in HEs in the GDoH. However, as it would have been impossible to survey all these health professionals, a study sample was drawn from the population and targeted maternity ward managers/matrons, operational managers, nursing assistants, medical practitioners, and environmental health practitioners. The sample was purposively recruited as health professionals with maternity ward experience would possess the information required to address the objectives pertaining to the second aim of the study.

To address the objectives of this investigation a cross sectional study was conducted to determine the knowledge, attitudes, level of training, waste management practices, and knowledge of the recruited Health Professionals in the hospitals under study. They were also asked to answer questions based on their experience and knowledge of mothers' traditions and customs when requesting to take their placentas home. A stratified sampling approach was used to identify

health professionals in each designation category. The following categories were identified.

- Matron/nursing supervisor/operational manager
- Professional nurse
- Nursing assistant
- Medical practitioner (doctor)
- Health care risk waste officer/environmental health practitioner.

Thereafter a purposive sampling approach was used to identify the HEs in each level of the operation.

3.2.2 Constraints encountered in accessing the study sites

The GDoH Policy and Development Directorate was not able to provide a research guideline to the researcher and thus several unplanned delays were experienced. After the first attempts to make appointments, input from the hospitals indicated that approval had to be obtained from the GDoH Provincial District Office before any appointments could be made. In some of the hospitals that were part of the study site, there were internal research committees and some would not grant approval without the District Committee's approval. This requirement disrupted the research timeframe and a new schedule had to be established. After more than six months, only the committees of the districts of Ekurhuleni and Tshwane had allowed the study to proceed at the selected hospitals. To ensure a representative sample and without naming the research participants, individual approval was obtained from the CEOs. All the approval letters are presented as appendices to this manuscript.

3.2.3 Selection of the sample

With the assistance of the research coordinator, the sample of health professionals was accessed. To determine which health practitioners were most responsible for obstetric and maternity ward practices, the organisational framework was examined. The CEO identified a liaison person and, with the aid of matrons and operational managers, potential participants among the health professionals were identified. A nursing manager may oversee not only the obstetrics and maternity wards but may also oversee several other wards. The manager of a ward is usually

an operational manager with several professional nurses and nursing assistants and student nurses reporting to this person. Medical doctors (or medical practitioners) specialising in obstetrics as well as environmental health practitioners were also targeted as it was assumed that HCRW formed part of their scope of practice at each study site.

3.3 Sampling technique

The study initially targeted a sample 27 hospitals but only 15 hospitals responded with approval letters during the data collection timeframe (November 2017 to January 2019), which means that 56% of the envisaged HE sample participated in this study. The survey questionnaire was disseminated to 75 health professionals (15 hospitals x 5 questionnaires for each HC worker categories) for their voluntary participation. However, 12 questionnaires were not completed as only 63 of the 75 questionnaires were returned. This was an acceptable return rate of 84%.

Table 3.1: Sample site representation (n=63)

District	Frequency	Percentage %
Johannesburg District	8	12.70
Tshwane District	32	50.79
West Rand District	10	15.87
Ekurhuleni District	8	12.70
Sedibeng District	5	7.94
Total	**63**	**100**

Table 3.1 shows that the sample representation was 50.79% forTshwane,15.87% for West Rand, and 12.70% each for the Johannesburg and Ekurhuleni districts. Sedibeng had a 7.94% representation. Table 3.1 and the tables that follow indicate a sample size of 63, unless otherwise stated. Table 3.2 shows the distribution of each category of the respondents that formed part of the sample, as was listed above. The lowest number of questionnaires was completed by medical practitioners (11.11%), while the majority was completed by professional nurses.

Table 3.2: Representation of the five categories of health professionals participating in the study (n=63)

Categories of health professionals	Frequency	Percentage %
Matron/nursing supervisor/operational manager	13	20.63
Professional nurse	16	25.41
Nursing assistant	13	20.63
Medical practitioner	7	11.11
Health care risk waste officer / environmental health practitioner	14	22.22
Total	**63**	**100**

Table 3.3 indicates the number of questionnaires per government hospital that was returned.

Table 3.3: Total questionnaires returned per sample site (n=63)

Sample Site (15 of the original 27 targeted HEs)	Frequency of Returned Questionnaires	Percentage %
1	4	6.35
3	5	7.94
5	5	7.94
8	4	6.35
10	4	6.35
12	4	6.35
14	5	7.94
15	4	6.35
19	5	7.94
20	1	1.59
21	5	7.94
23	4	6.35

25	5	7.94
26	5	7.94
27	3	4.73
Total (15 sample sites)	**63**	**100**

The stratified sampling technique was applied.

3.3.1 Appointment and training of a research assistant

During the pilot project, initial support was needed and one assistant was trained and familiarised with the questionnaire. This assistant was key in the interviewing process as well as the administration of the questionnaire to the recruited pilot participants from three participating hospitals. This function had to be performed in a setting where staff work 24-hour shifts. As a result the communication with the HEs from/with the three hospitals was challenging. Following the completion of the pilot study, the assistant was unable to proceed. In response a contact person was identified at each hospital who distributed and collected the questionnaires. The interview questionnaire was adapted, distributed and processed as a standard questionnaire.

A specialist statistician was responsible for the descriptive data processing that are reported in the tables and graphs. Her appointment letter is also presented as appendix D. Due to the exploratory nature of the investigation no inferential data processing was done.

3.3.2 Pilot study

A pilot study was undertaken to ensure that the questionnaire that had been developed was easy to understand. Data were collated and minor grammatical changes were made to the questionnaire after which the updated questionnaire was used to collect the data. The data collected during the pilot study was included in the total data set of the research. The researcher compiled the data bank using a personal laptop computer. The questions in the questionnaire were coded ranging from 001 to 401), depending on the number of options. The researcher checked that every answer according to its corresponding code was completed in the coding

blocks. Each completed questionnaire was coded with an identification number ranging from 1 to 75. The incomplete questionnaires that were part of this coding system were just ignored to arrive at a total questionnaire response rate of 63. After the completed questionnaires had been coded, a coding table was developed. Data were analysed and assistance was provided by a statistician using SAS Version 9.2.

The first three hospitals that had agreed to participate in the study were also used to conduct the pilot study. This was done to ensure that the questionnaire questions would be appropriate and easily understood. The respondents completed the pilot questionnaires and a research assistant facilitated it, as was mentioned above. The pilot was conducted at three hospitals and 15 health professionals participated in it over a six-month period (from November 2017 to April 2018). Minor grammatical improvements were made to the questionnaire. The information collected from the pilot participants was deemed sufficient and appropriate and was included in the study's overall data set.

It must be reiterated that, due to the small sample size of the pilot study and the fact that only the descriptive responses of the participants' responses were processed.

A limitation in the questionnaire, which was not to include questions that focused on the designation of the participants specifically was not identified. This shortcoming was corrected in the final questionnaire. The questionnaire was designed in seven sections, each formulated to obtain data regarding placenta health management in the hospital setting and in the community environment. The following apply:

- Section A: Demographic information (3.5.1).
- Section B: Patient and birth information (3.5.2)
- Section C: Placenta management at the hospital (3.5.3)
- Section D: Placenta management outside the hospital (3.5.4)
- Section E: Traditions and beliefs (3.5.5) etc

- Section F: General knowledge (3.5.6) etc
- Section G: Training (3.5.7).etc

The questionnaire (appendix A) was administered from November 2017 to January 2019. Sixty-three (63) of the seventy-five (75) questionnaires that had been distributed were returned, which equates to a cumulative return rate of 84%. Since the language of preference during the training of HEs was English and also because English is standard communication language within the hospital setting, health practitioners were assumed to be fluent in English. As a consequence the questionnaire was compiled in English. Due to the unique nature of the subject matter, plain language and brief, succinct questions were posed. Appendix A indicates that the questionnaire was presented in seven parts. As the researcher had to visit the hospitals at least four to six times and given the time and distance that had to betravelled between the various hospitals (Fig.1.2), a period of 16 months was set aside to gather the data.

3.3.3 Data and interpretation

Using a personal laptop computer, the researcher collated the data bank. An identification number ranging from 0001 to 0075 was coded for each questionnaire that had been sent out. A table was created after the completed questionnaires (63) had been returned and the descriptive data were analysed using SAS Version 9.2 by a trained statistician.

After the data had been analysed by the statistician, the researcher manually tested the accuracy of the data set to ensure the reliability of the data processing process. Fractions, proportions, and percentages of the data were determined. For the results, conclusions, and recommendations, the researcher scrutinised and evaluated the data that are presented in tables in this thesis.

3.4 Section A: Demographic information

Demographic questions were included to enable the researcher to identify the area where the questionnaires were completed. Different experiences as per the location of the health facilities (e.g., rural vs urban) could thus be established.

Table 3.4 shows that the sample was mainly representative of the Tshwane District as 32 (50.79%) of the respondents came from facilities in this region. The lowest representative sample was from the Sedibeng District as only 5 (7.94%) Health Professionals from this district completed and returned the questionnaire.

Table 3.4: Health districts represented by the respondents

Districts	Frequency	Percentage %
Johannesburg District	8	12.70
Tshwane District	32	50.79
West Rand District	10	15.87
Ekurhuleni District	8	12.70
Sedibeng District	5	7.94
Total	**63**	**100**

3.4.1 Hospitals represented in the study

The highest representation was from the Tshwane district with 19 study sites (50.7%) (Table 3.4). Figure 3.2 illustrates the different levels of hospitals that were represented in the study as the overall study site. The graph indicates that the highest category was district hospitals.

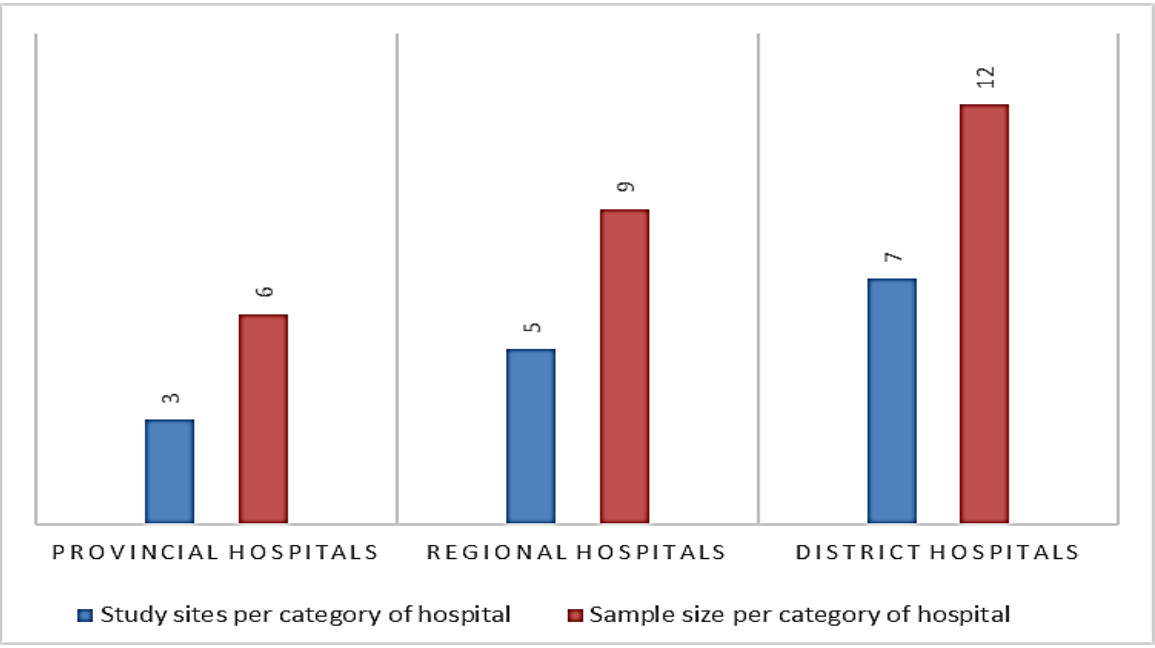

Figure 3.2: Representation rate of the different category of hospitals in the study

A nearly equal rate of representation was achieved for four of the five participant categories (Table 3.4), but the medical practitioners had a low representation rate (7 or 11.11%). Medical doctors felt that health care risk waste management was not their responsibility, that they were too busy to complete the questionnaire, that they were not willing to be represented, that they were not available after appointments had been made, and that they were not at work or were on rounds and therefore not available. The medical practitioners who were represented felt that the content of the questionnaire was relevant and that it triggered their interest in this field of study.

3.4.2 Designation of the respondents per category

The respondents were categorised according to their designations:(1) matron/nursing supervisor/operational manager;(2) professional nurse, (3) nursing assistant, (4) medical practitioner, and (5) health care waste officer/ environmental health practitioner (Table 3.5).

Table 3.5:Designation of respondents (n=63)

Categories of staff in health establishments	Frequency	Percentage %
Matron/nursing supervisor/operational manager	13	20.63
Professional nurse	16	25.41
Nursing assistant	13	20.63
Medical practitioner	7	11.11
Health care risk waste officer / environmental health practitioner	14	22.22
Total	**63**	**100**

3.4.3 Coding of hospitals

Hospitals (government owned in this study) means a place where people who are ill or injured are treated and taken care of by health professionals (Cambridge Dictionary, 2020). Only government owned hospitals were sampled. The total number of hospitals (27) that were targeted was coded but only the 15 hospitals (study sites) from which completed questionnaires were received are listed in Table 3.6.

Table 3.6: List of coded participating hospitals and frequency of representation by the respondents (n=63)

Code number	Participating hospital	Frequency	Percentage %
1		4	6.35
3		5	7.94
5		5	7.94
8		4	6.35
10		4	6.35
12		4	6.35
14		5	7.94
15		4	6.35

19		5	7.94
20		1	1.59
21		5	7.94
23		4	6.35
25		5	7.94
26		5	7.94
27		3	4.73
Total		**63**	**100**

3.4.4 Discussion: Demographic information

The demographic information revealed that the Tshwane District had the highest rate of participation (19 or 50.7%) (Table 3.4). The group of participants with the highest response rate was professional nurses, with medical practitioners representing the lowest responses rate (Figure 3.2). Table 3.6 lists the number of participants per hospitals (63 participants in total). Of these, 8 were from provincial, 14 were from regional, and 19 were from district hospitals.

3.5 Section B: Patient and birth information

Patient and birth data were collected from hospital files/data to determine the average age of patients who had given birth in the month preceding data collection (the data set did not distinguish between live and dead births) and to determine how many single or twin births had occurred. This data assisted in determining the total placenta weight generated at the health establishments under study.

The largest group of patients giving birth was aged between 26 and 35 years (22, 34.92%) (Table 3.7). No births were recorded for the age group 41 and older and between 10 to 16 years. These data may be inconclusive as just more than half of the health professional respondents addressed this question while the other half did not respond to it, probably as they did not have ready access to the data. It may also be possible that those who did respond relied on their memory and that they did not consult actual data in the files, as this would have been time consuming.

Table 3.7: Age categories of birth mothers in the month preceding data collection (n=63)

Age categories of birth mothers	Frequency	Percentage %
10 to 16 years	0	0
17 to 21 years	1	1.59
22 to 25 years	4	6.35
26 to 30 years	12	19.05
31 to 35 years	10	15.87
36 to 40 years	4	6.35
Older than 41 years	0	0
Question not completed	32	50.79
Total	**63**	**100**

However, the finding that most birth giving mothers were between 26 and 36 years old (Table 3.7) correspond with a study by Bellieni (2016), who determined that the best fertility age is approximately 15 to 44 years (United Nations, n.d.(a); Bewley, 2005; Painter, 2018; Statistics South Africa, 2019). In an article in *USA today* by Painter (2018), it is argued that most babies are born to mothers between the ages of 20 to 30. The author states that birth rates have fallen except for the age group of women in their 40s (Painter, 2018). The annual number of live births is defined as "the number of live births taking place in a certain country or area during a year" (United Nations, n.d.(b); World Health Organisation, n.d.; Campana, 2017).

Table 3.8: Number of births per month, including still births and miscarriages (n=63)

Number of Births	Frequency	Percentage %
Not answered	26	41.27
01 to 10	3	4.76
11 to 20	0	0
21 to 30	0	0

31 to 40	0	0
41 to 50	9	14.29
More than 51 (please specify, e.g., 51 to 699)	25	39.68
Total	**63**	**100**

Table 3.7 shows that more than 51 (25, 39.68%) births were recorded each month. The age group 41 to 50 years was selected by 9 (14.29%) of the respondents and only 3 (4.76%) indicated 5 to 10 births a month. A total of 26 (41.27%) respondents did not complete this question and thus the data are inconclusive. This may be attributed to the fact that these respondents did not have access to the official data and thus did not wish to guess.

A Statistics South Africa (2018) report reveals the number of births registered provincially and per district (municipality) in Gauteng, but no mention is made of twin births.

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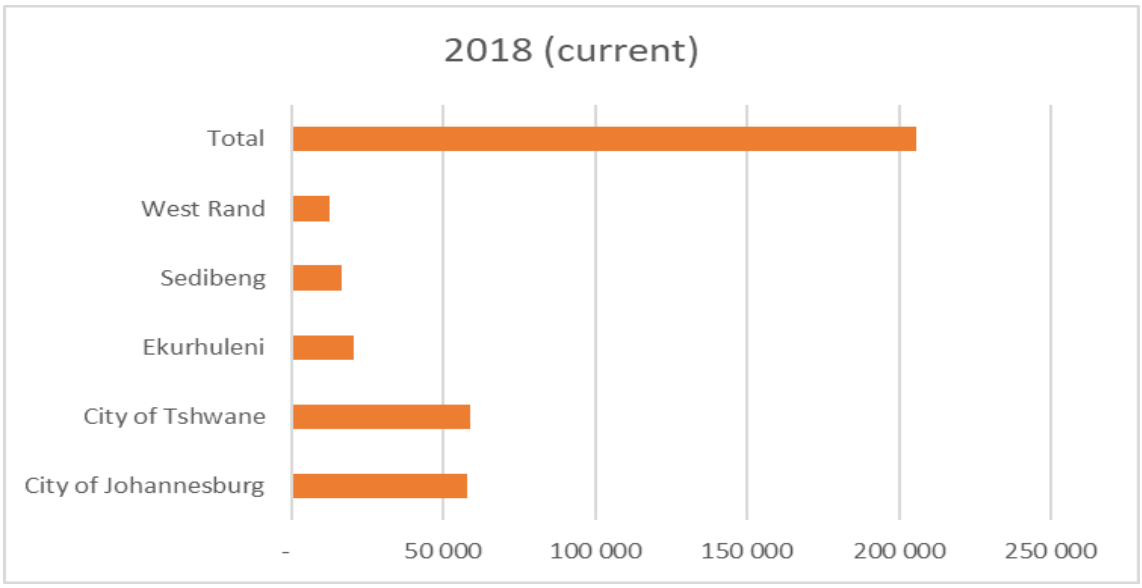

Figure 3.3: Total birth registrations for 2018[2] with breakdown into districts

Source: Department of Statistics, 2018

[2]2019/2020 data were not available at the time of the study

When the number of births per month was investigated (Table 3.7), it was found to be much higher than anticipated. An average birth rate per month of between 51 and 699 (Table 3.8) (25, 39.68%) was indicated, but the exact number of births was unclear. This corresponds with an article based on the Gauteng Health Department (2019) which states: “By lunchtime on the first of January 2019, over 106 babies had been born in public health facilities around Gauteng Province”. Although most data could be found in the monthly statistical report that is routinely submitted, it was evident that lower ranking officials in the health care sphere did not know what the total monthly birth rate was. It was also obvious that, in some hospitals, twin births were not a frequent occurrence (Table 3.9). This may be attributed to the fact that most of the hospitals under study were district hospitals (Figure 3.3) and they may rarely have assisted with twin births as twin birth is classified as a complicated issue and thus twin pregnancies are referred to regional or tertiary hospitals (South Africa. National Department of Health, 2015; South Africa. Department of Health KwaZulu-Natal, 2018; Chopra, Daviaud, Pattinson, Fonn & Lawn, 2009; Emergency delivery of twins in KZN, 2018; Western Cape Government, 2020).

Table 3.9: Average number of twin births per month

Twin births per month in 15 Gov/Provincial hospitals	Frequency	Percentage %
0	7	11.11
1	6	9.52
2	6	9.52
3	3	4.77
4 to 5	7	11.11
6 to 7	5	7.94
8 to10	6	9.52
More than 10, please specify	5	7.94
Question not completed	18	28.57
Total	63	100

The data in Table 3.9 are also vague and twin births could not be clearly established. As the information could not be analysed, these data are inconclusive as a total of 18 respondents (representing 28.57%) did not complete this question.

According to Huggies (n.d.), a company that manufactures disposal nappies, twin births account for more than 90% of multiple births and far outnumber triplets or quads. The company states that only 3% of all the babies born come in multiples. The main reasons for twin births are assisted fertility techniques, the number of couples undergoing reproductive assistance, as well as the specialised care of premature babies. The reason that this information was sought was the understanding that multiple births are traditionally and culturally viewed as different from single births, and this might impact the manner in which the placenta is treated. However, due to a lack of clear data, this was beyond the scope of the study.

According to Statistics South Africa (2019), the highest number of births in 2018/2019 was recorded in Gauteng. Figure 3.4 shows the total registered births as reported in 2019. Most births occurred in Gauteng at 23% of the total number of births of 1 009 065. This includes the total number of births that were registered in 2018, which was 927 113, including 81 952 late registrations. Unfortunately, no mention is made of twin births (Statistics South Africa, 2019).

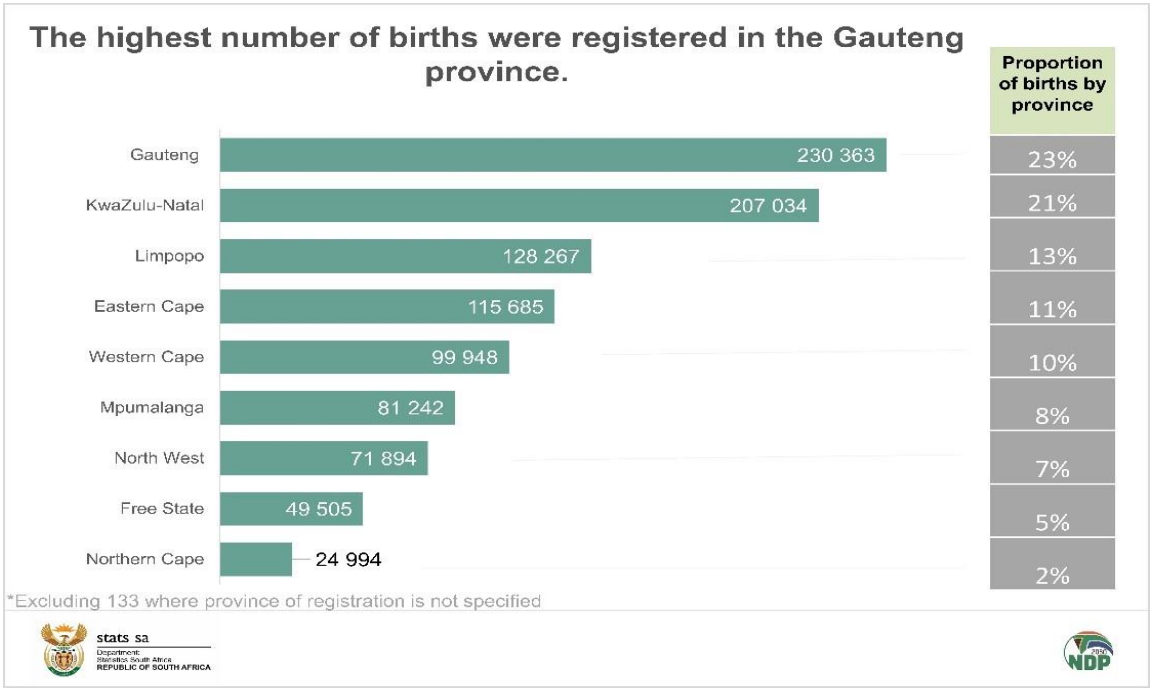

Figure 3.4: Highest to lowest number of births in 2018

Source: Statistics South Africa, 2019

In terms of patient and birth information, the respondents indicated that birth mothers were mostly in the age group 26 to 36 years (Table 3.7). This corresponds with a study by Bellieni (2016), who argues that the most prevalent fertility age is approximately 15 to 44 years. An article in the *United States of America Today* (Painter, 2018) states that most babies are born to mothers aged between 20 to 30, and that birth rates have fallen except for women in their 40s. The annual number of live births is defined as the number of live births in a certain country or area during a year (United Nations, n.d.(a); World Health Organization, n.d.; Geneva Foundation for Medical Education and Research, 2017).

When the number of births per month was investigated (Table 3.8), it became apparent that higher birth rates were revealed by the respondents than had been anticipated by the researcher. Of the 63 respondents, 25 (39.68%) stated that between 51 and 699 (Table 3.8) births had occurred, but these numbers were unspecified. The Gauteng Department of Health (2019) stated in an article that, by lunchtime on 1 January 2019, over 106 babies had been born. This suggests that,

if this trend continued, in the region of 3 000 babies were born in January alone. Although most data about births could only be traced in monthly statistical reports that are routinely submitted, it was evident that neither lower ranking health officials nor doctors knew accurately what the total monthly birth rates were. It was also obvious that twin birth was not a frequent occurrence in some hospitals, as is shown in Table 3.6. As was stated earlier, this was attributed to the fact that most hospitals under study were district hospitals (Figure 3.2) that would rarely have assisted with twin births.

3.6 Section C: Placenta management at the hospitals

This section focuses on hospitals' internal placenta management procedures and administrative compliance. The management of pathological waste in health establishments should be rigorously regulated and compliance is required from a pollution prevention perspective. It is also the generator's responsibility to manage pathological waste in a legally compliant manner.

Table 3.10 indicates that 61 (96.83%) of the hospitals under study did have an official placenta register. Only one (1.59%) respondent indicated that the facility did not have such a register and one did not supply an answer.

