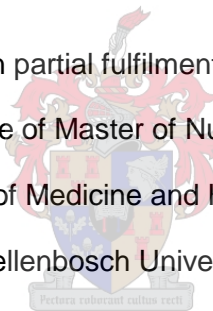


FACTORS CAUSING MATERNAL DEATHS AT LEVEL ONE HOSPITALS AND MIDWIFE OBSTETRIC UNITS IN THE WESTERN CAPE

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Thesis presented in partial fulfilment of the requirements
for the degree of Master of Nursing Science
in the Faculty of Medicine and Health Sciences
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DECLARATION

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ABSTRACT

Background: Maternal deaths in South Africa remain a concern as the target of maternal mortality ratio (MMR) of 38 maternal deaths per 100,000 live births not being reached as anticipated in 2015. The Western Cape has the lowest MMR in South Africa. However, there is a lack of or inadequate information with regard to maternal deaths in the Western Cape at level one hospitals and midwife obstetric units (MOUs). Strategies to reduce maternal deaths at level two and three hospitals in the Western Cape are not necessarily appropriate for level one hospitals or MOUs. The aim of this study was to determine the factors causing maternal deaths at level one hospitals and MOUs in the Western Cape.

Methods: A retrospective quantitative study with a descriptive design was performed. Records of 86 maternal deaths out of the 92 which occurred at level one hospitals and MOUs between 2008 and 2012 were reviewed. The data was extracted from the electronic database of the National Committee for Confidential Enquiries into Maternal Deaths (NCCEMD). Data was analysed separately for the level one hospitals and MOUs. Additional analysis was done to determine the factors for the Cape Town Metropole separately from the other health districts which are Cape Winelands, Eden, Klein Karoo, Overberg and West Coast. The researcher used an existing validated tool. The 2008 version of the NCCEMD's assessors' form was used as the data collection tool. Ethics approval was sought from the Stellenbosch University Health Research Ethics Committee, the Western Cape Department of Health and the NCCEMD.

Results: The most common primary cause category of maternal death at level one hospitals was non-pregnancy-related infections, specifically tuberculosis and pneumonia. While the most common primary cause category of maternal death at MOUs was hypertension. The most common final causes of death at both level one hospitals and MOUs were cardiac and respiratory failure. Analysis of the avoidable factors at both levels of care showed that medical related factors such as management

of the patient at an inappropriate level of care and problem recognition/diagnosis were most common.

Conclusion: The primary causes of maternal deaths differed according to levels of care. Therefore strategies to decrease maternal deaths should be specific for particular levels of care. In particular, level one hospitals must screen and treat pregnant women for tuberculosis and pneumonia, while MOUs must improve the management of acute, severe hypertension.

Key words: Maternal deaths; maternal mortality; South Africa; Western Cape; developed countries; developing countries; Sub-Saharan; causes; avoidable factors; and midwives.

OPSOMMING

Agtergrond: Moedersterftes in Suid-Afrika, met die moedersterftes-verhouding teiken van 38 moedersterftes per 100,000 lewende babas, wat nie soos verwag in 2015 bereik gaan word nie, is nog steeds 'n bekommernis. Die Wes-Kaap is die provinsie met die laagste moedersterftes-verhouding in Suid-Afrika. Daar is egter 'n gebrek aan of onvoldoende inligting ten opsigte van moedersterftes by vlak een hospitale en vroedvrou verlossingseenhede. Strategieë om moedersterftes by vlak twee en drie hospitale te verminder, is nie noodwendig toepaslik vir vlak een hospitale of vroedvrou verlossingseenhede nie. Die doel van die studie was om die faktore wat moedersterftes by vlak een hospitale en vroedvrou verlossingseenhede in die Wes-Kaap veroorsaak, te bepaal.

Metode: 'n Retrospektiewe kwantitatiewe studie met 'n beskrywende ontwerp was gedoen. Rekords van 86 moedersterftes uit 92 sterftes wat by vlak een hospitale and vroedvrou verlossingseenhede gedurende 2008 en 2012 plaasgevind het, is bestudeer. Die data is vanaf die elektroniese databasis van die "Committee for Confidential Enquiries into Maternal Deaths" (NCCEMD), verkry. Hierdie data is apart vir vlak een hospitale and vroedvrou verlossingseenhede geanaliseer. Addisionele analise is gedoen om die faktore vir Kaapstad Metropool afsonderlik van dié vir die ander gesondheidsdistrikte te bepaal. Die navorser het 'n bestaande gevalideerde instrument gebruik. As instrument vir data versameling, is die 2008 weergawe van die assessorsvorm van die NCCEMD gebruik. Etiese goedkeuring is van Stellenbosch Universiteit Gesondheidsnavorsingsetiekkomitee, die Wes-Kaapse Departement van Gesondheid en die NCCEMD verkry.

Resultate: Die mees algemene primêre oorsaak kategorie van moedersterfte by vlak een hospitale was nie-swangerskap verwante infeksies, spesifiek tuberkulose en pneumonie. Terwyl die mees algemene primêre oorsaak kategorie van moedersterfte by vroedvrou verlossingseenhede hipertensie was. Die mees algemene finale oorsake van sterftes by beide vlak een hospitale and vroedvrou verlossingseenhede was

kardiale en respiratoriese versaking. Analise van die voorkombare faktore het aangedui dat medies-verwante faktore soos hantering van die pasiënt by 'n ontoepaslike vlak van sorg en die herkenning van die probleem/diagnose die algemeenste was.

Slotsom: Die primêre oorsake van moedersterftes verskil volgens die vlak van sorg. Gevolglik moet strategieë vir die vermindering van moedersterftes spesifiek vir sekere vlakke van sorg wees. Swanger vroue moet by vlak een hospitale spesifiek vir tuberkulose en pneumonie gesif en behandel word, terwyl die hantering van akute, ernstige hipertensie by MOUs verbeter moet word.

Sleutelwoorde: Moedersterftes; moeder mortaliteit; Suid-Afrika; Wes-Kaap; ontwikkelde lande; ontwikkelende lande, Sub-Sahara; oorsake; voorkombare faktore; en vroedvroue.

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ABBREVIATIONS

AIDS	Acquired immune deficiency syndrome
HAART	Highly active antiretroviral therapy
HIV	Human immunodeficiency virus
MDG	Millennium development goal
MMR	Maternal mortality ratio
MOUs	Midwife obstetric units
NCCEMD	National Committee for Confidential Enquiries into Maternal Deaths
NPRI	Non-pregnancy-related infection
WHO	World Health Organization

1 CHAPTER ONE

FOUNDATION OF THE STUDY

1.1 INTRODUCTION

Maternal deaths are an indicator of the maternal health status worldwide. According to the United Nations' Millennium Development Goals (MDG), it is an important health indicator that had to be addressed by 2015 in order to improve maternal health (World Health Organization, 2010b:9). MDG number five indicated the need to reduce the maternal mortality ratio (MMR) worldwide by three quarters between 1990 and 2015 (World Health Organization, 2010b:9). The MMR target set for South Africa was 38 maternal deaths per 100,000 live births by 2015 (Republic of South Africa, 2010b:67). However, the MMR for the period 2008 to 2010 was much higher at 176.22 maternal deaths per 100,000 live births and has increased since the previous report of the National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD) (Republic of South Africa, 2012:xi). Though the most recent report of the NCCEMD indicated that the MMR decreased to 154.1 maternal deaths per 100,000 live births during 2011 and 2013 (Republic of South Africa, a.s.:v) the MMR is still above the MMR target set for South Africa.

South Africa is one of few countries with a system for confidential enquiries into maternal deaths. The NCCEMD defined the system as "a systematic multidisciplinary anonymous investigation of all or a representative sample of maternal deaths occurring in an area, region (state) or national level which identifies the numbers, causes and avoidable or remediable factors associated with them" (Republic of South Africa, 2006:ix). The reporting of maternal deaths to the NCCEMD in South Africa resulted in data regarding maternal deaths for the country as well as for the different provinces in the country. From the NCCEMD reports it is clear that the results regarding the maternal deaths in the country's provinces differ from province to

province. Within the provinces the causes of maternal deaths and the avoidable factors may differ from health district to health district as well as between the different levels of care.

The aim of the current study was to describe the factors causing maternal deaths at level one hospitals and midwife obstetric units (MOUs) in the Western Cape. For the purpose of the study factors causing maternal deaths are seen as causes of maternal deaths and avoidable factors of maternal deaths. In this chapter the foundation for this study is discussed which includes the research question, the research aim, the research objectives, and the methodology for the study.

1.2 SIGNIFICANCE OF PROBLEM

The MMR for South Africa and the Western Cape increased from 2008 to 2010 and the researcher acknowledges that the increase in the MMR may be due to a greater awareness and better reporting of maternal deaths. However, for the period 2011 to 2013 the MMR for the Western Cape decreased from 84.87 maternal deaths per 100,000 live births in 2008 to 2010, to 71.02 maternal deaths per 100,000 live births (Republic of South Africa, s.a.:17). Similarly, the MMR for South Africa decreased from the period 2008 to 2010 with 12.6% for the period 2011 to 2013 (Republic of South Africa, s.a.:v). Despite a year on year decrease in the MMR for South Africa since 2010 (Republic of South Africa, s.a.:3) the MMR target of 38 maternal deaths per 100,000 live births is still much lower than the MMR for the period 2011 to 2013 which is 154.06 maternal deaths per 100,000 live births (Republic of South Africa, s.a.:v).

Regardless of the decrease in the MMR of the Western Cape there may be a real increase in the number of maternal deaths in the different health districts in the Western Cape. The emphasis of the results published by the NCCEMD is mainly on the global view of maternal deaths in each province of the country. It is possible that the causes of maternal deaths and the avoidable factors in the different health districts are not similar to the results of the province. Furthermore, the strategy implemented to reduce maternal deaths in the province may not necessarily be applicable to all the

health districts in the province or level one hospitals and MOUs. Most of the hospitals in the rural areas are classified as level one hospitals. The concern of the researcher is that there is a lack of information with regard to the causes of maternal deaths and the avoidable factors related to these deaths that occurred at level one hospitals and MOUs.

1.3 RATIONALE

The WHO fact sheet (2014) stated that “most of maternal deaths can be prevented”. In addition, the NCCEMD reported that 60% of maternal deaths in the country were potentially avoidable according to the NCCEMD assessors. The MMR for the Western Cape has increased from 64.81 maternal deaths per 100,000 live births in 2011 to 78.64 per 100,000 live births in 2012 (Republic of South Africa, 2013:5). The Western Cape has six health districts and three of these health districts have a MMR of more than 100 maternal deaths per 100,000 live births for the period 2008 to 2010 (Republic of South Africa, 2012:295). Although the majority of deaths occurred at the level three (tertiary) hospitals in the Cape Town Metropole, the causes of maternal deaths and the avoidable factors causing maternal deaths in the other health districts may not be ignored.

The researcher observed a change in primary causes of maternal deaths in the Western Cape over the last decade. Though the Saving Mothers report 2008 to 2010 provided more information per province than previously, there is a lack of information regarding factors causing maternal deaths in the rural areas. Most of the health services in the rural areas are level one hospitals and 17.8% (excluding MOUs) of maternal deaths occurred at these hospitals. The question is whether there are factors related to the maternal deaths at level one hospitals and MOUs that could be addressed in order to reduce the number of maternal deaths at these health institutions. The level one hospitals and MOUs in the Cape Town Metropole have the advantage of direct involvement of the level three hospitals and are situated in the same geographical area. Therefore, it is possible that the factors related to the

maternal deaths are not the same as the factors related to maternal deaths in the other health districts.

1.4 PROBLEM STATEMENT

The MMR in the Western Cape is the lowest in the country and the majority of maternal deaths occurred at level three hospitals. The number of maternal deaths that occurred at level two hospitals was 18.2% of all deaths and the maternal deaths that occurred at level one hospitals and MOUs, 23.8% (Republic of South Africa, 2012:296). The factors causing maternal deaths within the Western Cape Province are known. However, there is inadequate or lack of evidence indicating the factors that cause maternal deaths at level one hospitals and MOUs as there is evidence of many of these deaths occurring at these units of care. The exploration of these factors causing maternal deaths will allow for evaluation of care at these institutions which influence the MMR in the Western Cape and South Africa.

1.5 RESEARCH AIM

The research aim was to describe the factors that caused maternal deaths at level one hospitals and MOUs in the Western Cape between 2008 and 2012 in order to evaluate midwifery/obstetrical care.

1.5.1 RESEARCH OBJECTIVES (RO)

The objectives of the study were:

RO 1: To describe the primary causes of maternal deaths at level one hospitals and MOUs in the Western Cape.

RO 2: To determine the final and contributory causes of maternal deaths at level one

hospitals and MOUs in the Western Cape.

RO 3: To describe the avoidable factors causing maternal deaths at level one hospitals and MOU's in the Western Cape.

1.6 RESEARCH QUESTION

The primary research question for this study was: "What are the factors causing maternal deaths at level one hospitals and MOUs in the Western Cape?"

1.6.1 RESEARCH SUB-QUESTIONS (SO)

SO 1: What are the primary causes of maternal deaths at level one hospitals and MOUs in the Western Cape?

SO 2: What are the final and contributory causes of maternal deaths at level one hospitals and MOU's in the Western Cape?

SO 3: What are the avoidable factors causing maternal deaths at level one hospitals and MOU's in the Western Cape?

1.7 CONCEPTUAL FRAMEWORK

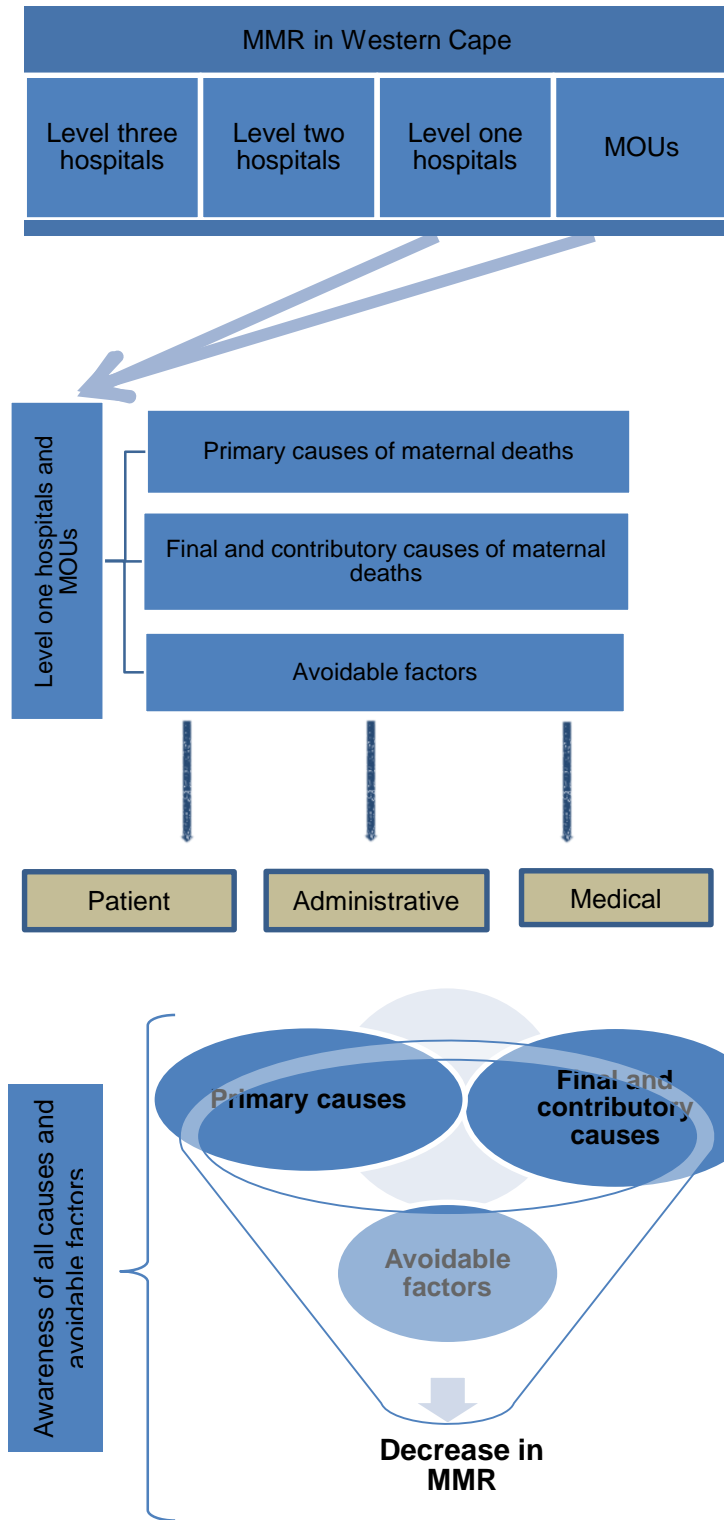
Maternal deaths are a global problem and is emphasised by the WHO as an aspect of concern for maternal health. South Africa is divided into nine provinces with district health systems classifying health establishments according to the nature and level of services they are able to provide (Republic of South Africa, 2006:42). The provinces are Gauteng, Limpopo, North West, Mpumalanga, KwaZulu-Natal, Eastern Cape, Northern Cape, Free State, and Western Cape.

Healthcare services in South Africa are rendered in three levels of care that is, primary level of care, secondary level of care, and tertiary level of care. The primary level of

care includes clinics rendering eight hour day services as well as clinics rendering a 24-hour service that include maternal and obstetrical services, namely, MOUs, community health centres (CHC), and district hospitals. The classification of public hospitals is done according to levels with level one being the district hospitals, level two the regional hospitals and level three the tertiary hospitals (Pelser, 2012:552).

Awareness of the causes (primary, final and contributory causes) of maternal deaths and the avoidable factors related to maternal deaths at the primary level of care (level one hospitals and MOUs), may lead to a reduction of maternal deaths in the Western Cape. The conceptual framework aims to show how information on causative factors of maternal deaths at the lowest level of care can be utilised to reduce the MMR of the Western Cape. Avoidable factors are divided into patient behaviour, administrative aspects, and health care providers' level of care. These avoidable factors relate to the delay phases of the model developed by Thaddeus and Maine (1994:1092). In this study, the research objectives were based on the factors in this conceptual framework (Figure 1.1).

Figure 1.1 Conceptual framework for maternal deaths



1.8 OPERATIONAL DEFINITIONS

Administrative related factors: Administrative related factors are avoidable factors caused by a lack of transport; barriers to access health care facilities; lack of health care facilities; lack of personnel; lack of appropriately trained staff; communication (Republic of South Africa, 2006:330).

Causes of death: The definition according to the World Health Organization is “all those diseases, morbid conditions or injuries which either resulted in or contributed to death and the circumstances of the accident or violence which produced such injuries” (World Health Organization, 2010a:31).

Direct cause: A direct cause is the result of complications of pregnancy, interventions, omissions or incorrect management (Republic of South Africa, 2006:x).

Factor: A factor is “an element or cause that contributes to a result”. (Collins Concise Dictionary, 2004:514).

Final and contributory causes: For the purpose of this study, final causes are organ system failures leading to the death and contributory causes are complications contributing to the death.

Indirect cause: An indirect cause is the result of pre-existing conditions or conditions that were aggravated by the physiological effects of pregnancy (Republic of South Africa, 2006:x).

Level one hospital: Level one hospital is also referred to as a district hospital and the service providers are general practitioners, family physicians and clinical nurse practitioners (Pelser, 2012:552).

Maternal death: Is defined as “the death of a woman while pregnant or within 42 days of termination of pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes” (World Health Organization, 2010a:156)

Medical related avoidable factors: For the purpose of this study, medical related factors refer to the assessment of the standard of care given to the pregnant woman by the health care workers (Republic of South Africa, 2006:330).

Midwife Obstetric Unit (MOU): A MOU is a community health centre rendering 24 hour maternal and obstetrical services for seven days a week. (Pelser, 2012:486).

