THE PROFILE OF MATERNAL DEATHS IN A DISTRICT HOSPITAL

A five-year review of maternal deaths at Northdale Hospital (2006 to 2010)

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October 2011

UNIVERSITY OF KWAZULU-NATAL
NELSON R. MANDELA SCHOOL OF MEDICINE
DEPARTMENT OF FAMILY MEDICINE

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Submitted in partial fulfilment of the requirements for the degree of "Master of Medicine (Family Medicine)" in the Nelson R. Mandela School of Medicine
University of KwaZulu-Natal

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DECLARATION OF OWNERSHIP

I, Dr Polycarpe N'djugumu Makinga, declare that:

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Signed: _____   Date: 20th October 2011

DEDICATION

This work is dedicated to my beloved wife Claudine and my sons: Roslin, Russell and Raffarin, for many sacrifices during the times of my studies.

May The Almighty God richly bless you!

IN THE LOVING MEMORY OF

My late father Eleuthère Ayuha Makinga (1936-1978) and my brothers Gosto Ndundula Makinga (1976-1977), Fulgence Ndinamwana Makinga (1962-1987) and Robert Lubilo Makinga (1971-2007), whose tragic and untimely passing on has left me in indescribable status of emotional pains.

ACKNOWLEDGEMENT

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ACRONYMS & ABBREVIATIONS

AIDS	=	Acquired Immuno-Deficiency Syndrome
ANC	=	Antenatal Clinic
ART	=	Antiretroviral Therapy
BP	=	Blood Pressure
CD4	=	Cluster of Differentiation 4
CEMD	=	Confidential Enquiry into Maternal Deaths
ERPOC	=	Evacuation of Retained Products of Conception
HAART	=	Highly Active Antiretroviral Therapy
HIV	=	Human Immunodeficiency Virus
ICA	=	Incomplete abortion
KZN	=	KwaZulu-Natal
MCWH	=	Maternal Child and Women's Health
MDG	=	Millennium Development Goal
MDNF	=	Maternal Death Notification Form
MMRe	=	Maternal Mortality Rate
MMRo	=	Maternal Mortality Ratio
NCCEMD	=	National Committee on Confidential Enquiry into Maternal Deaths
NDH	=	Northdale Hospital
O&G	=	Obstetrics and Gynaecology
PHC	=	Primary Health Care
PMTCT	=	Prevention of Mother-to-Child Transmission
PPH	=	Post-Partum Haemorrhage
PPIP	=	Perinatal Problem Identification Programme
TB	=	Tuberculosis
TOP	=	Termination of Pregnancy
UKZN	=	University of KwaZulu-Natal
UN	=	United Nations
UNICEF	=	United Nations Children Fund
WHO	=	World Health Organisation

ABSTRACT

Background

The estimated global number of maternal deaths has decreased from 536000 in 2005 to 358000 deaths in 2008. Sub Saharan Africa contributed with 57% of maternal deaths in 2008. Although there is a general decrease in maternal deaths, available data shows that most countries, including South Africa, will not meet their Millennium Development Goal 5 A target by 2015. The South African target is a maternal mortality ratio of 38 deaths per 100000. Based on various sources, South African maternal mortality ratio is on the increase. The United Nations interagency estimates placed South African maternal mortality ratio at 410 in 2008 from 260 in 1990. It is therefore necessary that health facilities, the government and the community at large make an effort to reduce avoidable maternal deaths.

Aims

The main aim of the study was to clinically and demographically profile maternal deaths at Northdale Hospital, assess the quality of care provided to maternal death patients and make recommendations to the hospital clinical management.
Secondary objectives included the determination of the following: the prevalence of Human Immunodeficiency Virus infection among maternal deaths, and the commonest primary and final causes of deaths.

Methods

This cross-sectional survey retrospectively reviewed maternal deaths patients' records at Northdale Hospital, a district hospital in South Africa. All 61 pregnancy-related deaths that were reported from January 2006 to December 2010 fulfilled the criteria of maternal deaths and were included in the study. Demographic and clinical characteristics of patients were extracted from patients' charts using a structured pre-designed data sheet. Descriptive statistics were computed and analysed using IBM SPSS software. Medical records of all 61 deaths were assessed by three assessors who determined the causes of death and evaluated the quality of care received by each patient.

Results

A decrease in number of maternal deaths and maternal mortality ratio has been noticed during the study period. The average maternal mortality ratio for the study period was 204 per 100000 live births: ranging from 219 to 168. The majority of participants were of African origin aged between 20 to 34 years; with a mean age of 28 ± 6.4 years. Of the 61 maternal deaths reviewed, only 33 patients (54.1%) had attended antenatal clinic. Of these patients who had antenatal care, 57.6% booked at 20th week of gestation or earlier. The median number of antenatal visits was 4 visits. Of the 28 patients who died in the postpartum period, seven delivered at home and six had a caesarean section. Of those patients who had a caesarean section, three died within 24 hours, as a result of anaesthetic complications. Only 73.8% of all maternal deaths and 93.9% of those who attended antenatal care were tested for Human Immunodeficiency Virus. Of the 39 patients who tested positive for Human Immunodeficiency Virus infection, only 17 (43.6%) patients had their Cluster of Differentiation 4 cell count results; 10 patients were on antiretroviral triple therapy and four were on antiretroviral dual therapy. Half of the patients died within 41 hours of admission to the hospital.