Table 3.10: Availability of a placenta register at the facility (n=63)

Availability of a register.	**Frequency**	**Percentage %**
Yes	61	96.83
No	1	1.58
Not sure	0	0
Question not completed	1	1.58
Total	**63**	**100**

The data in Table 3.11 indicate that all the hospitals under study had a register book in which placenta records were kept. This met the requirement of the Gauteng Health Care Waste Regulations (2004) and the National Health Act to manage

HCRW and human body tissue (Gauteng Health Care Risk Waste Regulations, 2004; South Africa, 2003).

Table 3.11: Alternative record keeping if placenta register is not available (n=63)

Availability of alternative placenta record keeping registrar	Frequency	Percentage %
Nothing	0	0
Have a file in which daily sheets are filled	0	0
Have an official register book	63	100
Have a loose page each day	0	0
Do not know	0	0
Other:(please specify)	0	0
Total	**63**	**100**

Table 3.12 indicates that 44 (69.84%) respondents indicated that a placenta register or book was kept in the maternity ward while 11 (17,47%) of the respondents indicated specifically that the register was kept at the nursing station. Keele University Medical School (2017) developed a human tissue handling guideline for the appropriate record management of human tissue at registered generators' sites. This school confirms the importance of keeping records and implementing a record of management procedures to ensure compliance with legislation. This document also refers to a specific template that must be used, underscores the request by 23 (36.51%) respondents (see Table 3.6) for a standardised consent form to record patients' request to dispose of the placenta at home.

The import and export of human tissue is also regulated by means of a human tissue register. Cipparone and Nathan (1981) state that, as far back as 1981,an analysis of the first 500 cases was submitted to the Placental Tissue Register, which indicates that this is not a new phenomenon.

Table 3.12: Location where the placenta register is kept (n=63)

Placenta register locality	Frequency	Percentage %
CEO's office	0	0
Maternity ward	44	69.84
Matron's office in the maternity ward	1	1.59
Nursing station in the maternity ward	11	17.47
In the intermediate storage area of the maternity ward	2	3.17
Infection control office	0	0
Slush room	1	1.59
Other (please specify):	2	3.17
Question not completed	2	3.17
Total	**63**	**100**

3.6.1 Types of containers used for placentas

Specican containers are red in colour, bucket shaped, have a solid lid, and are usually round, disposable, and puncture resistant. When sealed, such a container cannot accidently be opened as it is provided with a locking system (a two-phase clip-in system) It is spill proof under normal handling conditions and is used for the storage, refrigeration, and transportation of placentas. The container is made of high-density polyethylene (HDPE) and should be able to withstand temperatures of lower than -5℃. Labelling is done in accordance with the labelling requirement of SANS 10248-1:2008 and these containers adhere to all requirements as listed in Schedule 1 for the minimum requirements for packaging of HCRW in terms of regulation 9(2) of the Gauteng Health Care Risk Waste Regulations (2004).The international ISO biohazardous symbol must be displayed on these containers (SANS, 10248-1:2008a:21-28; Gauteng Health Care Risk Waste Regulations, 2004:10,34; Gauteng Department of Health, 2013:20,81-82).

These containers are available in different sizes and the size is determined by generation rates as well as the size of the freezing facility availability. Figure 3.5 shows the different available sizes.

Figure 3.5: Specican containers of various sizes
Source: Compass Waste, 2020

Table 3.13 lists the containers used in the hospitals under study. Ideally the placenta is placed in a first liner or plastic bag and then into a Specican. This procedure was followed in the majority of HEs as it was confirmed by 39 (61.90%) of the respondents. Fewer (10, 15.87%) placed the placenta directly into the Specican and 7 (11.11%) placed it in a liner/plastic bag. In some cases (3, 4.77%) the placenta was placed in a kidney dish and then in a Specican or plastic bag.

Table 3.13: Type of container/receptacle used for placentas (n=63)

Container types for initial storage of placentas	Frequency	Percentage %
None	0	0
Directly into Specican	10	15.87
Cardboard box	0	0
Liner/plastic bag	7	11.11

First in liner/plastic bag and then in a Specican	39	61.90
None of the above	0	0
Other, please specify:	3	4.77
Question not completed	4	6.35
Total	**63**	**100**

The time it takes after birth to placing the placenta in a suitable container is important for reasons of hygiene. Table 3.14 indicates that 10 (33.33%) participants agreed that the placenta was placed in a Specican within 10 minutes after birth, while 12 (19.05%) of the respondents stated that it took between 10 to 30 minutes to place the placenta in the Specican. A low percentage (6.34%) stated that it took more than 30 minutes to safely contain the placenta. The longer timeframe for the containment of placentas was attributed to theatre procedures such as a Caesarean section (C-section) to deliver a baby through incisions in the abdomen and uterus (Mayo Clinic, 2020). Only 4 (6.35%) of the respondents did not complete this question.

When risk ranking is applied, a medium risk was identified as only 21 (33.33%) of the respondents (Table 3.14) indicated that it took less than 10 minutes to contain the placenta in a Specican. Time delays can occur due to procedural processes during which the focus of the medical practitioner and professional nurse is to ensure that both the patient and infant are taken care off. Moreover, some procedures as indicated by 4 (6.34%) of the respondents take more time when births are assisted in theatre, and theatre procedures are longer than normal births in a ward.

Specicans are manufactured and distributed worldwide in different sizes to accommodate customers' needs. Different manufacturing technologies such as blow moulding or injection moulding using materials such as polyethylene and polypropylene with virgin plastic materials are used in different percentages to achieve various SANS requirements (such as for sharps containers – SANS 452:

2008) that address strength, durability, puncture resistance, and the ability to withstand below freeze point temperatures (SANS452:2008; Health Care Waste Management Policy for KwaZulu-Natal, 2008; Gauteng Health Care risk Waste Management Tender Specification, 2020). It is noteworthy that 26 of the respondents did not answer this question. This may be attributed to the fact that the designation of some participants did not expose them to direct birth procedures.

Table 3.14: Time taken to deposit the placenta into a Specican (n=63)

Time profile for placing of placentas in storage	Frequency	Percentage %
Within 10 minutes	21	33.33
Between 10 – 30 minutes	12	19.05
Longer than 30 minutes	4	6.34
Question not completed	26	41.28
Total	**63**	**100**

The respondents were requested to indicate if multiple placentas were placed in a Specican or cardboard box (Table 3.15). Only 2 (3.17%) indicated that no more than one placenta would be placed in a Specican, whereas the vast majority (92.06%) indicated that more than one placenta would be contained in a Specican (or other container).

Table 3.15: Number of placentas placed in a Specican/container (n=63)

Number of placentas in Specican	Frequency	Percentage %
Yes	58	92.06
No	2	3.17
Question not completed	3	4.77
Total	**63**	**100**

When asked how many placentas would be placed in one container (Table 3.16), it was revealed that between 6 to 20 placentas, and sometimes even more, would be

placed in one container. Only 5.17% indicated that one to five placentas would be placed in one container. Fifteen (23.82%) of the respondents did not complete this question.

Specicans or similar containers should be leak-proof and puncture-resistant (Infection Control Today, 2009; Bio Intelligence Service, 2011; Suwannee, 2002; United Nations, 2017; World Health Organization, 2014). Motlatla (2015), the United Nations Environmental Programme (UNEP) (2003), and the World Health Organization (WHO) (1999) also refer to the importance of correct classification of HCRW and the correct containerisation. Understanding the hazardous nature of the type of HCRW and the importance of correct containerisation during transportation is thus vital.

An astonishing 58 (92.06%) of the respondents indicated that more than one placenta would be placed in a Specican. However, each placenta would be individually packed in a plastic bag/liner before it is placed in the Specican (Tables 3.15 to 3.17). When calculating the number of placentas generated, a close correlation between 6 to 10 and 16 to 20 placentas was evident. This could be due to the different sizes of Specican containers available at hospitals. A Gauteng Department of Health tender specification (GT/GHD/168/2013) lists the following:

- 2.5 litres square Specican container
- 5 litres rectangular (square if 2.5) Specican container
- 10 litres rectangular Specican container
- 20 - 25 litres rectangular Specican container.

Table 3.17 indicates that 59 (93.66%) of the respondents stated that placentas were packed in separate plastic bags before they would be placed in a Specican, while four respondents stated that they were not, or only rarely, packed in plastic bags.

Table 3.16: The number of placentas placed in one container (n=63)

Number of placentas in one container	Frequency	Percentage %
1-5	3	4.76
6-10	20	31.74
11-15	7	11.11
16-20	13	20.63
More than 20	5	7.94
Question not completed	15	23.82
Total	**63**	**100**

Table 3.17: Placentas individually packed in small plastic bags before placed in the Specican (n=63)

Number of placentas packaged in plastic bags.	Frequency	Percentage %
Yes	59	93.66
No	2	3.17
Sometimes	2	3.17
Total	**63**	**100**

Table 3.18 indicates that 54 (85.71%) of the respondents agreed that the facility where they worked had a sufficient stock of placenta bags/liners and that they were

Table 3.18: Ready availability of stock of placenta bags/liners (n=63)

Availability of placenta bag liners	Frequency	Percentage %
Yes	54	85.71
No	3	4.76
Sometimes	4	6.35
Question not completed	2	3.18
Total	**63**	**100**

readily available. Only 4 (6.35%) indicated that there was sometimes enough stock of placenta bags and 3 (4.76%) indicated that there were never enough bags available.

In response the question whether the placenta was weighed at birth (Table 3.19), 42 (66,67%) indicated that this was indeed the case.

Table 3.19: Is every placenta weighed? (n=63)

Mass determination of placentas	Frequency	Percentage %
Yes	42	66.67
No	12	19.04
Sometimes	4	6.35
Question not completed	5	7.94
Total	**63**	**100**

Twelve (19.04%) of the respondents indicated that the placentas were not weighed and 6.35% indicated that it was sometimes weighed.

3.6.2 Storage of placentas

According to the Gauteng Health Care Risk Waste Management Regulations (2004), special requirements must be met regarding the correct storage of placentas. The data in Table 3.20 indicate that 63 (98.41%) of the respondents indicated that placentas were stored in a refrigerator/freezer. Only one (1.59%) indicated that they did not store the placenta in a refrigerator or freezer before collection.

Table 3.20: Storage of placentas in a refrigerator or freezer (n=63)

Cold storage of placentas in freezer	Frequency	Percentage %
Yes	62	98.41
No	1	1.59

Sometimes	0	0
Total	**63**	**100**

3.6.3 Access control to freezer areas

Placentas are categorised as pathological waste and must therefore be secured and refrigerated as prescribed by the Gauteng Health Care Risk Waste Management Regulations (2004). Table 3.18 indicates that 52 (82.54%) of the respondents stated that there was access control to the freezer area. However, 7 (11.11%) respondents indicated in that there was no access control to the freezer area, while only 2 (3.17%) indicated that access control was sometimes in place.

Table 3.21: Access control to the freezer area (n=63)

Access control to placental freezer area	Frequency	Percentage %
Yes	52	82.54
No	7	11.11
Sometimes	2	3.17
Total	**63**	**100**

3.6.3.1 Record keeping of freezer temperatures

Hospitals are provided with refrigeration facilities such as chest freezers. These

Table 3.1: Daily recording of freezer temperatures (n=63)

Are freezer temperatures recorded daily?	Frequency	Percentage %
Yes	20	31.75
No	36	57.14
Question not completed	7	11.11
Total	**63**	**100**

freezers are not industrial freezers and are not fitted with exterior thermometers for temperature monitoring purposes. The Gauteng Health Care Risk Waste Regulations, Section 3 (6)(c), requires a stable temperature of -2ºC.

This question was posed to determine if alternative temperature measurements were in place and, if so, how this was done. Table 3.22 shows that 36 (57.14%) of the respondents indicated that the temperatures of freezers were not recorded, while 20 (31.75%) of the respondents indicated that temperatures were recorded.

3.6.3.2 Storage of placentas without refrigeration

Section 3(6)(c) of the Gauteng Health Care Risk Waste Management Regulations (2004) prescribes the storage timeframes for pathological waste. This question to determine the 24-hour requirement was breached or adhered to (Table 3.23). The results indicated that the maximum storage time of placentas was not well known, as 21 (33.33%) of the respondents did not know the timeframe. Only 23.81% of the respondents indicated that the maximum storage time for placentas was12 hours

Table 3.2: Maximum storage time of placentas if refrigeration is unavailable (n=63)

Storage time for placentas	Frequency	Percentage %
12 hours	15	23.81
24 hours	3	4.76
36 hours	1	1.59
48 hours	0	0
72 hours	0	0
90 days	0	0
Do not know	21	33.33
Other, please specify:	14	22.22
Question not completed	9	14.29
Total	**63**	**100**

while 14 (22.22%) indicated that they wanted to specify a timeframe, which indicated that they were not sure. Nine (9), (14.29%) of the respondents did not complete this question.

3.6.4 Collection methodology by contracted service provider

The method of placenta collection was investigated to determine if the health professionals were aware of the procedures and of current contracted service providers. Table 3.24 reveals that 53 of the respondents (84.13%) knew that a contracted service provider needed to be appointed to collect placentas and other medical waste. However, there were various uncertainties regarding the exact practices used by service providers when collecting placentas in a Specican (Table 3.22, Table 3.25, Table 3.26).

Table 3.21 shows that 53 (84.13%) of the respondents indicated that a contract with an external service provider was in place. However, 7 (11.1%) indicated that they did not know if there was a contract with an external contractor for placenta disposal.

Table 3.3: Placenta collection contract with an external service provider (n=61)

External service provider	Frequency	Percentage %
Yes	53	84.13
No	1	1.59
Do not know	7	11.11
Question not completed	2	3.17
Total	**63**	**100**

Table 3.25 shows that 24 (38.10%) knew that placentas were collected along with other health care risk waste, whereas 22 (34.92%) did not know how placentas were collected or by whom. Thirteen (20.63%) of the respondents indicated that placentas were collected separately by a contractor. Only 4(6.35%) of the respondents did not complete this question.

Table 3.4: Collection method of placentas (n=59)

Collection method for placentas	Frequency	Percentage %
Collected along with other health care risk waste	24	38.10
Collected separately by the contractor	13	20.63
Do not know	22	34.92
Other (please specify):	0	0
Question not completed	4	6.35
Total	**63**	**100**

3.6.4.1 Storage of unfrozen placentas

Section 3(6)(c) of the Gauteng Health Care Risk Waste Management Regulations (2004) prescribes the storage timeframe for pathological waste as 24hours if not stored at -2ºC.Where storage is at -2ºC, the storage time must not exceed 90 days. This question determined if placentas were stored at -2ºC or not before collection by contracted service providers.

Table 3.5: Freezing of placentas before collection (n=61)

Are placentas frozen prior to collection?	Frequency	Percentage %
Yes	59	93.65
No	1	1.59
Sometimes	1	1.59
Question not completed	2	3.17
Total	63	100

Table 3.26 shows that 59 (93.65%) of the respondents were aware that placentas were frozen before collection by an external company. One (1.59%) respondent indicated that it was not collected in a frozen state by an external company. Two (3.17%) of the respondents did not complete this question.

When investigating the requirement to refrigerate or freeze placentas (Tables 3.22, 3.23, 3.26 and 3.27, it was found that the temperatures of refrigerators were not recorded or monitored and that the storage times in freezers were not monitored in a number of cases. However, it was noted that the majority (93.65%) of the respondents did know that placentas should be frozen before collection. However, where freezing facilities were not available or not working, the participants were unaware of alternative measures. Only a few respondents (15, 23.81%) indicated that placentas were kept in the health care waste refrigerator if not frozen (Table 3.24).

Table 3.27: Storage of unfrozen placentas (n=42)

Methods to store unfrozen placentas	Frequency	Percentage %
In a Specican on the floor of the slush room	0	0
In the office of a staff member	0	0
In the kitchen refrigerator	0	0
In the main storage area	1	1.59
In the health care waste refrigerator	15	23.81
In the mortuary	7	11.11
Do not know	12	19.05
Other, please specify:	7	11.11
Question not completed	21	33.33
Total	**63**	**100**

3.6.4.2 Procedure when freezer or storage area is full

Section 3(6)(c) and Schedule 9 of the Gauteng Health Care Risk Waste Management Regulations (2004) prescribe the storage requirements for pathological waste. This question was posed to determine if best practices prevailed when storage facilities were not available or when they were full.

Some respondents (19, 30.16%) indicated that the service provider was contacted on a day when the freezers were full (Table 3.28). Fourteen (22.22%) of the respondents indicated that they contact the contracted service provider when the freezer/storage area was full. Eleven (17.46%) of the respondents indicated that they stored placentas in the mortuary when the freezer/storage area was full. Nine (14.29%) of the respondents indicated that they did not know, as they were not involved in the final placenta management process.

Table 3.28: Actions taken when the freezer or storage area is full (n=63)

Timing for action when storage is inadequate	Frequency	Percentage %
Only when it is ¾ full	1	1.59
Sometimes	2	3.17
No	5	7.93
None of the above. Please specify what you do.	9	14.29
It is placed in the mortuary	11	17.46
Yes	14	22.22
Service provider comes on a specific day of the week	19	30.16
Question not completed	2	3.17
Total	**63**	**100**

3 .7 Collection of placentas

Section 3(6)(c) of the Gauteng Health Care Risk Waste Management Regulations (2004) prescribes the timeframes for the storage of pathological waste. This question was posed to determine if the 24-hour storage requirement was breached or adhered to. Table 3.29 shows that 12 (19.05%) of the respondents indicated daily collection, whereas 12(19.05%) indicated that the placentas were collected twice a week. Only 5 (7.94%) of the respondents indicated that collection was requested on a call basis made to the service provider.

Taslimi, Batta and Kwon (2020) describe various logistical problems associated with pathological waste collection, such as using vehicles with an inadequate load capacity, risky collection routes, too large volumes, and infrequency of collection.

Table 3.29: Frequency of placenta collection per week (n=63)

Placenta collection frequency	Frequency	Percentage %
Never	0	0
1(once)	9	14.29
2 times	12	19.05
3 times	8	12.69
4 times	0	0
5 times	1	1.59
6 times	1	1.59
Daily	12	19.05
Call basis	5	7.94
Other, please specify:	10	15.87
Question not completed	5	7.94
Total	**63**	**100**

Shihand Lin (2003) and Shih and Chang (2001) also describe route and timeframe problems. According to Alagöz and Kocasoy (2008), the handling of health care risk waste is one of the most important environmental problems in Turkey. They state that approximately 25 to 30 tons of HCRW is generated at hospitals and clinics daily on the European and the Asian sides of İstanbul. The study highlights problems with handling and lament the fact that there is no systematic program for the transportation of HCRW to final disposal sites.

Table 3.30 shows that 47 (74.60%) of the respondents expressed satisfaction with the frequency of collection of placentas, while 12 (19.05%) of the respondents did

not know what the collection frequency was. Four (6.35%) of the respondents did not complete this question.

Table 3.30: Satisfaction with the collection frequency of placentas (n=59)

Are you satisfied with the frequency of collection of placentas?	Frequency	Percentage %
Yes	47	74.60
No	0	0
Do not know	12	19.05
Other, please specify:	0	0
Question not completed	4	6.35
Total	**63**	**100**

3 .7.1 Handling and disposal of placentas

Table 3.31 shows that 48 (76.18%) of the respondents did not know what happened to the placenta after collection by the contractor. A concern is that in Table 3.30 the majority of the respondents (74.60%) indicated satisfaction with the frequency of collection, whereas they were not sure what happened with the placentas after collection. This uncertainty may contribute to unidentified risks in the management of placentas in all hospitals. Also, knowledge of final disposal methods of placentas should be included in a standard operating procedure (SOP) in all hospitals and this should also be addressed during regular training sessions.

Le, Hoboy, Germain, Miller, Thompson, Herstein ... and Lowe (2018) investigated whether workers in health facilities in the USA where medical waste was generated were adequately trained to handle highly infectious waste. The results showed that hesitance to work with highly infectious waste was probably due to the lack of knowledge and training related to highly infectious diseases that such workers could be exposed to. This point is also raised by Aung, Luan and Xu (2019), who found that the correct management of health care risk waste was impacted by a lack of knowledge among and training of health workers. Zamparas, Kapsalis,

Kyriakopoulos, Aravossis, Kanteraki, Vantarakisand Kalavrouziotis (2019) also urge appropriate training programs to enhance staff awareness and skills as an essential aspect in their integrated approach to medical waste management in Western Greece.

Various procedures should be adhered to in the collection process of placentas as well as in incidences where this medical waste is not collected within the specified time. A low percentage of respondents admitted that, in such cases, the placentas were burnt either on (3.18%) or outside (3.18%) the premises of the hospitals. However, the majority either did not know (38.09%) or thought that other disposal measures were then utilised (38.09%). There is evidence of cases where placentas were not collected, failure to issue manifests and safe disposal certificates, and other health-threatening mistakes in the process of releasing and collecting placentas.

Table 3.31: Procedure/s when placentas are not collected by external contractors (n=53)

Non-collection of placentas alternative options	Frequency	Percentage %
Buried on site	1	1.59
Burned in a special place at the hospital	2	3.18
Burned outside the hospital premises	2	3.18
Do not know	24	38.09
Other, please specify	24	38.09
Question not completed	10	15.87
Total	**63**	**100**

3.7.2 Administrative control measures regarding placenta collection

Specific administrative control measures must be in place to ensure effective record keeping, such the issuing of manifests, safe disposal certificates, and retrieval records.

3.7.3 Manifest or safe disposal certificates

This question was posed to determine legal compliance with the provision in section 22 of the Gauteng Health Care Risk Waste Management Regulations (2004) that prescribes the issuing of a manifest or tracking document as proof of treatment and safe disposal of pathological waste.

Table 3.32 shows that 29 (46.03%) of the respondents indicated that administrative controls were in place and that manifest documents were issued. As many as19 (30.16%) of the respondents indicated that they only sometimes received the manifest document, while 6 (9.52%) of the respondents did not complete this question.

Table 3.32: Manifest (collection slip) received upon collection of placentas (n=57)

Placenta deliveries record keeping	Frequency	Percentage %
Yes	29	46.03
No	9	14.29
Sometimes	19	30.16
I do not know what a manifest (collection slip) document is	0	0
Question not completed	6	9.52
Total	**63**	**100**

Further uncertainties are verified by the data in Table 3.33. A major problem was exposed as 22 (34.93%) of the respondents indicated that they did not know if a safe disposal certificate was received from treatment plants. The limited data return in terms of this question may again be attributed to the fact that the questionnaire presupposed that health professionals, whose job descriptions fell beyond the disposal of pathological waste, should have knowledge of the intricacies of disposal measures. This was obviously not the case.

Table 3.33: Safe disposal certificate for the treatment of placentas at a registered incineration plant (n=56)

Registered incineration record keeping	Frequency	Percentage %
Yes	17	26.98
No	17	26.98
Sometimes	0	0
I do not know what a safe disposal certificate is	22	34.93
Question not completed	7	11.11
Total	**63**	**100**

Table 3.33 shows that an equal number of respondents indicated that they received (17, 2.98%) or did not receive (17, 26.98%) manifest documents, thus the results are inconclusive. However, 22 (34.92%) of the respondents indicated that they did not know what a safe disposal certificate was.

Table 3.32 indicates that 46% of the respondents knew what a manifest document was and that they received such documents. This document is a legal document that signifies that the generated health care risk waste was collected by a service provider or contractor, whereas a safe disposal certificate verifies that the waste that was collected was treated by the contractor at an authorised HCRW treatment facility.

Peng, Wu, Wang, Li, Zhang and Wei (2020) report that a book is used in health facilities in Wuhan, China, to keep accurate record of all the Covid-19 generated waste that is collected. They confirm that the management of this waste should be done by specially trained people. Zhang, Wang, Song, Zhang and Wang (2016) completed a study at the Tianjin Industrial Park in China and confirm that the benefits of a manifest system are the following: waste can be tracked; it is an effective tool to keep record of volumes and types of waste; and the flow of the waste stream can be analysed, which contributes to improved waste management. These benefits are not limited to the field of HCRW as a study by Sovacool (2019)

concerning electronic waste recycling demonstrated that a lack of recording and documentation led to the under reporting of electronic waste in Ghana. These points highlight the importance of training to ensure legal compliance with requirements and underscore the importance of accurate data reporting.

Table 3.55 later indicates that 53 (84.13%) of the respondents had been trained in health care waste management. However, it is a matter of concern that retrospectivity or confirmation is not observed in Table 3.32 and Table 3.33. In fact, only 46.03% of the respondents indicated that they knew what a manifest document was and that they were aware of the issuing of such documents. A further concern is that 34.63% of the respondents (Table 3.33) did not know of the existence of a safe disposal certificate. This is in conflict with the findings reflected in Table 3.69 later which indicates cumulatively that 61 (98.83%) of the respondents rated their level of knowledge as average to excellent.

3.7.4 Placentas buried on hospital premises

Chapter 8 of the Gauteng Health Care Risk Waste Management Regulations (2004) prescribes a holistic management system that must be followed. In section 46 it addresses all offences and penalties that can apply if the regulations are breached. It was thus important to determine if an ethical code of conduct directed the actions and practices of Health Professionals in terms of placenta management.

When comparing the results in Table 3.28 with those in Table 3.31 regarding the burial of placentas on hospital premises, the majority of the respondents (60,95.24%) indicated that placentas were not buried on hospital premises, while 3 (4.67%) did not answer the question. This might be because not all the respondents were sure what happened to placentas when service providers did not collect them, as indicated in Table 3.34 where 1 (1.59%) respondent indicated that burial occurred on site.

Table 3.34: Are placentas buried on hospital premises? (n=60)

Placenta burial on site	Frequency	Percentage %
Yes	0	0
No	60	95.24
Sometimes	0	0
If sometimes, please elaborate:	0	0
Question not completed	3	4.76
Total	**63**	**100**

According to Korean folk culture, the placenta is burned using straw, chaff, wood or charcoal near the place where the baby was born until only ashes are left. Depending on the family and the region, the ashes are washed away or buried, usually under a tree (Pilyoung, n.d.).