Patient related avoidable factors: Patient related avoidable factors are “avoidable factors or missed opportunities related to the woman and her environment” (Republic of South Africa, 2006:329).

Primary cause: For the purpose of this study, primary cause of maternal death is the specific disease or disorder/condition that resulted in the death of the woman.

1.9 RESEARCH METHODOLOGY

The aim of this study was to determine and describe the factors causing maternal deaths at level one hospitals and MOU's. A quantitative study was done to describe the variables using statistical data. The research design selected for this quantitative study was a retrospective descriptive design as little knowledge is available with regard to factors causing maternal deaths at level one hospitals and MOU's in the Western Cape. A retrospective document review was done based on the research objectives for the study. Further discussion of the methodology used was done in chapter three.

1.10 DURATION OF THE STUDY

The duration of the data collection was over a period of three months from November 2014 to January 2015. Submission of the study proposal for ethics approval was done in April and approval from the Stellenbosch University Health Research Ethics Committee was received in July 2014. Permission to perform the study was granted by the Western Cape Department of Health in October 2014. While waiting for the ethics approval, chapter one and two were written. The researcher conducted the pilot study as discussed in chapter three.

1.11 CHAPTER OUTLINE

The thesis contains the following five chapters:

Chapter 1 provides the foundation of the study and contains an introduction, the significance of the study, the rationale, the problem statement, the research aim, the research questions and the conceptual framework.

Chapter 2 contains the discussion of the literature review that was done. The literature review included scientific articles and published reports.

Chapter 3 contains the research methodology used for the study which is discussed in depth. This includes the research design, study setting, population, sampling, data collection tool, pilot study, reliability, validity and data collection process and data analysis.

Chapter 4 presents the study results. Bar charts and frequency tables are used for categorical data, whereas means, standard deviations and ranges are used in the case of continuous data.

Chapter 5 provides the discussion of the study findings, the limitations of the study as well as recommendations.

1.12 SIGNIFICANCE OF THE STUDY

The aim of the study was to determine the factors that caused maternal deaths at level one hospitals and MOUs in the Western Cape. The significance of the study is that there is an urgent need in the Western Cape to reduce MMR due to the fact that the MMR increased in 2012. The factors causing maternal deaths in the province are in the public domain and known, but factors causing maternal deaths in the different health districts are unknown and situations within the health districts differ. The level one hospitals in the rural areas are isolated and also different from the one level one hospitals in the Cape Town Metropole.

Three of the health districts, Central Karoo, Overberg and West Coast, have only level one hospitals and no level two or three hospitals. The level one hospitals in these three health districts are geographically far from the referral hospitals. Therefore, the health care workers in these districts have a bigger responsibility and the factors causing maternal deaths there may be different from those at level one hospitals which are not so isolated.

In order to reduce the MMR in the Western Cape, knowledge with regard to the factors causing all maternal deaths, specifically at level one hospitals and MOUs is needed in order to prevent avoidable deaths. As indicated in the conceptual framework for maternal deaths (Figure 1.1) the awareness of causes and avoidable factors may lead to a reduction in the MMR. The findings of this study provide information on the causes of maternal deaths as well as the avoidable factors. Insight into the avoidable factors in the different health districts may be of assistance to the Western Cape Department of Health in future strategic planning. Currently the province focuses on the Essential Steps in Managing Obstetric Emergencies (ESMOE) programme for all levels of care but this programme does not necessarily address the specific needs of the level one hospitals and MOUs in the different health districts.

1.13 SUMMARY

This chapter provided a motivation for, and broad overview of the study. The purpose of this chapter was to introduce the reader to the research problem related to maternal deaths in the Western Cape and the significance of the lack of knowledge regarding factors causing maternal deaths at level one hospitals and MOUs. The conceptual framework applicable to the study was presented and displayed in figure 1.1. In chapter two, the researcher discussed the processes followed in reviewing the literature and the findings of the review related to the research question.

1.14 CONCLUSION

With this study the researcher gained insight into the factors causing maternal deaths at level one hospitals and MOUs in the Western Cape. The findings of this study provide important knowledge that may be of value to the Western Cape Department of Health. The aim of the study was not to determine the MMR of the different health districts but to identify causes and avoidable factors for level one hospitals and MOUs, which may be important to reduce the MMR in the Western Cape.

2 CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

In chapter one, the foundation of this study was explained and the research aim and objectives were described. A literature review was performed based on the topic of the study and organised around the concept of maternal deaths. The content is divided according to literature related to the World Health Organization (WHO), developed countries, developing countries, Sub-Saharan Africa, South Africa, Western Cape, levels of care, and demographics. Each division, except the level of care and the demographics divisions, is further divided into subheadings for causes of maternal deaths and the factors causing maternal deaths.

2.2 REVIEWING AND PRESENTING THE LITERATURE

The review of the literature related to the topic of this study commenced in March 2013 to ascertain what data related to level one hospitals and MOUs are available in the NCCEMD reports. This review was an important step for the researcher in order to avoid duplication and to identify gaps in the reports. Following the review of the NCCEMD reports, the purpose for reviewing literature was to learn about the latest scientific evidence related to maternal deaths globally and in South Africa. Additionally, to identify available data collection tools and to include the latest literature, the researcher searched for literature continuously until 2014. The databases used were PUBMED, CINAHL, Science Direct, WHO website, South African Nursing Council website, South Africa Department of Health website, and Western Cape Department of Health website. The key terms used in the search were maternal deaths, maternal mortality, South Africa, Western Cape, causes, avoidable factors, and midwives.

2.3 FINDINGS FROM THE LITERATURE REVIEW

According to Polit and Beck (2006:133) the literature review provides information on what is known or not known about the relevant topic and leads the researcher to gaps that may exist in the existing knowledge. De Vos, Strydom, Fouché and Delport (2011:134) stated that "...a review of the literature is aimed at contributing to a clearer understanding of the nature and meaning of the problem that has been identified." Rai, Anand, Misra, Kant and Upadhyay (2012:197) stated that the documentation of maternal deaths worldwide has not been standardised and the absence of a standard method of documentation impacts on how global comparisons are made.

2.4 THE WORLD HEALTH ORGANIZATION

The United Nations Millennium Declaration was adopted in 2000 by all states, including South Africa, who are members of the United Nations. By adopting this Declaration, the members indicated their commitment to the Millennium Development Goals (MDG's) and to reach the specific targets for 2015 (Republic of South Africa, 2010:13). One of the targets for the improvement of maternal health (MDG 5) was to reduce the maternal mortality ratio (MMR) by three quarters in 2015. In South Africa there was an increase in the MMR from 2005 to 2010 and the same applies to the Western Cape (Republic of South Africa, 2012:xii).

Globally the decline in maternal deaths since the acceptance of the MDGs was meaningful. However, the rate of decline in maternal mortality in the WHO African region; WHO region of the Americas; and WHO Eastern Mediterranean region, were lower than the global rate of decline of 3.1% annually between 1990 and 2010. The annual rate of MMR decline in the African region was 2.7% (World Health Organization, 2012:13). According to the WHO, the decrease in the MMR in South Africa was only 9% for the period 2000 to 2010 (World Health Organization, 2012:78) The WHO finding requires the evaluation of and the reasons for the slow decline in order to accelerate the maternal survival with the introduction of sustainable development goals. However,

it should be noted that the WHO figures for South Africa do not always correlate with the national data for South Africa in the NCCEMD's Saving Mothers reports (Republic of South Africa, 2006:31).

2.4.1 Causes of maternal deaths

In a systematic analysis of global causes of maternal deaths, the WHO estimates that for 2010 the maternal deaths worldwide was 287 000 (Say, Chou, Gemmill, Tunçalp, Moller, Daniels, Gümezoglu, Temmerman & Alkema, 2014:e323). Further the authors assert that most of these maternal deaths were avoidable. Therefore, there is a need to understand the causes of maternal deaths in order to implement measures that will assist in the elimination of avoidable maternal deaths. The authors have further grouped the causes for maternal deaths according to the following categories: abortions, embolism, obstetric haemorrhage, hypertensive disorders, pregnancy-related sepsis and other causes (Say *et al.*, 2014:e325). In the data collection tool used for this study, the primary causes were also grouped according to the disease entity and correlates with the categories mentioned above. The results showed that indirect causes, that is, conditions not related to pregnancy, and haemorrhages are worldwide causes of maternal deaths (Say *et al.*, 2014:e328). The majority of the data (78%) used in the article by Say *et al.* was taken from reliable registration systems of 58 countries. For four of the countries (France, United Kingdom, South Africa and Mexico), the data included was from the confidential enquiries into maternal deaths in these countries.

2.4.2 Avoidable factors causing maternal deaths

Antenatal care is very important to monitor the wellbeing of the pregnant woman and her baby. Therefore, antenatal coverage has been stressed by the WHO as a safety net in order to reduce maternal mortality (World Health Organization, 2010b:10). Additionally, the WHO recommends that it is essential for a pregnant woman to have at least a total of four antenatal visits during her pregnancy.

Maternal deaths are influenced by the age of the pregnant women. Pregnant women

younger than 20 years have a higher risk of pregnancy-related death than pregnant women between the age of 20 and 30 years (World Health Organization, 2010b:9). The WHO further states that 15% of adolescent female deaths were due to maternal conditions and it was a leading cause of death for this age group (World Health Organization, 2010b:9). Therefore, actions to reduce maternal deaths need to be communicated to mothers and women of all age groups (World Health Organization, 2010b:9).

In view of the fact that hypertension is one of the most prominent causes of maternal deaths, the WHO emphasises the importance of magnesium sulphate treatment for prevention of eclampsia which is commonly associated with maternal deaths. According to Say *et al.* (2014:e332) there are barriers to the usage of magnesium sulphate treatment. The barriers include limited availability of magnesium sulphate and the absence of clear guidelines to direct the administration of magnesium sulphate. These findings emphasise the importance of standard guidelines for the management of a patient with hypertension and the prevention of eclampsia. Furthermore, the training of health care workers on the management of hypertension and their understanding of the purpose and effect of magnesium sulphate treatment is essential.

To reduce maternal deaths, skilled health care workers at births are essential (World Health Organization, 2010b:10). Skilled health care workers are trained to provide appropriate advice and maternal care to mothers. According to the WHO rural populations, lower socioeconomic groups, ethnic minority groups and migrants have less access to skilled health care workers (World Health Organization, 2010b:10). The organization further stated in the WHO fact sheet (2014) that access to emergency obstetric care can prevent maternal deaths.

2.5 MATERNAL DEATHS IN DEVELOPED COUNTRIES

In developed countries the MMR is much lower than the MMR in developing countries. In a recent report by the WHO (2014:22) on trends in maternal mortality, the MMR for

developed regions is indicated as 16 maternal deaths per 100,000 live births. The MMR in developed regions has decreased by 37% from 1990 to 2013. Sweden, one of the developed countries and one of the countries with the lowest MMR, emphasised the role of the midwives in reducing the MMR in the country and their role as the healthcare worker of choice (United Nations, 2011:3).

2.5.1 Causes of maternal deaths in developed countries

A systematic review done by Khan, Wojdyla, Say, Gülmezoglu and Van Look (2006:1073) showed that there are differences between the most common causes of maternal deaths in developing countries and those of developed countries. In developing countries, one third of maternal deaths are caused by maternal infections (Rana, Pradhan, Manandhar, Bitsta, Adhikari, Gurung & Amatya, 2009:245); whereas sepsis accounts for only 4.7% of maternal deaths in developed countries according to Say *et al.*, (2014:e326). In contrast to the developing countries, the leading causes of maternal deaths in developed countries include embolism, complications of caesarean section and anaesthesia (Khan *et al.*, 2006:1073).

In a WHO study of the global causes of maternal deaths, 24.7% are classified as indirect causes and 16.3% as haemorrhage of which postpartum haemorrhage is the most common. The results of this study also showed that embolism is a cause in 13.8% of maternal deaths in developed countries in comparison with 3.1% in developing countries (Say *et al.* 2014:e326). Furthermore, the most common cause of maternal deaths in the United Arab Emirates is thromboembolic events, followed by haemorrhage and then infections (Ghazal-Aswad, Badrinath, Sidky, Abdul-Razak, Davison & Mirghani, 2011: 212).

2.5.2 Avoidable factors causing maternal deaths in developed countries

Although the causes of maternal deaths in developed countries differ from those in developing countries, the factors causing maternal deaths are not necessarily different. Farquhar, Sadler, Masson, Bohm and Haslam (2011:331.e4) performed a

retrospective study of causative and potentially avoidable factors in New Zealand. The factors were classified as organisational or administrative factors; factors related to personnel; technology and equipment; environment; and barriers to access care. In 55% of the maternal deaths cases included in the study, causative factors were present and more than a third of these deaths were seen as potentially avoidable. More than one causative factor was present in most of these cases. Suicide was a common cause of maternal deaths in New Zealand and 70% of mothers who committed suicide had causative factors such as delay in accessing care (Farquhar et al., 2011:331.e7).

2.6 MATERNAL DEATHS IN DEVELOPING COUNTRIES

The MMR for the developing countries is 230 maternal deaths per 100 000 live births according to the WHO report on trends in maternal mortality and is 46% lower than the MMR in 1990 (World Health Organization, 2014:22). The developing country with the highest MMR is Sierra Leone with an estimated MMR of 1 100 per 100 000 live births (World Health Organization, 2014:23).

2.6.1 Causes of maternal deaths in developing countries

The main causes of maternal deaths in developing countries are haemorrhage, hypertensive disorders and sepsis (Khan *et al.*, 2006:1073). Although this is a generalization of maternal death causes in developing countries, most of the causes are context specific and mostly localized to even country or province.

A study done in Nepal showed that the most common direct cause of maternal deaths was pregnancy-related sepsis, followed by obstetric haemorrhage and then hypertensive disorders in pregnancy. These findings are similar to other developing countries. One third of maternal deaths in developing countries are caused by maternal infections (Rana, 2009:245).

In South East Nigeria a retrospective multi-institutional study was done on maternal mortality trends by Nwagha, Nwachukwu, Dim, Ibekwe and Onyebuchi (2010:326),

which showed that there as well sepsis (26%) was the most common cause of maternal death. The authors further stated that abortions is illegal in Nigeria and that the number of patients with complications related to abortions were very low. However, the contribution of unsafe abortions to sepsis was not determined. Nigeria has a high MMR similar to other countries in Africa. According to a WHO study, one third of maternal deaths in the world occur in Nigeria and India (Say, *et al.* 2014:e329).

The role of sepsis due to unsafe abortions is emphasised in a retrospective study done in India by Bhattacharyya, Majhi, Seal, Mukhopadhyay, Kamilya and Mukherji (2008:503). The study covered a period of 20 years and showed that there was a significant decrease in sepsis related maternal deaths in India but that sepsis was still one of the most common causes of maternal deaths. Unsafe abortions are still performed by inexperienced and untrained people despite the legalisation of medical termination of pregnancy in India. Bhattacharyya *et al.* (2008:502) further stated that hypertensive disorders were the most common cause of maternal deaths in the first 5 years but decreased significantly after the management of hypertension was changed by introducing magnesium sulphate treatment. According to the WHO, magnesium sulphate treatment is an essential drug in obstetrics (Say *et al.*, 2014:e332). Despite legalisation of abortions in some countries and the introduction of antibiotics, sepsis is still one of the most common causes of maternal deaths in developing countries.

2.6.2 Avoidable factors causing maternal deaths in developing countries

The role of health care workers in preventing maternal deaths is very important and the standard of clinical care and the deficiencies thereof need to be determined. A meta-analysis of avoidable factors done in low and lower-middle income countries (82% of countries from Africa) showed that 66.7% of the avoidable factors identified are linked to health care workers (Merali, Lipsitz, Hevelone, Gawande, Lashoher, Agrawal & Spector, 2014:4). They stated that "...the majority of deaths were thought to have been avoidable if health care workers performed better." Continuous training of health care workers and evaluation of their knowledge and competencies should be implemented as a strategy to reduce maternal deaths.

The second avoidable factor identified in the study done by Merali et al. (2014:4), is related to the influence of the community on the mother's behaviour such as the peer pressure on the mother from the community and the control of decision-making by the community members. Due to peer pressure from the community, the control of decision-making by the community, not recognizing danger signs, concern about the care of the children; and not trusting the health services (Merali et al, 2014:4) the mother tend to not seeking help as soon as possible. The delay by the mother in seeking help is supported by the study done by Thaddeus & Maine (1994:1092). Furthermore, Merali et al (2014:8) describe blood transfusion as a factor causing maternal deaths. The availability of blood when a mother needed a blood transfusion was determined by the lack of material to collect the blood, a shortage of blood donors, and access to a blood bank. Blood transfusion is seen as part of basic emergency care in obstetrics (Rai et al., 2012:199).

In addition, Rai et al. (2012:199) stated that the focus should not only be on the number of maternal deaths but also be on the factors behind the deaths which can be avoided. These factors include the women's awareness of warning signs of problems in pregnancy, the access to services, the travelling to services and the cost thereof, and the quality of care at the services. The authors further emphasised family planning, safe abortions, focused antenatal care, skilled birth attendants, and basic emergency obstetric care as interventions in order to prevent maternal deaths.

A descriptive retrospective case study was done by Thorsen, Sundby and Malata (2012:2) to determine community and facility factors causing maternal death in Malawi. The MMR for Malawi was 675 maternal deaths per 100 000 live births for 2010. The delay model of Thaddeus and Maine was applied and used as basis for the recommendations. Delay in seeking help by the women, was influenced by the presence of a traditional birth attendant, the inability to recognize the signs and symptoms or underestimating the severity of the problem. According to Thorsen *et al.* (2012:9), the third phase of the delay model, that is, delay in treatment, is an indication of substandard care by health care providers.

Internationally the role of unskilled birth attendants at births has been identified as an avoidable factor in developing countries and specifically in Africa. Therefore, the number of skilled birth attendants should be increased. However, according to Rai et al. (2012:199) the increase alone is not sufficient and the quality of care by the skilled birth attendant should be focused on as well. Other factors contributing to maternal death in developing countries are unsafe abortions and lack of antenatal care (Nwagha *et al.*, 2010:326).

2.7 MATERNAL DEATHS IN SUB-SAHARAN AFRICA (SSA)

A study done in 181 countries in 2010, showed that the estimated number of maternal deaths worldwide was 287 000 and 56% of these deaths occurred in Sub-Saharan Africa (World Health Organization, 2012:22). The MMR for Sub-Saharan Africa was 500 maternal deaths per 100 000 live births and was the highest in the developing regions of the WHO. One of the concerns identified was the lack of a complete registration system in most of the countries included in the study (World Health Organization, 2012:3). Furthermore, Drife (2008:501) found that there is under-reporting of maternal mortality in countries without a confidential enquiry system. He also emphasized the importance of practice guidelines to improve maternal care.

2.7.1 Causes of maternal deaths in SSA

The WHO's study on global causes of maternal deaths showed that almost a quarter (24.5%) of maternal deaths in Sub-Saharan Africa were due to haemorrhage, while indirect causes contributed to 28.6% of maternal deaths. Similar to the developed and developing countries, postpartum haemorrhage is the most common cause of haemorrhage (Say *et al.*, 2014:e326-e327).

2.7.2 Avoidable factors causing maternal deaths in SSA

Stover and Ross (2010:693) did a study to determine what effect increased

contraceptive use had on maternal mortality. The authors found that the advantage of increased contraceptive usage by women, is a decrease in the number of high-risk births and, therefore, a decline in the MMR. Age and parity were also compared to the MMR as they are indirectly linked to contraceptive usage. According to Ross and Blanc (2012:458) the maternal deaths in the developing countries should increase due to an increase in the number of woman of reproductive age. They showed that although the number of woman of reproductive age increased, there was a decline in fertility among these women due to the use of contraceptives. The decline in fertility lead to fewer maternal deaths than expected. However, the number of women at reproductive age in SSA increased with two thirds. Therefore, the SSA has a high fertility rate that lead to an increase in births and an increase in maternal deaths.