The five most common primary causes of maternal deaths at Northdale Hospital were non-pregnancy related sepsis (54.1%), miscarriage (14.8%), acute collapse (8.2%), pregnancy related sepsis (6.6%), and anaesthetic complications (4.9%). Antepartum haemorrhage, postpartum haemorrhage, pre-existing maternal conditions, hypertension, embolism and an unknown cause contributed 1.6% each.

Almost half of maternal deaths were assessed as avoidable. Equally, almost half of maternal deaths received care that was assessed as substandard. Of these 30 patients who received substandard care, a different approach to the management would have made **no** difference for eight patients (13.1%) whose deaths were unavoidable anyway. A multidisciplinary approach to patients' management, availability of blood/blood products and resuscitation medicines, and good communication with consultants at the regional hospital are some of the strengths on which Northdale Hospital should capitalise. Some of the problems that contributed to substandard care include: difficulties in referring patients to the regional hospital, inability of staff to manage

emergencies correctly, inconsistent patients' monitoring, and poor communication with the casualty department and the private sector.

Conclusion

The study has confirmed that the profile of maternal deaths at facility level may paint a totally different picture to what is found at the national level. While there is an increase at the national level, the number of maternal deaths and the maternal mortality ratio are on the decrease at Northdale Hospital, this decrease should be treated with caution as this may just be a yearly fluctuation. Non-pregnancy related sepsis remains the leading cause at both national and district hospital (Northdale Hospital) levels; the other four major causes of maternal deaths are somewhat different. The fact that almost half of the patients received substandard care and almost half of the deaths were assessed as avoidable is an issue of concern. The hospital should capitalise on its strength and build a basis for improvement in patient care.

Recommendations

The Primary Health Care coordinator should sensitise the community to improve their health seeking behaviour. The establishment of a mothers' waiting lodge and acquisition of an ambulance dedicated to pregnant women and stationed at the hospital may reduce the number of home deliveries and delays in women at risk of complications accessing the health facility.

The Prevention of Mother-to-Child Transmission programme should be strengthened and contraceptive use by all women but specifically by those tested positive for human immunodeficiency virus should be encouraged. Medical officers should be trained in the management of obstetrical emergencies (especially septic abortion) and resuscitation. Medical Interns should not be left unsupervised when attending to critically ill patients. Family physicians should actively assist the department of Obstetrics and Gynaecology in managing patients with medical conditions. Innovative ways should be found to improve the referral difficulties between Northdale and Grey's Hospitals.

Key words

Maternal, Mortality, Rate, Ratio, Northdale, Causes of Deaths, Quality of Care, Audit, Confidential enquiry,

1. INTRODUCTION

Pregnancy is not considered a disease or a health disorder, but a physiological state – the outcome of which is expected to be a happy one. When the outcome is poor or fatal for either the mother or the fetus, the mother, if survived, and the whole family remains devastated forever. Therefore, the responsibility is placed on the shoulders of the family physician and/or the obstetrician to ensure that the outcome is successful for both the fetus and the mother. It is impossible, despite advances in technology, therapeutics, and obstetrics to completely eliminate maternal mortality; however efforts should continually be made to improve the quality of care that is offered to pregnant women in order to progressively reduce or eliminate **avoidable** maternal deaths.

Factors contributing to avoidable deaths are classified as patient-related factors, healthcare worker-related factors and administrative-related factors. Causes of maternal deaths, however, are categorised into two majors divisions: primary causes, sometimes referred to as obstetrical causes and final causes.

Globally, more than half a million women die each year because of complications related to pregnancy and childbirth. Of the estimated 536,000 maternal deaths worldwide in 2005, low and middle income countries accounted for more than 99%. About half of the maternal deaths (265,000) occurred in sub-Saharan Africa alone and one third took place in South Asia (187,000). [1] In 2008 the estimated number of maternal deaths globally decreased to 358,000 with sub-Saharan Africa accounting for 204,000 deaths (57.0%). [2]

1.1. WHAT IS THE PROBLEM?

The number of women dying as a result of child birth is not decreasing as expected. The MDG (Millennium Development Goal) 5A calls for a reduction in the Maternal Mortality Ratio (MMRo) by three-quarters between 1990 and 2015. At the present rate of progress, the world will fall well short of the target for maternal mortality reduction. Data suggests that in order to reach the target, the global MMRo would have to be

reduced by an average of 5.5% a year between 1990 and 2015. The current average rate of reduction is less than 2.3% a year. "The estimated 1.7% annual rate of reduction in sub-Saharan Africa, where levels of mortality are highest, is slower than in any other region" (UNICEF). [1]

1.2. WHAT IS KNOWN SO FAR?

The investigator in this study is a Clinical Manager at Northdale Hospital (NDH), a district hospital in Pietermaritzburg, South Africa. He has been working for this hospital from September 2006 up to the present date (October 2011) as the Head of the Obstetrics & Gynaecology (O&G) Department. In the last five years, January 2006 to December 2010, there were ± 500 deliveries and ± 1 pregnancy related death every month at NDH. The caesarean section rate is ± 25%. A database called Perinatal Problem Identification Programme (PPIP) is used to collate data related to perinatal and maternal deaths. Perinatal deaths data is collected with much detail but there is serious lack of details for data related to maternal deaths in the PPIP data collection tools.