Burns (2014) emphasises the practice of burial in Australia in her study, stating that the burial of the placenta is the most common way of disposing of it. Burial usually occurs under a special tree or a fruit bearing tree or shrub. Mollagee, (2009), Loke (2013), Knapp, van Bogaert and Ogunbanjo (2008), and Fiossi-Kpadonou, Kpadonou, Azon-Kouanou and Aflya (2015) all refer to taking the placenta home and found no reference regarding the burial of placenta at hospitals.

3.7.5 Patients requesting to take placentas home

Although the Gauteng Health Care Risk Waste Management Regulations (2004) document prescribes various requirements for placenta disposal, no mention is made of the traditional management of placentas when taken home. This suggests that disposal of placentas at home is not regulated or even fully understood.

Table 3.35 shows that 36 (57.14%) of the respondents reported that patients did not want access to the placentas after birth, while12 (19.05%) indicated that patients wanted access to placentas when or after leaving the hospital. Some indicated that

patients sometimes requested the placenta (7.94%), while only 3 (4.76%) of the respondents did not complete this question.

Table 3.35: Request by patients for the placenta when or after leaving the hospital (n=63)

Requests for placentas by departing patients	Frequency	Percentage %
Yes	12	19.05
No	36	57.14
Sometimes	5	7.94
Do not know	7	11.11
Question not completed	3	4.76
Total	63	100

Burns (2014) refers to the importance of the placenta as part of the birth process and the loss that a mother feels when the placenta is discarded and not presented to her, especially when a surgical intervention was necessary. Burns (2014) describes three rituals of disposal, namely placenta burial, 'placentophagy' (consuming the placenta), and lotus birth, which refers to leaving the umbilical cord attached to the placenta until it has dried and detached from the baby with time. Table 3.36 indicates that 44 (53.97%) of the respondents did not know how they could retrieve the patient's placenta when the patient had already left the hospital. Nearly half of the respondents (26, 41.27%) did not complete this question. The responses indicated that it appeared unimportant for the patient to access the placenta after leaving the hospital; however, Table 3.37 contradicts this notion as it indicates that some patients wanted to retrieve their placentas after they had left the hospital.

Table 3.36: Retrieval process of placentas (n=63)

Retrieval process of placentas	Frequency	Percentage %
The service provider must bring it back	0	0
An official from the hospital must stop the truck on its way to the incineration plant	0	0
The police must stop the truck on its way to the incineration plant	0	0
The truck driver must return the placenta	0	0
The nurse on duty must stop the truck before leaving the hospital premises	3	4.76
Don't know	13	20.64
Other, please specify:	21	33.33
Question not completed	26	41.27
Total	**63**	**100**

3 .8 General discussion of the demographic information (3.5.1), Patient and birth information (3.5.2), and placenta management at the hospital

It was evident that administrative requirements were met and that contingency plans were in place in accordance with requirements for placenta registers, weighting, refrigeration, and access control (Tables 3.10 to 3.12, 3.19, 3.20, 3.21). These findings confirmed compliance with requirements as described in section 3 of the National Health Act (South Africa, 2003), which requires every person in charge of a health establishment to keep health records. Chapter 8 of the Act, which refers to the control and use of blood, blood products and gametes in humans, also seemed to be generally adhered to (South Africa, 2003; Pepper, 2012). The majority of the respondents was acquainted with the infection prevention and control (IPC) policy and strategy requirements (2007) as well as the guidelines for the prevention and containment of antimicrobial resistance in South African hospitals (2018), as the majority (39, 61.90%) (Table 3.13) managed the procedure of placing the placenta first into a small liner or plastic bag before containing it in a Specican (Table 3.17). This practice was confirmed as the availability of liners was confirmed by 54

(85.71%) of the participants (Table 3.18). However, a matter of concern is that placentas were still placed directly into Specicans, as admitted by 10 (15.87%) of the respondents, which means that a splash risk existed (Table 3.13). Such a risk is not limited to IPC procedures but will also impact traceability, identification, and the possibility of recovery of a placenta if the patient has been discharged and only desires the retrieval of the placenta upon arrival at home.

In light of risk ranking concerns, a medium risk was identified due to the fact that only 21 (33.33%) of the respondents (Table 3.14) indicated that it took less than 10 minutes to place the placenta in a Specican. They admitted that delays occurred which might have been caused by procedural processes that took the focus of the medical practitioner and professional nurse away from the placenta to ensure that both the patient and infant would be taken care of. An additional factor that impacted a longer time frame for placenta containment could be that some procedures, although in fewer instances (4, 6.34%), occurred in theatre − and it is a known fact that theatre procedures take longer than normal births in a ward.

The majority of the respondents (58,92.06%) indicated that more than one placenta would be placed in a Specican (Tables 3.15 to 3.17). Most confirmed, however, that placentas were individually packed in small plastic bags/liners before they would be placed in a Specican (Table 3.17). However, when the number of placentas was calculated, a close correlation seemed to exist between 6to 10 and 16 to 20 placentas in one container, depending on the size of the container used. The Gauteng Department of Health tender specification document (GT/GHD/168/2014) (Figure 3.5) makes provision for various sizes, such as 5 litre and 25 litre Specicans.

When practices related to refrigeration were evaluated (Tables 3.22, 3.23, 3.26, 3.27), it was evident that temperatures of refrigerators were in many instances not recorded or monitored and that storage times in freezers were not controlled. Although the results were generally inconclusive regarding this aspect of the investigation, the lack of temperature control is a matter of concern. However, it

was noted that the majority (59, 93.65%) of the respondents knew that placentas should be frozen before collection by the contracted service provider. Unfortunately, in instances where freezing facilities were not available or not working, the respondents were ignorant of alternative measures to ensure risk and contamination prevention.

Table 3.24 indicates that most of the respondents (53, 84.13%) knew that a service provider needed to be contracted and that some had in fact been appointed. However, various uncertainties existed regarding the procedures followed by service providers when collecting placenta in Specicans (Table 3.25, Table 3.28, and Table 3.29). The respondents further revealed disconcerting uncertainty (Table 3.31) regarding uncollected placentas, and a concern is that only 47 (74.60%) of the respondents indicated their satisfaction with the frequency of collection (Table 3.30). Uncertainties can contribute to unidentified risks in the management of placentas in all hospitals and a standard operating procedure (SOP) should thus be developed to address this issue, which can also be resolved by means of regular training.

In terms of the administrative aspect of placenta management, fewer than 50% (29, 46.03%) of the respondents were aware that manifest documents need to be received when placentas are collected. Also,19 (30.16%) of the respondents indicated that they *sometimes* received a manifest document (Table 3.32). Uncertainty regarding this aspect of placenta management is verified in Table 3.30, which indicates that 22 (34.93%) of the respondents did not know if a safe disposal certificates were received from treatment plants. It is acknowledged that some of the respondents did not work directly with placenta disposal practices and that they might have been ignorant of administrative requirements in this regard. However, in the interest of a holistic approach to safety and health risk eradication in any hospital, this is clearly an aspect that should be addressed during information and awareness training sessions involving all Health Professionals. The fact that health care waste officers had not communicated these important details to all co-workers

and that it had not been identified as a reporting indicator seems an oversight that should be redressed as a matter of urgency.

It was evident (Table 3.34) that placentas were not buried on hospital premises as declared by 60 (95.24%) of the respondents. However, the fact that a few indicated burial on hospital premises raises serious concern. Most respondents (36, 57.14%) indicated that patients rarely wanted to retrieve their placentas (Table 3.35), but12 (19.05%) of the respondents indicated that they had received requests for retrieval of the placenta when the patient had already left the hospital.

Table 3.36 indicates that respondents did not know how they could retrieve the patient's placenta when the patient had already left the hospital. Moreover, the fact that 26 (41.27%) of the respondents did not complete this question points to much uncertainty in this regard. It is assumed that retrieval was requested but that the question was not completed as there could have been a perceived conflict between legal requirements and adherence to traditional belief systems. Moreover, conflict between ethical concerns, health risk possibilities, and the right of patients under the Constitution of South Africa may have rendered this a grey area for most of the participants due to a lack of training and awareness information.

3.9 Section D: Placenta management outside the hospital

The Gauteng Health Care Risk Waste Management Regulations document (2004) prescribes the management procedure that must be followed for placenta management in hospitals in detail, but it does not provide any guidance in terms of traditional management practices when a placenta is retrieved and taken home. No guidance on procedures is provided and no mention is made of an official legal procedure.

According to Table 3.37, 55 (87.30%) of the respondents indicated that patients did not want to take their placentas home. Uncertainty was illustrated by 5(7.94%) of the respondents. This finding contradicts the finding (Table 3.35) that 52 (82.54%)

of the respondents thought that patients sometimes requested to take their placentas home. This difference could be attributed to non-standardised procedures or a lack of inclusion of the option to take the placenta home as part of the admission documentation that is administered by the professional nurse when a patient is admitted to hospital.

Table 3.37: Do patients want to take the placenta home after birth? (n=63)

Choice to take placentas home	Frequency	Percentage %
Yes	55	87.30
No	3	4.76
Not sure	5	7.94
Total	**63**	**100**

According to Table 3.38, 52 (82.54%) of the respondents indicated that patients sometimes requested to take their placentas home, while 8 (12.70%) of respondents indicated that patients never requested to take their placentas home. The question was not completed by 3 (4.76%) of the respondents. Schuette, Brown, Cuthbert, Coyle, Wisner, Hoffman and Clark (2017) state that 66% of the respondents in their study was familiar with placentophagy, which refers to the act of consuming part or all of the afterbirth. Coyle, Hulse, Wisner, Driscoll and Clark confirm that some women (and their families) consume the placenta (placentophagy) either by cooking it or eating it raw for the prevention of postpartum depression (PPD) and other health benefits. They made this point as early as the 1970s and found that this practice occurred especially in Chicago, Illinois. Concern regarding this practice has been expressed as poorly treated placentas may not be sterile and might contain unique microbiota (Aagaard, Antony, Ganu, Petrosino and Versalovic, 2014; Theis, Romero, Winters, Greenberg, Gomez-Lopez, Alhousseini and Hassan, 2019:267).

Burnes (2014), Callaghan (2007) and Birdsong (1998) state that, in most Western countries, the placenta is not taken home as it is seen as part of health care risk

waste and thus little attention is given to the placenta and its cultural values in these regions of the world.

Table 3.38: `Frequency of patients requesting to take their placentas home (n=60)

Request to take placentas home	Frequency	Percentage %
Never	8	12.70
Sometimes	52	82.54
Always	0	0
Question not completed	3	4.76
Total	**63**	**100**

3.9.1 Permission to take the placenta home

This relatively unknown practice was investigated to accumulate data for further guideline development. Table 3.39 shows that 14 (22.22%) of the respondents indicated that an affidavit or consent form had to be provided for placenta retrieval, while 9 (14.29%) indicated that the patient had to ask the doctor. Four (6.35%) of the respondents did not complete this question. Most respondents (34, 53.97%) indicated that the nurse had to be asked. This finding is also confirmed by the data in Table 3.38 (52, 82.54%). Clearly, when a patient request to take the placenta home, the person who is most likely to be consulted has to provide the correct information and legal guidelines. This confirms the importance of addressing this practice by means of meticulous record keeping and informing the patient of available choices, procedures, and timelines.

Baergen, Thaker and Heller (2013) conducted a study among practicing perinatal pathologists and found that61.1% of the respondents indicated no specific religious requirements for the consumption or burial of placenta after delivery. They found that the main purposes for retrieving the placenta were encapsulation and

consumption. They were also aware that people of certain cultures had several reasons to request retrieval of the placenta after birth.

Table 3.39: Permission to take the placenta home (n=59)

Permission to take placentas home	Frequency	Percentage %
Ask the doctor	9	14.29
Ask the nurse	34	53.97
Just take the placenta and place it in a handbag	0	0
Don't know	2	3.17
Other (please specify):	14	22.22
Question not completed	4	6.35
Total	**63**	**100**

Young, Gryder, David, Teng, Gerstenberger and Benyshek (2016) refer to the practice of taking a placenta home as 'maternal placentophagy'. They found this practice popular in 2016 and discovered that the main purpose was to ingest the placenta as a processed and encapsulated supplement for health benefits. They analysed 28 placentas for 14 trace minerals using plasma mass spectrometry and the analysis detected small quantities of arsenic, cadmium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, rubidium, selenium, strontium, uranium, and zinc. They argue that a daily dose of placenta capsules (3300 mg/per day) contains approximately 0.018±0.0004 mg copper, 2.19±0.533 mg iron, 0.005±0.000mg selenium, and 0.180±0.018 mg zinc. An encapsulated placenta thus provides a modest source of trace micronutrients and a minimal source of toxic elements. Eysseric-Guerin, Scolan, Faure, Jourdil, Stanke-Labesque and Allibe (2018) confirm that drug abuse during pregnancies leads to an O-desmethyltramadol and N-desmethyltramadol concentration of 473ng/g in placenta. Not only are chemicals and heavy metals present in the placenta, but Addo, Palakodety, Hartwell, Tingare and Fry (2020) indicate that placentas also contain MicroRNAs, which are epigenetic modifiers that play an important role in the control

and expression of genes. Moreover, they argue that the placenta is susceptible to exposure to environmental toxicants during pregnancy. These results should thus be considered when releasing a placenta for ingestion in any form.

The Royal Women's Hospital (2016) in Australia has developed a fact sheet guiding mothers regarding procedures to be followed if the placenta is sent to a laboratory for further examination. They are informed of the procedures to be followed to collect the placenta and that, in such cases, the placenta will not be available immediately for burial. They also discourage mothers from consuming placentas if infections were detected. In such cases, the placenta will be destroyed. Baergen, Thaker and Heller (2013) also refer to similar administrative requirements that need to be met before a placenta is handed over to the mother.

3.9.2 Who should inform patients regarding their right to take the placenta home?

This section reports on the part of the investigation that determines if patients were informed of their right to take the placenta home. An important consideration was who the responsible person would be to inform the patient of her rights.

Table 3.40 shows that 32 (50.79%) of the respondents deemed professional nurses and medical practitioners the most important people to inform patients that they may take the placenta home. Twenty (31.75%) stated that patients were not informed of this right, while 4 did not know.

Table 3.40 illustrates that there was a 50% chance that a mother who was not aware of the procedures to be followed might request the placenta after it had already been disposed of in a Specican. This finding implies the probability that a request for placenta retrieval might be imminent.

Table 3.40: Do doctors and professional nurses inform patients that they may take the placenta home? (n=59)

Permission by doctors or nurses to take placentas home.	Frequency	Percentage %
Yes	32	50.79
No	20	31.75
Sometimes	3	4.76
Do not know	4	6.35
Question not completed	4	3.65
Total	**63**	**100**

3.9.3 Containment of the placenta when a patient takes it home

The traditional procedure of taking placentas home is a grey area for professionals and was investigated for the purpose of providing appropriate guidelines in this regard. Table 3.35 indicates that, according to the participants, some patients wanted to take the placentas home, and they were thus aware that this required a certain container and procedures to remove it from the hospital.

Table 3.41 shows that 15 (23.81%) of the respondents were aware that the placenta should be placed in a non-permeable container such as a plastic bag for transfer home. Three (4.77%) of the respondents indicated that the placenta would be placed in the patient's own plastic container or bag. It is this researcher's contention that, in cases where the patient does not want to take the placenta home, there should be some notification and an administrative process to inform the patient of the whereabouts and disposal procedures of the placenta (see Table 3.42).

According to the Gauteng Health Care Risk Waste Management Regulations (2004), the containment of the placenta is part of pathological waste classification and management. However, no information is provided regarding the container requirements for taking the placenta home for traditional or cultural disposal.

Table 3.41: Containers used for transporting the placenta home (n=57)

Containers if placenta is not transported home	Frequency	Percentage %
Put it in a plastic bag	21	33.33
Put it in a commercial carry bag (e.g., a Checkers ora Pick ‘nPay plastic bag)	1	1.59
The hospital provides a plastic bag/container	15	23.81
The patient places it in her own plastic container	3	4.77
A company that dries the placenta removes the placenta	0	0
The placenta is sundried and then taken home	1	1.59
Do not know	14	22.22
None of the above, please specify:	2	3.17
Question not completed	6	9.52
Total	**63**	**100**

Mllbrand (2014) reports that wide variations exist in the policies of different hospitals and mentions that, in some hospitals, they refuse to authorise the mother to take the placenta home, especially when it is damaged or was sent to pathology to test for abnormalities.

The World Health Organization (1997) publication, *Guidelines for the safe transport of infectious substances and diagnostic specimens,* provides a systematic approach in terms of the requirements for the transportation of the placenta. For instance, triple packaging should be used as components of a primary, secondary, and outer shipping package. The primary receptacle should be labelled, be leak proof, and puncture resistant and should be wrapped in absorbent material. The secondary receptacle should be durable, leak resistant, and made of absorbent material and wrapping, and the third is the packaging in which the secondary receptacle is placed for protection during transportation. This container must be provided with a letter or formal consent document (or any other type of information) to enable identification

of the content, the shipping company, and the receiver. These data should be displayed on the outside of the secondary receptacle and all required transportation symbols must be indicated on the container (World Health Organization, 1997).

According to a question posed to the European Parliament in 2013, a region in central Macedonia issued a directive for home births as it classified the placenta as 'Hazardous medical waste of an infectious nature'. A subsequent joint ministerial decision (No. 37591/2031/03) stipulated that the disposal of hazardous medical waste should be dealt with by entities that are authorised to do so. The discussion further informed patients wishing to give birth at home that there should be adequate control when the placenta was handed over to incinerator staff. A midwife faced disciplinary action for not ensuring that the placenta was destroyed as hazardous medical waste and she was suspended for a year after the directive was passed in December 2012 in Thessaloniki in Greece (European Parliament, 2013). In South Africa, none such directives exist and the issue of the management of home birth placentas is still an extremely grey area.

3.9.4 Procedure to be taken when a placenta is not taken home

The Gauteng Health Care Risk Waste Management Regulations (2004) are highly prescriptive, and this question was posed to determine legal compliance. Table 3.42 indicates 22 (34.92%) indicated that the nurse should be notified and 20 (31.74%) stated that written consent should be given to send the placenta for disposal. The results in Table 3.38 and Table 3.41 confirm that some patients took the placentas home, which underscores the need to determine what tracing methods should be available if the placenta needs to be located for health risk reasons after it was taken home (Table 3.43).

The results indicate uncertainties regarding the correct procedure, although there were a strong indication of compliance as 20 (31.74%) respondents indicated that they were aware of the consent form requirement. It is acknowledged that procedural uncertainties in terms of role clarity could have contributed to the inconclusive finding. The Royal Women's Hospital (2016) in Australia addressed

this issue by implementing a fact sheet that informs the patient of her options as well as what will happen if the placenta is sent for further analysis or when the patient wants to take the placenta home.

Table 3.42: Procedure if a patient does not take the placenta home (n=58)

Procedure if placental is not taken home	Frequency	Percentage %
Notify the nurse	22	34.92
Notify the doctor	1	1.59
Tell nobody and just leave the placenta at the hospital	12	19.05
Give written consent for destruction of the placenta	20	31.74
Don't know	3	4.76
Question not completed	5	7.40
Total	**63**	**100**

A clinical practice guideline issued by King Edward Memorial Hospital in Western Australia specifies five specific requirements for the patient when the placenta is taken home as a safe handling guideline. It contains the following information:

- Check if the placenta can be taken home (considerations for pathological examination and exclusion criteria apply).
- The midwife, obstetrician and operating theatre staff must be informed before the operation procedure is performed.
- The placenta should be taken home the same day as the birth date.
- A statement is included that there are inadequate data in support of any health benefits of placentophagy (Western Australia. Northern Metropolitan Health Service, 2020).

A Mid-Yorkshire Hospital information booklet for women (2018) also indicates procedures to be followed when the placenta is taken home but differs in terms of

containment as it recommends double bagging and placement in a leak-proof container. A standardised release form is included in the booklet.

Table 3.43: Methods to trace the placenta if taken home (n=61)

Methods to trace placentas	Frequency	Percentage %
Satellite tracking	0	0
Barcoding	5	7.94
Word of mouth	0	0
A legal letter is signed before the placenta is taken home	17	26.98
It is noted in the patient file	15	23.81
Don't know	21	33.33
None of the above, please specify	3	4.76
Question not completed	2	3.18
Total	**63**	**100**

Table 3.43 shows that 21 (33.33%) of the respondents did not know what tracing methods to use to locate a placenta, if any, while the rest of the results are inconclusive.

3 .9.5 Transportation methods used by patients after birth

Section 20 of the Gauteng Health Care Risk Waste Management Regulations (2004) describes the general transportation requirements for the service provider, but no mention is made of requirements for patients taking their placentas home. This question was intended to determine the behaviour of patients when the placenta is taken home.

According to the respondents, patients use different types of transportation to return to their homes after giving birth. The use of public transport (such as minibus taxis, trains, and buses) was reported by 11 (17.46%) of the respondents, although the majority (40, 63.49%) indicated that the family would collect the patient using a

private vehicle (Table 3.44). It is acknowledged that not all the respondents would be intimately acquainted with patients' transportation methods as not many would witness the patient leaving the hospital, and no records were kept of patients' transport arrangements. The indication that patients would be transported by means of a family vehicle was thus possibly based on reasonable surmise.

The Mid-Yorkshire Hospital booklet prescribes the containment of a placenta in plastic bags that are sealed and placed into a leak-proof container for transport home (Mid-Yorkshire Hospitals, 2015). The WHO publication, *Guidelines for the safe transport of infectious substances and diagnostic specimens,* provides a systematic approach towards the requirements for the transportation of the placenta in triple packaging. This container must be provided with a letter or formal consent document or any other type of information to enable identification of the content, the shipping company (or sender), and the receiver (World Health Organization, 1997).

Table 3.44: Transportation method used by patients to go home after giving birth (n=63)

Methods to return home	**Frequency**	**Percentage %**
Family comes and collects the patient using their own motor vehicle	40	63.49
Patients use public transport like a taxi or bus	11	17.46
Patients use their own cars (drive themselves)	2	3.17
Patients walk home from hospital/CHC	0	0
Patients use a motorcycle	0	0
Patients use a horse or donkey drawn cart	0	0
Do not know	10	15.88
None of the above, please specify:	0	0
Total	**63**	**100**

3.9.6 How patients handle placentas when arriving home

When patients arrive home, they are in a specific local government jurisdiction. Current bylaws do not address the traditional management of placentas and this question was thus posed to determine the behaviour of patients when arriving home. More than one option could be selected and the frequencies, that are presented in Table 3.45, thus exceed 63. In total, 38 respondents (42.20%) indicated that the patients would bury the placenta on arrival home. All the other results are inconclusive. A noteworthy point is that 9 (10%) of the respondents indicated that the placentas would be given to traditional healers, and it can only be surmised that these healers would process them and use the product for 'muti' (traditional medicine).

Table 3.45: What does the patient do with the placenta upon arriving home? (n=90)

Final destination of placenta upon arrival at home	Frequency	Percentage %
Bury it	38	42.20
Burn it	7	7.77
Cook and consume it	2	2.22
Dry it	8	8.88
Dry it and place it in capsules/tablet form for consumption by the patient	1	1.11
Eat it (raw)	2	2.22
Give it to a traditional healer	9	10.00
Place in a freezer	0	0
Place in a refrigerator with food	0	0
Do not know	22	24.44
None of the above, please specify	1	1.11
Total	**90**	**100**

(Note: more than one answer could be provided)

Pan, Chan, Wong, Klokol and Chernykh (2017) refer to literature that indicates that the placenta can be used for its nutrient content such as collagen, elastin, laminin, vitamins, trace elements, nucleic acids, amino acids, peptides, cytokines, and growth factors. They also refer to placental therapy where placenta extracts can be absorbed by binding to receptors on the surface of certain cells. This process reportedly stimulates inactive or damaged cells, tissue and organs and can repair them or assist with regeneration. Placenta extracts reportedly have anti-inflammatory, anti-oxidative, and anti-microbial qualities that assist wound healing, hair growth, relieve and reduce pain, and improve health and energy properties. In an article in the *Mail and Guardian,* Khoza and Mapoma (1994) reported that a 'muti' (traditional medicine) shop owner said that the placenta was sold by traditional healers to counter infertility and for good luck.

The dried placenta can be purchased on the worldwide web as 'dried human placenta' or 'Zi He Che', as the Chinese refer to it, at a price of $386.00 for 50 sachets. This means that the use of the placenta is current and that derivatives can easily be imported from China (Eastern Chinese Medicine Export Company, 2011).

3.9.7 How the patient handles the placenta

This question was posed to determine if there are additional risk factors to be considered when the placenta is not buried. The Gauteng Health Care Risk Waste Management Regulations document (2004) prescribes the handling of the placenta as pathological waste, but it does not address aspects such as socio-economic viability or the spread of communicable diseases due to the mismanagement of placenta tissue.

Table 3.46 shows that 37 (58.73%) of the respondents did not know if the placenta were buried immediately, and no further conclusions could be drawn from the data.

Table 3.46: What do patients do with the placenta if it is not buried immediately? (n=63)

Alternatives to burial of placentas	Frequency	Percentage %
Place in the refrigerator	5	7.94
Place in the freezer	5	7.94
Place in the sun to dry	3	4.76
Place in a cool area in the home	7	11.11
Place in an outside area out of sight	2	3.17
Give it to the dogs to eat	0	0
Burn it	3	4.76
Cook it and eat it	0	0
Do not know	37	58.73
Other, please specify	1	1.59
Total	**63**	**100**

Table 3.47 shows that 27 (42.86%) of the respondents indicated that they thought the placenta was usually buried at home, while 19 (30.16%) respondents indicated that they did not know where the placenta would be buried.