2.8 MATERNAL DEATHS IN SOUTH AFRICA (RSA)

A national system for confidential enquiries into maternal deaths was implemented by the National Department of Health in October 1997 in South Africa. The first report was published in 1999 with the title "Saving Mothers: Report on Confidential Enquiries into Maternal Deaths in South Africa 1998" (Republic of South Africa, 2006:2). The National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD) was established and one of their responsibilities was to submit a report to the Minister of Health every three years for approval and publication (Republic of South Africa, 2012:1). These reports provide valuable statistics related to maternal deaths and recommendations for their prevention. The indicators used were causes of maternal deaths, maternal age, parity, institutional deaths, contributing causes and avoidable factors. Since the implementation of the confidential enquiries, the number of reported cases increased due to better reporting, which supports the view of Drife (2008:501).

The maternal deaths in South Africa have increased since 2002 according to the NCCEMD reports and recommendations were made on how to decrease maternal deaths in order to achieve the MDGs. The impact of HIV on maternal death has contributed to an increase in the MMR nationally as well as in Western Cape.

2.8.1 Causes of maternal deaths in RSA

In South Africa, the most common primary causes of maternal deaths for the period 2008 to 2010 were non-pregnancy-related infections (NPRI), obstetric haemorrhage, hypertension, and pregnancy-related infections. The main factors for the non-pregnancy-related infections were HIV infections and related conditions such as tuberculosis (Republic of South Africa, 2012:xi). Although non-pregnancy-related infections and hypertension were also among the most common causes of maternal deaths in the Western Cape, the third most common cause in the Western Cape was pre-existing medical and surgical disorders (Republic of South Africa, 2012:298).

For the period 2008 to 2010 the most common direct causes of maternal death in South Africa correlated with causes in other developing countries. Before 2008 the most common direct cause was hypertensive disorders in pregnancy. This change may be the result of the national implementation of guidelines for the management of hypertensive disorders in South Africa and supports the findings of Bhattacharyya *et al*, (2008:503).

From 2002 the MMR increased nationally as well as in the Western Cape until 2010. However, the latest data from the NCCEMD reports indicated a decline in the MMR from 2011. The category of non-pregnancy related infections, as a cause of maternal death was more than that of direct causes for the period 2008 to 2010. Obstetric haemorrhage is identified as one of the most important avoidable causes and deaths due to haemorrhage during or after a caesarean section have increased (Republic of South Africa, 2013:3). Further, in the most recent Savings Mothers report from the NCCEMD it was indicated that there was a decrease in NPRI as a cause of death in South Africa but obstetric haemorrhage as a cause of death increased (Republic of South Africa, a.s.:6). Most of the maternal deaths due to obstetric haemorrhage occurred at level one hospitals (18%) (Republic of South Africa, a.s.:13).

2.8.2 Avoidable factors causing maternal deaths in RSA

The NCCEMD classified avoidable factors as patient related factors, administrative

related factors, medical related factors, resuscitation related factors, and anaesthetic related factors. For the period 2008 to 2010, inadequately trained doctors was the most common administrative avoidable factor in RSA. Other administrative avoidable factors included the lack of intensive care beds and lack of transport (Republic of South Africa, 2012:301). Lack of intensive care beds, inadequately trained doctors and lack of blood products were the most common avoidable factors in South Africa for the period 2011 to 2013 (Republic of South Africa, s.a.:23). Patient related factors are based on patient behaviour, community factors, socio-economic and political influences. The most recent Saving Mothers report showed that delay in seeking medical help, unsafe abortions and lack of attending antenatal care were the most important administrative avoidable factors in South Africa (Republic of South Africa,s.a.:23).

The lack of adequately trained doctors and nurses as a medical related avoidable factor leads to the question of accountability. According to De Mesquita and Kismödi (2012:79), the lack of accountability of staff involved with maternal deaths needs to be emphasised. The authors further stated that the acceptance of accountability for maternal deaths by staff and the protection of human rights needs to be part of a strategy for maternal care. Furthermore, Rai et al. (2012:201) stated that knowledge of the underlying factors of maternal deaths is necessary in order to avoid maternal deaths. Midwives are key role players in the prevention of maternal deaths and independent practitioners. The Nursing Act, 2005 (Act no.33 of 2005) emphasises in chapter two section 30(1) that in order to practice independently, midwives need to be competent and capable to take responsibility and accountability for their practice (Republic of South Africa, 2005: 34). Therefore, in order to accept responsibility and accountability for the care of the pregnant mother, midwives need to be aware of the factors causing maternal deaths.

The knowledge and understanding of causes of maternal deaths by midwives is an essential competency according to the International Confederation of Midwives (Essential competencies for basic midwifery practice, 2010). The system of reporting maternal deaths depends largely on the cooperation of the health care services and personnel. In South Africa the provincial assessors provide feedback to the services in

the different health districts as soon as the national reports are available and approved by the Minister of Health. The aim of the feedback is to make midwives, medical practitioners, obstetricians, and management aware of the factors causing maternal deaths in the country and its provinces. However, data from the health districts and specifically the level one hospitals and MOUs are limited.

A cross-sectional population-based survey done in South Africa to investigate the differences in access to health services in the rural and urban areas, found that women in the rural areas tend to have less than the expected four antenatal clinic visits (Wabiri, Chersich, Zuma, Blaauw, Goudge, & Dwane, 2013:e73864). The study further showed that low income women had more antenatal visits but fewer than 50% of the women attended an antenatal clinic before 20 weeks gestation. Another important consideration addressed in this study was the HIV testing during pregnancy. According to the findings of the study, HIV testing was offered to fewer pregnant women in the rural areas during the pregnancy (Wabiri et al., 2013:e73864). The data collection for the study was done by gathering data through home visits from women who had been pregnant the previous two years. A limitation of the study is that the data could have been influenced by recall of the woman as the interviews were conducted retrospectively and was based on the recall by the woman for up to two years.

A mixed-method study done by Silal, Penn-Kekana, Harris, Birch and McIntyre (2012:120) regarding access to health services in South Africa, indicated that the high cost of public transport is a barrier to access in the rural areas. Other barriers to access in the rural areas are longer travelling times to the health facility and the actions and attitudes of health care providers. The authors state further that there is a need to respond to patient related barriers in order to improve antenatal care attendance and eliminate delay in seeking help by pregnant women.

Avoidable factors for maternal deaths due to eclampsia were described as a delay by the patient in seeking help and not attending antenatal clinics frequently. Furthermore, the delay in transport between institutions; communication between institutions; substandard care where the correct diagnosis was made; delay in referring the patient;

management of the patient at an institution that is not appropriate; making the incorrect diagnosis; and monitoring problems were factors that may be avoided by the health care providers and administration (Moodley, 2010: 2).

The factors due to delay, that is, delay in seeking help, delay in transport, and delay in referring the patient, support the model of Thaddeus and Maine (1994:1092). Thaddeus and Maine developed a model based on delay factors that may have an influence on maternal deaths. The model focuses on three phases of delay of which delay in seeking care on the part of the patient and/or family is phase one. Phase two is delay in reaching the health care facility due to the accessibility of the facility and transport problems. The third phase of delay is the delay in initiating adequate care at the facility due to referral problems and lack of supplies, equipment, and trained personnel (Thaddeus & Maine, 1994:1092). This delay model identifies the avoidable factors related to the patient, administration, and health care personnel.

2.9 MATERNAL DEATHS IN THE WESTERN CAPE

The previous Saving Mothers report from the NCCEMD shows an increase in the MMR for the Western Cape from the period 2005 to 2007 (73.12 maternal deaths per 100,000 live births) to 84.87 maternal deaths per 100,000 live births for the period 2008 to 2010 (Republic of South Africa, 2012:11). However, MMR for the period 2008 to 2010 for the Western Cape is much lower compared to the national MMR of 176.22 maternal deaths per 100,000 live births for the same period and the lowest MMR in the country (Republic of South Africa, 2012:xi, 294). The findings of the national statistics on maternal deaths in South Africa revealed that the primary causes of maternal deaths in the Western Cape differed from that of the other provinces in the country. The most common causes of maternal deaths in the Western Cape were non-pregnancy-related infections (mostly HIV-related conditions), hypertension and pre-existing medical and surgical disorders (Republic of South Africa, 2012:298). While in the other provinces pre-existing medical and surgical disorders is not one on the most common causes but

obstetric haemorrhage is one of the most common causes of deaths.

The analysis of the MMR per disease category as reported by the NCCEMD, indicated that all categories for the Western Cape were consistently 15% lower than that of the national averages (Republic of South Africa, 2012:7). From the above information it is evident that the circumstances related to maternal deaths in the Western Cape are different from the rest of the provinces in South Africa. The most recent data of the NCCEMD in the public domain for the period 2011 to 2012 re-emphasised these findings.

2.9.1 Causes of maternal deaths in the Western Cape

The 2011 and 2012 maternal death data of the NCCEMD, published as an interim report, showed that non-pregnancy-related infections was still the most common cause of maternal death in the Western Cape. The second most common cause was medical and surgical disorders, followed by hypertension, pregnancy-related infections and then obstetric haemorrhage (Republic of South Africa, 2013:6).

Hypertension has been the most common direct cause of maternal deaths in the Western Cape for a more than a decade. For the period 2008 to 2010 hypertension as a cause of death decreased from 23% (2005 to 2007) to 16% of all deaths in the Western Cape (Republic of South Africa, 2012:298). According to the most recent Saving Mothers report (Republic of South Africa, s.a.:17) the institutional MMR for hypertension decreased from 14.26 maternal deaths per 100,000 live births for period 2008 to 2010, to 12.78 deaths per 100,000 live births for the period 2011 to 2013. For the same periods medical and surgical disorders increased from an institutional MMR of 10.43 to 13.85 in 2011 to 2013.

In developed countries, developing countries, Sub-Saharan Africa and South Africa, obstetric haemorrhage is one of the three most common causes of maternal deaths. In South Africa and in five of the country's provinces, which is Gauteng, KwaZulu Natal, Limpopo, Mpumalanga and North West, obstetric haemorrhage is the second most common cause and the most common direct cause of death. In three provinces which

is Eastern Cape, Free State and Northern Cape, obstetric haemorrhage is the third most common cause of death (Republic of South Africa,a.s.:15). In contrast to the other provinces, obstetric haemorrhage is not under the three most common causes of maternal deaths in the Western Cape which indicates that the causes of maternal deaths in the Western Cape differ from the causes in the rest of the country.

2.9.2 Avoidable factors causing maternal deaths in the Western Cape

In South Africa, the majority of patients dying after giving birth did receive antenatal care but the most common avoidable cause related to the patient was a delay in seeking medical help. In the Western Cape, 74.6% of maternal deaths occurred while receiving antenatal care (Republic of South Africa, 2012:297).

The maternal mortality data for the period 2008 to 2010 showed that in the majority of maternal deaths, the assessors in the Western Cape could not find any avoidable factor related to medical care. When avoidable factors were present the most common one was where the correct diagnosis was made but the management was seen as substandard by the assessors (Republic of South Africa, 2012:302). Substandard care refers to failure in clinical care or clinical care below the expected standard of care for the specific diagnosis (Republic of South Africa, 2012:336-337). The finding that substandard management was the most common avoidable factor in the Western Cape, correlates with the findings on substandard management for the country in the same report.

Antenatal care was emphasised by the WHO as an important aspect in the care of a pregnant woman in order to identify risk factors and save mothers and babies (World Health Organization, 2010b:10). In the Western Cape, 74.6% of maternal deaths between 2008 and 2010 occurred in patients receiving antenatal care (Republic of South Africa, 2012:297). However, during the same period and in 11.6% of maternal deaths, there was a delay in seeking medical help, which was the most common patient related avoidable factor (Republic of South Africa, 2012:300). The reasons for the delay in seeking medical help were not specified. To implement strategies to decrease

this patient related avoidable factor, more information is needed per health district as the reasons may be different for the various health districts.

In the Western Cape the lack of intensive care beds and lack of blood products are the most common administrative factors (Republic of South Africa, 2012:301). The most common avoidable factor related to health care personnel in the Western Cape was in cases where the correct diagnosis was made, but the assessors saw the management as substandard (Republic of South Africa, 2012:302). These factors are similar to the third phase of the delay model.

2.10 LEVELS OF CARE IN SOUTH AFRICA

In the Western Cape, 49.2% of maternal deaths occurred at level three hospitals, which indicate the effectiveness of the referral system. Based on the effective referral system, it can be expected that the percentage of maternal deaths at level two hospitals is higher than that at level one hospitals. However, the percentage of maternal deaths (23.8) at level one hospital and midwife obstetric units is higher than the percentage of deaths (18.2) at the level two hospitals (Republic of South Africa, 2012:296-297).

2.11 SOUTH AFRICAN DEMOGRAPHICS

Lessons learned from the results of the 2005 – 2007 NCCEMD report are that in 49.7% of maternal deaths due to eclampsia, the women were younger than 24 years (Moodley, 2010:2). This report further stated that only 5.8% of the women who died due to eclampsia experienced the first convulsion during the postpartum period and 93.6% was in the antenatal period.

2.12 FINAL AND CONTRIBUTORY CAUSES OF MATERNAL DEATHS IN SOUTH AFRICA

To the researcher's knowledge there is no literature on final and contributory causes of maternal deaths internationally and in South Africa, final and contributory causes were not determined per province. Therefore, the researcher intends to analyse the final and contributory causes of maternal deaths at level one hospitals and MOUs in the Western Cape.

2.13 SUMMARY

From the findings of the literature review it is evident that the causes of maternal deaths in developed countries are not similar to the causes in developing countries. Similarly, the causes of maternal deaths in the Western Cape differ from the other provinces in South Africa. However, the delay model of Thaddeus and Maine (1994) is applicable to developed and developing countries with regard to avoidable factors.

Obstetric haemorrhage is one of the three leading causes of maternal deaths in developing countries, Sub-Saharan Africa and South Africa while it is not a leading cause of death in developed countries and in the Western Cape. The avoidable factors causing maternal deaths in the Western Cape is similar to the avoidable factors for South Africa with one exception which is unsafe abortions. Unsafe abortion was not one of the most common avoidable factor in the Western Cape. The importance of antenatal care, the role of the patient, usage of essential drugs, availability of blood and standard of care are supported by studies applicable to developed as well as developing countries including South Africa. In the following chapter, the methodology of the study is discussed.

2.14 CONCLUSION

In this chapter the results of the literature review presented are related to the research objectives of this study. It is evident that the management of hypertension as a cause of maternal death is important in order to reduce maternal deaths. The causes of maternal deaths for the developed countries are not the same as the causes of maternal deaths in developing countries and in the SSH countries.

3 CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research methodology is the description of the techniques the researcher use for the study including the collection and analysis of data, which is relevant to the research question (Polit & Beck, 2006:15). A quantitative approach was used for the study, which is defined as a formal and systematic process whereby the researcher collects numerical data for understanding certain aspects of the research problem (Grove, Burns & Gray, 2013:23). The focus of a quantitative approach is to minimise bias and maximise validity and precision (Polit & Beck, 2006:15).

In chapter two, an overview was presented of the literature review done and information was gathered with regard to the research methodology applied in the different studies. The research methodology for this study is described in this chapter and is based on the information from chapter two.

3.2 RESEARCH METHODOLOGY

The aim of this study was to determine and describe the factors causing maternal deaths at level one hospital and MOUs. A quantitative study was done to describe the variables through statistical data.

3.2.1 Research design

Research design can be seen as a blueprint of how the researcher will conduct the study (Grove, Burns & Gray, 2013:214). In this study, subjects were not exposed to treatment and no comparison between subjects was done.

The research design selected for this quantitative study was a retrospective descriptive

design as little knowledge is available with regard to factors causing maternal deaths at level one hospitals and MOUs in the Western Cape. A retrospective document review was done based on the research objectives for the study.

3.2.2 Study setting

The study was done in a natural setting as the researcher did not manipulate or control the environment and focused on the real situation by doing a retrospective record review. The data collected was based on the causes of maternal deaths that occurred in the Western Cape between 2008 and 2012 in the six health districts.

3.2.3 Population and sampling

Polit and Beck (2006:259) described *population* as “the entire aggregation of cases that meet specified criteria.” For this study, the population constituted all maternal deaths that occurred at level one hospitals and MOUs in the Western Cape between January 2008 and December 2012. Sampling is a portion of the population the researcher selects to represent the total population under study (Polit & Beck, 2006:260). The researcher did not use a sample, but included the total population of 92. The factors causing the maternal deaths at level one hospitals and MOUs were determined for each of the six health districts as the circumstances varied from one health district to another.

3.2.3.1 Inclusion criteria

The inclusion criteria for the study were electronic data base files of maternal deaths at all level one hospitals and MOUs in the Western Cape for the period 2008 to 2012, which were in the public domain.

3.3 DATA COLLECTION TOOL

An existing data collection tool was used to extract data from the electronic database of the NCCEMD. The tool is the 2008 version of the “Maternal Mortality – Assessors

Control sheet,” which was used until 2013 to capture the data on the NCCEMD’s electronic database (Appendix 4).

The data collection tool is divided into the following sections: demographics; cause of death; final cause of death and other complications; avoidable factors; clinical management and emergency care problems; summary of the case; subjective opinion of the assessors regarding the avoidability of the death; and suggestions for prevention. The data on the electronic database under the last two sections was not extracted onto the data collection tool used in the study as it is not relevant to the study.

3.3.1 Demographics

All the information for level one hospitals and MOUs in the Western Cape found under the demographics section was extracted from the electronic database, except the name of the health services where the maternal death occurred. The reason for this decision was based on ethical consideration not to identify the health services. The participants were identified by a unique number on the electronic database. On the data collection tool as well as on the electronic database the terminology Community Health Centre (CHC) was used, which includes the MOUs. Therefore, the data captured under CHC was used for this study to describe the factors causing maternal deaths at MOUs.

3.3.2 Cause of death

The cause of death is the primary disease entity and the categories were divided into subcategories. The categories were: coincidental cause; medical and surgical disorders; non-pregnancy-related infections; ectopic pregnancy; miscarriage; hyperemesis gravidarum; pregnancy-related infections; obstetric haemorrhage; hypertension; anaesthetic complications; embolism; acute collapse; unknown. The expectation was to extract the primary causes of deaths for the total population from the electronic database and analyse the causes for the MOUs and level one hospitals separately. Furthermore, the expectation was to determine that most common primary causes of deaths in the Cape Town Metropole separately from the other health

districts.

3.3.3 Final cause of death and other complications

The categories for the final cause of death and other complications were the same on the data collection tool. The categories were: circulatory system; respiratory failure; cardiac failure; acute cardiopulmonary failure due to embolism; renal failure; liver failure; cerebral complications; metabolic; haematological; immune system failure; unknown; other-specify. The category “other-specify” is rarely used as an option but provides an opportunity for assessors to specify final and contributory causes which are not applicable to the other categories. Data under the section “other complications” was used as the contributory cause data in the study and could be multiple responses. The decision to change from other complications to contributory cause was based on the approach that were followed by the NCCEMD which is to refer to other complications as contributory causes.

3.3.4 Avoidable factors

The avoidable factors on the data collection tool were divided into two categories: patient orientated problems and administrative problems. Each sections could have multiple responses. The researcher acknowledges the importance of community, socio-economic and political influences, but for the purpose of this study, these influences were not included. Patient orientated problems and administrative problems will be discussed in chapter 4 - 4.2.4 as patient related avoidable factors and administrative related avoidable factors according to figure 1.1.