Based on the hospital's PPIP database, [3] the commonest primary causes of maternal deaths for the study period as coded by nursing staff and doctors using PPIP codes are as follow: non-obstetrical causes (27.9%), non-pregnancy related sepsis which include Acquired Immuno-Deficiency Syndrome (AIDS) (26.2%), abortion (13.1%), pregnancy related sepsis (8.2%), anaesthetic complications (4.9%), pre-existing maternal conditions (4.9%), acute collapse due to an unknown cause (3.3%), embolism (3.3%), hypertensive disorders in pregnancy (3.3%), and unknown causes (3.6%). The final causes of deaths were as follow: respiratory failure (32%); immune systems failure (26.9%); cardiac failure (7.2%); septic shock (7.2%); cerebral complications (6.2%); hypovolemic shock (6.2%); metabolic dysfunctions (3.1%); liver failure (2.1%); other organ failures (5.2%) and unknown causes (2.1%).

In accordance with the Department of Health recommendations, each maternal death is discussed during the departmental monthly mortality and morbidity review meeting and notified to the provincial Maternal Child and Women Health (MCWH) unit for confidential enquiry purposes. A Maternal Death Notification Form (MDNF) is completed to this

effect. A copy of the patient's medical records is also sent to MCWH with the duly completed MDNF. The process of maternal death notification and confidential enquiry culminates with the publication of what is known as the Saving Mothers Report, published every three years. In the 2005-2007 Saving Mothers Report, the five leading causes of maternal deaths included: non-pregnancy related infections (43.7%); hypertension (15.7%); obstetrical haemorrhages (12.4%); pre-existing maternal diseases (6%); and pregnancy-related sepsis (5.6%). [4] The province of KwaZulu-Natal (KZN) had the highest number of notified maternal deaths while the Northern Cape Province had the lowest with 935 and 144 reported deaths respectively (excluding coincidental deaths). [5]

The exact Maternal Mortality Rate (MMRe) and MMRo for South Africa is not known due to a number of factors such as:

- Many deaths occurring outside hospitals that are not reported;
- There may be, to some extent, underreporting of deaths occurring in hospitals;
- Some deaths are misclassified, and
- The denominator for MMRe is not readily available.

There were 3959 maternal deaths notified for the triennial period of 2005-2007 in South Africa. [4] UNICEF estimates that the "reported" MMRo in South Africa was 170 per 100,000 live births for the period of 2003 to 2008 but the adjusted ratio was estimated at 400 per 100,000 live births for 2005 in South Africa. [6]

1.3. WHAT NEEDS TO BE KNOWN?

When a death occurs, the events and actions carried out by healthcare workers may not necessarily have been all wrong. Some events might have been favourable and some actions might have been commendable and courageous. This study intends to explore both correct and incorrect actions occurring during the process of caring for maternal death patients. Also there may be common characteristics among maternal death patients at a district hospital in KZN.

The study undertook to explore negative and positive incidents occurring in the management of maternal death patients and common characteristics existing among

maternal death patients with the view to making recommendations on policies and clinical guidelines for the management of pregnant patients in order to mitigate the negative impact of poor clinical judgement and health systems related problems on maternal mortality.

1.4. WHY IS THIS IMPORTANT?

Confidential Enquiries into Maternal Deaths (CEMD) in South Africa have been established since 1999. Four reports known as the Saving Mothers Reports have been published so far, [4] where the number of reported maternal deaths and their causes are presented in an aggregated manner. Recommendations have been suggested in order to improve the care that is provided to pregnant women. These reports are normally written in a manner that data for the whole country is aggregated and analysed. An individual health facility is not able to understand, in sufficient detail, what is happening at its level.

It is also not correct to assume that what is happening at the national level is the same as what is happening at a specific health facility. This has been proven in the case of the Human Immunodeficiency Virus (HIV) epidemic, where for instance the prevalence of HIV infection in South Africa in 2009 was estimated to be 29.4% among antenatal clinic (ANC) attendees nationally; but the same was estimated at 39.5% for KZN Province and 16.9% for Western Cape Province. [7] This proves that the national HIV epidemic statistics represent a sum of various and often discordant small provincial or community epidemics. It is therefore not safe to assume that the findings at national level are a true reflection of what is happening at a particular health facility. This is equally true in the case of maternal deaths, with regard to the characteristics of patients dying as a result of child bearing and the leading cause of death at a district hospital level. It is therefore important that individual facilities investigate maternal deaths in their facilities in order to understand exactly what their priorities are in reducing the occurrence of such deaths.