Pocica (2018), Holister (2018), Bruns (2014), Chikako and Vodounon (2017), Cairns (2005), Panelli and Tipa (2007), Dike (2013) and Buckley (2006) also addressed this issue and agree that a family member will mostly assist by bringing a container, placing the placenta in it, and burying it at home at a designated spot within an agreed upon timeframe, with small differences as per cultural beliefs and customs. Planting a tree on top of the placenta was viewed as the most prevalent practice.

Table 3.47: Where are placentas buried? (n=63)

Burial sites for placentas	Frequency	Percentage %
Close to home	4	6.35
At home	27	42.86
At a special place in a vacant or open area	0	0
On a family farm	0	0
At the family home	7	11.11
Under a tree	1	1.59
Under a newly planted tree	2	3.17
Will not be buried at all	0	0
At a place of remembrance	3	4.76
Do not know	19	30.16
None of the above, please specify:	0	0
Total	**63**	**100**

The time lapse for the burial of the placenta varied (Table 3.48). More than half of the respondents (37, 58.73%) did not know what the required time lapse was for the placenta to be buried.

A company referred to as Aqiqah.sg describes the burial of the placenta and the umbilical cord on its web page and provides services such as the collection of the placenta from the hospital or the home, cleansing the placenta and umbilical cord, commissioning grave diggers to dig and bury the placenta for the family is the Pusara Aman/Bedok Reservoir areas near Masjid Alkaff, as advertised on the site. Although the written word describes a deep burial so that animals cannot get in contact with the placenta, the picture depicts the burial site as shallow. The Aqiqah should be performed within the first week (on the seventh day) after the birth. In addition, there is reference to the Sunnah for parents to give Sadaqah, which means a value equal to the weight in gold of the baby's hair when shaved on the seventh day after birth (Aqiqah.sg,n.d.).

Figure 3.6: Photo of a Muslim placenta burial site

Source: Aqiqah.sg, n.d.

Chikako and Vodounon (2017) describe the burial of the placenta in Niger (West Africa) as elbow-length deep. Various other rituals follow, for example when it is a baby boy the placenta must be placed on the right side of the hole facing north and the hole is then covered with soil and watered three times, and in the case of a girl it is placed on the left side of the hole and it is watered four times. The site is then covered with broken shards of unglazed pots and goat excrement.

3.9.8 Timeframe for the burial of the placenta

The Gauteng Health Care Risk Waste Management Regulations (2004) prescribes the storage timeframes of pathological waste in section 3(6)(c). These requirements are limited to a health care facility and are not legally applicable to the home of a patient. This question was designed to determine the timeframe that it takes the patient (or her family) to finally dispose of the placenta.

Approximately a third (19, 30.16%) of the respondents indicated that the placenta was buried on the day that the patient arrived home. This is important as it suggests that burying the placenta will, in some instances, occur as soon as possible (Table

3.48). The Royal Hospital for Women fact sheet prescribes that the placenta should be kept cold for not more than 48 hours before burial.

Table 3.48: Maximum time that elapses before the placenta is buried (n=61)

Time elapses before burial of placentas	Frequency	Percentage %
Same day when the patient arrives home	19	30.16
Within 2-3 days after birth	2	3.17
Within a week after birth	1	1.59
It is kept until nature absorbs it	0	0
Until the mother and father arrive to view the baby	1	1.59
Until the oldest family member visits the baby	0	0
When the mother stops bleeding	0	0
Do not know	37	58.73
None of above, please specify	1	1.59
Question not completed	2	3.17
Total	**63**	**100**

The literature review revealed a wide variation intime periods before burial of the placenta, for instance from 48 to 72 hours without refrigeration and 7 to 60 days when refrigerated. When it is kept for longer than 7 days, it should be frozen (Pocica, 2018; Holister, 2018; Bruns, 2014; Chikako & Vodounon, 2017; The Royal Hospital for Women, 2018; Cairns, 2005; Panelli & Tipa, 2007; Dike, 2013; Buckley, 2006).

3.9.9 Types of containers for the burial of placentas

The Gauteng Health Care Risk Waste Management Regulations (2004) prescribes the packaging or containerisation requirements when handling health care risk waste in section 3(6)(c). These requirements do not address the methodology followed by the patient to package their own placentas. As the respondents were health professionals and were of diverse cultural groups, they might not have been personally involved with the actual burial process. This relatively high percentage

of ignorance (34, 53.97%) as well as diverse but limited information about other types of container, renders the data inconclusive.

Table 3.49:Type of container/receptacle used to bury the placenta (n=62)

Burial container types	Frequency	Percentage %
A cloth	3	4.76
Glass jar	5	7.94
Just as it is	7	11.11
Metallic type container	4	6.35
Plastic bag	6	9.52
Plastic container	2	3.17
Porcelain jar	0	0
Traditional wooden box	1	1.59
Do not know	34	53.97
Other, please specify:	0	0
Question not completed	1	1.59
Total	**63**	**100**

Chikako and Vodounon (2017) describe the burial of the placenta in an unglazed pot that represents protection for the baby. In the hospital, the patient provides a plastic bucket with a lid, and the midwife would place chlorine-based bleach in the bucket and place the placenta in it before presenting it to the family of the patient. Pocica (2018) describes that an unspecified container or 'Ziplock' bag can be used and must be brought in a cooler bag for the transportation of the placenta (Lynnea, 2015; Copal, n.d.; Medical Supplies, 2020; Carolina Birth and Wellness, 2017).

This question was posed to determine if there are additional risk factors to be considered when the placenta is not buried. This question was posed to determine if there are additional risk factors to be considered when the placenta is not buried. In 2011, The United States of America issued an international publication under the patent cooperation treaty (PCT) titled *Biodegradable placenta transport and burial kit* number WO 2011/049469 Al. The main aim of this publication was to avoid some

of the disadvantages of existing methods used for the transportation, storage, and burial of the placenta and to guide the public in terms of a safe choice. The kit consists of a liner and an outer container to hold the inner liner and these are made of biodegradable materials (Bradley, 2011).

A variety of container types, sizes, and colours are available worldwide for the intention of incineration. In Scotland (2020), a 11.5 litre Sharpguard placenta waste container with 5 bags can be purchased from various suppliers for the transportation of the placenta. In Ireland, a yellow placenta bag is available with the use of a 'Sharpak disposalpack' container. It is like the sharp's containers used in South Africa, but the colour coding differs from the one used in South Africa where placentas are contained in red liners and Specicans (The Patron Group, 2020; GHCRWM Regulations, 2004).

3.9.10 Depth of hole for burial of placenta

The Gauteng Health Care Risk Waste Management Regulations document (2004) does not address the issue of burial depth and the question was thus posed to determine the possibility of contact with other individuals or animals with the placenta after burial. When specific details of the hole in which a placenta might be buried were suggested (Table 3.51), 50 (79.36%) of the respondents indicated ignorance of this requirement, and the data are thus inconclusive.

Although the data reported in Table 3.50 were inconclusive for this specific question, the responses indicated no specific depth at which the placenta will be buried, which suggests that shallow burial could result in exposure of the placenta to the environment. The guide for placenta burial published by Pocica (2018) recommends that the placenta should be buried 12 inches (5.08 cm) into the ground, but the depth can also be determined by the type of tree and climate factors that should be considered. In Latino rituals, the placenta is buried in the dirt floor of the house, according to Lemon (2002). Chikako and Vodounon (2017) describe the burial of the placenta in Niger (West Africa) as elbow-length deep.

Table 3.50: Depth of hole in which the placenta needs to be buried (n=62)

Depth of burial hole	Frequency	Percentage %
5 cm	1	1.50
Less than 15 cm	3	4.70
More than 1 m	1	1.50
Maximum of 1.5 m	4	6.30
Do not know	28	44.40
None of the above, please specify	1	1.50
Question not completed	25	40.00
Total	**63**	**100**

3.9.11 Animal contact with the placenta after burial

The Gauteng Health Care Risk Waste Management Regulations document (2004) does not address this issue and the question was posed to determine the possibility of cross contamination and/or the likelihood of spreading disease.

Table 3.51 shows that 28 (44.44%) of the respondents indicated that animals could get in contact with the placenta, while 24 (38.10%) of the respondents indicated that they did not know.

Table 3.51: Potential for dogs and other animals to have contact with placentas after burial (n=63)

Potential for animal contact with placentas	Frequency	Percentage %
Yes	28	44.44
No	6	9.52
Do not know	24	38.10
Sometimes, please specify	5	7.94
Total	**63**	**100**

Pocica (2018), Lemon (2002) and Chikako and Vodounon (2017) describe relatively shallow burials of placentas which corresponds with the finding in Table 3.51 where 44.44% of the respondents indicated that there was a chance that animals could dig up the placenta. This is a matter of concern. However, when a tree forms part of the burial ritual, it can act as a primary obstacle for animals to reach the placenta (Pocica, 2018).

3.10 Section E: Traditions and Beliefs

Table 3.52 reflects the responses for aspects relating to traditions and beliefs associated with placentas. Note that more than one answer could have been provided. The traditions of Indian women (33, 39.75%) were predominantly referred to, followed by references to those of African women (20,24.09%). The information regarding Indian and African women's beliefs regarding placenta management comprised a combined response rate of 53 (63.84%).

Table 3.52: Is the tradition of taking the placenta home limited to specific cultural groups?

Cultural specificity related to placenta burial	Frequency	Percentage %
Indian women	33	39.75
African women	20	24.09
White women	5	6.02
Coloured women	2	2.40
Do not know	13	15.66
None of the above. Please specify	8	9.64
Question not completed	2	2.40
Total	**83**	**100**

(Note: more than one answer could be provided)

The tradition of placenta burial is a general custom among Islamic, Jewish, Xhoza, Sotho, Nigerian, Ghanaian, Navajo Indians, Maoris, Hindus, Buddhists, and even people in Hollywood. Although the placenta is buried in different places, it is

believed that it offers various health effects such as fertility, protection, avoiding curses, and offering strength (Placenta Remedies Network, 2020; Mollagee, 2009; Loke, 2013; Knapp, van Bogaert & Ogunbanjo, 2008; Fiossi-Kpadonou, Kpadonou, Azon-Kouanou & Aflya, 2015; Mollage, 2009; Young & Benyshek, 2010).

3.10.1 Religious and population groups who believe the placenta needs to be taken home

As people's religious beliefs was an unknown factor, this question was designed to determine which population groups were most likely to take the placenta home. Table 3.53 shows that the results are inconclusive as 25 (23.36%) of the respondents indicated that this tradition featured most among people of the Muslim faith, but 23 (21.50%) did not know and 20 (18.69%) did not answer the question.

Table 3.53: Is the tradition of taking the placenta home limited to specific religion/s?

Association of religion with placenta burial	Frequency	Percentage %
African traditional religion	12	11.21
Buddhism	1	0.93
Christianity	9	8.41
Hinduism	3	2.80
Islam	7	6.54
Judaism	1	0.93
Muslim	25	23.36
Satanism	3	2.80
Do not know	23	21.50
None of the above, please specify	3	2.80
Question not completed	20	18.69
Total	**107**	**100**

(Note: more than one answer could be provided)

More than one option could be chosen to answer this question. It was like the one posed in Table 3.53 but differed in that it provided a more open-ended range of options. The total frequency is 84 and not 63 as in other tables.

The Indian population group was clearly identified as the group of patients who tended to take their placentas home, followed by the Zulu population group (12, 14.29%). The respondents did not list population groups such as the Northern Sotho, Southern Sotho or Swati groups, possibly because their traditions were unfamiliar to people born and raised in KwaZulu-Natal. This finding corresponds with a study by Gatrad and Sheikh (2001), who describe the customs associated with Muslim births as follows:

- ***Adhan***

  The father, or a respected member of the community, whispers the *Adhan* into the baby's right ear. The name of Allah the Creator is repeated and is followed by the Declaration of Faith. It should be performed as soon as possible after birth and only takes a few minutes.
- ***Tahneek***

  Shortly after birth, before the baby feeds, a piece of a softened date is rubbed into the baby's upper palate. The date can be substituted with honey. A respected family member performs this ritual in the belief that the person's positive attributes will be transmitted to the baby.
- ***Taweez***

  This is a black piece of string with a small pouch containing a prayer which is tied around the baby's wrist or neck. It is mostly practised by Muslims from the Indian subcontinent. It is believed that this ritual will protect the baby against ill health.

Their customs are also described by Joseph, Najmabadi, Peteet, Shami, Siapno and Smith (2006), who provide a holistic description of the welcoming customs and

rituals that are performed when a baby is born. Rituals in a Muslim community are also associated with the placenta.

Table 3.54: Population groups that tend to take the placenta home (n=84)

Population group preference to take placenta home	Frequency	Percentage %
Khoi and San (the Bushmen)	3	3.57
Coloured	1	1.19
Indian	35	41.67
Ndebele	2	2.38
Northern Sotho	0	0
Pedi	1	1.19
Sotho	1	1.19
South Sotho	0	0
Swati	0	0
Tsonga	5	5.95
Tswana	1	1.19
Venda	2	2.38
White	2	2.38
Xhosa	6	7.14
Zulu	12	14.29
Other, please specify	9	10.71
Question not completed	4	4.76
Total	**84**	**100**

(Note: More than one answer could be provided)

In Australia, Indian women represent 10% of births in this country (Wells & Dietsch, 2014). Kaphle, Hancock and Newman (2013) state that, in Nepal, the traditions and spiritual beliefs associated with giving birth conflict with medical views of childbirth.

3.10.2 Traditional rituals of placenta handling

The term ‘traditions’ refers to practices that are passed on from generation to generation. The traditional handling of the placenta has been smothered in surmise and thus required investigation.

Table 3.55: Traditional ritual/procedure when the placenta arrives home (n=63)

Traditional rituals when placentas arrive home	Frequency	Percentage %
Traditional healer must pray	1	1.59
Traditional ceremony follows	4	6.35
Mother and baby are kept separated from family until bleeding has stopped and only then is the placenta buried	3	4.76
Mother, baby and placenta must be kept together until burial	0	0
Ceremonial burial	2	3.17
Do not know	53	84.13
None of the above, please specify:	0	0
Total	**63**	**100**

Table 3.55 shows that 53 (84.13%) of the respondents did not know what these rituals are, and the results are thus inconclusive. According to Wells and Dietsch (2014), there are eight sacraments for Indian women of the Hindu religion that relate to the period from pregnancy to giving birth. These are essential and seen as a ‘law’ that needs to be adhered to in order to achieve purity and perfection. Each sacrament has its own set of rituals and can also be practised by non-Hindu Indian women. The article further explores the knowledge base of midwives who are not necessarily of the same culture and religion as the birth mothers, and they warn of the sensitivity to understand and respect the differences in tradition and the rituals that go with it. According to Bradley (2014), placentas were traditionally exposed to ceremonial handling by many cultures around the world. However, in the Western world the human placenta is regarded as nothing more than human waste.

3.10.3 Religion of the patient taking the placenta home

Religious beliefs and practices guide the patient to handle the placenta in a certain way. The question was posed to determine the most likely religious practices when the placenta arrives home. Table 3.56 shows that 53 (84.13%) of the respondents indicated that they did not know and the result is thus inconclusive.

Table 3.56: Religious requirements that must be met when the placenta arrives home (n=62)

Religious requirements when placenta arrives home	Frequency	Percentage %
Prayer	2	3.17
Religious burial	4	6.35
Religious sacraments	2	3.17
Worship	1	1.59
Don't know	53	84.13
None of the above, please specify	0	0
Question not completed	1	1.59
Total	**63**	**100**

3.10.4 General Discussion

The handling and treatment of placentas in various countries were explored and briefly referred to.

3.10.5 Historic treatment of the placenta

Many similarities in placenta care can be found across history. The prevalence of this phenomenon in Africa, the Middle and Far East, Asia, Europe, America, New Zealand, and the Pacific is briefly discussed.

3.10.5.1 Africa

Nigeria and Ghana: The 'Ibo' tribe treated the placenta as a deceased twin and a full burial rite was performed.

Kenya: The Kikuyu placed the placenta in an untouched field and covered it with grass and grains. Other cultures buried the placenta under a tree.

Mali: The placenta was prepared by washing, drying, and placing it in a basket and it was then buried by the father.

Southern Africa: The **Xhosa** buried the placenta in the kraal as it would add to fertility. The **Sotho** people buried the placenta in an area of protection as 'witchdoctors' would steal the placenta to curse the family. They also buried the umbilical cord in the yard when it fell off as they believed that witches could get hold of it.

3.10.5.2 The Middle/Far East

Arabian Peninsula: The future fertility of the woman was determined by how the placenta was positioned.

Judaism: The placenta was buried.

Islam: The placenta was buried as it was believed that "from the (earth) did we create you, and into it shall we return you".

Turkey: The umbilical cord and placenta were kept together and were buried in the mosque courtyard or thrown over a wall into a school yard or buried in a stable or thrown into water. The symbolism ranged from the child being a devout person, to being educated, an animal lover, or for the child to search for its destiny. The placenta was wrapped up and buried in a clean piece of cloth after birth.

Most traditions disappeared in Turkey as most women started giving birth in hospitals, but the belief regarding the umbilical cord is still common (Placenta Remedies Network, 2020; Mollagee, 2009; Loke, 2013; Knapp, van Bogaert &Ogunbanjo, 2008; Fiossi-Kpadonou, Kpadonou, Azon-Kouanou & Aflya, 2015).

3.10.5.3 Asia

Vietnam and China: The placenta was deemed a life-giving force. It was dried and prepared as part of a recipe of a potion to ingested for energy and vitality.

Indonesia: The father was required to clean, wrap, and bury the placenta on the day of giving birth.

Korea: The placenta was burned and the ashes were kept and used as medicine for the child.

Cambodia: The placenta was wrapped in banana tree leaves and placed next to the new-born for three days for rebirth.

Thai: The placenta was salted and placed in an earthen jar or clay pot and buried under a tree as a symbol of the Asian year of the child's birth.

3.10.5.4 Europe

France: It was commercially used in cosmetics such as creams.

Brittan: The collection of placentas from hospitals was banned in 1994 due to the huge quantities bought and exported to France as it was used in protein and albumin rich products, used for burn medication, and to make enzymes.

Hawaii: The placenta was brought home, washed, and buried, followed by a religious ritual and a tree was planted on it.

Navajo Indians: They buried the placenta in the sacred four corners of the tribe reservation to connect it with the ancestral land and people.

South America: The placenta was burned after birth to neutralise it and the ashes were buried in the ground to protect the family against evil spirits.

Bolivian Aymara and Quecha: They believed the placenta was a spirit and it was washed and buried by the husband in a secret and shady place.

3.10.5.6 New Zealand and the Pacific area

The Maori: They gave the placenta as a gift to the father or to the earth. It was usually buried under a tree near where the birth took place or a pit or the nest of

green ants. If eaten by the green ants, it was seen that no other births would take place.

Samoa: The placenta had to be burned and buried so that no evil spirit could find it.

3.10.6 General discussion: Placenta management outside the hospital

Table 3.37 indicates that 55 (87.30%) of the respondents agreed that patients did not want their placentas, but Table 3.39 indicates that 34 (53.97%) of respondents indicated that patients in fact did ask for their placentas. These data are contradictory. Table 3.38 indicates that the patients *sometimes* took their placentas home, which corresponds with Table 3.35 where 12 (19.05%) of the respondents indicated that placentas were sometimes retrieved.

The respondents indicated that the official who would be approached for permission to take the placenta home was generally the professional nurse (34, 53.97%) (Table 3.41). Patients were also mostly informed by nurses and doctors that they could take the placenta home, but only 32 (50.79%) of the respondents indicated 'yes' while 20 (31.75%) indicated 'no' to this question, and thus this finding is inconclusive (Table 3.43). This finding corresponds with the data in Table 3.45, which indicate that the patients did not know if they should notify the nurse (22, 34.92%) or just provide a written consent for the disposal of the placenta (20, 31.74%), and thus these results are also inconclusive.

Clear role clarity should be established by heads of health establishments and these roles should also be spelt out in a standard operating procedure, a guideline, or a specified delegation of seconded responsibilities, as is required by the Health Act (2003).The head of a health establishment is responsible for the management of human tissue and is thus obliged to ensure that all relevant health professionals are

informed of all procedures in relation to health care risk waste, including placentas (South Africa,2003).

In terms of the containerisation of placentas when taken home, it is evident that no specific method stood out in Table 3.41(17, 26.98%; 15, 23.81%;21, 33.33%). The method used to trace the placenta when it was taken home (Table 3.40) was also inconclusive. These findings raise concerns in terms of the cradle-to-grave approach in the management of placentas and may well expose unauthorised dumping when placentas are taken home.

When investigating the behaviour of patients in terms of the management of the placenta at home, most of the respondents (40, 63.49%) thought that patients were collected by family members who owned a motor vehicle (Table 3.44). Others (11, 17.46%) referred to the use of public transport like a taxi or bus. Most of the respondents (38, 42.20%)also indicated that the family/father would bury the placenta when arriving home (Table 3.45). Table 3.46 (37, 58.73%), Table 3.47 (19, 30.16%), Table 3.48 (37, 58.73%), Table 3.49 (34, 53.97%) and Table 3.50 (50, 79.36) confirmed that the way in which placentas is handled is relatively unknown to health professionals. Table 3.51 indicated that 28 (44.44%) of the respondents were of the view that dogs or other animals could get into contact with a buried placenta, but 24 (38.10%) of the respondents were not sure if this was possible.

In conclusion, it was evident that limited knowledge existed among the responding Health Professionals regarding the handling of placentas when they were taken home. However, the concerns were raised that animals might dig up the placenta which would pose a health risk. Dogs that scavenge and unearth placenta tissue can transmit zoonotic diseases to humans. These diseases may vary from short term to major life changing illnesses and could ultimately cause death (Wells, 2017; Seymor, 2018; World Health Organization, 2006).

A zoonotic agent may be a bacterium, virus, fungus, or other communicable disease. WHO (2006) indicates that at least 61% of all human pathogens are of the zoonotic kind and they represent 75% of all emerging pathogens. Unfortunately, the poor people in our society are most at risk and there is a strong association between poverty and living in close contact with animals that can act as a reservoir for disease. In some diseases, the risk factors are clear, such as in Bovine Tuberculosis, Anthrax, and Brucellosis which mainly affect livestock keepers and those involved in the processing of livestock products (World Health Organization, 2006; Standley, Carlin, Sorrell, Barry, Bile, Diakite, ... &Katz, 2019; O'Neil, 2018; Moro & Abah, 2019). O'Neil (2018) also indicates that zoonotic infections and parasites can be transmitted from common household pets to humans, which is a phenomenon that is not well reported but was verified almost ten years ago by Day *et al.* (2012).

3.10.7 General discussion: Traditions and beliefs

South Africa is one of the most culturally diverse countries in the world and is aptly referred to as the 'Rainbow Nation' as it boasts 11 official languages and eight other recognised languages that, combined, manifest as a rich, vibrant and diverse society.

Figure 3.7 illustrates the diversity of home languages in the Gauteng Province for the census period 1996 and 2001.Population numbers are expressed as percentages (%) of the Gauteng population speaking each of the 11 official languages (i.e., their mother tongue) in South Africa.

The most frequently spoken language in Gauteng was isiZulu (as reflected in both census years and equated to 1.6 million people in 1996 and 1.9 million people in 2001), followed by Afrikaans and Sesotho. The least spoken language was siSwati (Statistics South Africa, 2001; South Africa's diverse culture, artistic and linguistic heritage, n.d.; Van W. Scheepers, 2010; Belfield, 2012).

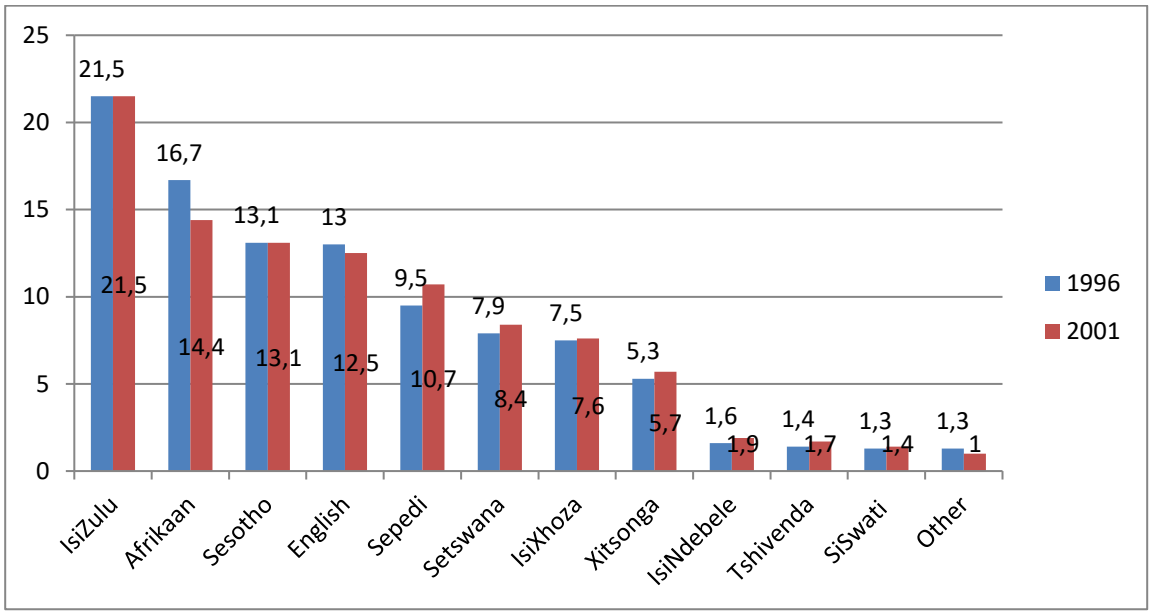

Figure 3.7: Distribution of the South African population by first or home language speakers (census 1996 and 2001) Gauteng Province

Source: Statistics South Africa, 2001

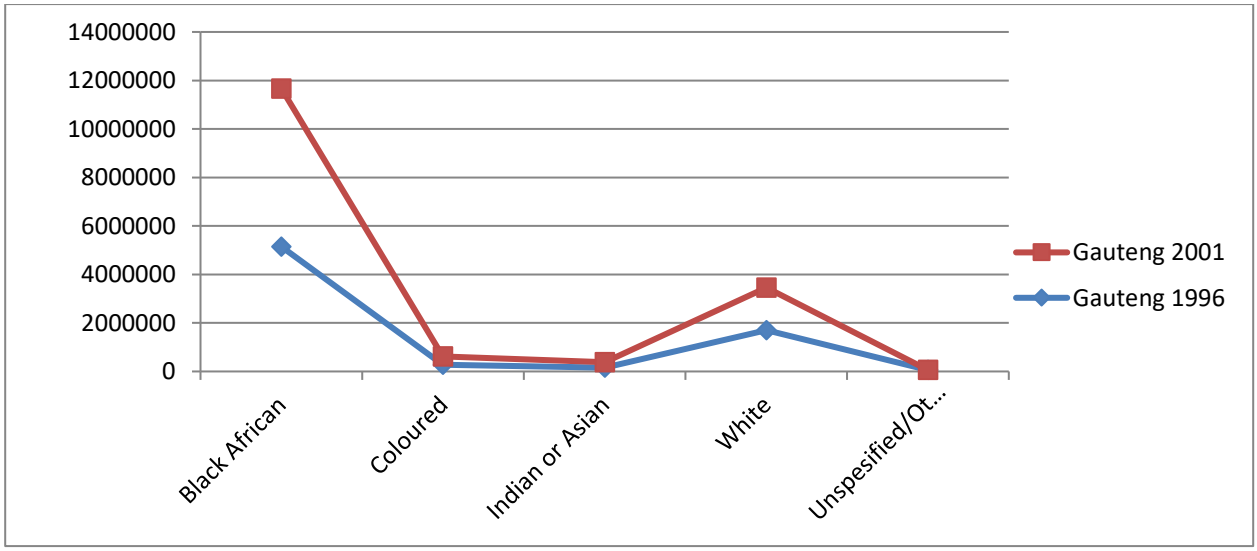

Figure 3.8: Population diversity in Gauteng Province 1996 and 2001 as per census outcome

Source: Statistics South Africa, Census 1996 and 2001

Culture is a combination of traditions, beliefs, spirituality, and knowledge and reflects the characteristics of a specific group of people that can be identified by

their social habits, religion, traditions, language, arts, and music (Zimmermann, 2014; Nkomo, 2015; Aranda & Knight, 1997).