3.3.5 Clinical management and Emergency care problems

Clinical management and emergency care problems is the third broad category were avoidable factors were sought. The section is divided into four subsections on the data collection tool, that is, timing of emergency; timing of death; medical care; and resuscitation. The timing of emergency indicated at what stage of the pregnancy the problem was identified, for example early in pregnancy or in the ante-, intra- or postpartum period. The same stages during the pregnancy are applicable to the timing

of death. The medical care is reported according to the applicable level of care where the participant was treated and it may be at more than one level of care. Clinical management and emergency care problems will be discussed as medical related avoidable factors according to figure 1.1 in chapter 4 – 4.2.4.

3.3.6 Summary of the case

The data collection tool made provision for a short summary of the case and the information was extracted from the electronic database.

3.3.7 Suggestions for prevention

The suggestion for prevention data on the data collection tools was not extracted from the participants' files as it was not one of the study objectives. Further, the suggestions made was generalised and not specific for level one hospitals and MOUs and therefore not appropriate to the study.

3.4 PILOT STUDY

“A pilot study is a smaller version of a proposed study, and researchers frequently conduct these to refine the methodology” (Burns & Grove, 2011:49). The pilot study was done to identify weaknesses with the methodology and correct these before collecting the actual data. The researcher used the data collection sheet to evaluate the suitability of the tool in collecting data. The researcher used maternal deaths that met the inclusion criteria.

During the pilot study the researcher extracted the data of all the maternal deaths that occurred at level one hospitals and MOUs for the period 1 January 2008 to 31 December 2008. Only ten participants' files who met the inclusion criteria were found and two participants' files could not be found. With the help of the researcher's co-supervisor, the data was extracted from the electronic database of the NCCEMD and captured on the assessor's control sheet of the NCCEMD (2008 version). Each participant's file was identified on the electronic database by a unique number

according to the NCCEMD process. The section regarding suggestions for prevention on the data extraction tool, was not applicable to this study and therefore, not included in the study. The other data collected during the pilot study were included in the study as the population was small.

3.5 RELIABILITY AND VALIDITY

According to Polit and Beck (2006:40), reliability is used when the study measures variables and determines the consistency and accuracy of the information. Validity is “the extent to which an instrument measures the attributes of a concept accurately” (LoBiondo-Wood & Haber, 2010:286). Further, Grove et al. (2013:389) stated that some of the aspects related to reliability are stability, precision and comparability. Therefore, both reliability and validity refer to the degree of potential measurement errors.

The researcher used an existing tool which had been validated. Further the supervisor and co-supervisor who are experts in the area of maternal mortality validated the tool and the tool was also used by the NCCEMD to collect data for the Saving Mothers reports from 2008 to 2013. The consistency and uniformity with regard to the data collection process were assured during the pilot study as well as the feasibility of the study.

3.6 DATA COLLECTION

The researcher collected data over a period of four weeks through a retrospective document review. Data was collected from the maternal deaths register of the Mother, Child and Woman’s Health Directorate of the Western Cape and the electronic database of NCCEMD. Only data from the NCCEMD that were in the public domain at that time were included. The existing assessor’s control sheet of the NCCEMD (2008 version) was used to extract data. The researcher received permission from the

NCCEMD to use the document (Appendix 3). To maintain confidentiality, all information identifying patients and services, were not captured. On the NCCEMD electronic database, participants were allocated unique numbers. The individual hospitals were not identified and the identifiable data on the data collection tool was not completed. Therefore, confidentiality was guaranteed and the researcher, who is also a provincial assessor for NCCEMD, was the only collector of data.

3.7 DATA ANALYSIS

A statistician from Stellenbosch University was consulted regarding the analysis of the data. The collected data was transferred from the assessor's control sheet of the NCCEMD (2008 version) and captured on a Microsoft Excel sheet and analysed by using the Statistical Package for Social Sciences (SPSS).

All data was captured on SPSS according to the year of death, the level of care and health district in which the death occurred. The variables for the demographics data were based on the aspects on the assessor's control sheet of the NCCEMD (2008 version). The labelling of the variables was done on the SPSS document.

Initially the separate spreadsheets were used to capture the data according to the research objectives of the study. These spreadsheets identified the demographics; primary causes; final and contributory causes; and avoidable factors. All the data on these spreadsheets were merged afterwards onto one spreadsheet.

The interpretation of the data was done with the assistance of the statistician. The data of the level one hospitals and MOUs in the Cape Town Metropole was analysed and presented separately from the data of level one hospitals and MOUs in the other districts.

The analysis of the collected data was based on the research objectives of the study. Frequency tables and bar charts were used in the case of categorical data, while means, standard deviations and ranges in the case of continuous data. Frequency

tables display the frequency distribution of the variables and can be ungrouped or grouped frequency distribution (Grove, Burns & Gray, 2013:550-551). It is a method used to describe the occurrences of events being studied (LoBiondo-Wood & Haber, 2010:578). The mean is one of the measurements to indicate the central tendency of the responses for the different variables under study and is the average of all the scores (LoBiondo-Wood & Haber, 2010:315). Both the standard deviation and the range measure the variability to describe the dispersion of the data. Standard deviation is used in relation to the mean as it measures the “average deviation of the scores from the mean” and “the range is the difference between the highest and the lowest scores” (LoBiondo-Wood & Haber, 2010:317-318).

3.7.1 Demographics

The frequencies of the variables for the demographics data were determined and were based on the variables on the assessor’s control sheet of the NCCEMD (2008 version). These included the age; parity before the delivery; antenatal care; HIV status; present pregnancy outcome; route of delivery; referral; did the mother have an anaesthetic; did the mother have a hysterectomy; did the mother have a post-mortem; did the mother have prolonged labour; mid-upper arm circumference; previous caesarean sections; and anaemia during pregnancy. The results are presented in frequency tables and the mean, standard deviation and ranges were also determined.

3.7.2 Primary causes of death

The frequency of the main categories or disease entity of the primary causes of deaths as well as the subcategories were determined according to the level of care and the health district relevant to the study. The data for the level one hospitals and for the MOUs was presented as a frequency table. The primary causes of death for the health districts were analysed separately for the Cape Metropole and other health districts and presented in a table according to the main categories which were coincidental causes; medical and surgical disorders; non-pregnancy-related infections; ectopic pregnancy; miscarriage; hyperemesis gravidarum; pregnancy-related infections; obstetric haemorrhage; hypertension; anaesthetic complications; embolism; acute

collapse; and unknown.

3.7.3 Final and contributory causes of death

The final and contributory causes of deaths were captured as a multiple-response field on the SPSS document. Tables were used to present the final causes and the contributory causes separately.

3.7.4 Avoidable factors

The patient related factors, administrative factors and medical factors could have more than one response and were captured as multiple-response fields on the SPSS document. Frequency tables were used to analyse the data separately for each category.

The avoidable factors were analysed utilizing frequency tables which include:

- The difference between the avoidable factors of the health services in Cape Town Metropole and that of the five other health districts
- The differences between the avoidable factors of the MOUs and the level one hospitals.

3.8 ETHICAL CONSIDERATIONS

The proposal for the study was submitted to the Stellenbosch University Health Research Ethics Committee for ethical approval, which was obtained (Appendix 1). In the study, the human participants were deceased persons. Therefore, the researcher obtained a waiver of consent from the Stellenbosch University Health Research Ethics Committee, as the deceased involved were not able to give the researcher permission to use their data. The researcher was strongly committed to confidentiality with respect to participants' names as well as the names of the health services due to the sensitive nature of the information. No health service was identified.

Permission to use the data of the Western Cape was granted by the Western Cape Department of Health (Appendix 3) and the National Committee for Confidential Enquiry into Maternal Deaths (Appendix 5). Participants have a right to confidentiality, which was protected. All the data collected will be stored and locked away for a period of 5 years in such a way that only the researcher, supervisors and statistician will have access to the information.

3.9 SUMMARY

The study was a quantitative, retrospective descriptive study of maternal deaths that occurred at level one hospitals and MOUs in the Western Cape between 2008 and 2012. Data was extracted from the electronic database of the NCCEMD and analysed by using the SPSS program. Frequency tables and bar charts were used to display the results. To maximise control and standardisation, a structured process was applied to describe the variables through statistical data. In the next chapter the findings of the study as described in this chapter are presented and discussed.

4 CHAPTER FOUR

RESULTS

4.1 INTRODUCTION

In chapter three the methodology of the study was described and it was indicated that the analysis of the data was done according to the research objectives of the study. In this chapter the results for the demographics, primary causes of maternal deaths, final and contributory causes of maternal deaths and the avoidable factors are presented. Demographics also include risk factors. Tables and figures are included to provide more detailed information of results for health districts, levels of care or factors that caused maternal deaths.

4.2 DATA ANALYSIS

The population of the study was 92 (N) maternal deaths that occurred at level one hospitals and MOUs in the Western Cape between 2008 and 2012. The data was extracted from the electronic database for maternal deaths of the NCCEMD. Although the total population for the maternal deaths was 92 (N=100%) only 86 (n) maternal deaths were available on the system. Information on six of the maternal deaths was not available. Though total population was 92, included in the detailed analysis were 86 participants' files. Further, analysis was done on the available maternal deaths 86 (94%) out of the total 92 deaths.

Figure 4.1 shows the number of maternal deaths for the period 2008 to 2012 per year out of the total population. In 2008 the maternal deaths were the lowest at ten (11%). Most of the maternal deaths, 24 (26%), occurred in 2009. In 2010 the number of maternal deaths decreased from 24 (26%) in 2009 to 19 (21%). There was a further decrease of maternal deaths in 2011 to 14 (15%). Despite the decrease of maternal

deaths over these two years, the number increased again in 2012 to 19 (21%) maternal deaths.

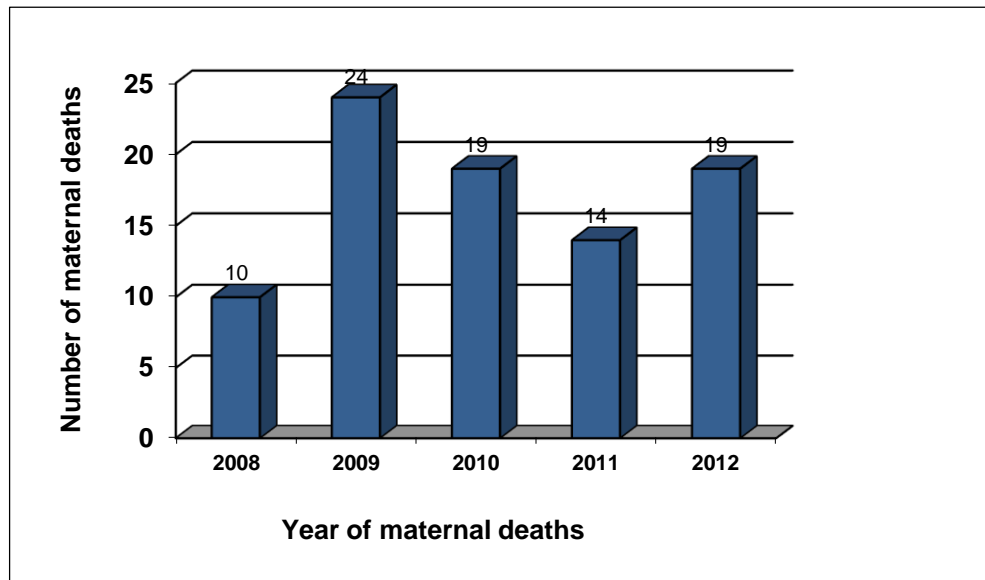


Figure 4.1 Maternal Deaths per Year (n = 86)

The maternal deaths per health districts are shown in Figure 4.2. Three health districts, Cape Town Metropole, Eden and West Coast, together contributed 69 (80%) to maternal deaths during 2008 and 2012. Maternal deaths that occurred at level one hospitals and MOUs in the Cape Town Metropole alone contributed to 41 (48%) of maternal deaths.

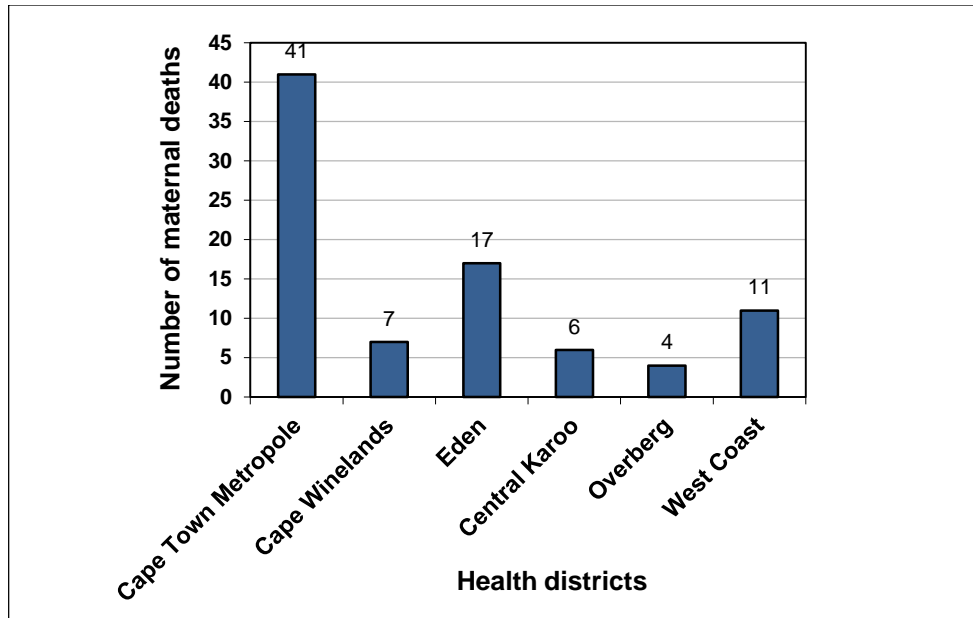


Figure 4.2 Maternal Deaths per Health District (n=86)

All the maternal deaths that occurred at MOUs were in the Cape Town Metropole health district (Figure 4.3) and contributed 20 (23%) to maternal deaths. The number of maternal deaths at level one hospital were 66 (77 %).

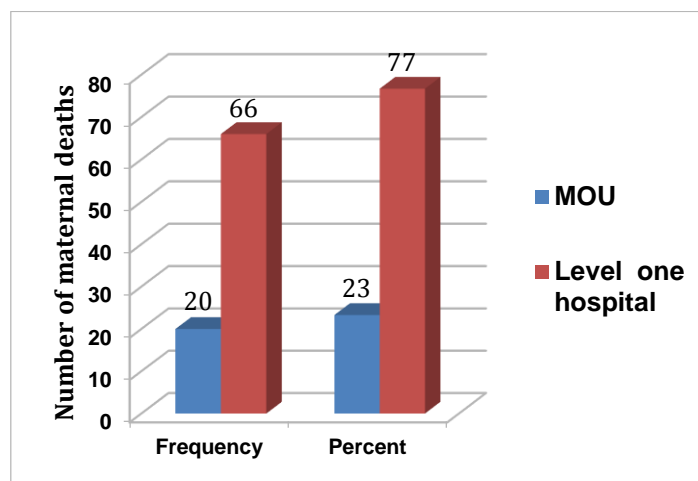


Figure 4.3 Maternal Deaths per level of care (n=86)

4.2.1 Demographics

The analysis of demographics was done according to the accessible sample of $n = 86$ and the remaining 6 deaths that were not available were not included in this analysis. There were more deaths at the level one hospitals compared to the MOUs. This was possibly due to the fact that the mothers were referred from the MOUs before demise but not in time for the condition to be effectively managed at the level one hospital.

4.2.1.1 Age on participants' files (n= 86)

The ages on the participants' files ranged between 15 years to 40 years with a mean age of 27.0 and a standard deviation (SD) of 6.1. The mean age of maternal deaths at MOUs was 29.5 years with a SD of 6.5. While the mean age at the level one hospitals was 26.2 years and the standard deviation 5.8. The range for age at level one hospitals was 15 to 40 years and for the MOUs, between 21 years and 40 years as indicated on Figure 4.4. The age on one participant's file could not be found. The minimum age of deaths at the MOU was 21 because most of the clients below 21 years are managed at the level one hospital.

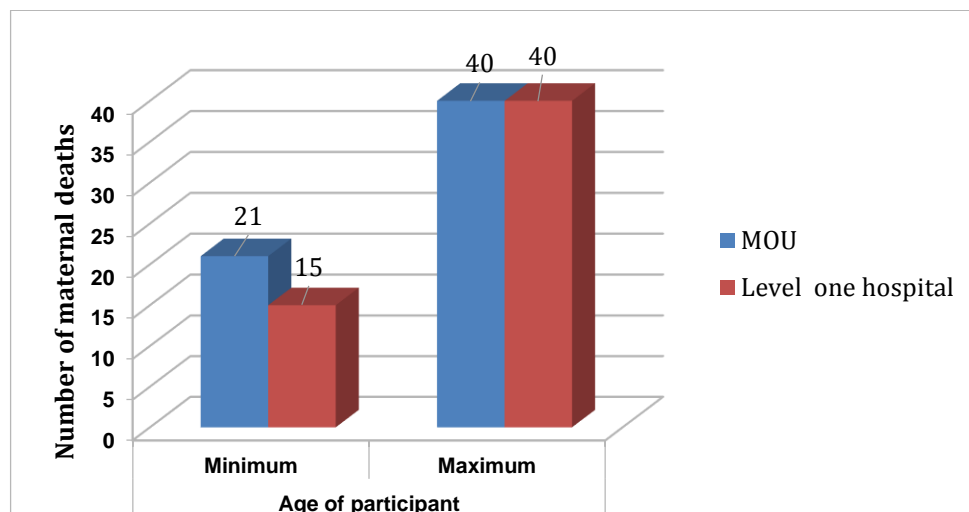


Figure 4.4 Age on participants' files per level of care (n=86)

4.2.1.2 Gravidity and parity before delivery

Table 4.1 illustrates the gravidity and parity before delivery per level of care. The majority of participants' files 35 (40.7%) indicated gravida one while six (7.0%) indicated gravida five or more. At MOUs the majority of participants' files seven (8.1%) indicated gravida two whereas four participants' files (4.7%) were gravida five and more. At the level one hospitals 31 (36.0%) of the participants' files indicated gravida one and only two (2.3%) of participants' files indicated gravida five and more. At the level one hospitals where there was high mortality, the mortality decreased with increase in parity with para 0 at (38.3%) and para 4 and more with two (2.3%). Further the higher the gravidity the lower the mortality with gravida 1 having 31(36%) reducing to gravida 5 and more having two deaths (2.3%). This could have been linked to the women having more experiences with pregnancy labour and birth as the parity and gravidity increases. The mortality at the MOUs was not influenced by the gravidity and parity. However the total for both MOUs and level one showed a similar pattern where the mortality was seen to decrease from 35 (40.7%) to six (7.0%) for the number of gravidity and the increase in parity para 0 at 37 (43.0%) and para 4 or more at four (4.7%) showing a decrease in mortality. The total could have been influenced by the level one deaths as the numbers were higher than the MOU deaths.

Table 4.1 Gravidity and parity before delivery per level of care (n = 86)

		Level of Care					
		MOU		Level one hospital		Total of both	
		number	%	number	%	number	%
Gravidity	Gravidity 1	4	4.7	31	36.0	35	40.7
	Gravidity 2	7	8.1	16	18.6	23	26.7
	Gravidity 3	2	2.3	14	16.3	16	18.6
	Gravidity 4	3	3.5	3	3.5	6	7.0
	Gravidity 5 and more	4	4.7	2	2.3	6	7.0
Parity	Parity 0	4	4.7	33	38.3	37	43.0
	Parity 1	8	9.3	19	22.1	27	31.4
	Parity 2	4	4.7	10	11.6	14	16.3
	Parity 3	2	2.3	2	2.3	4	4.7
	Parity 4 and more	2	2.3	2	2.3	4	4.7

4.2.1.3 Antenatal care

Those who received antenatal care were 62 (72.1%) and for seven (8.1%) of these cases, information on antenatal care attendance were unknown. The unbooked women were 17 (19.8%).