Furthermore, the method of CEMD concentrates all its efforts on finding what went wrong in the process of managing those patients who died. However, there may have

been many good things done by healthcare workers that go unnoticed. By exposing these positive factors, members of staff can be encouraged to be more involved in the care of patients and in so doing the health system in general can build upon these positive foundations to improve maternal, child and women healthcare generally.

1.5. HOW WILL THIS STUDY SOLVE THE PROBLEM?

While specific objectives of this study focus on the demographic and clinical profile of maternal deaths, the ultimate goal is to inform policies and clinical guidelines at a district level with regard to improving maternal health. Decision-makers can only change the *status quo* if they have sufficient knowledge of what is happening at their facilities. This study will make recommendations to NDH management which may be also applicable to other district hospitals in the province.

2. PURPOSE OF THE STUDY

2.1.   MAIN OBJECTIVE

The primary objective of the study is to explore the standard of care that a woman receives prior to her death, with the view of making recommendations to the hospital clinical managers on how best the policies and clinical protocols can be changed in order to improve patients' care.

2.2.   SECONDARY OBJECTIVES

In order to attain the above main objective, the study will address the following secondary objectives:

- To review the demographic, and clinical characteristics, such as HIV status, CD4 count, parity, gravidity, etc. of maternal deaths at NDH

- To determine the commonest primary and final causes of maternal deaths at NDH and compare them to the 2005-2007 Saving Mothers Report findings

- To determine the prevalence of HIV infection among maternal death patients at NDH

- To determine evidence of compliance (positive interventions / circumstances) or failure of compliance (negative incidents) with the Saving Mothers Report recommendations in the process of caring for maternal deaths.

3. OPERATIONAL DEFINITIONS

3.1. MATERNAL DEATH

Maternal death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. [8-10]

To facilitate the identification of maternal deaths in circumstances in which cause of death attribution is inadequate, a new category referred to as **pregnancy-related death** has been introduced. Pregnancy-related death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death. [8]

3.2. MATERNAL MORTALITY RATE

Maternal Mortality Rate (MMRe) is the number of maternal deaths per 1,000 women of reproductive age (15-49 years). It is an impact indicator that assesses the risk of a woman of reproductive age suffering a maternal death. [9, 11, 12] It is calculated as follow:

$$MMRe = \frac{Number\_of\_maternal\_deaths\_occuring\_in\_a\_given\_period}{Number\_of\_women\_of\_reproductive\_age\_in\_a\_given\_period} \times 1000$$

3.3. MATERNAL MORTALITY RATIO

Maternal Mortality Ratio (MMRo) is the number of maternal deaths per 100,000 live births. It is an impact indicator that assesses the obstetrical risk of a woman dying from a given pregnancy. [9, 11, 12] This most commonly used indicator is calculated as follows:

$$MMRo = \frac{Number\_of\_maternal\_deaths\_occuring\_in\_a\_given\_period}{Number\_of\_live\_births\_in\_the\_same\_period} \times 100000$$

3.4. PATIENTS INFECTED WITH HIV

With regard to HIV status, patients will be classified into four categories:
- HIV positive patients are those with a positive HIV test.
- HIV negative patients will be those who had a negative HIV test.
- HIV status unknown patients are those patients who had no documented HIV test results.
- Patients with AIDS are those who present with an AIDS-defining condition or those diagnosed as WHO clinical stage III or IV of AIDS disease.

Testing for HIV usually involves the use of "Rapid tests".
- If the test is negative the patient is regarded as HIV negative but the test is repeated at 32nd week of pregnancy.
- If the test is positive, a confirmatory test is done by repeating the rapid test using a different test kit.
    - If the confirmatory test is positive again, the patient is regarded as HIV positive.
    - If the confirmatory test is negative. The test result is said to be discordant, and an Elisa test is then done. The result from the Elisa test is considered to be final.

3.5. DEFINITION OF TEENAGER

Any patient who was less than 20 years old at the time of death was classified, in this study, as a teenage patient.

3.6. ADVANCED MATERNAL AGE

Any patient who was 35 years or more at the time of death was classified, in this study, as an advanced maternal age patient.

3.7. PRIMARY CAUSE OF DEATH

For the purpose of this study, primary cause of maternal death means the particular obstetric condition or pathology that initiated the chain of events eventually leading to the woman's death. Conditions such as postpartum haemorrhage, eclampsia, AIDS, septicaemia, etc. will be considered as a primary cause of death. Primary causes of death may be subdivided into direct causes (e.g. postpartum haemorrhage, eclampsia, and pregnancy related sepsis), indirect causes (AIDS, pre-existing maternal conditions, etc.) and unknown causes.

3.8. FINAL CAUSE OF DEATH

The failing organ that led to the death will be considered as the final cause of death. For instance; pulmonary embolism may lead to respiratory failure and death. Pulmonary embolism is the primary cause of death but respiratory failure is the final cause of death.

3.9. CONTRIBUTING FACTORS

These are conditions or factors that aggravate the primary or the final cause of death. For instance, anaemia may exacerbate respiratory distress in a patient with postpartum or antepartum haemorrhage.