A high increase in black population numbers and a lesser increase in the white population group (Figure 3.8) are noticeable. Although there was a smaller increase in the Coloured and Indian or Asian group, the total growth rate for the period between 1996 to 2001 (five years) was 1.6% and can be quantified to about 1488757 people. With 2020 calculated as a full year, it is estimated that, from 2001 to2020 (with a constant 1.6% growth rate), a growth of 5657276 could be expected. This translates to a total of 14494455 people residing in the province with a wide range of population groupings as indicated in Table 3.57

In Table 3.50, it is evident that the respondents perceived that the Indian population group would predominantly ask to take the placenta home, which is a finding that is confirmed by the data in Table 3.52. Thus, when the Hindu (3, 2.8%), Islam (7, 6.54%), Muslim (25, 23.36%) and Christian (9, 8.41%) religious groups that were referred to are calculated together, they comprise 44 (41.11%) of the religions referred to by the participants. This perception is confirmed by the data in Table 3.51 where it is shown that the respondents saw the Indian population group (35, 41.67%) as the most likely group that will take the placenta home. When asked what the traditional procedures or religious requirements were when patients took the placenta home, 53 (84.13%) of the respondent did not know (Table 3.52 and Table 3.53 (53, 84.13%). This finding corresponds with the data in Table 3.43 (37, 58.73%), Table 3.44 (19, 30.16%), Table 3.45 (37, 58.73%), Table 3.46 (34, 53.97%) and Table 3.47 (50, 79.36%), where the data were also inconclusive.

It is evident that further research should be conducted to investigate the procedures, methods, and religious methodologies followed by mainly Indian women when placentas are taken home. Moreover, patients should be included in such a study

to gain a more accurate picture of the phenomenon of placenta management and disposal at home.

3.11 Section F: General Knowledge

This section elaborates on the respondents' knowledge of ordering stock, available stock levels, and frequency of orders of HCW consumables such as Specicans and liners/plastic bags.

The knowledge of the respondents about procedures such as spill management and support required was investigated and the respondents' insight was sought regarding support systems as well as their satisfaction with the current HCRW management system in the hospitals where they were employed.

Table 3.57 indicates that 49 (77.77%) of the respondents felt that they never ran out of stock of Specicans, which is the Gauteng Department of Health tender approved container.

Table 3.57: Do you run out of stock of Specicans? (n=63)

Availability of Specicans	Frequency	Percentage %
Never	49	77.77
At least once a month	5	7.94
We have over stocked quantities in our store – older than 6 months	0	0
Once every 3 months	4	6.35
Every week	0	0
Continuously	1	1.59
None of the above, please specify	4	6.35
Total	**63**	**100**

Vumase (2009) found that 92% of the hospitals that was surveyed experienced shortages in the provision of health care waste containers over a period of 12 months, the main reason being shortage of funds. A similar study in Bangladesh found that 60% of the state hospitals manually handled HCRW due to shortages of HCRW container stocks (Hassan, Ahmed, Rahman & Biswas, 2008:36; Olaniyi, Ogola & Tshitangano, 2018).

According to the IUSS Health Facility Guide (2014), methods of health care waste containment consist of the use of reusable and disposable containers (plastic liners, plastic containers as per classification of the waste type, and various sizes and colours as per SANS 10248-1:2008colour coding requirements). It states that the procurement department plays a crucial role in the replenishing of consumable stock and in ensuring enough stock in the warehouse for further distribution. The following are essential steps in ensuring that enough stock is on hand: a re-order limit and date (to ensure that the HCFs do not run out of stock), written order requests from each unit, orders processed in accordance with the Public Finance Management Act (1999) requirements, and enough storage space for the stock. Stock levels will also be influenced by the occurrence of strikes or any other emergencies and contingency plans should be in place to prevent shortfalls in stock levels (South Africa, 1999; South African National Standards, 2008; Health Professions Council of South Africa, 2016).

The WHO guide (2014) also refers to “environmentally preferable purchasing” which is a green way of looking at the purchasing of the least damaging products in terms of environmental impact and aspects such as life cycle thinking solutions. These solutions should consider aspects such as costs, risk, and waste management that should be considered in purchase requests of health care waste consumables and containers (World Health Organization, 2014:68-69; California Department of Health Services, 2000; Karliner, 2010; Practice Green Health, 2020).

3.11.1 Health care risk waste stock management

To ensure that all generated placentas are correctly managed and handled, consumables of specific colour and size should be provided in a hospital setting. These requirements are described in SANS10248-1:2008 and in the Gauteng Health Care Risk Waste Management Regulations (2004) section 9. Stock control is important to ensure that all consumables are readily available for use.

A question was posed to determine whether packaging requirements were met, and Table 3.58 indicates that 47(74.60%) of the respondents did not run out of stock of red liners/plastic bags as approved by the Gauteng Department of Health tender approved list.

Several studies that were undertaken in South Africa and Africa investigated the management of HCRW in different provinces and countries. Some studies detected shortages of consumables while others made no mention of the procurement

Table 3.58: Availability of red liners/plastic bags (n=63)

Availability of red liners/plastic bags	Frequency	Percentage %
Never	47	74.60
At least once a month	5	7.95
We have over stocked quantities of liners/plastic bags in our store – Older than 3 months	1	1.59
Once every 3 months as least	5	7.95
Every week	2	3.16
Continuously	1	1.59
None of the above, please specify:	2	3.16
Total	**63**	**100**

aspects in terms of the provisioning of consumables such as liners and containers as part the process evaluation or efficiency of management systems (Kwikiriza,

Stewart, Mutahunga, Dobson & Wilkinson, 2019; Heunis, 2016; Semenyaand Moja, 2016; Makhura, Matlala & Kekana, 2016; Vusame, 2009; Olaniyi, Ogola & Tshitangano, 2018; Malebatja, 2016; Udofia, Fobil & Gulis, 2015; Motlatla, 2015:119). Table 3.59 indicates that 55 (87.30%) of the respondents felt that their needs were addressed adequately by the current waste management system.

HCRWM systems have been outsourced by the government since approximately 2004.If a risk assessment and needs analysis is used it can determine if needs are effectively and adequately addressed. The demise of local hospital incinerators for the treatment of HCRW was due to non-compliance with the air emissions standards as promulgated under the Air Emissions Act No. 39 of 2004 (South Africa, 2004b).

Table 3.59: Does the current waste management system address all your HCRW management needs? (n=63)

HCRW needs satisfied?	Frequency	Percentage %
Yes	55	87.30
No	5	7.95
Not sure	2	3.16
Question not completed	1	1.59
Total	**63**	**100**

This Act compelled the management of HCFs in South Africa to enter into service level agreements and/or tender agreements with external service providers in the private sector to ensure legal compliance in terms of HCRW management, transportation, treatment, and final disposal.

Although most of the respondents indicated that they were satisfied, there is evidence of incidences when service providers were found guilty of mismanagement of health care risk waste in Gauteng. For instance, in 2007 the treatment capacity was exceeded from 31 000 tons to 42000 tons in two years, and

thus only part of the generated HCRW could be treated. This was due to the closure of treatment plants that were not compliant with the National Environmental Management Act, and the Department of Environmental Affairs consequently had to landfill HCRW at a site treating highly hazardous (H:H) materials in Gauteng (Parliamentary Monitoring Group, 2010).

In Ethiopia, a study conducted in 2019 revealed unsatisfactory results in terms of adequate provisioning of supplies for waste handlers (Deress, Jemal, Girma & Adane, 2019).HCRW management systems are clearly dependent on the viability of the treatment capacity of a plant and addressing the needs of treatment within set timeframes as stipulated by the Gauteng Health Care Risk Waste Regulations (2004).This has a direct effect on the success of health professionals to containerise HCRW correctly and ensure its final disposal. For instance, a study by Olaniyi, Ogola and Tshitangano (2018) in the Vembe district in Limpopo concluded that HCRW was not being efficiently managed. In the current study, one hazard associated with placenta treatment has been highlighted as blood spillage, and Table 3.60 shows that 55 (87.30%) of the respondents knew how to manage blood spillages. It is therefore a matter of concern that not 100% of the health care professional indicated knowledge in this regard, as any blood spillage may compromise the health of those who might come into contact with it.

Table 3.60: Respondents' knowledge of treating a blood spill (n=62)

Knowledge of treatment of blood spils	Frequency	Percentage
Yes	55	87.30
No	5	7.94
Not sure	2	3.17
Question not completed	1	1.59
Total	**63**	**100**

A systematic review and cross-sectional study was conducted by Mannocci, di Bella, Barbato, Castellani, La Torre, De Giustiandand Del Cimmuto (2020).They reviewed 53 peer reviewed, original, and review study articles with the aim of

identifying reliable and valid tools to enable the assessment of the knowledge, attitudes, and practices of professionals in health facilities, with specific focus on biomedical waste or HCRW. Various countries such as Asia, Europe, America, Australia, and Spain were represented in the review. This review concluded that there is a dire need to create high quality questionnaires in this field to investigate problems, eliminate generalisations, and facilitate international comparisons of findings.

Wafula, Musiime and Oporia (2019) found that, in Kampala in Uganda, satisfactory knowledge levels of health workers existed. They concluded that refresher training should be provided on a continual basis. Olaifa, Govender and Ross (2018) found that, at a KwaZulu-Natal district Hospital in South Africa, 241 (42.7%) of the respondents indicated that the knowledge base regarding HCRW was poor. They also found that50% of the respondents had a good attitude towards good disposal practices of HCRW, but only 53.9% illustrated good HCW management practices. During 2019, a similar study was undertaken in Debre Markos in the north-western region of Ethiopia where the levels of knowledge, attitude, and practices regarding HCRW management were found to be unsatisfactory (Deress, Jemal, Girma & Adane**,** 2019).

Sanches, Mekaro, Figueiredo and Andrè (2018) focused on the entire waste management system and found some gaps in knowledge as75% of the surveyed nurses did not know the requirements for packaging of chemical waste. This latter study concluded that the knowledge of nurses was unsatisfactory in regard to HCW management and that nurses experienced challenges in terms of good management of HCRW due to health professional shortages and a variety of other responsibilities. Mathur, Dwivedi, Hassan and Misra (2011) conducted a cross-sectional study and found that there were differences in the levels of knowledge between the different occupational strata. They highlighted that the cleaning staff was the least knowledgeable.

It is an undeniable fact that HCWM practices should always be guided by standard operating procedures. Therefore, by considering the outcomes of the studies referred to above, it is a concern that although all SOPs, guidelines, and best practice guidelines are available in provincial and district hospitals, health workers who do not have adequate knowledge and they and their patients thus remain at risk.

Table 3.61 shows that 50 (79.37%) of the respondents had access to a standard operating procedure (SOP) for the handling and management of placentas.

Table 3.61: Is an SOP available for the management of placentas? (n=63)

SOP availability	Frequency	Percentage
Yes	50	79.36
No	4	6.35
Not sure	9	14.29
Total	**63**	**100**

3.11.2 Support for HCRW workers by senior management

Table 3.62 shows that 50 (79.36%) of the respondents felt that they had enough support from senior management in their hospitals for the management of HCRW.

Relevant operating procedures from the United Kingdom, South Africa, Trinidad, Tobago, and Australia were sourced and various SOPs applicable tobio-samples, retained placentas, placental history, removal of the placenta after birth, labour rooms, and nursing departments were perused. Considering the discussion based on the data in Table 3.57, it may be concluded that, although SOPs and guidelines are available and even implemented, knowledge gaps at some levels of management and among operational personnel still exist. It is therefore essential to ensure continuous training in all health settings. The main challenge is the implementation phase of already approved SOPs (Trinidad and Tobago Ministry of

Health, 2011; Verma, 2018; Viscusi, Dezateux, Peakman, Sebire, Spreckley, Virasami & Ward, 2015; Royal Hospital for Women, 2018).

The Gauteng Health Care Risk Waste Management Regulations document (2004) describes the responsibilities of waste generators in hospitals and it was therefore important to determine if senior management support was provided to assist operational officials. Table 3.62 indicates that 50 (79.38%) of the respondents were satisfied with the management support they received from senior management in their hospitals for the management of HCRW.

Table 3.62: Support by senior management in terms of HCRW management (n=63)

Senior management support re HCRW	Frequency	Percentage
Yes	50	79.36
No	6	9.53
Not sure	7	11.11
Total	**63**	**100**

The literature review revealed that there are still hospitals with unsatisfactory support from management in various countries as well as in South Africa (Deress, Jemal, Girma & Adane, 2019; Mannocci, di Bella, Barbato, Castellani, La Torre, De Giusti & Del Cimmuto, 2020; Uchechukwu, Babatunde & Anne, 2017; Motlatla, 2015:4-28). A medical waste review conducted by Olaniyi, Ogola and Tshitangano (2018) concludes that there are still challenges that need to be addressed and practices that need to be corrected before medical waste will be successfully manged in South Africa. One of the shortfalls is the lack of development of a national health care risk waste policy for South Africa.

Table 3.63 shows that 23 (36.51%) of the respondents indicated that they used a standardised consent form for patients to authorise the disposal of the placenta at home.

This is commendable, but it is vital to also establish a data base, as indicated by 16 (25.39%) of the respondents. Combined, 39 (61.90%) indicated the need for a management system and not a restrictive policy as indicated by 12 (19.05%) of the respondents.

If the responses of the respondents who supported a data set and standardised consent form are combined (16, 25.39% and 23, 36.51%), then their proposal should form the basis for the standardisation of a consent form.

Table 3.63: How should retention of the placenta be managed by the mother? (n=63)

Mother's role in placenta retention	Frequency	Percentage
No placentas must be given back to any patient	12	19.05
Implement a data base of patients that wish to take the placenta home.	16	25.39
Patients need to declare possession of the placenta at a local area police station.	5	7.94
All placentas should be treated before they are given to the patient.	2	3.17
Utilise a standardised consent form signed by the patient to authorise the disposal of the placenta at home.	23	36.51
None of the above, please specify:	5	7.94
Total	**63**	**100**

Currently, there is a lack of standardisation in this regard as some hospitals require an affidavit from a local South African Police station while other hospitals have a register book to record placenta movement, but these operations are not collated into a data base and thus merely serve as compliance with an administrative requirement.

An SOP should be developed and implemented on a national scale to ensure the standardisation of the release of the placenta to the patient. Several hospitals such

as the Royal Hospital for Women in Australia and the Mid-Yorkshire Hospitals in the United Kingdom have established well-functioning SOPs in this regard (Royal Women's Hospital, 2016; Mid-Yorkshire Hospitals, 2015).

3.12 Increased Efficiency and Health Care Worker Accountability

As part of the responsibility of all professional health care givers and allied workers, compliance with an ethical code of conduct issued by the relevant department as well as the Health Professions Council of South Africa is essential. A question was posed to establish if accountability and efficient services were rendered.

Table 3.64 shows that 36 (57.14%) of the officials felt that, if procedures were clearly explained, it would help them to become more efficient and accountable to the patients. Ten (15.87%) of the respondents recommended that this be done during pre-natal classes, while11 (17.46%) recommended that a pamphlet should be developed and disseminated to patients.

Giacchetta and Marchetti (2013) observed the entire system of health care waste management and the development of a policy for health care risk waste management in Italy. Their subsequent recommendations contributed to efficiency and cost saving where the reduction of medical waste was monitored after implementation of a HCRW policy. Sheldon (1996) refers to accountability in her book *Achieving accountability in business and government: Managing for efficiency, effectiveness and economy* and argues that transnational and domestic corporations and governments are plagued by a crisis in terms of accountability. She explains that this crisis consists mainly of a lack of competitiveness, morals and ethics, and systems that are fraught with cases of fraud and inefficiency.

Table 3.64: How can facilities become more efficient and health care professionals rendered accountable to patients in the management of health care risk waste at hospitals? (n=63)

Accountability and efficiency regarding health care risk waste	Frequency	Percentage
Explain procedures clearly	36	57.14
Explain the options regarding taking the placenta home during the admission procedure of the patient	3	4.76
Develop pamphlets to address the proper management of placentas	11	17.46
Doctors must address the option of taking placentas home after birth with patients	1	1.59
Prenatal classes should address the options of placenta care	10	15.87
None of the above, please specify:	2	3.18
Total	**63**	**100**

3.13 General Discussion: General Lack of Knowledge

A section was included in the questionnaire that posed 7 questions to understand the level of knowledge of officials in health establishments in Gauteng Province. Table 3.57 indicates that 49 (77.77%) of the respondents indicated that stock of Specicans was always available. This finding corresponds with the availability of small liners as confirmed by 54 (85.71%) of the respondents (Table 3.18 and Table 3.58). This finding of ample stocks was further confirmed by 47 (74.60%) of the respondents who stated that they never ran out of red liners. Of the 63 respondents, 55 (87.30%) indicated that they were satisfied with the current waste management system in the hospitals where they worked. Table 3.60 indicates that 55 (87.3%) of the respondents knew how to manage blood spills and Table 3.61 (50, 79.36%) shows that standard operating procedures were available in hospitals to manage placentas. Table 3.21, however, contradicts the results presented in Table 3.60 and Table 3.61, as was evident from the responses that showed that most respondents (53, 84.13%) knew that a contracted service provider was appointed. However, there were some close representations of various uncertainties with regards to the exact practice used by service providers when collecting placenta Specicans (Table

3.25, Table 3.28, Table 3.29). The respondents also indicated their uncertainty in Table 3.28 (24,38.09%) as they did not know what happened when placentas were not collected. A concern was that responses recorded in Table 3.30 indicated the satisfaction of 47 (74.60%) respondents with the frequency of collection, while they were not sure what happened with the placentas. This uncertainty can contribute to an unidentified risk in the management of placentas in all hospitals and this issue should be included in a standard operating procedure and addressed through regular training. These results correspond with those of a study by Uchechukwu, Babatunde and Anne (2017), who found that although procedures were available, training and awareness campaigns were still required for deeper insight and more knowledge. Mathur, Dwivedi, Hassan and Misra (2011) found that knowledge differed among the different categories of Health Professionals, as doctors, nurses, and laboratory technicians were better informed than sanitary/cleaning staff. They emphasise the importance of training to assist in correcting inappropriate and non-existing practices.

It is evident from Table 3.62 that 50 (79.38%) of the respondents felt satisfied with the management support that they received regarding health care risk waste management. When asked what support all categories of health professionals would like to receive in terms of managing placentas (Table 3.63), they listed the need for a standardised consent form (23, 36.51%) and clear explanations of procedures (36,57.14%) to help them to become more efficient and accountable to the patients (Table 3.64).

3.14 Section G: Training

3.14.1 In-service training

Section 6(3) of the Gauteng Health Care Regulations (2004) stipulates that the generator must ensure that continual training and education programmes are provided for all Health Professionals. This section determined whether training requirements were met and whether additional training was required. Table 3.65 indicates that 53 (84.13%) of the respondents had been trained in health care risk

waste management. Although this is a relatively acceptable level, a higher percentage of training is desirable.

Table 3.65: Health care risk waste management training (n=63)

Need for HCRW management training	Frequency	Percentage
Yes	53	84.13
No	7	11.11
Not in the past year	2	3.17
Do not know of any training	1	1.59
Total	**63**	**100**

Table 3.66 shows that 52 (82.54%) of the respondents did not make use of the distance learning programme offered by the Gauteng Department of Health.

Table 3.66: Distance health care waste management training programme enrolment (n=63)

Distance HCW management training enrolment	Frequency	Percentage
Yes	11	17.46
No	52	82.54
Not sure	0	0
Total	**63**	**100**

The distance learning courses were devised to assist Health Professionals in enhancing their awareness of healthcare issues and to learn more about HCRWM. Several courses are also presented by different universities such as NIMS University (duration 1 year at a cost of £2800 [R58,586 as 1£=R20.3426 on 10 November 2020]); Coursera (duration 2 online videos, no cost); EtLog Health GMbH (information regarding price and duration was not available) and Class Central (Central University of Punjab) that offers a 15-week course online at no cost −you only pay for the issuing of the certificate after completing the course (Garg, 2020;

EtLog Health GMbH, n.d.; Coursera, 2020; India. University of NIMS, 2020; OANDA, 2019).

When looking at the data provided by Statistics South Africa as part of a survey to determine the impact of Covid-19 on households, it was indicated that 75.9% of the individuals had smart phones, 36.1% had access to tablets, and 61.2% had access to laptops. This illustrates that access to online courses should not pose a problem for most South African Health Professionals (South African Education Statistics, 2020).

The current distance learning course should be made available online to ensure a continued learning platform for workers under the auspices of the Gauteng Department of Health to ensure access and effective information utilisation. Online courses are not new but seem to be underutilised by departmental officials. Many courses are cost-free and only take about 8 weeks to complete.

Moreover, Table 3.67 shows that 34 (53.97%) of the officials had not attended the four-hour training sessions onsite. These courses are regularly arranged by the Provincial Gauteng Department of Health Office. This finding is contradictory to the outcome of the data in Table 3.62 which shows that 53 (84.13%) officials were trained in health care risk waste management.

Table 3.67: Have you completed the four-hour professional contract training course? (n=61)

Completion of four-year professional training course	Frequency	Percentage
Yes	24	38.10
No	34	53.97
Not sure	3	4.76
Question not complete	2	3.17
Total	**63**	**100**

Table 3.68 indicates that all the respondents felt that health care risk waste management training is necessary.

Table 3.68: Is health care waste management training necessary? (n=63)

HCW management training necessity	Frequency	Percentage
Yes	63	100
No	0	0
Total	63	100

Table 3.68 indicates that all the respondents (63, 100%) agreed that health care waste management is necessary. This explains the 0% response rate in Table 3.66. Several studies also confirmed the importance of continuous training, as mentioned in the discussion on Table 3.60, which indicates that satisfactory knowledge levels among the health workers existed. However, refresher training should be provided and attended on a continuous basis (Olaifa, Govender &Ross, 2018; Deress, Jemal, Girma & Adane, 2019; Sanches, Mekaro, Figueiredo & Andrè, 2018; Mathur, Dwivedi, Hassan & Misra, 2011:143-145; Wafula, Musiime & Oporia, 2019).

Table 3.69: Reasons why training is not necessary (n=63)

Necessity for training	Frequency	Percentage
It is a waste of time	0	0
My duties do not include health care waste management	0	0
I have been trained on the same subject numerous times already	0	0
Health care waste training formed part of my studies and I do not need further training	0	0
Do not know	0	0
Other, please specify:	0	0
Total	**63**	**0**

As all the respondents indicated that they felt that training is necessary, as none answered this question.

3.14.2 Knowledge rating of health care risk waste management

As part of the responsibility of continuous in-service education and training, it was important to determine what level of knowledge officials possessed. No knowledge test was administered but the respondents were requested to rate their knowledge in the management of health care risk waste. Table 3.70 shows that, cumulatively, 61 (96.83%) of the respondents rated their knowledge as average and above.

Mathur, Dwivedi, Hassan and Misra (2011) mention in their cross-sectional study that the knowledge of Health Professionals may vary among different levels of occupation with the least knowledgeable being the cleaning staff. According to

Table 3.70: Knowledge ratings of health care risk waste management (n=63)

Knowledge ratings of HCRW management	Frequency	Percentage
Poor - no knowledge	1	1.59
Limited knowledge	1	1.59
Average	19	30.16
More than average	23	36.51
Excellent	19	30.16
Total	**63**	**100**

Olaniyi, Ogola and Tshitangano (2018), self-knowledge rating should be subjectively evaluated as challenges will always need to be addressed and practices will always need to be corrected before medical waste is successfully manged in South Africa. Based on the data, it was evident that training was provided but that some training programmes (Table 6.66 – distance training programme) were not well known or supported.