With reference to the time of the first antenatal care visit, 30 (34.9%) of the cases received antenatal care before 20 weeks of gestation (Figure 4.5). A third (22) of the 66 cases at level one hospitals attended antenatal care before 20 weeks of gestation compared to eight of the 20 mothers at MOUs. The data clearly shows that there were more deaths in cases that booked before 20 weeks 30 (34.9%) than those after 20 weeks 25 (29.1%) and even less for those that did not book at all 17 (19.8%) or the unknown cases 14 (16.3%). The combined unbooked and unknown cases would give a different higher risk 31 (36.0%) compared to booking early or at least any booking in pregnancy.

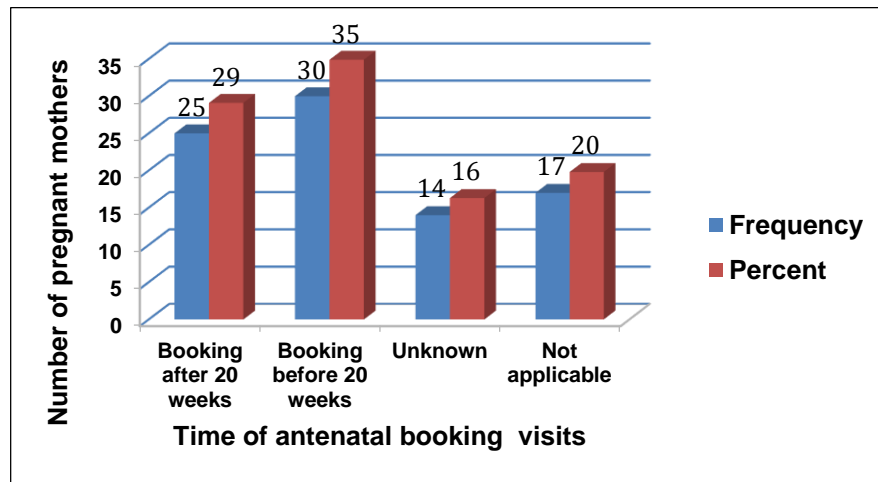


Figure 4.5 Antenatal booking during pregnancy (n=86)

4.2.1.4 Human immunodeficiency virus (HIV) status (n = 86)

The results of the maternal deaths' HIV status are reflected on Figure 4.6. Data collected made provision for five responses: unknown HIV status; HIV negative; HIV positive but not acquired immune deficiency syndrome (AIDS); AIDS but did not receive highly active antiretroviral therapy (HAART); AIDS and did receive HAART. Frequencies for each response were analysed separately for the MOUs and the level one hospitals and reflected as a percentage of all maternal deaths at the specific level of care.

Minority of cases from the files that were HIV negative 12 (14.0%) were from the MOUs while 30 (34.9%) were from the level one hospitals. Four (4.7%) of the deaths from the MOU were unknown while 12 (14.0%) of the unknown maternal deaths were at level one hospitals. At the MOUs all the maternal deaths two (2.3%) who were HIV positive and had AIDS did receive HAART. At level one hospitals only seven of 16 mothers who were HIV positive with AIDS received HAART. Although the total number of the known cases with HIV/AIDS, 28 (32.6%) were high we cannot conclusively indicate that most of these deaths were caused by HIV/AIDS as the HIV negative cases were just as high.

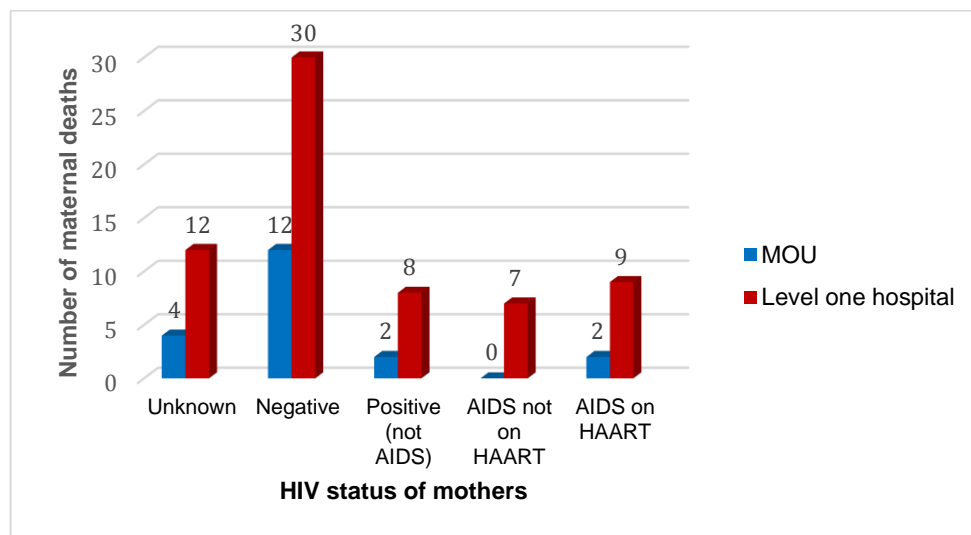


Figure 4.6 HIV status of mothers (n=86)

4.2.1.5 Present pregnancy outcome (n = 86)

Table 4.2 summarises the present pregnancy outcome per level of care. The majority of the babies were born alive 42 (48.8 %) while 33 (38.4%) of the babies were undelivered. Ectopic pregnancies and miscarriages together constituted five cases (5.8%). More babies, 11 out of 20 deaths, were not delivered at time of the death (undelivered) at the MOUs than at the level one hospitals which was 22 out of 66 deaths.

Table 4.2. Present pregnancy outcome per level of care (n = 86)

		Level of Care					
		MOU		Level one hospital		Total of both	
		number	%	number	%	number	%
Pregnancy outcome	Live born	8	9.3	34	39.5	42	48.8
	Stillborn	1	1.2	5	5.8	6	7.0
	Neonatal death	0	0.0	0	0.0	0	0.0
	Miscarriage	0	0.0	4	4.7	4	4.7
	Ectopic	0	0.0	1	1.2	1	1.2
	Undelivered	11	12.8	22	25.6	33	38.4
	Total	20	23.3	66	76.7	86	100.00

4.2.1.6 Route of delivery (n = 86)

Table 4.3 gives the route of delivery per level of care. Most of the babies 33 (38.4%) were undelivered whereas 17 (19.8%) of these babies were delivered by means of a caesarean section. Four (4.7%) of the participants' files indicated that the route of delivery was not applicable as the outcome of the pregnancy was a miscarriage.

Table 4.3 Route of delivery per level of care (n = 86)

		Level of Care					
		MOU		Level one hospital		Total of both	
		number	%	number	%	number	%
Route of delivery	Vaginal	7	8.1	23	26.7	30	34.9
	Assisted	0	0.0	1	1.2	1	1.2
	Caesarean section	2	2.3	15	17.4	17	19.8
	Ectopic	0	0.0	1	1.2	1	1.2
	Undelivered	11	12.8	22	25.6	33	38.4
	Not applicable	0	0.0	4	4.7	4	4.7
	Total	20	23.2	66	76.7	86	100.00

4.2.1.7 Referral (n = 86)

Analysis was also done to determine the number of referrals from MOUs to level one hospitals. It was found that 63 cases (73.3%) were not referred from other levels of care to a level one hospital. However, five (5.8%) was referred from level two and level three hospitals to level one hospitals and 4 of the cases (4.7%) were referred by general practitioners (Figure 4.7).

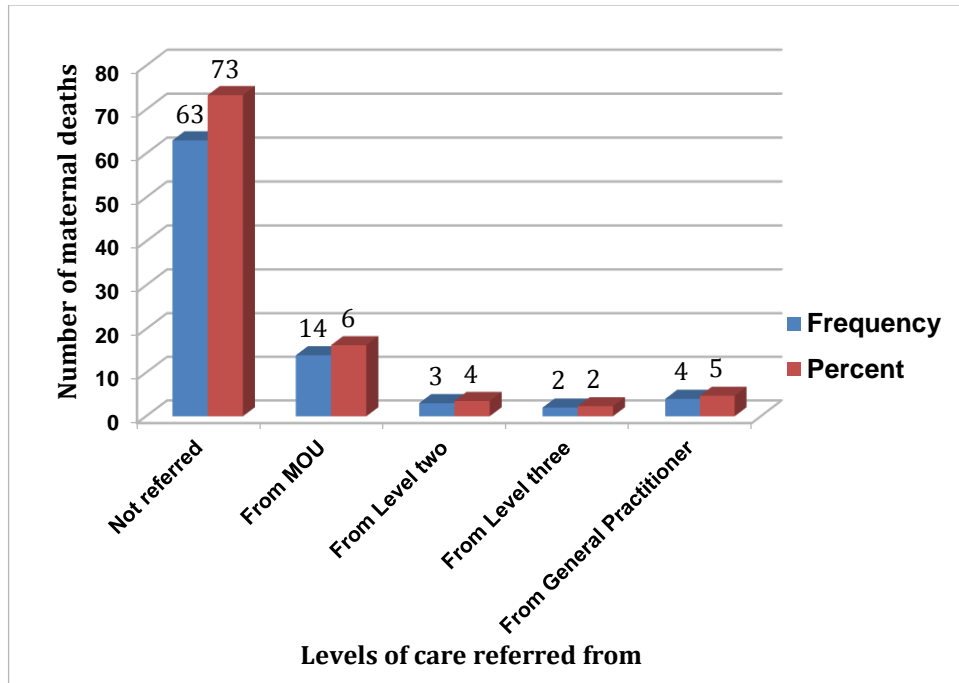


Figure 4.7 Referrals from other levels of care to level one hospitals (n=86)

4.2.1.8 Use of anaesthetic (n = 86)

Majority of participants' files 66 (76.7%) indicated that no anaesthetic was given. An anaesthetic, general or spinal, was given to 17 (19.8%) at level one hospitals and three (3.5%) participants received anaesthetic at other levels of care and were discharged home. One of the cases was discharged home, re-admitted at an MOU and referred to a level one hospital where the maternal death occurred. The other two (2.3%) maternal deaths occurred at an MOU.

4.2.1.9 Hysterectomies performed (n = 86)

Hysterectomies were performed on only two (2.3%) of mothers at level one hospitals and the majority of mothers 84 (97.7%) did not have a hysterectomy. In cases of death due to haemorrhage this could have been a life saver.

4.2.1.10 Post-mortem performed (n = 86)

In more than half, 46 (53.5%) of participants' files it was indicated that a post mortem was performed. Post-mortems were done on 19 of the 20 maternal deaths that occurred at the MOUs and on 27 of the 66 maternal deaths at level one hospitals. This could have helped determine the causes of deaths.

4.2.1.11 Prolonged labour (n = 86)

The cases of mothers who had prolonged labour was also determined and it was found that in three (3.5%) of pregnant mothers prolonged labour was absent. In a further 36 (41.9%) of the cases indicated that prolonged labour is not applicable and in 11 (12.8%) of the cases were not known if pregnant mother had prolonged labour or not.

4.2.1.12 Mid-upper arm circumference (n = 86)

The database of the NCCEMD makes provision for the measurement of the mid-upper arm circumference. However, data for only two participants two (2.3%) were recorded and therefore not analysed. The two mid-upper arm circumferences were 30 cm and 33 cm.

4.2.1.13 History of previous caesarean (n = 86)

Only eight (9.3%) of the cases indicated a history of a previous caesarean section and in nine (10.5%) of participants' files it was indicated as unknown. The majority of the cases 69 (80.2%) indicated no history of a previous caesarean section. This could be due to the fact that the highest number of cases were primigravidas as earlier indicated.

4.2.1.14 Anaemia during pregnancy (n = 86)

It was found that anaemia was present in 22 (25.6%) of the cases during pregnancy as compared to 38 (44.2%) of pregnant mothers without anaemia in pregnancy. In 26 (30.2%) of the cases it was indicated that anaemia during pregnancy is unknown.

4.2.2 Primary causes of maternal deaths

Summarise in Table 4.4 on page 53 are the primary causes of maternal deaths per level of care. The most common primary causes of the maternal deaths were: non-pregnancy-related infections (NPRI); hypertension; acute collapse; obstetric haemorrhage; embolism; medical and surgical disorders.

Table 4.4 Primary causes of maternal deaths per level of care (n = 86)

		Level of Care					
		MOU		Level one hospital		Total of both	
		number	%	number	%	number	%
Primary causes	Coincidental: motor vehicle accident	0	0.0	1	1.2	1	1.2
	Coincidental: assault	0	0.0	1	1.2	1	1.2
	Coincidental: other	0	0.0	2	2.3	2	2.3
	Medical & surgical: cardiac	1	1.2	2	2.3	3	3.5
	Medical & surgical: central nervous system	1	1.2	0	0.0	1	1.2
	Medical & surgical: respiratory	0	0.0	1	1.2	1	1.2
	Medical & surgical: neoplasm	0	0.0	1	1.2	1	1.2
	Medical & surgical: other	0	0.0	1	1.2	1	1.2
	NPRI: other pneumonia	1	1.2	7	8.1	8	9.3
	NPRI: Tuberculosis	0	0.0	10	11.6	10	11.6
	NPRI: other meningitis	0	0.0	1	1.2	1	1.2
	NPRI: kaposi's sarcoma	0	0.0	1	1.2	1	1.2
	NPRI: gastroenteritis	0	0.0	1	1.2	1	1.2
	NPRI: other	0	0.0	2	2.3	2	2.3
	Ectopic: <20 weeks	0	0.0	1	1.2	1	1.2
	Miscarriage: septic	0	0.0	4	4.7	4	4.7
	Pregnancy related sepsis: chorioamniotis with ruptured membranes	0	0.0	1	1.2	1	1.2
	Pregnancy related sepsis: puerperal sepsis after normal vaginal delivery	0	0.0	1	1.2	1	1.2
	Obstetric haemorrhage: abruptio placenta with hypertension	1	1.2	1	1.2	2	2.3
	Obstetric haemorrhage: abruptio placenta without hypertension	0	0.0	1	1.2	1	1.2
	Obstetric haemorrhage: placenta praevia	0	0.0	1	1.2	1	1.2
	Obstetric haemorrhage: morbidly adherent placenta	0	0.0	1	1.2	1	1.2
	Obstetric haemorrhage: uterine atony	1	1.2	0	0.0	1	1.2
	Obstetric haemorrhage: bleeding after caesarean section	0	0.0	2	2.3	2	2.3
	Hypertension: proteinuric hypertension	5	5.8	4	4.7	9	10.5
	Hypertension: eclampsia	1	1.2	2	2.3	3	3.5
	Anaesthesia : general	0	0.0	1	1.2	1	1.2
	Anaesthesia: spinal	0	0.0	1	1.2	1	1.2
	Embolism: pulmonary	3	3.5	3	3.5	6	7.0
	Embolism: amniotic fluid	1	1.2	1	1.2	2	2.3
	Acute collapse - cause unknown	3	3.5	6	7.0	9	10.5
	Unknown: death at home or outside health services	1	1.2	2	2.3	3	3.5
	Unknown: no primary cause found	1	1.2	2	2.3	3	3.5
	Total	20	23.3	66	76.7	86	100.0

4.2.2.1 Non-pregnancy-related infections (NPRI) (n = 86)

NPRIs were the primary cause of death in 23 cases (26.7%). Tuberculosis as a category of NPRI, was the primary cause in ten (11.6%) and pneumonia in eight (9.3%) cases. In 2008 alone, three of the ten maternal deaths were caused by NPRI with tuberculosis contributed two to maternal deaths and pneumonia one. During 2009, there was an increase in the number of maternal deaths due to NPRI as a primary cause with a decrease in tuberculosis but an increase in pneumonia as a cause. For the period 2008 to 2009 the only categories classified under NPRI that caused maternal deaths at level one hospitals and MOUs, were tuberculosis and pneumonia. However, for the period 2010 to 2012, Kaposi's sarcoma (one) in 2010, meningitis, (one) in 2011 gastroenteritis (one) in 2011 and other NPRI such as abscesses (two) were primary causes of maternal deaths.

4.2.2.2 Hypertension (n = 86)

The second most common primary cause indicated on participants' files was, hypertension. Hypertension contributed to 12 (14.0%) of maternal deaths of which nine (10.5%) were due to proteinuric hypertension. More maternal deaths at MOUs were caused by proteinuric hypertension compared to the maternal deaths at level one hospitals. Eclampsia contributed three (3.5%) to the primary cause of maternal deaths with two deaths at level one hospitals and one death at an MOU.

Proteinuric hypertension as a cause of maternal deaths increased from 10% in 2008 to 21% in 2009 with no maternal deaths due to eclampsia. During 2010 and 2011 all the maternal deaths due to hypertension were caused by eclampsia and proteinuric hypertension was not a cause. However in 2012, proteinuric hypertension was the cause of death in three of the maternal deaths with eclampsia causing one maternal death.

4.2.2.3 Acute collapse - causes unknown (n = 86)

Acute collapse, where the cause was unknown, was indicated as the primary cause of maternal death in nine cases (10.5%). Participants' files indicated that there was no maternal deaths due to acute collapse in 2012.

4.2.2.4 Obstetric haemorrhage (n = 86)

Participants' files indicated that in eights (9.3%) of maternal deaths the primary cause was obstetric haemorrhage. Half of these deaths were due to abruptio placenta with hypertension and haemorrhage after a caesarean section. Most of the maternal deaths caused by obstetric haemorrhage occurred between 2010 and 2012 with no maternal deaths due to obstetric haemorrhage in 2009.

4.2.2.5 Embolism (n = 86)

Eight (9.3%) of maternal deaths were due to embolism with pulmonary embolism six (7.0%) as the most common cause in this category. Embolism was the primary cause of death for five of the twenty deaths at MOUs. All the maternal deaths caused by embolism were during the period 2009 and 2010.

4.2.2.6 Medical and surgical disorders (n = 86)

Medical and surgical disorders were the primary cause of death in seven (8.1%) of maternal deaths with cardiac conditions indicated as the most common cause. The other conditions in this category were respiratory conditions, neoplasm and other which was not specified. Most of the deaths caused by medical and surgical disorders occurred in 2012.

4.2.2.7 Primary causes of maternal deaths according to level of care (n = 86)

Various primary causes of maternal deaths at MOUs and level one hospitals are reflected in Table 4.4 on page 53. Some findings are discussed below.

The primary causes of maternal deaths were analysed separately for the MOUs where 20 (23.3%) of deaths occurred while 66 (76.7%) of death occurred at level one hospitals. At the MOUs the most common primary causes were hypertension; embolism; acute collapse. Hypertension was the cause of death in six of the 20 cases that occurred at MOUs. The two applicable categories under hypertension were proteinuric hypertension five and eclampsia one of the 20 deaths. Embolism was the second most common primary cause and contributed four to the 20 maternal deaths at MOUs which included pulmonary embolism and amniotic fluid embolism. The cause of death for three of the 20 deaths at MOUs was unknown and the cause was classified as acute collapse.

At level one hospitals, the most common primary causes of maternal deaths were NPRI; obstetric haemorrhage; hypertension; acute collapse; medical and surgical disorders. Majority of the deaths, 22 (25.6%) at level one hospitals were due to NPRI with pneumonia ten (11.6%) as the most common category. Obstetric haemorrhage, six deaths (7.0%), hypertension, six deaths (7.0%) and acute collapse, six deaths (7.0%) were the second most common causes at level one hospitals. Haemorrhage after a caesarean as a category of obstetric haemorrhage, was the most common cause.

4.2.2.8 Primary causes of maternal deaths for Cape Town Metropole and other health districts (n = 86)

Additionally to the data in Table 4.4, the data for Cape Town Metropole was analysed separately from the other health district. The results included the MOUs and the level one hospitals for the Cape Town Metropole and are reflected in Table 4.5. Results reflect primary causes of the health districts outside Cape Town Metropole combined as “other” and include the Cape Winelands, Eden, Central Karoo, Overberg and West Coast.