3.10. ACUTE COLLAPSE

Acute collapse in a pregnant or postpartum woman is a non-specific condition that implies a complete or partial loss of consciousness secondary to a cerebral or cardio-vascular event. Causes of acute collapse include thrombosis/thromboembolism, haemorrhage, amniotic fluid embolism, genital tract sepsis, anaesthetic complications, etc. The patient's clinical presentation may vary depending on the cause. Cough, dyspnoea and chest pains are common symptoms of pulmonary embolism. [13, 14]

3.11. AVOIDABLE FACTORS

Avoidable factors are things that might have been done or might not have been done. Because they were done or not done they may have contributed (or not) to the deaths but were not causes of death. They can be divided into patient-related, administrative-related, and healthcare worker-related.

Patient related factors may include factors such as poor help seeking behaviour, refusal of treatment, etc.

Administrative or health system related factors include issues such as poor transportation systems between home and health facility or between two health facilities, lack of equipment, shortage of staff in numbers and or quality, etc.

Healthcare worker related factors are mainly those relating to patient mismanagement: negligence, misdiagnosis and inappropriate or inadequate treatment, etc.

3.12. LEVELS OF CARE

The South African health system places hospitals into five different categories according to Government Gazettes Vol. 554, No. 3455221 and No. 3455222, of the Republic of South Africa published in Pretoria on 12 August 2011 and other related documents:

- **District hospitals** [15-21]
    - (1) Districts hospitals are categorised into small, medium and large hospitals according to the number of beds:
        - Small district hospitals: 50 to 150 beds;
        - Medium district hospitals: 150 to 300 beds;
        - Large district hospitals: 300 to 600 beds;
    - (2) A district hospital must:
        - serve a defined population within a health district and support primary health care (PHC);
        - provide a district hospital package of care on a 24-hour basis;

- have general practitioners and clinical nurse practitioners providing health services;

- provide services that include in-patient and ambulatory health services as well as emergency health services.

(3) A district hospital receives outreach and support from general specialists based at regional hospitals.

(4) A district hospital may only provide the following specialist services:

- Paediatrics,

- Obstetrics & Gynaecology

- Internal medicine and

- General surgery.

- **Regional hospitals** [15-21]

(1) A regional hospital must, on a 24-hour basis, provides:

- health services in the fields of internal medicine, paediatrics, O&G, general surgery and

- health services in at least one of the following specialities:

  - Orthopaedic surgery

  - Psychiatry

  - Anaesthetics

  - Diagnostic radiology

- trauma and emergency services;

- short term ventilation in a critical care unit and

- services to a defined, regional drainage population, limited to provincial boundaries and receive referrals from several district hospitals

(2) A regional hospital receives outreach and support from tertiary hospitals.

(3) A regional hospital has between 400 and 800 beds.

- **Tertiary hospitals** [15-21]

A tertiary hospital must:

- provide specialist level services provided by regional hospitals;

- provide subspecialties of specialities referred to above;

- provide intensive care services under the supervision of a specialist or specialist intensivist; and
- receive referrals from regional hospitals not limited to provincial boundaries; and
- have between 400 and 800 beds

- **Central hospitals** [15-21]

  (1) A central hospital must:
  - provide tertiary hospital services and central referral services and may provide national referral services;
  - provide training of health care providers;
  - conduct research;
  - receives patients referred to it from more than one province;
  - be attached to a medical school as the main teaching platform and
  - have a maximum of 1200 beds.

  (2) Central referral services are provided in highly specialised units, require unique, highly skilled and scarce personnel and are provided at a small number of sites nationwide.

  (3) National referral services –
  - Refer to super-specialised national referral units and
  - Represent extremely specialised and expensive services (e.g. heart and lung transplants, bone marrow transplants, liver transplants, cochlear implants).

- **Specialised hospitals** [15-21]

  A specialised hospital:
  - Provides specialised health services such as:
    - psychiatric services;
    - tuberculosis services;
    - treatment of infectious diseases;
    - rehabilitation services; and
  - Has a maximum of 600 beds

3.13. BOOKED PATIENT FOR ANTENATAL CARE

With regard to antenatal care, a booked patient is a pregnant woman who has attended an ANC at least once. The booking visit is usually the one during which the health care worker extracts valuable background information on the patient's health status, performs a complete physical examination of the patient and orders appropriate investigations. This visit books the patient for antenatal, intrapartum and postpartum care in a particular health system or health facility. [22-27]

3.14. UNBOOKED PATIENT FOR ANTENATAL CARE

With regard to antenatal care, an unbooked patient, also referred to as a non-clinic case, is a pregnant woman who has never attended an ANC. [22-27] A patient who has attended an ANC before but has no proof of their attendance may be considered as being unbooked.