3.14.3 General discussion: Training and education

Training is part of the Gauteng Department of Health's contract provisions as per tender specifications. Table 3.65 shows that 53 (84.13%) of the respondents were

trained, while Table 3.66 shows that 52 (82.54%) of the respondents did not register for the distance learning programme that is provided by contracted service providers. This means that the programme should either be stopped or that active awareness initiatives should be launched to promote this training programme.

The data presented in Table 3.67 indicate whether the respondents participated in and completed the four-hour onsite training sessions as provided by the contracted service provider. Thirty-four (34, 53.97%) of the respondents indicated that they had not completed the training, while only 24 (38.10%) (Table 3.67) indicated that they had attended the course. The data in Table 3.68 (63, 100%) and Table 3.69 (63, 100%) indicate that all the respondents agreed that training in health care waste management is important. Table 3.67 indicates cumulatively that 61 (98.83%) of the respondents rated their level of knowledge as average to excellent. This finding was not verified by detailed knowledge evaluation and might be skewed. Uchechukwu, Babatunde and Anne (2017) found that although the knowledge of the health care participants in their study was high, their practice was poor. This finding may also relate to Table 3.64, where the majority of the respondents (53.97%) indicated that they had neither attended the 4-hour onsite training course nor participated in a distance learning programme. Table 3.66 indicates that 52 (82.54%) of the respondents agreed that they had not made use of the distance learning programme that had been provided by the contracted service provider. It can be speculated that internal training programmes were offered as 53 (84.13%) of the officials had been exposed to in-service training (Table 3.65).

3.15 Conclusion

The findings of this study are critical in informing the management of HEs regarding health care risk waste management, especially in terms of pathological waste (placentas in particular) in Gauteng Province. Demographic information, patient and birth information, placenta management inside and outside hospitals, the impact of traditional beliefs on placenta management, and general knowledge and training of five categories of health professionals were investigated at hospitals in the Gauteng Province.

The study revealed that medical practitioners (i.e., doctors) felt that health care risk waste management was not their responsibility. However, the medical practitioners who completed the questionnaire believed that the content of the questionnaire was applicable and that it triggered their interest in the subject.

It was evident that the researcher had underestimated the number of births in hospitals per month as it could be as many as 699 (Table 3.8).

Administrative requirements for placenta management inside the hospitals were met in terms of the registration, weighing, and single lining for containment of placentas before placement in a Specican within 10 minutes after birth. However, a slight splash risk was identified (Table 3.13). Ten (15.87%) of the respondents indicated that they transferred the placenta directly into the Specican without placing it in a lining first. It was found that different time frames elapsed before containing placentas in Specicans, mainly because theatre procedures could prolong the final containerisation of placentas. It was confirmed that between 6to 20placentas were placed in a Specican, but this practice varied according to the different sizes of Specicans being available.

Refrigeration practices involving placentas require additional attention as neither temperatures nor the frequency of collection were monitored. The respondents were also unsure about what happened to the Specicans containing placentas when collection was not done as per the collection schedule.

Administrative issues were uncovered as the respondents agreed that manifest documents were received; however, it was confirmed by 19 (30.16%) of the respondents that manifest documents were sometimes not received. It was also revealed that there were uncertainties about the whereabouts and existence of safe disposal certificates.

It was confirmed by 60 (95.24%) of the respondents that placentas were not buried on hospital premises. Although 36 (57.14%) of the respondents indicated that patients did not want to take their placentas home, there was evidence that retrieval was requested after patients had left the hospital premises. This indicates that not enough information reached the patients prior to giving birth in terms of their right to keep the placenta. Moreover, the health professionals were uncertain about the methods and procedures to follow in order to address diverse religious and traditional customs when the patient requested to take the placenta home. The concern was raised by 28 (44.44%) of the respondents that dogs could dig up and get into contact with buried placentas.

The respondents confirmed that most patients were picked up from the hospitals by family members using their own vehicles. However, it must be acknowledged that this information may have relied on a perception rather than on accurate data as no record of such transport arrangements were kept. The main responsible person for the release of the placenta was identified as the professional nurse. The respondents also indicated that a standardised consent form was completed and they agreed that clear communication should be initiated with the patient/her nearest family to enable the professional nurse to understand her role and responsibility in terms placenta availability if required. It was also recommended that a pamphlet/information guideline should be developed and that the information should be made available during prenatal classes to patients.

It was determined that two groups of patients usually took the placenta home, namely Indian and African women. In terms of religious categories and cultural diversity, it was determined that the Indian population most frequently requested to retain the placenta. Many people in this group adhere to the Muslim and Hindu religions and it was evident that both these groups retained the placenta, although frequencies per religious group were not established. It was clear that many respondents were unfamiliar with specific management requirements for retaining

the placenta and this necessitates further research and clear SOP guidelines as a matter of urgency.

Stocks of consumables, such as liners and Specicans, were readily available to the users and the respondents indicated that they were satisfied with the current HCRWM system. The health professionals were familiar with the management of blood spills associated with placenta handling as a standard operating procedure for this was available. The participating professionals were also aware that a contracted service provider was responsible for health care risk waste removal and disposal. However, there were uncertainties about what would happen to the placenta should the service provider deviate from the collection schedule. The respondents were also uncertain of the exact practices employed by service providers when collecting Specicans and disposing of the contents. Satisfaction was expressed regarding management support in terms of health care risk waste management.

Ongoing training of Health Professionals was highlighted as paramount and it was found that 53 (84.13%) of the 63 respondents had been exposed the HCRW training, but when the two options of training – a distance learning programme and a four-hour onsite training course – were investigated, the majority indicated that they had not attended nor taken part in such distance learning programmes. However, all the respondents agreed that training in health care risk waste management was important. When self-evaluation was requested as an indicator of the knowledge level of the respondents, their self-ratings ranged between average to excellent. This level of confidence is concerning as the data indicated low attendance of two types of refresher courses available to professionals, and thus the issue of ongoing and even compulsory internal training should be investigated for clear guidelines to hospital management teams. The distance learning programme that seemed be poorly accessed should be revised, and/or a marketing programme should be developed to address the nonparticipation of professionals.

The health practitioners revealed that some patients wanted to take their placentas home. However, home disposal methods and practices are still nebulous and future studies should further explore this phenomenon using patient interviews.

The outcomes of the study will be appropriately presented to relevant legislative and managerial bodies to inform them of the findings so that the gap between HCRW legal requirements and actual practices can closed.

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CHAPTER 4

CONCLUSION AND RECOMMENDATIONS

4.1 Introduction

This chapter presents a summary of all the chapters in this report. It revisits highlights of the study and emphasises the legal framework, alternative treatment technologies in the health care risk waste sector, and placenta management in health establishments in Gauteng. The discourse will also address outstanding issues identified during the assessment and presentation of recommendations in earlier chapters.

The study report commenced with a general background to the study (Chapter 1). Demographic information was provided, followed by an introduction to HCRW treatment technologies (incineration versus alternative technologies), HCRW disposal strategies, and the legal framework in which HCRW management is embedded. The research aims and objectives were presented, followed by a brief discussion of the delimitations of the study. The researcher then discussed the study methodology, materials and methods, and constraints. A pilot study led by an assistant researcher was conducted, and this process was described. The study design and sampling techniques were explained, followed by a discussion on the actual questionnaire survey that was conducted, with special focus on design, coding, interpretation, and evaluation. A short outline of the study concluded this chapter.

Chapter 2 focused on the history of waste management, and an insightful discussion on the problems in the waste management industry was presented. An extensive discussion on the legal framework for waste management followed, with particular attention to global legislation guiding waste management practices in areas and countries such as the European Union, Africa, Asia, Australia, New Zealand, the United States of America, Namibia, and South Africa. The discourse

also addressed the advantages and disadvantages of incineration and alternative treatment technologies in South Africa, the concept of a circular economy, and current HCRW disposal methods in the health care waste sector in developing countries. Concepts of health care waste management such as illegal dumping and landfilling in South Africa were also highlighted.

The life cycle assessment framework, which can be associated with the cradle-to-grave principle in HCRWM, with additional emphasis on costing and performance, was discussed with reference to authors in the field such as Widhedenb and Ringström (2007), Bhatt, Bradford and Abbassi (2019), the United States of America. Environmental Protection Agency (2006), and Krishna and Manickam (2017:57-76).

Issues such as waste classification and licencing and authorisation requirements applicable to the waste classification and licencing of treatment plants for HCRW disposal were summarised. A comparative evaluation of the NEWster® and the Alkaline Hydrolysis alternative treatment systems presented with reference to process phases, system requirements, design, technical details, treatment verification processes, costs, and the responsibilities of the HCRW generator.

In Chapter 3, the cross-sectional study that was conducted to determine the knowledge, attitudes, training levels, understanding of traditional beliefs, and the waste management knowledge of Health Professionals in selected hospitals in Gauteng was presented in great detail. An extensive literature review had been conducted to determine the prevalence of traditional and cultural belief systems regarding the management, transportation, containerisation, knowledge, and practices associated with placenta management in- and outside the health establishment environment. This information was integrated with the data and findings of the study.

Sampling was done according to a multi-stage method that allowed health care worker participants to be identified and recruited according to the following job categories:

- matron/nursing supervisor/operational manager
- professional nurse
- nursing assistant
- medical practitioner
- health care risk waste officer/environmental health practitioner.

A questionnaire was administered to elicit data. This field work was conducted from January 2017 to January 2019.Ofthe 75 questionnaires that had been disseminated, 63 were completed and returned, which equates to a return rate of 84%. The questionnaire was piloted using participants from three of the participating hospitals and a research assistant, while the researcher administered the interview questionnaires to all the other respondents. The questionnaire included the following sections:

- Section A: Demographic information
- Section B: Patient and birth information
- Section C: Placenta management at the hospital
- Section D: Placenta management outside the hospital
- Section E: Traditions and beliefs
- Section F: General knowledge
- Section G: Training.

Descriptive data were presented in tables and discussed and analysed in detail.
This chapter, Chapter 4, concludes this study report and addresses future developmental projects and shortfalls that exist in the HCRW field in South Africa, especially in governmental health establishments in the province of Gauteng.

4.2 Conclusions

This study confirms that several countries have progressed successfully in the development and implementation of new and improved sets of legislation guiding HCRW. This legislation form part of the greater international network of legal compliance and standardisation regarding waste management and have more similarities than differences (European Commission, 2019; Gabela, 2007; Głuszyński, n.d.; Hasan & Rahman, 2018; Luga, 2016; Motlatla, 2015:20-40; New Zealand, 2018; Olaifa, Govender & Ross, 2018; Olaniyi, Ogola & Tshitangano, 2018; Republic of Namibia, 2011; Society for Direct Initiative for Social and Health Action, 2005; South Africa. SAWIS, 2019; Western Australia, 2016; Yazie, Tebeje & Chufa, 2019)

It was established that the sets of legislation in the various regions and countries that were reviewed generally adhere to globally agreed requirements. In South Africa, this encouraged the privatisation of treatment capacity (Magallan Risk Services & Kobus Otto and Associates, 2009; Gauteng Department of Agriculture, Conservation, Land and Environment, 2003:2-46; Leonard, 1996; Magner, 2014; Mathebula, 2001). In South Africa, HCRW is currently treated exclusively by means of incineration, yet several alternative treatment methods for HCRW are available. These methods do not necessarily require a waste management licence, but operators are responsible for declaring the volumes of HCRW being treated and disposed of. Alternative treatment technologies used in sectors other than the health care environment, namely Alkaline Hydrolysis and NEWster® sterilising units, were evaluated for the treatment of pathological waste. If utilised for this purpose, they will have to be specified in the waste management licence authorisation document in accordance with requirements by the National Environmental Management: Waste Act of South Africa (South Africa, 2008b:59-69).

In the first part of the study, two alternative technologies for HCRW were investigated for application in the health care field. The operational management

parameters of these systems make them both ideal for consideration as alternative pathological waste treatment technologies, but their application should be investigated further in terms of risk rating. Moreover, occupational health and wellness considerations should also be investigated before purchasing any one of these two alternative technologies. Based on the results of the investigation, it is concluded that the volumes of generated waste versus treatment volumes will play a role in the choice of technology that is most suitable for use in health care establishments. Various concerns regarding the operational handling, management, maintenance, and optimal treatment efficiency of both systems were highlighted, but it was concluded that the NEWster® technology, which is the smaller of the two units, is more suitable for small-scale operators such as district hospitals, clinics, and community health establishments. This is because the cycle time is less and the capacity of the unit versus generation rates is more in line with legal requirements. This investigation was conducted against the backdrop of the findings, insights, recommendations, and legal frameworks as expounded by a range of authors and bodies, such as Bovetti (2016), Costley (2020), European Commission (2002), Gelfand Centre (2021), Ginters *et al.* (2010), Jiang *et al*. (2012), Kaye *et al.* (1998), Kruger (2020), Mokoena (2007), NEWster® (2020), Pinho *et al.* (2015), Power and Maker (2007:5), Prinie (2002), South Africa. Department of Environmental Affairs and Tourism (2008a:1-132), South African Waste Information System (2019), UNEP (2012), United Nations Environment Programme (2012), Van Wyngaard (2015), Wang *et al*. (2016), Waste Resolution Technologies (Pty) Ltd (2020) and Waste Prevention Association (2003).

The findings of the second part of this study are critical as it is envisaged that they may inform improved management of health care risk waste, with specific focus on placentas as pathological waste, particularly in terms of waste that is generated in governmental health establishments in the Gauteng Province.

4.2.1 Demographic information

The study was conducted in the Gauteng Province of South Africa and provincial (academic), regional, and district hospitals participated. The highest participation

rate was achieved from the Tshwane District (19, or 50.7% of the participants) (Table 3.3). The category that had the lowest representation rate was medical practitioners (doctors) (7 or 11.11% of the participants).

4.2.2 Patient and birth information

It was evident that the researcher had underestimated the number of births in the hospitals as it could be as many as 699 babies per month (Table 3.8), as was revealed by 25 (39.68%) of the participants. The average age of birth mothers was estimated to be between 26 and 35 years (Table 3.7).

4.2.3 Placenta management at hospitals

Hospital requirements in terms of the registration of placentas were met, although the practice of weighing placentas was confirmed by only 42 (66.67%) of the respondents. Placenta registers were used and they were reportedly mostly located in the maternity ward/at the nursing station in the maternity ward. Nearly 100% of the respondents agreed that placentas were individually packed in small red plastic bags, which were always available as indicated by 54 (85.71%) of the respondents. The red liner was reportedly the first method of containment before the placenta would be placed in a Specican. However, splash risk was identified which is an important infection prevention and control concern as it poses some health risks. Ten (15.87%) of the respondents indicated that they placed placentas directly in the Specicans for disposal (Table 3.13). Various timeframes elapsed before placentas were contained in Specicans, arguably because theatre procedures prolonged the final containerisation of the placenta which could take up to 30 minutes. It was confirmed that between 6 to20 placentas were placed in a Specican, but this number varied due to the different sizes of available Specicans. Contrary to the findings of other research studies, stocks of consumables such as liners and Specicans were readily available in the hospitals under study. In hospitals where this was not the case, authors argued that financial constraint was the prohibiting factor.

The majority of the participants (62, 98.41%) agreed that placentas were stored in freezers (Table 3.20) most of the time, but the study argues that some access control concerns need to be addressed. It was concerning that most freezers were not equipped with a thermometer or mechanism to verify freezer temperatures. It was confirmed that placentas were frozen before collection by a contracted service provider, but the respondents were vague about what happened to the placenta if it was not frozen, when a freezer was not available, or when the storage capacity was full. The findings in this regard were thus inconclusive and further investigations in this regard are proposed.

It was evident that there were some uncertainties regarding the practices of contractors who collected and transported placentas for final disposal. Collection frequencies could also not be verified. This could be attributed to the different capacities of the health establishments and the different generation rates of HCRW. However, 47 (74.6%) of the respondents indicated satisfaction with the contracted services provided (Table 3.30). A concern must be highlighted in this regard, however, as part of the service contract includes the provision of a manifest and a destruction certificate, which 17 (26.98%) of the respondents were unaware of (Table 3.33).

Most of the respondents (60, 95.24%) indicated that no placentas were buried on hospital premises (Table 3.34). Many indicated that some patients would request their placentas, which also happened after the patient had left the hospital (Table 3.35, Table 3.38, Table 3.37 and Table 3.38) as reported by a number of respondents (12, 19.05%; 3, 4.76%; 55, 87.3% and 52, 82.54% respectively). When patients requested to take the placenta home, nurses were usually the primary source for consultation and permission (Table 3.39). Thirty-four (53.97%) of the respondents indicated that there was about a 50% chance that a mother might not be aware of the procedure for placenta management that should be followed and she might thus request the placenta after it had already been disposed of in a Specican, which meant that placenta retrieval was problematic in some instances

(Table 3.40). This indicates that not enough information regarding patients' right to access their placentas reaches them. Moreover, many health professionals were unsure of the methods, procedures, and religious practices that are followed when a patient takes the placenta home, and this practice was identified as a grey area in the HEs under study.

Methods to contain the placenta when taking it home are indicated in Table 3.41. Of the 63 respondents,15 (23.81%) indicated that placentas were placed in a non-permeable container such as a plastic bag and then given to mothers/a family member to be taken home for private disposal according to traditional beliefs and customs. This practice is contradictory to the WHO *Guidelines for the safe transport of infectious substances and diagnostic specimens* (n.d:1-15) well as SOPs developed by various hospitals abroad. Unfortunately, current South African regulations and policies do not prescribe a method for placenta containment when transporting them home for consumption, traditional burials, or encapsulation.

Uncertainties thus existed regarding correct placenta management procedures, although there was some indication of record keeping compliance. For instance, 20 (31.74%) of the respondents indicated that they were aware of the requirement to issue a consent form if the mother wishes to retain her placenta. The professional nurse was deemed the most important person by 22 (34.92%) of the respondents to be notified by patients who wished to take the placenta home (Table 3.42). The respondents were generally unfamiliar with any tracing method to track a placenta after it had been taken home. Most respondents (40 ,63.49%) indicated that family members picked patients up from the hospitals in their own vehicles (Table 3.44), while 38 (42.20%) indicated that patients would bury the placenta upon their arrival home (Table 3.45). It was noteworthy that nine (10%) of the respondents indicated that placentas would be given to traditional healers for medicinal purposes. Pan, Chan, Wong, Klokoland Chernykh (2017) confirm that placenta extracts can be used as medicine among traditional communities. The fact that dried placenta

formulations can be bought on the Internet is a concern (Eastern Chinese Medicine Export Company, 2011), as no legal protocols exist for such formulations.

It was evident that the majority of the professional nurses did not know what procedures to follow when a placenta is taken home. As many as 37 (58.73%) of the respondents confessed their ignorance in this regard (Table 3.46). Approximately a third (19, 30.16%) of the respondents thought that the placenta would be buried on the same day that the patient arrived home. This is a logical assumption as they would have been aware that the burial of pathological waste should take place as soon as possible (Table 3.48).The literature review indicated time frames for placenta disposal of between 48 to 72 hours without refrigeration, and 7 to 60 days when refrigerated (Pocica, 2018; Holister, 2018; Bruns, 2014; Chikako & Vodounon, 2017; Royal Hospital for Women, 2018; Cairns, 2005; Panelli & Tipa, 2007; Dike, 2013; Buckley, 2006).

As the respondents were health professionals belonging to various race and religious groups, they might not have been personally involved in the burial rites of placentas, and this could explain the high percentage of respondents (34, 53.97%) who did not know what containers would be used to bury placentas. The literature indicates that patented and other containers are available for this purpose in various countries (Lynnea, 2015; Copal, n.d.; Medical Supplies, 2020; Carolina Birth and Wellness, 2017; Bradley, 2011; (The) Patron Group, 2020).

The depth of the hole for burial was another grey area, according to the literature, it can vary in accordance with the ritual that will be followed for the burial. When the placenta is buried under a tree, the depth of the hole may be influenced by the root congestion or the depth may be determined by the nature of the tree that will be planted on top of the placenta to symbolise birth. Due to uncertainties in the responses of the respondents (Table 3.48), no definitive conclusions could be reached. It is, however, assumed that the hole might be quite deep, as 28 (44.44%)

of the respondents indicated that animals should be prevented from digging up and coming into contact with the placenta.

A recommendation based on the findings regarding placenta disposal at home is that future studies in this field should include the voices of mothers/family members of all race groups to capture definitive data for the development of effective guidelines for the disposal of placentas at home.

4.2.4 Section D: Placenta management outside the hospital premises

It was confirmed by the respondents that most patients would be collected from hospital by family members using their own vehicles, but no recorded data to confirm this practice were available. The person mainly responsible for the release of the placenta was identified as the professional nurse, and it was acknowledged that a standardised consent form should be provided for this purpose. Moreover, clear communication should take place to enable the professional nurse to understand her role and responsibilities in this regard. It was also recommended that a placenta information pamphlet be developed and that information regarding placenta retainment rights should also be made available to patients during prenatal classes.

4.2.5 Section E: Traditions and beliefs

It was reported that predominantly Indian (33, 39.75%) and African women (20, 24.09%) requested to take their placentas home. Taking religion as part of cultural diversity into account, the dominant group that took the placenta home was Indian mothers who may have belonged to either the Hindu or Muslim faiths. Many people of Indian origin may also embrace the Christian or other faith groups and the findings in this regard are thus based on surmise as the study made no distinction between religious groups and placenta management for sensitivity reasons. The data indicated that the Zulu population group (12, 14.29%) was the second largest group that requested to take the placenta home. However, no religious distinctions were associated with this group either as no data were elicited that linked Zulu

mothers who took the placenta home with a particular faith. Traditional rituals that are distinctive to any of the groups were also unknown. These findings underscore the need for consultation prior to birth and a subsequent updated data set to furnish policy makers and hospital management teams with authentic data that will enable them to devise guidelines and protocols for the safe disposal of placentas at home and in hospitals.

Investigating the management of placentas after home births was beyond the scope of this study, and this is a field of study that should be addressed as a matter of urgency.

4.2.6 General knowledge

This section elaborates on the respondents' knowledge regarding ordering, stock levels, and frequency of orders of HCW consumables such as Specicans and liners/plastic bags. A high percentage of respondents (77.77%) indicated that they did not run out of stock of Specicans and red liners, which closely corresponded with the finding (Table 3.58) that the hospitals never ran out of liners.

Most respondents (55, 87.30%) also indicated that their needs were met by the current waste management systemin the hospitals where they worked (Table 3.59). In terms of the threat of blood spills (Table 3.60), 55(87.30%) of the respondents indicated that they knew how to manage such spillages. Moreover, it was found that a standard operating procedure for blood spills was available as this was confirmed by 50 (79.37%) of the respondents (Table 3.61). Fifty (79.38%) of the respondents were also satisfied with the managerial support they received in terms of HCRW management (Table 3.62).

A finding related to the combined response rates of 16 (25.39%) and 23 (36.51%) of the respondents (Table 3.63) suggests that a standardised form and a data base should form the basis for a consent form that will allow the removal of placentas from hospitals. Currently, there is a lack of standardisation in this regard as some hospitals require an affidavit from a local South African Police station, while other

hospitals merely have a register in which placenta data are recorded. Unfortunately, the data are not collated in a data base and the procedure thus merely serves to comply with an administrative requirement.

The respondents felt that it was important to explain all procedures clearly to the mothers/families as this would help them to become more efficient and accountable to the patients (Table 3.64). Thirty-six (57.14%) of the respondents recommended information dissemination at pre-natal classes, while 11 (17.46%) recommended the development of an information pamphlet for the dissemination of placenta management practices to mothers and families.

4.2.7 Training

It was found that 53 (84.13%) of the respondents had been trained in HCRW management, but when referring to the two options of training (i.e.a distance learning programme and a4-hour onsite training programme), the majority indicated that they had not attended such as distance learning programme. However, all the participants indicated that training in health care risk waste is important.

The study revealed that medical practitioners (i.e. doctors) felt that health care risk waste management was not their responsibility. However, in another study(Mathur, Dwivedi, Hassan & Misra, 2011:143-145) the authors mentioned that doctors were one of the levels of HC workers that had a good knowledge of HCRWM. The medical practitioners that completed the questionnaires believed that the content of the questionnaire was highly applicable and agreed that it had triggered their interest in the subject. A concern was that 21 (33.33%) of the respondents did not know what the maximum storage time for placentas was (Table 3.20).

When self-evaluation was done on the knowledge level of respondents, the results varied between medium to excellent. However, this is a concern as the data showed low attendance of two courses available to professionals, and thus the provision of internal training facilities, should be investigated in depth. At this point it is recommended that the distance learning programme be made available online

and that the Gauteng Department of Health should invest in the marketing of the programme as it was evident that smartphones, computers, and laptops were available to at least 75% of the sample, and this will make online training feasible. A disconcerting factor is that no corrective actions existed for the non-participation of professionals in these training sessions. It is argued that this lapse in professional development of Health Professionals should be investigated and addressed by hospital management teams.

4.3 Recommendations

The following recommendations are offered for consideration:

4.3.1 Legal frameworks

The continued development and revision of legal documents, strategies, policies, standard operating procedures, and standardisation of colour coding worldwide should be a priority in HEs, particularly in terms of HCRWM.

4.3.2 Alternative treatment technologies

Application of the NEWster® technology for HCRW disposal should be investigated further. For instance, capacity versus cost ratio should be determined as a financial model and guideline. It is recommended that the Gauteng Department of Health (and possibly these departments in all other provinces of South Africa) should consider this HCRW treatment technology to curb the several service inconsistencies and even illegal activities associated with HCRW disposal, such as the indiscriminate dumping and burning of such waste.

4.3.3 Placenta management

It is recommended that a national process should be devised and implemented for the safe and consistent containment method for patients who want to take the placenta home, irrespective of whether it will be buried, consumed, or encapsulated.