Table 4.5 Primary causes of maternal deaths for Cape Town Metropole and other health districts (n = 86)

		Health Districts					
		Cape Town Metropole		Other Health Districts		Total of both	
		number	%	number	%	number	%
Primary causes	Coincidental: motor vehicle accident	0	0.0	1	1.2	1	1.2
	Coincidental: assault	0	0.0	1	1.2	1	1.2
	Coincidental: other	1	1.2	1	1.2	2	2.3
	Medical & surgical: cardiac	2	2.3	1	1.2	3	3.5
	Med & Surgical: CNS	1	1.2	0	0.0	1	1.2
	Medical & surgical: respiratory	0	0.0	1	1.2	1	1.2
	Medical & surgical: neoplasm	0	0.0	1	1.2	1	1.2
	Medical & Surgical: other	0	0.0	1	1.2	1	1.2
	NPRI: other pneumonia	3	3.5	5	5.8	8	9.3
	NPRI: Tuberculosis	4	4.7	6	7.0	10	11.6
	NPRI: other meningitis	0	0.0	1	1.2	1	1.2
	NPRI: Kaposi's sarcoma	0	0.0	1	1.2	1	1.2
	NPRI: gastroenteritis	1	1.2	0	0.0	1	1.2
	NPRI: other	1	1.2	1	1.2	2	2.3
	Ectopic: <20 weeks	1	1.2	0	0.0	1	1.2
	Miscarriage: septic	1	1.2	3	3.5	4	4.7
	Pregnancy related sepsis: chorioamnionitis with ruptured membranes	1	1.2	0	0.0	1	1.2
	Pregnancy related sepsis: puerperal sepsis after normal vaginal delivery	0	0.0	1	1.2	1	1.2
	Obstetric haemorrhage: abruptio with hypertension	1	1.2	1	1.2	2	2.3
	Obstetric haemorrhage: Abruptio without hypertension	0	0.0	1	1.2	1	1.2
	Obstetric haemorrhage: placenta praevia	0	0.0	1	1.2	1	1.2
	Obstetric haemorrhage: morbidly adherent placenta	1	1.2	0	0.0	1	1.2
	Obstetric haemorrhage: uterine atony	1	1.2	0	0.0	1	1.2
	Obstetric haemorrhage: bleeding after caesarean section	0	0.0	2	2.3	2	2.3
	Hypertension: proteinuric hypertension	6	7.0	3	3.5	9	10.5
	Hypertension: eclampsia	2	2.3	1	1.2	3	3.5
	Anaesthesia: general	1	1.2	0	0.0	1	1.2
	Anaesthesia: spinal	1	1.2	0	0.0	1	1.2
	Embolism: pulmonary	3	3.5	3	3.5	6	7.0
	Embolism: amniotic fluid	1	1.2	1	1.2	2	2.3
	Acute collapse - cause unknown	5	5.8	4	4.7	9	10.5
	Unknown: death at home or outside health services	1	1.2	2	2.3	3	3.5
	Unknown: no primary cause found	2	2.3	1	1.2	3	3.5
Total	41	48.2	45	52.3	86	100.0	

In four health districts, which were Cape Town Metropole eight (9.3%) deaths, Eden five (5.8%) deaths, Overberg two (2.3%) deaths, and West Coast four (4.7%) deaths, the most common primary cause of maternal death was NPRI. In the Central Karoo health district, embolism, two deaths (2.3%) was the most common primary cause and NPRI, two deaths (2.3%); acute collapse, two deaths (2.3%); medical and surgical disorders, two deaths (2.3%) were the most common causes in the Cape Winelands health district.

Tuberculosis was the most common NPRI cause of maternal death in Cape Town Metropole, four deaths (4.7%) as well as in the other health districts, six deaths (7.0%). Acute collapse with the cause unknown contributed five (5.8%) to maternal deaths in Cape Town Metropole compared to the four (4.7%) maternal deaths in the other health districts. Septic miscarriages contributed one (1.2%) to the maternal deaths in Cape Town Metropole and three (3.5%) to the maternal deaths in the other health districts. Obstetric haemorrhage after a caesarean, two deaths (2.3%) as a primary cause was only found in the health districts outside Cape Town Metropole while anaesthetic as primary cause was only found in Cape Town Metropole and not in the other health districts. Anaesthetic contributed two (2.3%) to maternal deaths in Cape Town Metropole.

4.2.3 Final and contributory causes of maternal deaths

The final causes of maternal deaths are displayed in Table 4.6 and in Table 4.7 the contributory causes are summarised. While there is one final cause per maternal death, not all deaths had a contributory cause. However, in some of the cases more than one contributory cause were present.

Table 4.6 Final causes of maternal deaths per level of care (n = 86)

		Final causes					
		MOU		Level one hospital		Total of both	
		number	%	number	%	number	%
Final causes	Circulatory system: hypovolemic shock	2	2.3	7	8.1	9	10.5
	Circulatory system: septic shock	0	0.0	8	9.3	8	9.3
	Respiratory failure	5	9.8	15	17.4	20	23.3
	Cardiac failure: Pulmonary oedema	5	9.8	8	9.3	13	15.1
	Cardiac failure: cardiac arrest	0	0.0	11	12.8	11	12.8
	Acute cardiopulmonary failure due to embolism	2	2.3	2	2.3	4	4.7
	Renal Failure	0	0.0	1	1.2	1	1.2
	Cerebral complications: intracranial haemorrhage	1	1.2	0	0.0	1	1.2
	Cerebral complications: cerebral oedema	0	0.0	1	1.2	1	1.2
	Cerebral complications: meningitis	0	0.0	1	1.2	1	1.2
	Cerebral complications: brain death	0	0.0	1	1.2	1	1.2
	Cerebral complications: unspecified	0	0.0	1	1.2	1	1.2
	Immune system failure	0	0.0	2	2.3	2	2.3
	Unknown: home death	4	4.7	1	1.2	5	5.8
	Unknown	1	1.2	6	7.0	7	8.1
	Other	0	0.0	1	1.2	1	1.2
	Total	20	23.2	66	76.7	86	100.0

The three most common final causes of maternal deaths were cardiac failure, 24 deaths (27.9%), respiratory failure, 20 deaths (23.3%) and circulatory system failure, 17 deaths (19.8%). The category circulatory system is divided into hypovolemic shock and septic shock, which contributed to nine (10.5%) and eight (9.3%) respectively to the final causes. Pulmonary oedema classified under cardiac failure was found to be the final cause, 13 deaths (15.1%). In four cases (4.7%) the final cause was acute

cardiopulmonary failure due to embolism. Five of the participants (5.8%) had cerebral complications caused by intracranial haemorrhage, cerebral oedema, meningitis, brain death and one case was unspecified. Three participants' files (3.5%) indicated disseminated intravascular coagulations as final cause and severe anaemia was the final cause for three (3.5%) participants. Immune system failure was the final cause of maternal deaths in only two (2.3%), but it was the most common contributory cause, 20 deaths (23.3%). In 12 cases (14.0%) the final causes of maternal deaths were unknown. The same system classification for the final causes of maternal deaths were used for the contributory causes and summarise in Table 4.7. The causes for the Cape Town Metropole were analysed separate from the other health districts. Other health districts are Cape Winelands, Eden, Central Karoo, Overberg and West Coast.

Table 4.7 Contributory causes of maternal deaths for Cape Town Metropole and other health districts (n = 86)

		Health Districts					
		Cape Town Metropole		Other Health Districts		Total of both	
		number	%	number	%	number	%
Contributory causes	Circulation system	3	3.5	1	1.2	4	4.7
	Respiratory failure	4	4.7	4	4.7	8	9.3
	Cardiac failure	5	5.8	2	2.3	7	8.1
	Renal failure	3	3.5	1	1.2	4	4.7
	Cerebral complications	0	0.0	4	4.7	4	4.7
	Metabolic	0	0.0	2	2.3	2	2.3
	Haematological	2	2.3	4	4.7	6	7.0
	Immune system failure	10	11.6	10	11.6	20	23.3
	Unknown	1	1.2	1	1.2	2	2.3

The three most common contributory causes were immune system failure, respiratory failure and cardiac failure. Immune system failure was the most common contributory cause in the Cape Metropole, ten deaths (11.6%) as well as in the other health districts, ten deaths (11.6%). The second most common contributory cause of maternal deaths in the Cape Town Metropole was cardiac failure, five deaths (5.8%) whilst respiratory failure was a contributory factor in four deaths (4.7%). The other health districts had cerebral complications, four deaths (4.7%) and haematological causes, 4 deaths (4.7%) as the second most common contributory causes. Haematological causes include disseminated intravascular coagulation (DIC) and severe anaemia as categories. Severe anaemia as a contributory cause was absent in the Cape Town Metropole but two (2.3%) participants' files indicated that DIC was a contributory cause. However, in the other health districts severe anaemia was a contributory cause in one case (1.2%) and DIC in three cases (3.5%). Circulatory system as a contributory cause was more common in the Cape Town Metropole, three cases (3.5%) than in the other health districts with one case (1.2%).

4.2.4 Avoidable factors

The results of the avoidable factors were divided into patient related, administrative related and medical related avoidable factors. These categories had multiple responses as more than one factor under a category could be applicable and thus recorded to participants' files and will be discussed below. Most of the avoidable factors were found to be medical related. In 41 (47.7%) of maternal deaths the emergency happened in the antenatal period after 20 weeks of gestation and 34 (39.5%) in the postpartum period. However, the time of most of the maternal deaths was mostly in the postpartum period 46 (53.5%).

4.2.4.1 Patient related avoidable factors

The patient related avoidable factors causing maternal deaths are summarised in Table 4.8 on page 62.

Table 4.8 Patient related avoidable factors for Cape Town Metropole and other health district (n = 86)

		Health Districts			
		Cape Town Metropole		Other Health Districts	
		number	%	number	%
Patient related avoidable factors	Lack of information	8	9.3	8	9.3
	No avoidable factor	15	17.4	28	32.6
	No antenatal care	10	11.6	4	4.7
	Infrequent antenatal care	3	3.5	0	0.0
	Delay in accessing medical help	3	3.5	6	7.0
	Declined medication/surgery/advice	3	3.5	3	3.5
	Other	1	1.2	0	0.0

For 43 (50.0%) maternal deaths there were no patient related avoidable factors but there was a lack of information in 16 (18.6 %) of the participants' files. The remaining 27 (31.4%) participants' files indicated patient related avoidable factors and more than one could be applicable for one maternal death. The two most common patient related avoidable factors were the absence of antenatal care 14 (16.3%) and delay in accessing medical help nine (10.5%). In the Cape Town Metropole ten (11.6%) mothers did not receive antenatal care comparing to four (4.7%) mothers in the other health districts. However, the most common patient related avoidable factor, six cases (7.0%) in the other health district was delay in accessing medical help.

Six (7.0%) of the cases had two avoidable factors with the second avoidable factor or delay in accessing medical help or they had declined medication, surgery or advice. No evidence was found to clarify whether it was medication or surgery or advice that was declined.

4.2.4.2 Administrative related avoidable factors

Summarised in Table 4.9 are the administrative related avoidable factors for Cape Town Metropole separate from other health districts.

Table 4.9 Administrative related avoidable factors for Cape Town Metropole and other health districts (n = 86)

		Health Districts			
		Cape Town Metropole		Other Health Districts	
		number	%	number	%
Administrative related avoidable factors	Lack of information	5	5.8	6	7.0
	No avoidable factor	30	34.9	32	37.2
	Transport problems: home-institution	0	0.0	1	1.2
	Transport problem: institution-institution	2	2.3	0	0.0
	Delay initiating critical care	0	0.0	2	2.3
	Lack of blood/blood products	1	1.2	1	1.2
	Lack of other facilities	1	1.2	0	0.0
	Lack of appropriately trained doctors	2	2.3	5	5.8
	Lack of appropriately trained nurses	0	0.0	2	2.3
	Other	1	1.2	0	0.0

In the majority of cases, 62 (72.1%) no administrative related avoidable factors were found and in 11 (12.8%) of cases there was a lack of information and the administrative related avoidable factors could not be determined. One or more administrative avoidable factor were found in the remainder 13 (15.1%) cases.

The most common administrative related avoidable factor was lack of appropriately trained doctors. Five (5.8%) of the cases had the following avoidable factors as a second or third factor: lack of blood or blood products; lack of appropriately trained nurses. Transport between institutions was indicated as an avoidable factor in the Cape

Town Metropole in two participants' files (2.3%) and was not one of the administrative avoidable factors in the other health districts. The most common administrative related avoidable factor in the other health districts was also lack of appropriately trained doctors 5 (5.8%). The lack of appropriately trained nurses as an avoidable factor was applicable to the other health districts and not to the Cape Town Metropole. This could be an indicator of the need for evaluation of training for the doctors or the subjective conclusion based on the perspective of the assessor.

Table 4.10 Administrative related avoidable factors per level of care (n = 86)

		Level of Care			
		MOU		Level one hospital	
		number	%	number	%
Administrative avoidable factors	Lack of information	3	3.5	8	9.3
	No avoidable factor	14	16.3	48	55.8
	Transport problems: home-institution	0	0.0	1	1.2
	Transport problem: institution-institution	2	2.3	0	0.0
	Delay initiating critical care	0	0.0	2	2.3
	Lack of blood/blood products	0	0.0	2	2.3
	Lack of other facilities	1	1.2	0	0.0
	Lack of appropriately trained doctors	0	0.0	7	8.1
	Lack of appropriately trained nurses	0	0.0	2	2.3
	Other	1	1.2	0	0.0

The most common administrative related avoidable factor at the MOUs was lack of information 3 (3.5%) followed by transport problems between the MOUs and the hospital to which they referred the mother, 2 cases (2.3%). At the level one hospitals there were no problems with the transport of a mother to another hospital. However,

the most common administrative avoidable factor was the lack of information 8(9.3%) and the lack of appropriately trained doctors 7 (8.1%).

4.2.4.3 Medical related avoidable factors

Table 4.11 Medical related avoidable factors for Cape Town Metropole and other health districts (n = 86)

		Health Districts			
		Cape Town Metropole		Other Health Districts	
		Number	%	number	%
Medical related	Lack of information	1	1.2	2	2.3
avoidable factors	No avoidable factor	24	27.9	12	14.0
	Initial assessment	0	0.0	2	2.3
	Problem recognition/diagnosis	8	9.3	17	19.8
	Delay in referring patient	3	3.5	6	7.0
	Managed at inappropriate level	8	9.3	18	20.9
	Incorrect management (wrong diagnosis)	1	1.2	9	10.5
	Sub-standard management (correct diagnosis)	4	4.7	14	16.3
	Monitoring not / infrequently done	1	1.2	3	3.5
	Monitoring: prolonged abnormal observations with no action	1	1.2	5	5.8

In 36 (41.9 %) of participants' files no medical related avoidable factors were found. Lack of information was found for three (3.5%). However, up to seven medical related avoidable factors were applicable to some of the cases. Management of women at inappropriate level of care as a medical related avoidable factor in Cape Town Metropole was eight (9.3%) while in other health districts it was as high as 18 (20.9%) where the pregnant mother should have been referred to a higher level of care.

Problem recognition/diagnosis was the second most common avoidable factor with eight (9.3%) in Cape Town Metropole. Majority of these cases 17 (19.8%) were in the other health districts. Another important medical related avoidable factor was sub-standard care four (4.7%) where the correct diagnosis was made but the care was recorded to be sub-standard in Cape Town Metropole with a high of 14 (16.3%) in the other health districts. Where the diagnosis was incorrect with inappropriate management there were less cases one (1.2%) at the Cape Town Metropole as compared to the other health districts, nine cases (10.5%).

Delay in referring the woman to an appropriate level of care was shown as an avoidable factor in three cases (3.5%) in the Cape Town Metropole and in six cases (7.0%) in the other districts. Although the referral processes are quite streamlined the choice of level of care in Cape Town Metropole seems improved with all other factors as compared to the other districts.

Ten (11.6%) of participants' files indicated that monitoring of the pregnant mother was a medical related avoidable factor. In six (7.0%) of these cases monitoring was done but there were abnormal observations for a prolonged period without actions been taken. In the other four (4.7%) cases the monitoring was either not done or infrequently done. The analysis of the medical avoidable factors in the MOUs was done separately from the level one hospitals and summarised in Table 4.12.

Table 4.12 Medical related avoidable factors per level of care (n = 86)

		Level of Care			
		MOU		Level one hospital	
		number	%	number	%
Medical related	Lack of information	1	1.2	2	2.3
avoidable factors	No avoidable factor	14	16.3	22	25.6
	Initial assessment	0	0.0	2	2.3
	Problem recognition/diagnosis	3	3.5	22	25.6
	Delay in referring patient	1	1.2	8	9.3
	Managed at inappropriate level	1	1.2	25	29.1
	Incorrect management (wrong diagnosis)	1	1.2	9	10.5
	Sub-standard management (correct diagnosis)	1	1.2	17	19.8
	Monitoring not / infrequently done	1	1.2	3	3.5
	Monitoring: prolonged abnormal observations with no action	1	1.2	5	5.8

Problem recognition/diagnosis, three cases (3.5 %) as indicate on Table 4.12 was the most common medical related avoidable factor at the MOUs. At level one hospitals the three most common medical related avoidable factors were the management of the mothers at an inappropriate level of care, 25 (29.1%); problem recognition/diagnosis, 22 (25.6 %); and sub-standard management 17(19.8%).

In 43 (50%) of the cases the results showed no resuscitation related avoidable factors and in 24 cases (27.9 %) resuscitation was not attempted. The reasons for not attempting resuscitation were not found. The most common avoidable factor related to resuscitation was breathing problems in seven (8.1%).

4.3 SUMMARY

In this chapter, the study results were presented according to the data collection tool to meet the study objectives. The primary causes of maternal deaths at MOUs were not similar to the primary causes of maternal deaths at level one hospitals. Further, it was found that NPRI as the most common primary cause of death in in the country and in the Western Cape was not the most common cause of death in all the health districts in the Western Cape.

Respiratory failure and pulmonary oedema were the most common final causes of deaths at MOUs and level one hospitals. Mothers with AIDS were all (100%) treated with HAART at the MOUs which is not the case at level one hospitals. Further, the results regarding antenatal care indicated that patient related avoidable factors are not similar for the different levels or care.

The results of the study indicated that there are some differences in the factors causing maternal deaths in the Cape Town Metropole and factors causing maternal deaths at the other health districts. In chapter five, the results and limitations of the study are discussed and based on the findings of the study, recommendations are made.

5 CHAPTER FIVE

DISCUSSION OF FINDINGS

5.1 INTRODUCTION

The results of the study were presented in chapter four and illustrated by means of tables and figures. Demographic data was presented per level of care and data related to the research objectives of the study was presented per level of care and/or per health district. Although the aim of the study was to use the total population of 92(N) deaths, only 86 (n) were available in the database and these were analysed.

In this chapter the results of the study are discussed and related to the study objectives. In addition to this, the identified limitations of the study are discussed and recommendations based on the findings, are made.

5.2 STUDY OBJECTIVES REVISED

The study aim was to describe the factors causing maternal deaths at level one hospitals and MOUs in the Western Cape. Furthermore, the study objectives were focused on describing the primary causes of maternal deaths; final and contributory causes of maternal deaths; and the avoidable factors.

5.3 DISCUSSION OF FINDINGS

As shown in chapter 4, Figure 4.1 there was a sudden increase in the number of maternal deaths from 2008 to 2009. The increase was possibly due to better reporting of maternal deaths in the Western Cape.

5.3.1 Demographics

The demographics were included to contextualise the study. It was found that four demographic factors were different for the level one hospitals and MOUs. These factors were: the age of the mother; gravidity; anaesthesia; and post-mortems performed.