4. LITERATURE REVIEW

Maternal mortality has generated a considerable amount of literature which looks at both understanding and measuring the problem, and suggesting solutions. Most ministries of health in various countries have put in place programmes to reduce maternal mortality. WHO collects maternal mortality data on an annual basis in order to study trends and progress towards the fifth MDG. The available literature suggests clearly that most deaths occur in low and middle income countries. [1, 4-7]

4.1. GLOBAL ESTIMATES OF MATERNAL DEATHS

WHO, UNFAP, UNICEF and the World Bank have estimated that the number of maternal deaths has reduced from 536000 in 2005 to 358000 maternal deaths in 2008 (95%CI [260000-560000]). The MMRo was estimated at 265 (95%CI [200-370]) in 2008. Developing countries accounted for 99% (355 000 deaths) of maternal deaths. Sub Saharan Africa contributed with 240 000 deaths (57%). [2]

The following countries had the highest absolute numbers of maternal deaths in 2008: India (63000), Nigeria (50000), Democratic Republic of the Congo (19000), Afghanistan (18000), Ethiopia (14000), Pakistan (14000), Bangladeshi (12000), Indonesia (10000), Sudan (9700) and Kenya (7900). However MMRo was the highest in the following countries: Afghanistan (1400), Chad (1200), Somalia (1200), Guinea Bissau (1000), Liberia (990), Burundi (970), Sierra Leone (970), the Central African Republic (850), Nigeria (840), Mali (830), and Niger (820). [2] Countries with the lowest MMRo in 2008 include Ireland (3 per 100 000 live births), Austria, Belgium, Denmark, Iceland and Sweden (5 per 100 000 live births). [2]

These UN inter-agency estimates differ from data published by countries' ministries of health or Vital Registration offices. For instance in 2002, Argentina, through its Vital Registration services, estimated its MMRo at 46 deaths per 100 000 live births, [28] yet the UN inter-agency estimates place the Argentina's MMRo between 63 and 70 during the period of 2000 to 2008. [2]

Figure 1 below groups countries in 6 broad categories: countries with MMRo of less than 20; countries with MMRo of 20 to 99; countries with MMRo of 100 to 299; countries with MMRo of 300 to 549; countries with MMRo of 550 to 999; countries with MMRo of 1000 or more; and countries where there is no data.

Figure 1: Maternal Mortality Ratio around the globe for 2008

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Source: http://whqlibdoc.who.int/publications/2010/9789241500265_eng.pdf

There is a correlation between maternal, stillbirth and neonatal deaths. Ten countries (India, Nigeria, China, Bangladesh, Democratic Republic of the Congo, Ethiopia, Indonesia, Tanzania and Afghanistan) were ranked among the top twelve countries with the highest number of maternal deaths, stillbirths and neonatal deaths in 2008. [29]

4.2.　MATERNAL DEATHS IN SOUTH AFRICA

Although the exact number of maternal deaths in South Africa is unknown, evidence from various sources of data indicate that South Africa is definitely not on track to achieve MDG 5, target 5A, and that maternal mortality has actually doubled since 1990.

Sources of maternal mortality data nationally include Vital Registration statistics, South African Demographic and Health Surveys of 1998, census of 2001 (as interpreted by Garenne et al., Dorrington et al. and Statistics South Africa), Community Survey of 2007 (as interpreted by Garenne et al. and Statistics South Africa), and the four Saving Mothers Reports. [30] While all these documents do not agree on the estimates of MMRo in South Africa, they all suggest that South African MMRo is much higher than the MDG 5 target for the country.

The UN inter-agency estimates of MMRo in South Africa were 230 in 1990, 440 in 2005 and 410 (range of uncertainty: 240 to 610) in 2008. [2] This shows that MMRo has actually doubled between 1990 and 2008 in South Africa. The absolute number of maternal deaths estimated by these UN agencies in 2008 is 4500 deaths with a Lifetime Risk (LTR) of maternal deaths of 1:100 and a proportion of maternal deaths among females of reproductive age deaths of 2.8%. The increase seen in South Africa may be attributed to HIV/AIDS. The UN inter-agency estimates the proportion of maternal deaths due HIV/AIDS to be 42.5%. [2] Hogan et al. estimates MMRo for South Africa to be 237 (range of uncertainty 146 to 372) in 2008. [10]

According to the National Committee on Confidential Enquiry into Maternal Deaths (NCCEMD) the number of reported maternal deaths has increased over the years, from 3296 in the 2002-2004 triennium to 3959 reported deaths in the 2005-2007 triennium (coincidental deaths excluded). [4] The MMRo of 151 deaths per 100 000 live births reported by the NCCEMD is in fact a facility-based MMRo.

4.3. CAUSES OF MATERNAL DEATHS

According to WHO 35% of all maternal deaths globally are caused by obstetrical haemorrhage. The second leading cause of maternal deaths globally is hypertensive disorders in pregnancy. [31]

A systematic review of causes of maternal deaths in the world by WHO lists the major causes of deaths in Africa between 1997 and 2002 as follows: haemorrhage (33.9%); sepsis/infections (9.7%); hypertensive disorders (9.1%); HIV/AIDS (6.2%); obstructed labour (4.1%); miscarriage (3.9%); anaemia (3.7%); embolism (2·0%); ectopic pregnancy (0·5%); other direct causes (4.9%); other indirect causes (16·7%); and unclassified deaths (5·4%). [32]