It is further recommended that a standard consent form should be developed, implemented, and locally authorised by a doctor. This should obviate the

procurement of an affidavit from a local police station, which is a time consuming and cumbersome process.

A standardised operating procedure (SOP) should be developed to guide professionals and to ensure the standardisation of practices and legal compliance for placenta management in all health establishments where women give birth. An information pamphlet should be developed and issued to all expecting parents to enable them to make an informed decision regarding placenta management. This pamphlet could be disseminated at prenatal classes. Such a pamphlet will limit incidences of retrieval of a placenta after the placenta has been placed in a Specican for disposal.

Training of Health Professionals should focus mainly on the following:

- Handling and disposal of placentas;
- Contract compliance;
- Information regarding patients' right to take the placenta home.

4.3.4 Further Developments

It is recommended that further studies be pursued to address the diversity in cultures, beliefs, and traditions per population group in South Africa, with specific reference to the management of placentas from patients' viewpoint to ensure that an individual's choice of burial or consumption of the placenta is rightfully executed. A recommendation based on the findings regarding placenta disposal at home is that future studies in this field should include the voices of mothers/family members of all race groups to capture definitive data for the development of effective guidelines for the disposal of placentas at home. Such a guideline could include home birth practices once this phenomenon has been extensively investigated. This was however not part of the scope of this study.

Relevant legislators should be informed of the results and outcomes of this study to ensure that the gap in legal provisioning in the field of placenta management is addressed. It was a glaring omission that no mention is made in the legal framework

of the traditional management of placentas. This should be addressed and legislative changes should be affected to ensure that the traditional management of placentas is authorised and monitored by a relevant body.

The trade in placentas should also be investigated to ensure that medicinal compounds derived from them are non-toxic, as the presence of heavy metals and chemicals in them may negatively impact the health of people who take traditional medicines made from placentas.

A financial model should be developed for the NEWster® technology and analysed for the Department of Health for possible inclusion in the building of new hospitals.

Hearing the voices of mothers and families regarding placenta management was beyond the scope of this study, and future research should thus address this largely under-studied topic exclusively.

4.3.5 Document development

The Gauteng Department of Health in the Tshwane District developed a standard operating procedure for the management of human tissue in 2019, which was scheduled for review in December 2020. Considering the content of the developed document and the objectives of the study, it was evident that the traditional management of placentas was not specifically addressed in the original document and this necessitated the development of an information pamphlet and a standard operating procedure for the management of pathological waste, particularly placentas, at health establishments where women give birth (Gauteng Department of Health, 2019).

Based on the literature review and the findings of this study, the researcher developed both a standard operating procedure and an information pamphlet that are attached. These may be used, possibly with minor adjustments, by governmental and private health establishments. Consideration should be given to

the fact that the legislative framework should be reviewed for effective and efficient application of the content of these two documents (Appendix E and Appendix F respectively).

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Appendix A: Questionnaire

IN COLLABORATION WITH THE CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE

DEPARTMENT OF LIFE SCIENCES

HEALTH CARE RISK WASTE MANAGEMENT

QUESTIONNAIRE

The purpose of this questionnaire is to investigate the practice and prevalence of traditional burial of placentas at home shortly after birth as well as identifying the need for training and stock rotation by health care risk waste management workers. This questionnaire will form part of a study for the qualification Doctor of Philosophy in Environmental Health Science (PhD) that also aims to compare two types of alternative technologies: the Alkaline Hydrolysis Treatment Technology with the NEWster® sterilizer system, for the local treatment of placentas. Additionally, the practice of traditional burial of placentas at home shortly after childbirth will be investigated.

I, Ms. Kathie Elizabeth Jansen, student number: 9011234, am a PhD student at the above-mentioned institution and the information received from the questionnaires will only be used for the purpose of the study. All names and contact details will only be used for verification purposes and will not be published.

This questionnaire is not a test but must be completed in full. It contains questions to determine the perceptions and knowledge of Health Professionals regarding the management of placentas in HEs and their general perceptions/attitudes towards health care waste management practices, specifically of pathological waste.

There are no rights and wrong answers.

1. To ensure the best value from the results, you should answer the questionnaire truthfully and as accurately as possible.

PERMISSION:

I, ...in my capacity of

....., hereby give permission for information obtained by the completion of the questionnaire to be used in the study.

....

Signature Date

TRADITIONAL BELIEFS AND MANAGEMENT OF PLACENTAS IN GOVERNMENT HOSPITALS IN GAUTENG DEPARTMENT OF HEALTH

Questionnaire number:

INSTRUCTIONS:

- ***Please mark appropriate number for correct answer with an "X" as applicable to your knowledge.***
- ***For other questions mark on yes/no/sometimes/any other as relevant to the specific question, to your knowledge.***
- ***The questionnaire consists of sections (A) to (G).***

SECTION A: DEMOGRAPHIC INFORMATION

Name of the Interviewer: _____

1. In which health district is your facility located?

Johannesburg District			1
Tshwane District			2
West Rand District			3
Ekurhuleni District			4
Sedibeng District			5

2. Indicate what your current designation is?

Matron/Nursing Supervisor			6
Professional Nurse			7
Nursing Assistant			8
Medical Practitioner			9
Health care risk waste officer			10

3. What is the name of the hospital where you currently work?

Provincial Hospitals		_____

Charlotte Maxeke Academic Hospital			11
Chris Hani Baragwanath Academic Hospital			12
Dr. George Mukhari Academic Hospital			13
Kalafong Hospital			15
Steve Biko Academic Hospital			16
Tembisa Hospital			17
Regional Hospitals			
Edenvale Hospital			18
Ruth First Hospital			19
Leratong Hospital			20
Mamelodi Hospital			21
Pholosong Hospital			22
Rahima Moosa Hospital			23
Sebokeng Hospital			24
Tambo Memorial Hospital			25
ThelleMogoerane Hospital			26
District Hospitals			
Bertha Gxowa Hospital			27
Bheki Mlangeni Hospital			28
Bronkhorstspruit Hospital			29
Carletonville Hospital			30
Dr. Yusuf Dadoo Hospital			31
Heidelberg Hospital			32
Jubilee Hospital			33
Kopanong Hospital			34
Odi Hospital			35
Pretoria West Hospital			36
South Rand Hospital			37
Tshwane District Hospital			38

SECTION B: PATIENT AND BIRTH INFORMATION

(Environmental Health Practitioners can omit this section)

4. What is the average age of patients, at the time of giving birth, who you treated or interacted with in the past month?

10-16 years			39
17-21 years			40
22-25 years			41
26-30 years			42
31-35 years			43
36-40 years			44
Older than 41 years			45

5. Indicate the number of births per month including still births and miscarriages.

0			46
5-10			47
11-20			48
21-30			49
31-40			50
41-50			51
More than 51, please specify:			52

6. How many twin births on average take place per month?

0			53
1			54
2			55
3			56
4 to 5			57
6 to 7			58
8 to 10			59

More than 10, please specify:			60

SECTION C: PLACENTA MANAGEMENT AT THE HOSPITAL

7. Do you/your facility have a placenta register?

Yes			61
No			62
Not sure			63

8. If a placenta register is not available, what do you use to record the placentas?

Nothing			64
Have a file where daily sheets are filled into			65
Have an official register book			66
Have a loose page each day			67
Do not know			68
Other, please specify:			69

9. Where is the placenta register kept in the hospital?

CEO office			70
Maternity ward			71
Matrons office in the maternity ward			72
Nursing station in the maternity ward			73
In the intermediate storage area of the maternity ward			74
Infection control office			75
Slush room			76
Other, please specify:			77

10. What type of container/receptacle do you use to put the placenta in?

None			78
Directly into Specican			79
Cardboard box			80
Liner / plastic bag			81
First liner/plastic bag and then into a Specican			82
None of the above			83
Other, please specify:			84

11. If the placenta is not placed directly into a Specican, indicate the period of time which it takes to place it in a Specican.

Within 10 minutes			85
Between 10 – 30 minutes			86
Longer than 30 minutes			87

12. Is more than one placenta placed in a Specican/cardboard box?

Yes			88
No			89

13. If you answered yes to question 12, indicate how many placentas are placed in one container.

1-5			90
6-10			91
11-15			92
16-20			93
More than 20			94

14. Are placentas individually packed in small plastic bags before they are placed in the Specican?

Yes			95
No			96
Sometimes			97

15. Do you have stock of placenta bags/liners readily available?

Yes			98
No			99
Sometimes			100

16. Do you weigh each placenta?

Yes			101
No			102
Sometimes			103

17. Do you store the placenta in a refrigerator/freezer?

Yes			104
No			105
Sometimes			106

18. Is there access control to the freezer area?

Yes			107
No			108
Sometimes			109

19. Do you record the freezer temperatures daily?

Yes			110
No			111

20. What is the maximum storage time of placentas if refrigeration is <u>not</u> available?

12 hours			112
24 hours			113
36 hours			114
48 hours			115
72 hours			116
90 days			117
Do not know			118
Other, please specify:			119

21. Do you have a contract with an external company to collect the placenta?

Yes		*(Please answer questions 22 to 27)*		120
No		*(Please continue with question 24 and 28)*		121
Do not know		*(Please answer questions 24 to 27)*		122

22. If yes, how is the placenta collected?

Collected with other health care risk waste			123
Collected separately by the contractor			124
Do not know			125
Other, please specify:			126

23. Do you freeze the placentas before collection by an external company?

Yes			127
No			128
Sometimes			129

24. If not frozen, where do you keep the placentas?

In a Specican on the floor of the slush room			130
In the office of a staff member			131
In the kitchen refrigerator			132
In the main storage area			133
In the health care waste refrigerator			134
In the mortuary			135
Do not know			136
Other, please specify:			137

25. Do you contact your contracted service provider when the freezer/storage area is full?

Yes			138
No			139
Only when it is ¾ full			140
Sometimes			141
Service provider comes on a specific day of the week			142
Its placed in the mortuary			143
None of the above. Please specify what you do:			144

26. How many times a week are the placentas collected?

Never			145
1			146
2			147
3			148
4			149
5			150
6			151
Daily			152
Call basis			153
Other, please specify:			154

27. Are you satisfied with the frequency of collection of placentas?

Yes			155
No			156
Do not know			157
Other, please specify:			158

28. If placentas are not collected by an external contractor, what happens with them?

Buried on site			159
Burned in a special place at the hospital			160
Burned outside the grounds of the hospital			161
Buried outside the grounds of the hospital			162
Do not know			163
Other, please specify:			164

29. Do you receive a manifest (collection slip) document when placentas are collected?

Yes			165
No			166
Sometimes			167
I do not know what a manifest (collection slip) document is			168

30. Do you receive a safe disposal certificate as proof that the placentas were treated at a registered incineration plant?

Yes			169
No			170
Sometimes			171
I do not know what a safe disposal certificate is			172

31. Are placentas buried on the hospital premises?

Yes			173
No			174
Sometimes			175
If sometimes, please elaborate:			176

32. Have you received requests from patients to retrieve the placenta after they have left the hospital?

Yes			177
No			178
Sometimes			179
Do not know			180
Other, please specify:			181

33. If yes, how are the placentas retrieved?

The service provider must bring it back			182
An official from the hospital must stop the truck on its way to the incineration plant			183
The police must stop the truck on its route to the incineration plant			184
The truck driver must return the placenta			185
The nurse on duty must stop the truck before leaving the hospital premises			186
Do not know			187
Other, please specify:			188

SECTION D: PLACENTA MANAGEMENT OUTSIDE THE HOSPITAL

34. Most patients do not want the placenta after birth. Is this statement true?

Yes			189
No			190
Not sure			191

35. How often do patients request to take their placentas home with them?

Never			192
Sometimes			193
Always			194

36. What must the patient do if patients **do want** to take the placenta home?

Ask the doctor			195
Ask the nurse			196
Just take the placenta and place it in their handbag			197
Do not know			198
Other, please specify:			199

37. Do doctors and nurses inform you that patients may take a placenta home?

Yes			200
No			201
Sometimes			202
Do not know			203
Other, please specify:			204

38. What container/containing method is used by the patient who takes the placenta home?

Put in a plastic bag			205
Put in a commercial carry bag e.g., a Checkers / a Pick a Pay plastic bag			206
The hospital provides a plastic bag to the patient			207
The patient places it in her own plastic container			208
A company that dries the placenta comes and take the placenta			209
The placenta is sundried and then taken home			210
Do not know			211
None of the above, please specify:			212

39. What must the patient do if they **do not want** to take the placenta home?

Notify the nurse			213
Notify the doctor			214
Tell nobody and just leave the placenta at the hospital			215
Give written consent for destruction of the placenta			216
Do not know			217

39. What method is used to trace the placenta that is taken home?

Satellite tracking			218
Barcoding			219
Word of mouth			220
A legal letter is signed before the placenta is taken home			221
It is noted in the patient file			222
Do not know			223
None of the above, please specify:			224

40. What transportation method do you think is **mostly** used by patients to go home after giving birth?

Family comes and collects the patient in their motor vehicle			225
Patients use public transport like a taxi or bus			226
Patients use their own cars			227
Patients walk home from hospital/CHC			228
Patients use a motorcycle			229
Patients use a horse or donkey drawn cart			230
Do not know			231
None of the above, please specify:			232

41. **What do you think** does the patient do with the placenta when arriving home? (May select *more than one opinion.)*

Buried			233
Burned			234
Cooked			235
Dried			236
Dried and placed in capsules/tablets and consumed by the patient			237
Eaten			238
Given to a Traditional healer			239
Place in a freezer			240
Place in a refrigerator with food			241
Do not know			242
None of the above, please specify:			243

42. If the placenta is not immediately buried, what do you think does the patient do with the placenta?

Place in the refrigerator			244
Place in the freezer			245
Place in the sun to dry			246
Place in a cool area in the home			247
Place in an outside area out of sight			248
Give it to the dogs to eat			249
Burn it			250
Cook it and eat it			251
Do not know			252
Other, please specify:			253

43. If buried, where do you think will the placenta be buried?

Close to home			254
At home			255
At a special place in a vacant or open area			256

On a family farm			257
At the family home			258
Under a tree			259
Under a newly planted tree			260
Will not be buried at all			261
At a place of remembrance			262
Do not know			263
None of the above, please specify:			264

44. What is the longest time before the placenta must be buried?

Same day when the patient arrives home			265
Within 2 to 3 days after birth			266
Within a week after birth			267
Is kept until nature absorbs it			268
Until the mother and father arrive to view the baby			269
Until the oldest family member visits the baby			270
When the mother stops bleeding			271
Do not know			272
None of the above, please specify:			273

45. What type of container/receptacle do you think is used to bury the placenta in?

A cloth			274
Glass jar			275
Just as it is			276
Metallic type container			277
Plastic bag			278
Plastic container			279
Porcelain jar			280
Traditional wooden box			281
Do not know			282

Other, please specify:			283

46. How deep do you think is the hole in which the placenta will be buried?

5 centimetres			284
Less than 15 centimetres			285
More than 1 centimetre			286
Maximum of 1.5 meter			287
Do not know			288
None of the above, please specify:			289

47. Do you think that dogs or any other type of animals could come into contact with the placenta after it has been buried?

Yes			290
No			291
Do not know			292
Sometimes, please specify:			293

SECTION E: TRADITION AND BELIEFS

48. Do you think the tradition of taking the placenta home is limited to?

Indian women			294
African women			295
White women			296
Coloured women			297
Don't know			298
None of the above, please specify:			299

49. Do you think the tradition of taking the placenta home is limited to the following religion/s? (More than one option can be indicated)

African traditional religion			300
Buddhism			301
Christianity			302
Hinduism			303
Islam			304
Judaism			305
Muslim			306
Satanism			307
Do not know			308
None of the above, please specify:			309

50. Which of these population groups, do you think, tend to take their placentas home?

Koi and San people			310
Coloured			311
Indian			312
Ndebele			313
Northern Sotho			314
Pedi			315
Sotho			316
South Sotho			317
Swati			318
Tsonga			319
Tswana			320
Venda			321
White			322
Xhosa			323
Zulu			324

Other, please specify:			325

51. What traditional rituals/procedures take place when the placenta arrives at home?

Traditional healer must pray			326
Traditional ceremony follows			327
Mother and baby are kept separated from family until bleeding has stopped and only then is the placenta buried			328
Mother, baby, and placenta must be kept together until burial			329
Ceremonial burial			330
Do not know			331
None of the above, please specify:			332

52. What religious requirements must be adhered to when the placenta arrives home?

Prayer			333
Religious burial			334
Religious sacraments			335
Worship			336
Do not know			337
None of the above, please specify:			338

SECTION F: GENERAL KNOWLEDGE

53. How regularly do you run out of stock of Specicans?

Never			339
At least once a month			340
We have over stocked quantities in our store - older than 6 months			341
Once every 3 months			342
Every week			343

Continuously			344
None of the above, please specify:			345

54. How often do you run out of stock of red liners/plastic bags?

Never			346
At Least once a month			347
We have over stocked quantities of liners/plastic bags in our store – Older than 3 months			348
Once every 3 months as least			349
Every week			350
Continuously			351
None of the above, please specify:			352

55. Do you feel that your needs are being met by the current waste management system?

Yes			353
No			354
Not sure			355

56. Do you know how to manage a blood spillage?

Yes			356
No			357
Not sure			358

57. Do you have a standard operating procedure to handle and manage placentas at your hospital?

Yes			359
No			360
Not sure			361

58. Do you feel there is enough support from senior management in your hospital in terms of health care risk waste management?

Yes			362
No			363
Not sure			364

59. What would you like to see happen with placenta management?

No placentas must be given back to any patient			365
Implement a data base of patients that wish to take the placenta home			366
Patient to declare placenta at local area police station			367
All placentas to be treated before it can be given to the patient			368
To have a standardized consent form of the patient that authorizes disposal of the placenta at home			369
None of the above, please specify:			370

60. What can the facility do to become more efficient and accountable to the patients in the management of the health care risk waste at hospitals?

Explain procedures clearly			371
Explain options of taking placenta home during admission of patient			372
Develop pamphlets to address the proper management of placentas			373
Doctors must address the option of taking placentas home after birth with patients			374
Prenatal classes should address the options of placenta care			375
None of the above, please specify:			376

SECTION G: TRAINING

61. Have you been trained in health care waste management?

Yes			377
No			378
Not in the past year			379
Do not know of any training			380

62. Have you enrolled for the distance health care waste management training programme?

Yes			381
No			382
Not sure			383

63. Have you completed the four-hour professionals contract training sessions?

Yes			384
No			385
Not sure			386

64. Do you feel that health care waste management training is necessary?

Yes			387
No			388

65. **If you answered no to question 65**, indicate why do you feel that training is not necessary?

It is a waste of time			389
My duties do not include health care waste management			390
I have been trained on the same subject numerous times already			391
Health care waste training formed part of my studies and I do not need further training			392
Do not know			393
Other, please specify:			394

66. Rate your knowledge in health care risk waste management? On a scale from one to five, where five is the highest level of knowledge.

Poor - no knowledge			395
Limited knowledge			396
Average			397
More than average			398
Excellent			399

Appendix B: Ethical clearance approval

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

IRB nr 00006240
REC Reference nr 230408-011
IORG0005187
FWA00012784

19 October 2016

MS KE JANSEN
DEPT OF AGRICULTURE
CUT

Dear Ms KE Jansen

HSREC 168/2016 (UFS-HSD2016/1316)
PROJECT TITLE: THE COMPARISON OF ALKALINE HYDROLYSIS WITH NEWSTER STERILIZING ALTERNATIVE TREATMENT TECHNOLOGIES AND CULTURAL BELIEFS IN PLACENTA MANAGEMENT IN GAUTENG, SOUTH AFRICA.

1. You are hereby kindly informed that, at the meeting held on 18 October 2016, the Health Sciences Research Ethics Committee (HSREC) approved the above project after all conditions were met.
2. The Committee must be informed of any serious adverse event and/or termination of the study.
3. Any amendment, extension or other modifications to the protocol must be submitted to the HSREC for approval.
4. A progress report should be submitted within one year of approval and annually for long term studies.
5. A final report should be submitted at the completion of the study.
6. Kindly use the **HSREC NR** as reference in correspondence to the HSREC Secretariat.
7. The HSREC functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act. No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2006); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 (for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; The International Conference on Harmonization and Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH Tripartite), Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines, Constitution of the HSREC of the Faculty of Health Sciences.

Yours faithfully

.....
PROF G JOUBERT
FOR CHAIR: HEALTH SCIENCES RESEARCH ETHICS COMMITTEE

Cc Dr H Roberts

Health Sciences Research Ethics Committee
Office of the Dean: Health Sciences
T: +27 (0)51 401 7795/7794 | F: +27 (0)51 444 4359 | E: ethicsfhs@ufs.ac.za
Block D, Dean's Division, Room D104 | P.O. Box/Posbus 339 (Internal Post Box G40) | Bloemfontein 9300 | South Africa
www.ufs.ac.za

Appendix C: Letters of approval for Hospitals taking part in the study

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

ENQUIRIES:
Office of the CEO
Dr JC Ganda
T | 018 788 1702
M | 073 2372437
E | Jatin.Ganda@gauteng.gov.za

8th of February 2017

To: Whom It May Concern

Re: GP_2016RP36_849 - Ms Kathie Jansen Jansen

The above noted protocol has been reviewed and approved. The research may be undertaken at Carletonville Hospital. Carletonville Hospital pledges to provide the required support in terms of access as well as guidance should it be required.

Sincerely yours.

Dr JC Ganda
CEO, Carletonville Hospital.

CARLETONVILLE HOSPITAL
Anaan Road, Carletonville 2499
T | 018 788 1700

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Dr. George Mukhari Academic Hospital

Office of the Director Clinical Services
Enquiries : Dr. PMT. Mabusela
Tel : (012) 529 3880
Fax : (012) 560 0099
Email: philly.mabusela@gauteng.gov.za
keitumetse.mongale@gauteng.gov.za

To :Ms KE Jansen
:Department of Life Sciences
:Central University Technology
:Private Bag
:Free State
0204

Date : 24 February 2017

PERMISSION TO CONDUCT RESEARCH

The Dr. George Mukhari Academic Hospital hereby grants you permission to conduct research on "The comparison of Alkaline Hydrolysis with newster sterilizing alternative treatment technologies and cultural beliefs in Placenta management in Gauteng to Dr. George Mukhari Academic Hospital."

This permission is granted subject to the following conditions:

- ☑ That you obtain Ethical Clearance from the Human Research Ethics Committee of the relevant University
- ☑ That the Hospital incurs no cost in the course of your research
- ☑ That access to the staff and patients at the Dr George Mukhari Hospital will not interrupt the daily provision of services.
- ☑ That prior to conducting the research you will liaise with the supervisors of the relevant sections to introduce yourself (with this letter) and to make arrangements with them in a manner that is convenient to the sections.

Yours sincerely

DR. PMT. MABUSELA
DIRECTOR CLINICAL SERVICES

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Leratong Hospital
Private Bag X2078
Krugersdorp
1740

Enquiries: Mr G J Dube
Tel: (011) 411-3531
Fax: (011) 410-8421
Email: GreyD@gpg.gov.za
Ref: 9/3/3/1

ATTENTION: MS KE JANSEN

SUBJECT: REQUEST TO CONDUCT RESEARCH: THE COMPARISON OF ALKALINE HYDROLYSIS WITH NEWSTER STERILIZING ALTERNATIVE TREATMENT TECHNOLOGIES AND CULTURAL BELIEFS IN PLACENTA MANAGEMENT IN GAUTENG, SOUTH AFRICA.

Permission has been granted to conduct research study entitled The Comparison of Alkaline Hydrolysis with Newster sterilizing alternative treatment Technologies and Cultural Beliefs in Placenta Management in Gauteng, South Africa based on the conditions indicated from Policy Planning and Research Department. For further arrangement contact Dr B J Wojtowicz on 011 411 3405.

It would be appreciated if you could share your result of the research with the Management of Leratong Hospital.

Thank you for showing interest in our institution.

Kind regards

CHIEF EXECUTIVE OFFICER
/ive
2017/01/16

LERATONG HOSPITAL
ADCOCK STREET, CHAMDOR
2017 -04- 12
PRIVATE BAG X2078, MOGALE CITY 1740
LERATONG HOSPITAL

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Enquiries: Dr Z Ngcwabe
Directorate: Sebokeng Hospital
Tel: +27 (0)16 930 3300
Fax: +27 (0)16 988 1964
Fax2mail: 086 570 7442
E-mail: ZolelaN@gpg.gov.za / Helena.Lewis@gauteng.gov.za
Ref: 1/6/2

TO : **Ms. K. Jansen**
D. Tech Environmental Health
Department of Life Sciences
Faculty of Health and Environmental Sciences
Central University of Technology, Free State

FROM : **Dr. OP Mashele, Acting Chief Executive Officer**
DATE : **07 February 2017**
RE : **Request to perform a study at Sebokeng Hospital**

Permission is hereby granted for your request to conduct the following study within Sebokeng Hospital.

The Comparison of Alkaline Hydrolysis and Newster Sterilizing alternative treatment technologies and cultural beliefs in placenta management in Guateng, South Africa.