Literature has shown that pregnant mothers younger than 20 years have a higher risk for maternal death than pregnant mothers above 20 years (World Health Organization, 2010b:9). In this study it was found that all mothers who died at MOUs were 21 years and older whereas the maternal deaths at level one hospitals were younger (15 years and above). Pregnant mothers younger than 20 years are high risk patients and are cared for at a hospital making it the very reason for higher deaths noticed at the level one hospitals. The finding that maternal mortality decreased as gravidity and parity increased at level one hospitals, could have been linked to women having more experience with birth.

Although there was a difference regarding anaesthesia given at level one hospitals and MOUs, it is not relevant as MOUs are not equipped to perform a caesarean section or give anaesthesia. Therefore, all the pregnant mothers with a need for anaesthesia needed to be referred to other levels of care. Caesarean section and anaesthesia complications are under the leading causes of maternal deaths in developed countries (Khan et al., 2006:1073). However, in South Africa anaesthesia is not one of the leading causes of maternal deaths (Republic of South Africa, s.a.:6). All the maternal deaths caused by anaesthesia in the study occurred in the Cape Town Metropole.

The importance of early booking (before 20 weeks of gestation) for antenatal care should be emphasised in order to reduce maternal mortality according to the WHO (2010b:10). Wabiri et al. (2013:e73864) found that less than half of pregnant mothers attended antenatal care before 20 weeks of gestation which correlates with the findings of this study which is 35% of maternal deaths. Though early attendance of antenatal care is seen as an important aspect to prevent maternal deaths, the results of this study indicated that there were more maternal deaths among the mothers who

attended antenatal care before 20 weeks of gestation than mothers who attended antenatal care after 20 weeks of gestation. It is possible that the mothers who attended antenatal care before 20 weeks of gestation did not have a minimum of four antenatal visits or did not attend antenatal care frequently. Therefore, high risk factors were not identified. The reason for the higher mortality among mothers who booked early in pregnancy is not clear and needs further investigation.

The treatment of mothers with AIDS at the MOUs was according to the NCCEMD guidelines as all of these mothers were on HAART. However the NCCEMD guidelines were not applied at level one hospitals as 11% of mothers who should have received HAART, did not receive any treatment. It is possible that more health care workers at MOUs were trained regarding the AIDS treatment program for pregnant mothers and were therefore more aware of the importance of HAART during pregnancy for patients with AIDS. Furthermore, the lack of compliance with the NCCEMD guidelines at level one hospitals may be a lack of awareness of the guidelines among health care workers or that mothers' HIV status was not determined early in pregnancy.

Severe anaemia and DIC were present as contributory causes of maternal death in the health districts and on 26% of participants' files it was indicated that anaemia during pregnancy was present. The pregnant mother with anaemia during pregnancy needs to be treated for anaemia before she delivers. If a pregnant mother did not receive antenatal care, the anaemia will not be known before the admission of the mother to the MOU or level one hospital. Therefore, the importance of antenatal care and the effective treatment of anaemia during the antenatal period should be emphasised.

A high percentage of post-mortems (95%) were performed on deceased mothers at MOUs to determine the cause of death. However, it was not clear if all the post-mortems were performed by the forensic pathology department which provides better quality information. This could be because the post-mortem was inconclusive or that results were not available as is sometimes the case in forensic investigations.

5.3.2 RO 1: Primary causes of maternal deaths at level one hospitals and MOUs in the Western Cape

Results of primary causes revealed that the most common primary cause of maternal deaths was NPRI (26.7%). This finding is similar to the findings of the NCCEMD, which indicated that NPRI is the most important primary cause of maternal deaths in South Africa (Republic of South Africa, 2012:xi) and in the Western Cape (Republic of South Africa, 2012:298). At level two and level three hospitals in South Africa, NPRI was also the most common cause of maternal deaths (Republic of South Africa, s.a.:13). However, according to the most recent NCCEMD report, NPRI as a primary cause of death had decreased with 25% in 2011 to 2013 since 2008 to 2010 (Republic of South Africa, s.a.:57). There was also a decline in NPRI as a primary cause of maternal death at level one hospitals and MOUs in the Western Cape in 2012. The decline in NPRI was possibly the result of more effective HIV/AIDS treatment specifically at MOUs where all the pregnant mothers with AIDS received HAART. Therefore, effective treatment for HIV/AIDS should be implemented at level one hospitals in all the health districts. The prevalence of tuberculosis in the Western Cape is high and the results showed that tuberculosis was one of the most common categories of NPRI causing maternal deaths at level one hospitals. This finding is supported by the findings in the most recent NCCEMD report indicating that tuberculosis is the most common NPRI cause of maternal deaths in the country (Republic of South Africa, s.a.:57). Therefore, the screening of pregnant mothers for tuberculosis and effective treatment of tuberculosis at level one hospitals are very important and should be done in the antenatal period.

Whilst the results of the study showed that the three most common causes of maternal deaths at level one hospitals and MOUs were NPRI, hypertension and acute collapse (cause unknown), the second most common cause in the Western Cape was medical and surgical disorders (Republic of South Africa, 2013:6). Mothers with pre-existing medical and surgical disorders are classified as high risk pregnancies and needed to be referred to a level two or three hospital during their pregnancy. The results of the study indicated that cardiac disorders as a medical and surgical disorder, were the

most common cause of death and there was an increase in medical and surgical disorders in 2012. The reason for the increase in 2012 could not be determined and justify further investigation into the specific medical or surgical condition. It is possible that the cardiac disorders were identified after the death occurred through a post-mortem. If the cardiac disorders were not known before the death occurred it explains the deaths caused by cardiac disorders at MOUs.

At level one hospitals the most common cause were NPRI, with hypertension, obstetric haemorrhage and acute collapse as the second most common causes. In contrast to this, the most common causes of maternal deaths at MOUs were hypertension, followed by embolism and acute collapse. Based on the high percentage of post-mortems performed, the number of maternal deaths due to acute collapse, where the cause was unknown, was higher than expected. It is possible that the reason for not knowing the causes of deaths in these cases is that the findings of the post-mortems were inconclusive.

Anaesthesia, general and spinal, as one of the second most common primary causes of maternal deaths in Cape Town Metropole, should be noted and investigated further. In the other health districts no maternal deaths were caused by anaesthesia. Maternal deaths caused by anaesthesia was indicated as one of the most common causes of maternal deaths in developed countries in a study by Khan *et al.* (2006:1073).

During 2009, there was an increase in NPRI as a primary cause of maternal death. Tuberculosis as a cause decreased but there was an increase in pneumonia. The increase in pneumonia as a cause was possibly due to the influence of the Influenza A virus subtype H1N1 (H1N1) virus which was present in the Western Cape. Pregnant mothers with symptoms indicating possible H1N1, were tested and on one participant's file it was indicated that the mother was tested positively for the H1N1 virus.

Embolism is one of the most common causes of maternal deaths in developed countries (Say *et al.*, 2104:e326; Khan *et al.*, 2006:1073). Although embolism was the most common cause in 2010, there were no deaths due to embolism after 2010. However, embolism was also the primary cause of maternal deaths in the Klein Karoo

health district for the period 2008 to 2012. Obese pregnant mothers have a higher risk for developing embolism after a caesarean section and therefore the measuring of the mother's mid-upper arm and determining the mother's body mass index during antenatal care are important. According to the 2008 – 2010 Saving Mothers report, embolism (pulmonary embolism and amniotic fluid embolism) was more common at level one hospitals in South Africa (Republic of South Africa, 2012:158). The absence of embolism as a primary cause of death for 2011 and 2012 may be the result of the implementation of thrombo-prophylaxis treatment as a preventative measure. However, the preventative treatment for embolism should be emphasised more.

In the analysis of hypertension as a primary cause (Table 4.5), it was found that the Cape Town Metropole had four maternal deaths. The majority of these maternal deaths in the Cape Town Metropole occurred at MOUs and the category proteinuric hypertension was the most common cause. A study done by Bhattacharyya *et al.* (2008:503) showed a decrease in maternal deaths due to hypertension after the implementation of magnesium sulphate treatment. Though hypertension is still one of the most common primary causes, it was noted that the management of pregnant mothers with hypertension at level one hospitals and MOUs included magnesium sulphate treatment. However, in one case no antihypertensive drug was administered. The correct management of acute, severe hypertension at MOUs and level one hospitals is an essential emergency aspect. Though magnesium sulphate treatment has been implemented at MOUs and level one hospital, the treatment of the hypertension before mothers is transferred to another level of care is important in order to save mother's lives.

5.3.3 RO 2: Final and contributory causes of maternal deaths at level one hospitals and MOUs in the Western Cape

The second research objective of the study was to describe the final and contributory causes of maternal deaths at level one hospitals and MOUs in the Western Cape.

The analysis of the final causes of maternal deaths showed that the failure of respiratory, cardiac and circulatory systems were the most common causes. Pulmonary oedema (15.1%) was the most common reasons for the cardiac failure and hypovolaemic shock (10.5%) and septic shock (9.3%) were the reasons for the failure of the circulatory system. Pulmonary oedema is frequently not recognised or recognised too late by the health care worker at level one hospitals and leading to the incorrect management of the mother. Simple history of the mother and counting of the respiratory rate would greatly aid to the recognition of pulmonary oedema. Similarly, hypovolaemic shock was not recognised by the health care workers at level one hospitals. Maternal deaths can be prevented if circulatory system failure and cardiac failure are identified early and treated timeously. Correct interpretation of the blood pressure and the pulse rate of the mother would aid to the identification of circulatory system and cardiac failure.

Contributory causes of maternal deaths may be seen as a potential avoidable factor according to Farqyhar *et al.* (2012:331.e7). Haematological disorders such as severe anaemia as a contributory cause of maternal death can be prevented by the identification and treatment of pregnant mothers during the antenatal period or on admission to the hospital. Serial attention to the haemoglobin levels of the mother would aid to the identification of anaemia.

5.3.4 RO 3: Avoidable factors causing maternal deaths at level one hospitals and MOUs in the Western Cape

The third research objective of the study was to describe the avoidable factors of maternal deaths at level one hospitals and MOUs in the Western Cape. Although no avoidable factor that caused maternal deaths was found in the majority of cases, the importance of some of the avoidable factors present need to be emphasised and addressed. It was found that there were multiple avoidable factors for 36 mothers. The most common avoidable factor was medical related factors.

5.3.4.1 Patient related avoidable factors

The patient related avoidable factors for the Cape Town Metropole were different from the patient related avoidable factors for the other five health districts. For the Cape Town Metropole antenatal attendance (15.1%) was identified as the most common avoidable factor whereas delay in seeking medical help by the mother (7.0%) was the most common avoidable factor in the other health district. Antenatal attendance includes mother who did not attend antenatal care (unbooked mothers) and the infrequent attendance of antenatal care. There may be a link between the lack of antenatal care and delay in seeking medical help. The reasons for the lack of antenatal care may be transport problems and accessibility to the services and mothers who did not attend antenatal care, are more likely to wait too long before they seek help.

Lack of antenatal care was the second most common factor in the other health districts followed by declining medication or surgery or advice. Five participants' files indicates two avoidable factors. Three of these participants' files did not have any antenatal care and then also declined medication or advice. The other two participants' files reflected that pregnant mothers did receive antenatal care, but they delayed seeking medical help and then also declined medication or advice.

5.3.4.2 Administrative related avoidable factors

The most common administrative related avoidable factor for maternal deaths that occurred in health districts outside the Cape Town Metropole was the lack of trained staff. The lack of trained staff refers to doctors and nursing staff who were not appropriately trained to manage obstetric emergency situations. Delay in initiating critical care due to overburden services was another avoidable factor. The reasons for these delays or the explanation for the overburdened service could not be determined but generally there is a high demand for critical service in the Western Cape. Level one hospitals do not have critical care units and if there is a need for critical care the mother needs to be referred to a higher level of care where the availability of critical care beds are often a problem. Therefore, there is a delay in transporting the mother to a facility

providing critical care and the initiation of critical care is delayed. Transport problems between the home of the pregnant mother and the health care facility, and the lack of blood and blood products were also found to be common avoidable factors. The reasons for the lack of blood and blood products could not be determined but it is possible that there was not sufficient number units of blood available in the hospital at time of the emergency.

In contrast to the above, the most common administrative avoidable factor in the Cape Town Metropole was transport problems from one institution to another. It was not clear between which levels of care the transport problems were experienced and it could have been experienced from MOUs, level one hospitals, other levels of care, or between level one hospitals and level two or three hospitals. This finding is important as the distances between level one hospitals or MOUs and the higher levels of care is shorter than the distances in the other health districts. The delay in transporting the mothers between institutions needs to be addressed. The second and third most common administrative avoidable factors were lack of appropriately trained doctors and lack of blood and blood products. These avoidable factors are a concern due to the fact that the level one hospitals and the MOUs in the Cape Town Metropole health district has the advantage of two level three hospitals and more opportunities for updating their knowledge and expertise.

5.3.4.3 Medical related avoidable factors

The majority of avoidable factors were related to medical care which includes nursing care. Although there is no evidence of medical related avoidable factors in 41.9% of participants' files, 35% of participants' files indicated more than one medical related avoidable factor. The multiple avoidable factors applicable to one case is a concern as in some cases there were seven avoidable factors applicable to one case. Seven avoidable factors for one case are not acceptable and an acceptable number should be two avoidable factors. The reason for suggesting that the aim should be two medical related avoidable factors per death is based on the link between some of the avoidable factors. For example, if the initial assessment of the mother was the problem, it is likely

that the incorrect diagnosis was made which lead to incorrect management of the mother. Similarly, if there was a delay in transporting the mother to another level of care, the avoidable factors will be delay in transferring and managed at an inappropriate level of care.

The management of a pregnant mother at level one hospitals and MOUs was seen as inappropriate for 26 (30.2%) mothers. More pregnant mothers in the other health districts than in the Cape Town Metropole were managed at an inappropriate level of care and should have been referred to other levels of care.

The recognition of problems was found to be an avoidable factor in 25 (29.1%) participants' files. If the problem was not recognised by the health care workers, the referral to the appropriate level of care was influenced. Problem recognition was found more commonly in the other health districts than in the Cape Town Metropole and it was the most common avoidable factor at the MOUs. In the West Coast and Overberg health districts, the recognition of problems was the most common medical related avoidable factor. The recognition of problems may be an indication of the knowledge and expertise of the medical and nursing staff. It was found that the lack of appropriately trained doctors was the only administrative related avoidable factor in the West Coast health district. Furthermore, the lack of appropriately trained doctors and nurses were the only two administrative related avoidable factors in the Overberg health district. The lack of appropriately trained doctors as well as nurses is a concern and despite the low number of maternal deaths in the Overberg health district ($n = 4$), training should be addressed. The Overberg health district is isolated and there is no level two hospital. To organise outreach training programs is an option, but will not necessarily address the problem. Therefore the suggestion is to send experienced doctors and midwives to work with the health care workers at the level one hospitals to train and guide them regarding appropriate maternal care. Merali (2104:4) stated that health care workers are linked to 67% of the avoidable factors and that strategies to reduce maternal deaths should include continuous training.

In the cases of 18 participants' files, the correct diagnosis was made but the management of the participants was sub-standard. Fourteen of these cases were in health districts outside the Cape Town Metropole. In addition to the sub-standard care, the diagnosis made was incorrect as indicated in ten participants' files of which only one was in the Cape Town Metropole. The incorrect diagnosis further led to incorrect management of the pregnant mothers. In the Overberg health district, half (50%) of the medical related avoidable factors were incorrect management due to the wrong diagnosis. The incorrect diagnosing of pregnant mothers, specifically in the health districts outside the Cape Town Metropole may be an indication of a lack of knowledge of the health care workers. Another avoidable factor was delay in referring the pregnant mother to an appropriate level of care. The delay was an avoidable factor in all the health districts except the Klein Karoo health district.

Monitoring problems identified were either that no monitoring was done or infrequent monitoring of the mother happened. In the case of six participants' files the pregnant mothers were monitored but there were abnormalities for prolonged periods and no actions were taken. Five of these cases were in the health districts outside the Cape Town Metropole health district. In the West Coast health district the monitoring of pregnant mothers is a concern as monitoring was either not done or infrequently done and there was evidence of prolonged abnormal monitoring and no actions taken. Other health districts with monitoring problems were Eden and the Cape Winelands where there were also prolonged abnormal monitoring without any action. Monitoring of the pregnant mother is essential to identify early warning signs regarding the mother's condition and progress in labour. The infrequent monitoring of the mother may be due to circumstances in smaller district hospitals as there are often not dedicated midwives on duty after hours to care for pregnant patients only. Often the midwife on duty is responsible for other services in the hospital. The finding that there was prolonged abnormal monitoring and no action was taken, is an indication of the lack of knowledge and staff not been capable to recognise abnormalities or a lack of responsibility and accountability.

No evidence was found that the initial assessments of the participants were a problem at level one hospitals and MOUs in the Cape Town Metropole. However, in the case of two participants' files in the other health districts, the initial assessment was an avoidable factor. The initial assessment is important to identify the problems and potential problems and to determine the further management of the mother. Therefore, the health care worker needs to perform a complete assessment.

The medical related avoidable factors also included resuscitation problems. Again, more than one factor could apply to a mother. The three most common problems in the Cape Town Metropole were related to breathing, airway and circulation. Whereas the other health districts had more problems related to circulation followed by breathing and airway problems. The problems related to breathing should be investigated to determine the intubation competencies of the doctor responsible for the anaesthetic as well as the availability of appropriate resuscitation equipment.

5.4 LIMITATIONS

The limitation of the study was that no information could be found for six maternal deaths (N = 92) at level one hospitals and MOUs which effected the sample size. If the information on the six maternal deaths were available, it may have influenced the results of the study. Although the aim is to have no or very few maternal deaths, because maternal mortality is such a serious end point, each death must be thoroughly reviewed and measures instituted to prevent the recurrence of any avoidable factors.

5.5 CONCLUSION

The study aim, to describe the factors that cause maternal deaths at level one hospitals and MOUs in the Western Cape, was achieved. The first objective, to determine the primary causes of maternal deaths, was reached. The primary causes were not only determined for the level one hospitals and the MOUs, but was also analysed separately

for the Cape Town Metropole and the other health districts. The most common cause for maternal death was NPRI, but the findings showed a decrease in NPRI as a cause in 2012. It was found that the primary causes are not similar to the primary causes of a developing country but also included causes associated with developed countries. These causes are embolism, anaesthesia and medical and surgical causes. There was no difference between the most common primary cause of deaths (NPRI) at level one hospitals and MOUs in the Western Cape and that at level two and level three hospitals in South Africa.

The second study objective was to determine the final and contributory causes and this objective was also reached. Immune system failure was the most common contributory cause but not a final cause of maternal death. The last study objective, to determine the avoidable factors, was also reached and very valuable information was found.

5.6 RECOMMENDATIONS

Actions implemented at level two and three hospitals to decrease maternal deaths will not necessarily be applicable to level one hospitals and MOUs. Therefore, the findings of this study should be taken into consideration to determine the specific actions for level one hospitals, for MOUs and for the different health districts in order to reduce the maternal deaths.

5.6.1 Health education at antenatal services

Although the results of the study showed that most of the pregnant mothers attended antenatal care before 20 weeks gestation, there were still a large proportion of pregnant mothers who attend antenatal care after 20 weeks of gestation. Therefore, communities should be educated regarding the importance to book for antenatal care before 20 weeks of gestation.

In the study it was found that one of the patient related avoidable factors was delay in accessing medical help. Therefore, it is recommended that health education at antenatal services should focus on the consequences of delay by the pregnant woman in seeking medical care. The barriers to access the facilities such as accessibility, health care workers attitudes and the confidence the community has in the services, should be determined. It is possible that the pregnant mother's previous negative experiences with the services influenced her decision.

5.6.2 Continuous Professional Development for all staff categories

According to literature one of the factors causing maternal mortality are health care workers and their ability to provide appropriate care. The findings of the study, showed that the most common administrative avoidable factor was the lack of appropriately trained doctors and nurses. Further findings were that not all maternal deaths with AIDS at level one hospitals received HAART and that monitoring of the participants was an avoidable factors.