The 2006-2008 Saving mothers' lives, a maternal deaths enquiry report of the United Kingdom (UK), revealed that there were 261 maternal deaths in the UK in 2006-2008. The leading causes of maternal deaths were as follows: cardiac conditions (20.3%); indirect neurological conditions (13.8% deaths); sepsis (10.0%); pre-eclampsia and eclampsia (7.3%); and thrombosis and thromboembolism (6.9%). [33]

In South Africa, the five leading causes of maternal deaths at the national level, for the period of 2005-2007 were: non-pregnancy related infections (43.7%); hypertension (15.7%); obstetrical haemorrhages (12.4%); pre-existing maternal diseases (6%); and pregnancy-related sepsis (5.6%). [4]

In other parts of the world haemorrhage or sepsis are the leading causes of deaths. An analysis of causes of maternal deaths in a facility-based investigation conducted by Kongnyuy et al. on 43 cases in Malawi reveals that the leading causes were obstetrical haemorrhage (30.3%), postpartum sepsis (16.3%), HIV/AIDS (16.3%), ruptured uterus (7%), complications of miscarriage (7%), anaemia (7%), and eclampsia (4.7%). In Africa, obstetrical haemorrhage is the leading cause of maternal death. [34] Pregnancy-related sepsis was the leading cause of maternal deaths in Tribhuvan University Teaching Hospital in Nepal between 1997 and 2006. [35] The leading causes of maternal

deaths in 2002 in Argentina were as follows: miscarriage (27.4%); haemorrhage (22.1%); infection/sepsis (9.5%); and hypertensive disorders (8.4%). [28]

Annually, one in eight maternal deaths (an estimated 67000 deaths occurring worldwide) is caused by unsafe abortion.[36]

4.4. DETERMINANTS OF MATERNAL DEATHS

More than any other factor, the quality of care received by patients appears to be the most influential determinant of maternal deaths. [2, 28, 31] Ramos et al. found that the larger the hospital size, the lower the risk of maternal death is. This is explained by the fact that in larger hospitals there are comprehensive obstetric care and specialist staff available. [28]

Seasonal variations of MMRo have been observed in Mozambique where the number of maternal deaths is higher at the beginning and at the end of the rainy season. Romagosa and colleagues, investigating seasonal variations in maternal mortality in Maputo, found that malaria-specific MMRo was significantly higher during the rainy season. [37]

Two studies have found that the patient's race is associated with maternal deaths. A study conducted in France [38] and an analysis of vital registration statistics in the United States of America [39] revealed that Black populations were more likely to suffer maternal deaths than their White or Hispanic counterparts. In the study conducted in France these rates were adjusted for socio-economic circumstances and education levels of the deceased. According to Saving Mothers' lives report of 2006-2008, Black African women and Black Caribbean women were more likely to die in the UK than their White counterparts with a risk ratio of 2.35 and 2.45 respectively. [33]

Determinants of unsafe abortion related maternal deaths include: restrictive abortion legislation; lack of women's empowerment; inadequate contraceptive services; poor social support for women; and inadequate health services/systems. [40] It is estimated

that more than 90% of Africans live in countries that have restrictive abortion laws as shown in the map below. [41]

Figure 2: Map of Africa depicting countries that have restrictive abortion law

Abortion laws in Africa

More than 90 per cent of Africans live in countries where abortion is restricted.

Abortion is allowed:
- only to save the woman's life, or prohibited altogether
- to preserve physical health
- to preserve mental health
- on socioeconomic grounds
- without restriction as to reason
- no data available

NINIAN CARTER/THE GLOBE AND MAIL » SOURCES: CENTER FOR REPRODUCTIVE RIGHTS; UNICEF; UN

Source: http://rudhro.wordpress.com/2010/05/11/africa%E2%80%99s-deadly-backroom-abortions/

With regard to confidential enquiries into maternal deaths, Hussein and colleagues argue that even when an adverse event such as a maternal death occurs there may still

be favourable circumstances or positive interventions that have taken place. [42] These circumstances or interventions should not be overlooked. The identification of favourable factors highlights strengths that exist within health systems and allows recommendations to capitalise and build on these. Their study, conducted in Ghana and Indonesia, showed that the identification of positive aspects within a confidential enquiry is a simple and acceptable modification of traditional ways of conducting an enquiry into maternal deaths.

4.5.   INTERVENTIONS TO REDUCE MATERNAL DEATHS

The major intervention that reduces maternal deaths is access to healthcare provided by skilled and trained healthcare workers in well-coordinated healthcare systems. The reduction of maternal deaths in China is attributed to the increase in the number of women delivering in hospital and women using contraceptive methods. [2, 31] Some interventions during the antenatal period have been found to be effective in reducing maternal mortality. In a meta-analysis carried out by Collin et al., interventions such as iron, calcium, and micronutrient supplementations, and prophylactic use of anti-malarial drugs and antibiotics were found to reduce maternal deaths substantially in Sub-Saharan Africa. The role of vitamin A supplementation requires further evidence. [43]