Kind regard

Dr. OP Mashele
Acting Chief Executive Officer

GAUTENG PROVINCE
REPUBLIC OF SOUTH AFRICA

ODI DISTRICT HOSPITAL

Private Bag X 509, Mabopane, 0190.
Enquiries: Ms S Shakwane Tel: 012 725 2399, SD 4124 and Fax: 012-725 2447, E-mail: shakwanedimakatso@gmail.com

OUTCOME OF THE REQUEST TO CONDUCT RESEARCH STUDY IN ODI DISTRICT HOSPITAL

RESEARCH PROJECT NUMBER	ODI-2017/04
RESEARCH TITLE	THE COMPARISON OF ALKALINE HYDROLYSIS AND NEWSTER STERILIZING ALTERNATIVE TREATMENT TECHNOLOGIES AND CULTURAL BELIEFS IN PLACENTA MANAGEMENT IN GAUTENG, SOUTH AFRICA
RESEARCHER	MS K.E. JANSEN
INSTITUTION	CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE: DEPARTMENT OF LIFE SCIENCES
DATE SUBMITTED	08 MAY 2017
DATE REVIEWED	15 MAY 2017
OUTCOME	PROVISIONAL

Thank you for submitting research project documents. The Research Committee reviewed the project documents on the 15 May 2017. **Provisional permission** is granted to the project. The following signed documents must be forwarded to the chairperson:

1. Gauteng Provincial Protocol Review Committee (GPPRC) approval letter.
2. Odi District Hospital is under the supervision of Tshwane Health District, therefore all research studies that are to be conducted must be approved by Tshwane Research Committee. We, therefore, recommend that you to consult the chairperson Dr Lufuno Razwiedani at 012 451 9036 or lufuno.razwiedani@gauteng.gov.za for further information.

Kind regards

Recommended/~~not recommended~~

Ms S Shakwane – Chairperson

2017/05/18
Date

Approved/~~not approved~~

Dr TP Dlamini
Clinical Manager

2017/05/18
Date

Department of Health

OFFICE OF THE CHIEF EXECUTIVE OFFICER
DR. YUSUF DADOO HOSPITAL

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

ENQUIRIES : P.M. Sofohlo
TELEPHONE : (011) 951-6161
FAX : 086 645 7730
Cell : 083 302 7153
E mail :SofohloP@gpg.gov.za
REF NO : 1/7/2/1

Date : 09.02.2017

Attention Kathie Jansen

RE: PERMISSION TO CONDUCT RESEARCH AT DR. YUSUF DADOO HOSPITAL

Research Title: The comparison of alkaline Hydrolysis and newster sterilizing alternative treatment technologies and cultural beliefs in placenta management in Gauteng South Africa

Permission is hereby granted to you Kathie Jansen to access Dr. Yusuf Dadoo Hospital and conduct research on the above mentioned topic.

Please consider the following:

- You will report to the office of the Chief Executive Officer **(CEO)** before initiating the study.
- Participants' rights and confidentiality will be maintained at all the time.
- You will submit a copy (electronic and hard copy) of your final research report to the office of the Chief Executive Officer **(CEO)** of Dr. Yusuf Dadoo Hospital.

You are therefore expected to adhere and comply with the Ethics of research as stipulated in the research policy. I reserve the right to withdraw my permission grated to you, if you breach any of the conditions mentioned above.

Thank you very much for choosing Dr. Yusuf Dadoo Hospital to conduct such an important study. I wish you good luck in your research.

Regards

Patrick Mbeko Sofohlo
Chief Executive Officer (Dr. Yusuf Dadoo Hospital)
Date: 09/02/2017

DR. YUSUF DADOO HOSPITAL
PRIVATE BAG X2006
KRUGERSDORP 1740
2017-02-09
CHIEF EXECUTIVE OFFICER

Dr. Yusuf Dadoo Hospital, Cnr. Hospital & Memorial Avenues, Krugersdorp, 1740

GAUTENG PROVINCE

RE PUBLIC OF SOUTN AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Enquiries:
Ms. G. Ngwenya
Office of the Nursing Director
Tell: (011): 488-4558
Fax: (011): 488-3786

09 November 2017

Ms. Kathie Elizabeth Jansen
Central University of the Free State
NHRD REF: GP 2016RP36 849

Dear. Ms. Kathie Elizabeth Jansen

RE: "Practice and prevalence of traditional burial of placentas at home shortly aHer birth as well as identifying the need for training and stock rotation by health care risk waste management workers"

Permission is granted for you to conduct the above recruitment activities as described in your request provided:

1. Charlotte Maxeke Johannesburg Academic hospital will not in anyway incur or inherit costs as a result of the said study.
2. Your study shall not disrupt services at the study sites.
3. Strict confidentiality shall be observed at all times.
4. Informed consent shall be solicited from patients participating in your study.

Please liaise with the Head of Department and Unit Manager or Sister in Charge to agree on the dates and time that would suit all parties.

Kindly forward this office with the results of your study on completion of the research.

Suppo te tsupported

Ms. M.M Pule
Nursing Director
Date: 09/11/2017

M Gv B■,.n h!' "' d
Chief Executive Officer

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Annexure 1

Declaration of intent from the clinic manager or hospital CEO

I give preliminary permission (name of researcher) to do his or her

research on The comparison of alkaline hydrolysis and
(research topic) in/ g* waste alternative treatment technologies
to cultural beliefs in placenta management
in Gauteng
__________ (name of clinic) or

__________ (name of CHC) or

Bronkhorstspruit Hospital (name of hospital).

I know that the final approval will be from the Tshwane Regional Research Ethics Committee and that this is only to indicate that the clinic/hospital is willing to assist.

Other comments or conditions prescribed by the clinic or CHC manager or hospital CEO:

Signature
Clinic Manager/CHC Manager/CEO

28/08/2018
Date

GAUTENG PROVINCE

KALAFONG HOSPITAL
PRIVATE BAG X39G
PRETORIA
0001

ENQUIRIES : MS NT LEDEGA
TEL 012 318 6995
FAX 012 373 6791
EMAIL
REF : KPTH 46/2018

TO: MS KE JANSEN

RE: PERMISSION TO CONDUCT RESEARCH

TITLE: THE COMPARISON OF ALKALINE HYDROLYSIS AND NEWSTER STERILEZENG ALTERNATIVE TREATMENT TECHNOLOGIES AND CULTURAL BELIEFS IN PLACENTA MANAGE IENT IN GAUTENG SOUTH AFRICA

Permission is hereby granted for the research to be conducted at Kalafong Provincial Tertiary Hospital.

This is done in accordance to the "Promotion of Access to Information Act, No 2 of 2000".

Please note that in addition to receiving approval from the hospital research committee, you are still required to seek permission from the relevant departments.

Furthermore, collecting of data and consent for participation remains the responsibility of the researcher.

You are also required to submit your final report or summary of your findings and recommendations to the office of the CEO,

Approved:

DR K.E LETEBELE-HARTELL
SENIOR MANAGER: ALL SERVICES
DATE:

Annexure 1

Declaration of intent from the clinic manager or hospital CEO

I give preliminary permission to *1 " ^**<>'+- (name of researcher) to do his or her research on The comparison of alkaline hydrolysis and newster Sterilizing alternative treatment technologies and cultural beliefs in placenta management in Gauteng. (research topic) in

(name of clinic) or

(name of CHC) or

Jubilee District Hospital (name of hospital).

I know that the final approval will be from the Tshwane/Metsweding Regional Research Ethics Committee and that this is only to indicate that the clinic/hospital is willing to assist.

Other comments or conditions prescribed by the clinic or CHC manager or hospital CEO:

audit can undertaken recommended with this
engagement be shared with me well

Signature
Clinic Manager/CHC Manager/CEO

2018.08.21
Date

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE CEO
Dr. A. Naidoo
Tambo Memorial Hospital
: (011) 898-8317
: (011) 892-0358
: AvisN@gpg.gov.za

MEMO

To : Ms Kathie Jansen

From : Dr A Naidoo
Chief Executive Officer

Date : 16 January 2017

Subject : **Request to Carry Out Research at Tambo Memorial Hospital**

This serves to grant permission to Ms Kathie Jansen to carry out a research study: *The comparison of Alkaline Hydrolysis and Newster Sterilizing alternative treatment technologies and culture beliefs in placenta management in Gauteng South Africa* at Tambo Memorial Hospital. This permission is granted in light of improving the skill capacity of the Gauteng Department of Health.

The permission is granted in line with the code of ethics or research.

The information of the Gauteng Health Department will be used for the purpose of research and it will be utilized discreetly and confidentiality will be maintained at all times.

The permission is granted in good faith with the notion and understanding that the abovementioned clause is upheld.

Furthermore, there should be no financial implication to the hospital.

The collection of data will be the responsibility of the researcher.

Yours Sincerely,

TAMBO MEMORIAL HOSPITAL
DR. A. NAIDOO
2017 -01- 16
CEO
GAUTENG PROVINCIAL GOVERNMENT

Dr A Naidoo
Chief Executive Officer

Subject: Application to conduct research at Pholosong Hospital
Importance: High

Dear Mr. Vusi Mthunzi,

I hope I find you in good health.

Please find attached an request for support and approval to conduct research at your hospital.

I have also attached additional information which you would possibly require to afford me the opportunity.

I trust that you will be able to respond with a positive reply in due course.

Thank you for the time that you took to read this email.

Kathie E. Jansen
Assistant Director: Health Care Risk Waste Management
Central Office
Gauteng Department of Health
tel: 012-3546176
Cell: 0824184923
Fax: 012-3546172

GAUTENG PROVINCE

Annaxurs 'I

Declaration of intent from the clinis manager or hospital CEO

I give preliminary permission \Kathie Elizabeth Jansen tc do her research on "The comparison of alkaline hydrolysis and NEWSTER sterilizing alternative treatment technologies and cultural beliefs in placenta managment in Gauteng, South Afrtca" in

Tshwane District Hospital (name of hospital)

I know that the inal approval wit! be from the Tshwane Regional Research Ethics Committee and that this is only to indicate that the clinic/hospital is willing to assist.

Other comments or conditions prescribed by the hospital CEO:

quarterly feedback; findings of the studies

Signature
Clinic Manager/CHG Manager/GEO

2018/03/02
Date

Tshwane District Hospital
Private Bag X179
PRETORIA 0001

2018 -03- 02

Tshwane Distrik Hospitaal
Privaatsak X179
PRETORIA 0001

PERMISSION TO CONDUCT RESEARCH: EDENVALE HOSPITAL

From: **Mondzanga, Claude (GPHEALTH)** <Claude.Mondzanga@gauteng.gov.za>
Date: Fri, 27 Jul 2018 at 09:26
Subject: RE: PERMISSION TO CONDUCT RESEARCH: EDENVALE HOSPITAL
To: Kathie Jansen < jansenkathie@gmail.com>
Cc: Ncoko, Loyiso (gphealth) < Loyiso.Ncoko@gauteng.gov.za>

Good morning Kathie

Apologies for the delay in reverting to you.

May I confirm that permission is hereby granted for the research you want to conduct at Edenvale hospital.

Please contact Mr Loyiso Ncoko, the Environmental Health Practitioner for any further arrangements necessary for the successful completion of the research.

His contact details are: Tel: 011 3216096; Cell: 0837581670 and Email:Loyiso.Ncoko@gauteng.gov.za

Warm regards

Dr. Claude Mondzanga

Acting CEO: Edenvale Regional Hospital

Modderfontein Road

Edenvale

Tel : 0113216001

Fax : 0114436162

GAUTENG PROVINCE
REPUBLIC OF SOUTH AFRICA

Annexure 1

Declaration of intent from the clinic manager or hospital CEO

I give preliminary permission (Kathie Elizabeth Jansen) to do her research on "The **comparison of alkaline hydrolysis and NEWSTER sterilizing alternative treatment technologies and cultural beliefs in placenta management in Gauteng, South Africa"** in

Pretoria West Hospital (name of hospital).

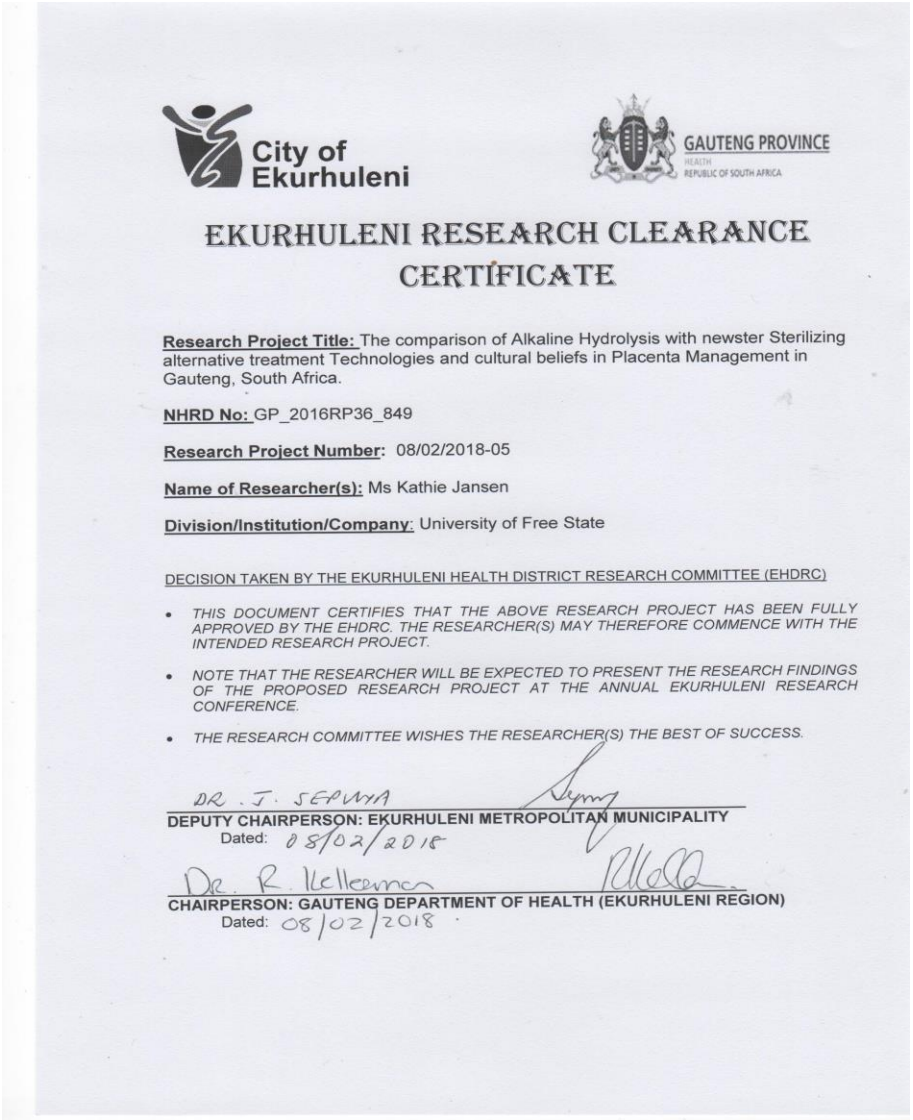
I know that the final approval will be from the Tshwane Regional Research Ethics Committee and that this is only to indicate that the clinic/hospital is willing to assist.

Other comments or conditions prescribed by the hospital CEO:

It will be appreciated if results are communicated as soon as they are available / completion of the study. The researcher should kindly report to the CEO's office on assumption of study @ the hospital.

Signature
Clinic Manager/CHC Manager/CEO

18/04/2018
Date



City of Ekurhuleni

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

EKURHULENI RESEARCH CLEARANCE CERTIFICATE

Research Project Title: The comparison of Alkaline Hydrolysis with newster Sterilizing alternative treatment Technologies and cultural beliefs in Placenta Management in Gauteng, South Africa.

NHRD No: GP_2016RP36_849

Research Project Number: 08/02/2018-05

Name of Researcher(s): Ms Kathie Jansen

Division/Institution/Company: University of Free State

DECISION TAKEN BY THE EKURHULENI HEALTH DISTRICT RESEARCH COMMITTEE (EHDRC)

- *THIS DOCUMENT CERTIFIES THAT THE ABOVE RESEARCH PROJECT HAS BEEN FULLY APPROVED BY THE EHDRC. THE RESEARCHER(S) MAY THEREFORE COMMENCE WITH THE INTENDED RESEARCH PROJECT.*
- *NOTE THAT THE RESEARCHER WILL BE EXPECTED TO PRESENT THE RESEARCH FINDINGS OF THE PROPOSED RESEARCH PROJECT AT THE ANNUAL EKURHULENI RESEARCH CONFERENCE.*
- *THE RESEARCH COMMITTEE WISHES THE RESEARCHER(S) THE BEST OF SUCCESS.*

DR. J. SEPHYA
DEPUTY CHAIRPERSON: EKURHULENI METROPOLITAN MUNICIPALITY
Dated: 08/02/2018

Dr. R. Ikelleman
CHAIRPERSON: GAUTENG DEPARTMENT OF HEALTH (EKURHULENI REGION)
Dated: 08/02/2018

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Enquiries: Mpho Moshime-Shabagu
Tel: +27 12 451 9036
E•mail: Mpho.Moshi me@gauteng.yov.za

TSHWANE RESEARCH COMMITTEE: CLEARANCE CERTIFICATE

MEETING: 10/2016
PROJECT NUMBER: 41/2018
NHRD REFERENCE NUMBER: GP 2016RP36 849

TOPIC: The comparison of alkaline hydrolysis and NEWSTER sterilizing alternative treatment technologies and cultural beliefs in placenta management in Gauteng, South Africa.

Principal investigator: Jansen Elizabeth Kathie
Co-supervisor: Rudie Pretorius

Supervisor: Dr. Robert
Co-supervisor: Prof Daan Cock

Facility:
Dr. George Mukhari Academic Hospital
Pretoria West Hospital
Steve Biko Academic Hospital
Mamelodi Regional Hospital
Tshwane district Hospital
ODI District Hospital
Kalafong Tertiary Hospital
Bronkhorstspruit Hospita
Jubilee District Hospital

Name of the Department: University of the Free State

NB: THIS OFFICE REQUEST A FULL REPORT ON THE OUTCOME OF THE RESEARCH DONE AND

NOTE THAT RESUBMISSION OF THE PROTOCOL BY RESEARcHER(Sr is REQUIRED IF THERE IS DEPARTURE FROM THE PROTOCOL PROCEDURES AS APPROVED BY THE COMMITTEE.

DECISION OF THE COMMITTEE: APPROVED

..... Date..... . .!..... !.!.é
Mr. Peter Silwimba
Deputy Chairperson: Tshwane Research Committee

..... **Date:** 2018.09.03
Mr Motho one Pitsi
Chief Director: Tshwane District Health

Appendix D: Approval letter from Statistical Consulting Services

Maryn Viljoen
Statistics Consulting Services

maryn.viljoen@vodamail.co.za
082 823 5731

Protocol and research methodology consultation • Ethical consultation • Database construction and capturing of data
Analyzing data using statistical software packages (SAS Version 9.1.3) • Statistics consultation services to analyze and interpret data
Conveys results with statistical tables and figures where needed

The Chairperson: Health Sciences Research Ethics Committee (HSREC)
For Attention: Mrs. M.G.E. Marais
Block D, Room 104
Francois Retief Building
Faculty of Health Sciences
University of the Free State

22 September 2016

Title: "THE COMPARISON OF ALKALINE HYDROLYSIS AND NEWSTER STERILIZING ALTERNATIVE TREATMENT TECHNOLOGIES AND CULTURAL BELIEFS IN PLACENTA MANAGEMENT IN GAUTENG, SOUTH AFRICA."

Researcher: K.E. Jansen (Student number: 9011234)
D. Tech Environmental Health
Department of Life Sciences
Faculty of Health and Environmental Sciences
Central University of Technology, Free State

I have seen and read through this protocol. I gave input and recommendations and will be the biostatistician responsible for the analysis of the data.

Maryn Viljoen
M.Sc. Risk Analysis (UFS)
maryn.viljoen@vodamail.co.za
082 82 35731

APPENDIX E:

STANDARD OPERATING PROCEDURE FOR TAKING A PLACENTA HOME

1. Introduction

The tradition of taking the placenta home is not an unknown in South Africa. Families that wish to take their placenta home requires guidance. This standard operating procedure was developed to guide you through the process and safeguarding the greater public.

2. Objective

To ensure a standardized procedure is available which must be followed when taking your placenta home or taking it for consumption or encapsulation.

3. Responsible person(s)

- Medical practitioner
- Health professionals
- Environmental Health Practitioner
- Infection Prevention and Control and
- Health Care Waste Officer

4. Legislation

- National health act, No. 61 of 2003, Chapter 8.
- Regulations regarding the general control of human bodies, tissue, blood, blood products and gametes (Regulation 180 of 2012).
- Gauteng health care risk waste management regulations, 2004.
- Western Cape Heath Care Risk Waste Management regulations.
- SOP for handling and disposal of human tissues in health facilities in Tshwane district.

5. Purpose

The purpose of this standard operating procedure (SOP) is to ensure a standard procedure for families to follow to retain and handle their placenta after birth.

6. Scope of application

- Medical practitioners
- Professional Nurses
- Environmental Health Practitioners
- Infection Prevention and Control
- Health Care Waste Officers and
- Patients admitted prenatal.

7. Implementation and evaluation

The professional nurse needs to inform patients that the placenta can be retained for traditional, cultural burial or consumption purposes.

There are strict legislative requirements for the disposal of placenta (pathological waste) which must be adhered to and prevent the spread of infection.

8. Roles and Responsibility of the Professional nurse and medical practitioner

The following two occupations will be responsible for the management of placentas in health establishments:

8.1 Professional nurse

- Provide the information pamphlet to the patient
- Provide verbal information to the patient regarding the pamphlet content
- Ensure that a valid affidavit is received before any placenta can be released for traditional handling by the patient
- Ensure that the tissue register is completed and signed with all relevant reference numbers or barcodes.
- Note the tracking information of the container in which the placenta is containerized in the tissue register

8.2 Medical practitioner

- Provide the information pamphlet to the patient when pregnancy is confirmed and discuss content

9. Procedures

The following procedures should be followed when a patient request their placenta for traditional reasons.

9.1 *Where a placenta is requested the following procedure must be followed by the patient*

- Inform the nurse and doctor of your intention to take the placenta home.
- This must be clearly reflected in the patient file (written).
- Complete the tissue register form and ensure that the patient signs the register.
- Please complete the consent form if you wish to take your placenta with you. If a consent form is not available an affidavit will be required.
- Provide a stamped affidavit from the police station illustrating your intention to take the placenta home with you to the professional nurse. The affidavit must be copied and filed in the patient file and the original must be filled in the tissue register.
- The release of the placenta must be signed off by the CEO or Manager of the hospital or designated person.
- Provide a leak proof container to the professional nurse for containment purposes if the hospital does not provide you with a bio-degradable, leakproof container.
- The placenta will be placed in a refrigerator until your departure date.
- The container may not be opened again and should be buried sealed.
- Request your placenta before leaving the hospital as it will be disposed of as pathological waste if left in the hospital. If so, it will not be retrievable.
- Please proceed with safe transportation of the contained placenta to your home or place of burial or collection of the company that will dry your placenta for encapsulation.
- An affidavit/letter of intent must be provided to the professional nurse when the placenta will be collected by a third party for encapsulation.
- After departing from the hospital, if the traditional practice can only be done later, the placenta must be kept cool and preferably refrigerated (-2℃) in a separate fridge only for that purpose.
- Burial should take place within 72 hours after arriving home.

9.2 Hygiene procedures should be kept, and the following is advised:

- All cuts or abrasions on the individual handling the placenta should be covered
- Wash your hands regularly and especially after burial
- Avoid contact with the placenta when eating or smoking.

9.3 Burial recommendations:

- Bury the placenta at least 1 meter below the ground
- Keep away from children
- Keep away from animals

9.4 *When the placenta is requested for consumption through encapsulation or other methods the following procedure is required:*

- Inform your midwife or professional nurse of your intension
- Arrangements can be made with the company that will be encapsulating the placenta for collection from the hospital before the patient is discharged.
- Where the intention is to cook and or consume in any other manner, the placenta must be placed in a cooler bag as if it was any other type of meat.
- Hygiene procedures should be closely followed, and the lining of the placenta is recommended before placing it into a leak proof container.

Any remains must be managed as pathological waste and methodologies of containment must adhere to legislative requirements and presented for destruction.

9.5 When the placenta is retained for further pathological examination the following is recommended

1. The pathology department will contact you when they are finished with their examination.
2. Collection and transport arrangements can be made with the pathology department.

3. The pathology department will dispose of the placenta fi not collected in 14 days and the placenta will not be able to be retrieved.
4. You will be requested to complete a consent for the release of the placenta for burial.
5. You will be responsible for the safe transport and burial of the placenta no later than 14 days after collection of the placenta.

10. Official documentation

- Ward register as prescribed in the standard operating procedure on the handling and disposal of human tissues in health facilities (Appendix A).
- Waste storage register as prescribed in the standard operating procedure on the handling and disposal of human tissues in health facilities (Appendix B).
- Affidavit form (Appendix C)
- Consent letter for collection by third party must describe the following information:
    - Company name and contact details
    - Address of company
    - A copy of the consent letter from patient with all patient details.

Appendix F: Ward form

WARD REGISTER

Enquiries:

Tel:

DATE	PATIENT'S NAME	FILE NO	TYPE OF TISSUE	BUCKET BARCODE	SIGNATURE	DATE OF REMOVAL HOLDING AREA	CO-SIGNATURE REMOVAL TO STORAGE AREA	

(Source: SOP on handling and disposal of human tissue in health facilities, 2019)

Appendix G: **Waste storage form**

WASTE STORAGE REGISTER

Enquiries:

Tel:

DATE	WARD	NO. OF BUCKETS	BUCKET BARCODE	SIGNATURE	DATE OF REMOVAL FROM FACILITY/HOSPITAL	CO-SIGNATURE REMOVAL TO STORAGE AREA	
						FACILITY	WASTE COMPANY

(Source: SOP on handling and disposal of human tissue in health facilities, 2019)

Appendix H: Affidavit

I,)

_____, I.D. number

_____residing at

_____

_____, hereby state/declares that on the

_____at approximately (time) _____ .

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Signature: _____

Name and surname: _____

Contact details: _____

Date: _____

I certify that the deponent has acknowledged that he/she understands the contents of the above statement, has no objection in taking the prescribed oath and/or affirmation that it is the truth and considers the prescribed oath and/or affirmation binding on his/her conscience.

Sworn/Affirmed and signed before me at _____on the _____day of _____ 20 _____.

_____

Ex Officio Commissioner of Oaths

Full Name: _____

Designation: _____

Business address: _____

APPENDIX I: TAKING MY PLACENTA HOME PAMPHLET