Therefore, the lack of appropriately trained doctors and nurses in all health districts needs urgent attention and the following are recommended:

- Continuous training and evaluation of doctors and nurses at level one hospitals and MOUs regarding maternal care.
- An investigation into the need for training of health care workers regarding the management of HIV/AIDS mothers in the antenatal period at level one hospitals.
- The importance of frequent and accurate monitoring of pregnant women, women in labour and in the postpartum period, need to be emphasised and evaluated regularly.
- The recognition and interpretation of abnormal monitoring and the appropriate actions for these abnormalities should be focused on.

5.6.3 Review transport system and schedules for pregnant mothers

The findings of the study showed the delay in transport between institutions in Cape Town Metropole was an avoidable factor. Therefore, it is recommended that the delay in transporting a pregnant woman in an emergency situation between institutions in the Cape Town Metropole, should be investigated. The evaluation of the effectiveness of protocols at the MOU and level one hospitals will ensure the effective use of the protocols during management and transfer of women during pregnancy birth and postpartum.

5.6.4 Management of acute, severe hypertension

Based in the findings that hypertension is one of the leading causes of maternal deaths, at specifically MOUs, guidelines should be established for the management of acute, severe hypertension at MOUs and level one hospitals before the transfer of the mother in order to save mother's lives.

5.6.5 Screening for and the treatment of tuberculosis

Tuberculosis was identified in the study as one of the important NPRI causing maternal deaths at MOUs and level one hospitals. Therefore, the recommendation is establishing of guidelines for tuberculosis screening with the first antenatal visit and the treatment of pregnant mothers with tuberculosis.

5.7 STUDY CONCLUSION

The study was done to determine the factors causing maternal deaths at level one hospitals and MOUs in the Western Cape between 2008 and 2012. From the findings of the study the factors causing maternal deaths could be described separately for the MOUs, level one hospitals, Cape Town Metropole and the other health districts.

At the MOUs the most common primary cause was hypertensive disorders. The avoidable factors were: transport between institutions; lack of facilities; problem recognition/diagnosis; no antenatal care; delay in seeking help by the pregnant mother; and breathing problems with resuscitation.

The most common primary cause for level one hospitals was NPRI and the avoidable factors were: lack of appropriately trained doctors and nurses; delay in initiating care; lack of blood/blood products; managing patients at an inappropriate level of care; problem recognition; and sub-standard care. The patient related avoidable factors were: no antenatal care; delay in seeking help by the participant; and the decline of medication, or surgery or advice.

In summary, through the evaluation of maternal deaths at level one hospitals and MOUs in the Western Cape, the causes and avoidable factors of these maternal deaths could be determined. The findings of the study provide useful information for the Health Authorities of the Western Cape which may assist them in improving maternal care and reducing the MMR in the Western Cape and South Africa.

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Appendix 1: Ethics approval from Stellenbosch University



UNIVERSITEIT • STELLENBOSCH • UNIVERSITY
jou kennisvenoot • your knowledge partner

Approval Notice New Application

27-Jun-2014
Louw, Helena HH

Ethics Reference #: S14/04/095

Title: Factors influencing maternal deaths at level one hospitals and midwife obstetric units in the Western Cape.

Dear Miss Helena Louw,

The **New Application** received on **05-May-2014**, was reviewed by members of **Health Research Ethics Committee 2** via Minimal Risk Review procedures on **21-May-2014** and was approved.

Please note the following information about your approved research protocol:

Protocol Approval Period: **12-Jun-2014 -12-Jun-2015**

Please remember to use your **protocol number** (S14/04/095) on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review:

Please note a template of the progress report is obtainable on www.sun.ac.za/rds and should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.

Translation of the consent document to the language applicable to the study participants should be submitted.

Federal Wide Assurance Number: 00001372
Institutional Review Board (IRB) Number: IRB0005239

The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Contact persons are Ms Claudette Abrahams at Western Cape Department of Health (healthres@pgwc.gov.za Tel: +27 21 483 9907) and Dr Helene Visser at City Health (Helene.Visser@capetown.gov.za Tel: +27 21 400 3981). Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required **BEFORE** approval can be obtained from these health authorities.

We wish you the best as you conduct your research.
For standard HREC forms and documents please visit: www.sun.ac.za/rds

If you have any questions or need further assistance, please contact the HREC office at 0219389207.

Included Documents:

Investigator CV
Letter of request
HREC Checklist
Supervisor CV

Synopsis
 Investigators declarations
 Application form
 Protocol
 Sincerely,
 Matruide Davids
 HREC Coordinator
 Health Research Ethics Committee 2

Investigator Responsibilities

Protection of Human Research Participants

Some of the responsibilities investigators have when conducting research involving human participants are listed below:

- 1 **Conducting the Research.** You are responsible for making sure that the research is conducted according to the HREC approved research protocol. You are also responsible for the actions of all your co-investigators and research staff involved with this research.
- 2 **Participant Enrolment.** You may not recruit or enrol participants prior to the HREC approval date or after the expiration date of HREC approval. All recruitment materials for any form of media must be approved by the HREC prior to their use. If you need to recruit more participants than was noted in your HREC approval letter, you must submit an amendment requesting an increase in the number of participants.
- 3 **Informed Consent.** You are responsible for obtaining and documenting effective informed consent using **only** the HREC-approved consent documents, and for ensuring that no human participants are involved in research prior to obtaining their informed consent. Please give all participants copies of the signed informed consent documents. Keep the originals in your secured research files for at least fifteen (15) years.
- 4 **Continuing Review.** The HREC must review and approve all HREC-approved research protocols at intervals appropriate to the degree of risk but not less than once per year. There is **no grace period**. Prior to the date on which the HREC approval of the research expires, it is **your responsibility to submit the continuing review report in a timely fashion to ensure a lapse in HREC approval does not occur**. If HREC approval of your research lapses, you must stop new participant enrolment, and contact the HREC office immediately.
- 5 **Amendments and Changes.** If you wish to amend or change any aspect of your research (such as research design, interventions or procedures, number of participants, participant population, informed consent document, instruments, surveys or recruiting material), you must submit the amendment to the HREC for review using the current Amendment Form. You **may not initiate** any amendments or changes to your research without first obtaining written HREC review and approval. The **only exception** is when it is necessary to eliminate apparent immediate hazards to participants and the HREC should be immediately informed of this necessity.
- 6 **Adverse or Unanticipated Events.** Any serious adverse events, participant complaints, and all unanticipated problems that involve risks to participants or others, as well as any research-related injuries, occurring at this institution or at other performance sites must be reported to the HREC within **five (5) days** of discovery of the incident. You must also report any instances of serious or continuing problems, or non-compliance with the HRECs requirements for protecting human research participants. The only exception to this policy is that the death of a research participant must be reported in accordance with the Stellenbosch University Health Research Ethics Committee Standard Operating Procedures www.sun025.sun.ac.za/portal/page/portal/Health_Sciences/English/Centres%20and%20Institutions/Research_Development_Support/Ethics/Application_package All reportable events should be submitted to the HREC using the Serious Adverse Event Report Form.
- 7 **Research Record Keeping.** You must keep the following research-related records, at a minimum, in a secure location for a minimum of fifteen years: the HREC approved research protocol and all amendments; all informed consent documents; recruiting materials; continuing review reports; adverse or unanticipated events; and all correspondence from the HREC
- 8 **Reports to the MCC and Sponsor.** When you submit the required annual report to the MCC or you submit required reports to your sponsor, you must provide a copy of that report to the HREC. You may submit the report at the time of continuing HREC review.
- 9 **Provision of Emergency Medical Care.** When a physician provides emergency medical care to a participant without prior HREC review and approval, to the extent permitted by law, such activities will not be recognised as research nor will the data obtained by any such activities should it be used in support of research.
- 10 **Final reports.** When you have completed (no further participant enrolment, interactions, interventions or data analysis) or stopped work on your research, you must submit a Final Report to the HREC.
- 11 **On-Site Evaluations, MCC Inspections, or Audits.** If you are notified that your research will be reviewed or audited by the MCC, the sponsor, any other external agency or any internal group, you must inform the HREC immediately of the impending audit/evaluation.

Appendix 2: Request for permission from Western Cape Department of Health

Mrs C Roderick
Western Cape Department of Health

29 June 2014

Subject: Permission for Health Research

Dear Mrs Roderick,

I am a Master's student at the Stellenbosch University Nursing Division and would like to apply for permission to conduct research on maternal deaths in the Western Cape.

The title of my study is "Factors causing maternal deaths at level one hospitals and midwife obstetric units in the Western Cape". It is a retrospective document review of maternal deaths and no institution will be involved. Only data from the National Committee on Confidential Enquiries into Maternal Deaths which are in the public domain will be used.

Request for research DOH
Attached please find the following documents:

- Annexure 2
- Research proposal of HH Louw
- A summary of the proposal
- Letter of ethics approval from Stellenbosch University Health Research Ethics Committee (**Ethics Reference #: S14/04/095**)

Kind regards

Hestelle Louw
Unit 4017
Greenways
Strand
7140
Email: hestelle@sun.ac.za
Cell phone: 082 5774809

Appendix 3: Permission obtained from Western Cape Department of Health



**Western Cape
Government**

Health

STRATEGY & HEALTH SUPPORT

Health.Research@westerncape.gov.za
tel: +27 21 483 6857; fax: +27 21 483 9895
5th Floor, Norton Rose House, 8 Riebeeck Street, Cape Town, 8001
www.capegateway.gov.za

REFERENCE: 2014RP085
ENQUIRIES: Ms Charlene Roderick

**Unit 4017
Greenways
STRAND
7140**

For attention: **Hester Helena Louw**

**Re: FACTORS INFLUENCING MATERNAL DEATHS AT LEVEL ONE HOSPITALS AND MIDWIFE OBSTETRIC UNITS IN THE WESTERN
CAPE**

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research.

Please contact the following people to assist you with any further enquiries in accessing the following sites:

Maternal Mortality Database L Shand Contact No. 021 483 2639

Kindly ensure that the following are adhered to:

1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final report within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
3. The reference number above should be quoted in all future correspondence.

Yours sincerely

DR J EVANS

ACTING DIRECTOR: HEALTH IMPACT ASSESSMENT

DATE:

CC

I DE VEGA

DIRECTOR: INFORMATION MANAGEMENT

Appendix 4: Request for permission to use from NCCEMD Maternal Mortality – Assessors Control Sheet (2008 version).

Prof J Moodley

Chairperson: NCCEMD

15 November 2013

Dear Prof Moodley,

I am one of the assessors for the NCCEMD in the Western Cape and doing my Masters in Nursing at Stellenbosch University. My topic is “Factors influencing maternal deaths in level one hospitals and Midwife Obstetric Units in Western Cape between 2008 and 2012”.

I would like to request permission to use the existing Maternal Mortality – Assessors Control Sheet (2008 version). This document includes information that does not apply to my study objectives and I would like to make changes to the document to fit my objectives by excluding some information that is not relevant to my study.

After I have received ethical approval for my study from Stellenbosch University in 2014, I will also apply for ethical approval from the NCCEMD to use the maternal mortality data of the Western Cape.

My contact details are: Email: hestelle@sun.ac.za; Cell phone: 082 5774809

Kind regards

Hestelle Louw

Unit 4017

Greenways

Strand

7140

Prof J Moodley

Chairperson: NCCEMD

5 November 2014

Dear Prof Moodley,

My previous letter dated 15 November 2013 and our conversation on 13 March 2014 refer.

I would like to request permission to use the maternal mortality data for the Western Cape for the period 2008 to 2012 which are in the public domain for my study. I received ethics approval from the Stellenbosch University and permission from the Western Cape Department of Health to use the Western Cape maternal mortality data.

My contact details are: Email: hestelle@sun.ac.za; Cell phone: 082 5774809

Kind regards

Hestelle Louw

Unit 4017

Greenways

Strand

7140

Appendix 5: Permission obtained from NCCEMD



Women's Health & HIV Research Unit
Department of Obstetrics & Gynaecology
Doris Duke Medical Research Institute
Level 3, Room C305
Nelson R Mandela School of Medicine
Telephone: +27 31 260 4241
Fax: +27 31 260 4037

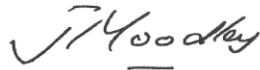
30 November 2015

TO WHOM IT MAY CONCERN

NCCEMD PERMISSION FOR MASTERS STUDY : HESTELLE LOUW

This is to certify that Hester H Louw was given permission to use a blank copy of the 2008 version of the Assessors Form and NCCEMD data that is in the public domain.

The decision to authorise this was done at an executive level.



J MOODLEY
Emeritus Professor
Department of Obstetrics and Gynaecology, UKZN
Chair of the Ministerial Committee on Confidential Enquiries into Maternal Deaths (NCCEMD)
National Department of Health.

Appendix 6: Data Collection Tool

G.P.-S. 004-1090

Maternal Mortality – Assessors Control Sheet 2008 version

DEMOGRAPHICS:

1. Unique Number:
2. Date death:
3. Province: 4. District: 5. Hospital:
Level: Home, CHC, Level 1, level 2, level 3, private
6. Age: 7. Parity before delivery:
8. Antenatal care: (yes/no/unknown), Gestational age at booking < 20wks (yes/no/unknown)
9. HIV status (mark only one):
Unknown, declined testing, negative, positive (not AIDS), AIDS not on HAART, AIDS on HAART
10. Present pregnancy outcome:
(Live born, stillborn, neonatal death, miscarriage, ectopic, undelivered)
11. Route of delivery: (vaginal, assisted, caesarean section, ectopic, undelivered)
12. Referral (yes/no): 13. If referred, from where:
14. Did she have an anaesthetic (yes/no)? If yes at what level
15. Did she have a hysterectomy (yes/no)?
16. Did she have a post-mortem (yes/no)?
17. Did she have prolonged labour (yes/no/N/A/unknown)?
18. What was the mid-upper arm circumference?cm
19. Did the woman have a previous C/S? (yes/no/unknown)
20. Was she anaemic during pregnancy (yes/no/unknown)?

CAUSE OF DEATH

DISEASE ENTITY

(Tick 1 main primary obstetric problem and circle the sub-category)

Coincidental cause: MVA, other accidents, assault, rape, herbal medicine, other (specify)	
Medical and Surgical disorders: Cardiac disease, endocrine, GIT, CNS, respiratory, haematological, genito-urinary, auto-immune, skeletal, psychiatric, neoplasm, other (specify)	
Non-pregnancy-related infections: PCP pneumonia, other pneumonia, TB, endocarditis, UTI, appendicitis, malaria, cryptococcal meningitis, other meningitis, Kaposi's sarcoma, toxoplasmosis, cholera, hepatitis, gastroenteritis, wasting syndrome, complications of anti-retroviral therapy, other (specify)	
Ectopic pregnancy: <20 weeks, >20 weeks	
Miscarriage: Septic miscarriage, haemorrhage (non- traumatic), uterine trauma, GTD, following legal TOP	
Hyperemesis gravidarum	
Pregnancy-related sepsis: Chorioamnionitis with ruptured membranes, chorioamnionitis without ruptured membranes, puerperal sepsis after NVD, puerperal sepsis after c/s, bowel trauma at c/s	
Obstetric haemorrhage Abruptio with/without h/t, praevia, other APH not specified Ruptured uterus with/without previous c/s, Retained placenta, morbidly adherent placenta, uterine atony, vaginal/cervical trauma, inverted uterus, bleeding during c/s, bleeding after c/s, other PPH not specified	
Hypertension: Chronic hypertension, proteinuric hypertension, eclampsia, HELLP, liver rupture, acute fatty liver.	
Anaesthetic complications: General / epidural / spinal anaesthetic	
Embolism: Pulmonary embolus, amniotic fluid embolus	
Acute collapse – cause unknown:	
Unknown: Death at home or outside health services, no primary cause found, lack information	

FINAL CAUSE OF DEATH AND OTHER COMPLICATIONS

Tick appropriate column, more than one column can be marked		Final	Complications
Circulatory system	Hypovolaemic shock Septic shock		
Respiratory failure			
Cardiac failure	Pulmonary oedema Cardiac arrest		
Acute cardiopulmonary failure due to embolism			
Renal failure			
Liver failure			
Cerebral complications	Intracranial haemorrhage Cerebral oedema resulting in coning Meningitis Cerebral emboli Brain death following hypoxic event Unspecified		
Metabolic	Maternal ketoacidosis Electrolyte imbalance Thyroid crisis Lactic acidosis Other		
Haematological	Disseminated intravascular coagulation Severe anaemia		
Immune system failure			
Unknown	Home death Unknown		
Other - specify			

AVOIDABLE FACTORS (Tick appropriate problem areas – each column must have at least 1 tick):

PATIENT ORIENTATED PROBLEMS:

Lack of information:	
No avoidable factor:	
No antenatal care:	
Infrequent antenatal care:	
Delay in accessing medical help:	
Declined medication/surgery/advice	
Family problem:	
Community problem:	
Unsafe abortion	
Other (specify)	

ADMINISTRATIVE PROBLEMS:

Lack of information:	
No avoidable factor:	
Transport problems i) home-institution ii) Institution-institution	
Lack of accessibility i) barriers to entry ii) other:	
Delay initiating critical care due to overburdened service e.g. long queues, competing emergencies.	
Lack of health care facilities: ICU Blood/blood products Other	
Lack of appropriately trained staff: i) Doctors ii) Nurses	
Communication problems: i) technical ii) interpersonal	
Other (specify):	

CLINICAL MANAGEMENT AND EMERGENCY CARE PROBLEMS

(Tick type & level where problem occurred - each column must have at least 1 tick):

TIMING of EMERGENCY:

Early pregnancy: <20w	
Antenatal period: ≥20w	
Intrapartum period:	
Postpartum period:	
Anaesthesia	

TIMING of DEATH

Early pregnancy: <20w	
Antenatal period: ≥20w	
Intrapartum period:	
Postpartum period:	
Anaesthesia	

MEDICAL CARE	1°	2°	3°	RESUSCITATION	
Lack of information:				Lack of information:	
No avoidable factor:				No avoidable factor:	
Initial assessment:				Airway problems:	
Problem recognition/diagnosis:				Breathing problems:	
Delay in referring patient:				Circulation problems:	
Managed at inappropriate level:				Drugs problems:	
Incorrect management (wrong diagnosis):				Investigation problems:	
Sub-standard management (correct diagnosis):				Monitoring problems:	
Monitoring problems:				Not attempted	
i) not/infrequently done					
ii) Prolonged abnormal observations with no action					

Give a short summary of the case:

(Include comments on possible unprofessional conduct and staff shortages where appropriate):

In your opinion, was this death clearly avoidable within the health system?
 (Leave out patient orientated factors and tick appropriate box. Only one box can be ticked)

No suboptimal care	
Suboptimal care but different management would have <u>made no</u> difference to the outcome	
Suboptimal care but different management <u>might</u> have made a difference to the outcome	
Suboptimal care where different management <u>would reasonably have been expected to have made a difference</u> to the outcome	

SUGGESTIONS FOR PREVENTION: Please list the interventions, which in your opinion could have prevented this patient's death? (In answering this question, please mention factors that could have prevented the condition that led to her death, as well as factors that could have improved the management of the emergency event)

Date: _____

Signed: _____

Appendix 7: Declaration by language and technical editor

Lize
Vorster
Communication

To whom it may concern

This letter serves as confirmation that I, Lize Vorster, performed the language editing of Hestelle Louw's thesis. Editing is done in track changes and the student has final control over accepting or rejecting changes by using their own discretion. This may result in a document still containing some mistakes as human error always plays a role.

Yours sincerely



Lize Vorster
Language Practitioner

Vygie street 9, Welgevonden Estate, Stellenbosch, 7600 * e-mail: lizevorster@gmail.com * cell: 082 856 8221