Karolinski et al. investigated on lost opportunities in the management of obstetric conditions to reduce maternal mortality. In their multicentre study conducted in Argentina and Uruguay, they determined that evidence-based practices that treat or prevent causes of maternal deaths were used only in 58% of circumstances where they were indicated when treating patients who died or those who suffered severe maternal morbidity. Such practices included the use of magnesium sulphate in eclampsia and severe pre-eclampsia; active management of third stage of labour; prophylactic use of antibiotics in preterm rupture of membrane; blood transfusion in severe haemorrhage; and timely caesarean section for obstructed labour. Lost opportunities therefore accounted for 42% of circumstances. Karolinski et al. remark further that an intervention was more likely to be used if it was intended to treat or cure a condition than when it was intended to prevent a condition. [44]

The use of misoprostol has been found to be effective in preventing postpartum haemorrhage; one of the leading causes of maternal deaths in many African countries. In a double blind randomised control trial, Hoj et al. found that sublingual misoprostol can significantly reduce the frequency of severe postpartum haemorrhage. [45]

A Cochrane review has shown that the effect of calcium gluconate on blood pressure (BP) is beneficial to pregnant women. The authors suggest that calcium supplementation during pregnancy, especially for those women with low dietary calcium intake or high risk of pre-eclampsia, reduces the risk of hypertension, pre-eclampsia, preterm birth, and in the composite outcome, maternal death or severe morbidity. [46, 47]

A number of other interventions during antenatal care can reduce the number of stillbirths and maternal deaths. For example, pre-conceptual folic acid, improvement in nutrition, management of infection, screening and management of communicable and non-communicable disease (diabetes, syphilis, malaria, and hypertension), and comprehensive emergency obstetric care are among interventions that are aimed at reducing the number of stillbirths but, in fact, also reduce the number of maternal deaths. [48]

5. METHODOLOGY

5.1. TYPE OF RESEARCH

This study can be viewed as an epidemiological study and a health systems research at the same time. It is an epidemiological study because it profiles maternal deaths at NDH on the basis of their clinical and demographic characteristics. Furthermore this study is also a health systems research as it seeks to explore the strengths and weaknesses of the functioning of the hospital and advise the hospital management on issues of policies and clinical guidelines with regard to patients' management.

5.2. STUDY DESIGN

The study design of this retrospective medical records review is an observational cross-sectional survey. Patients' medical records were reviewed using a pre-designed structured data collection sheet.

5.3. SETTING

The study was carried out at NDH in Pietermaritzburg, South Africa. NDH is a district hospital in the uMgungundlovu health district of KZN province.

5.3.1. Catchment area & catchment population

NDH catchment population was estimated at 582 700 inhabitants for the year 2010. [†] The hospital serves populations of Pietermaritzburg Central Business District and surrounding suburbs such as Northdale, Raisethorpe, Mountain Rise, Dunveria, Willowton, Eastwood, Glenwood and Woodlands.

[†] Source: KwaZulu-Natal Department of Health, Geographic Information Systems, Natalia House - Pietermaritzburg

5.3.2. The Obstetrics & Gynaecology unit

The NDH's O&G in-patient unit has four wards: labour ward (18 beds); postnatal ward (36 beds); antenatal ward (36 beds), and gynaecology ward (12 beds).

The O&G outpatient component comprise of ANC, termination of pregnancy (TOP) clinic, gynaecology clinic and family planning clinic.

Most maternal deaths happen in the O&G unit but they can also happen in other units such as the Casualty Department, female medical wards, Outpatient Departments, theatres, etc.

5.3.3. Patients' flow

The majority of patients come from the surrounding suburbs. Most of them are of middle or low income backgrounds. There are 24 clinics and community health centres that refer patients to Northdale. All these facilities offer ANC services, however only two conduct deliveries. Obstetric patients not in labour referred to this hospital are seen in the ANC where they are screened for high risk factors or any other problems. High risk patients are referred to Grey's Hospital for regional care. Some complicated cases that can be managed at the district level are kept at NDH. Low risk patients requiring admission, at 24 weeks or more gestation, are admitted either to the labour ward (if in established labour) or to the antenatal ward (if not in established labour). Patients under 24 weeks of gestation are admitted to the gynaecology ward. Patients who have delivered vaginally are observed in the postnatal ward for, at most, 12 hours before discharge. Uncomplicated post caesarean section patients are discharged on the 3rd post-operative day.

5.3.4. Staffing

Because NDH is a district hospital, there are no medical specialists in the O&G Unit. Care is provided by six medical officers, six advanced midwives and a number of basic

midwives, professional nurses, and staff nurses. The number of staff fluctuates with time in quantity and quality.

5.3.5. Levels of care and referral criteria

Northdale Hospital provides care to all low risk pregnant women. Stable ectopic pregnancies, safe abortions, antepartum haemorrhage with live fetus, stable postpartum haemorrhage, and pregnancy induced hypertension with no proteinuria are managed at NDH. High risk pregnant women, patients who are acutely ill and requiring admission to High Care or Intensive Care Units and complicated surgery are referred to Grey's Hospital for regional or tertiary care. Cases for referral to Grey's Hospital will include: severe pre-eclampsia; imminent eclampsia; eclampsia; antepartum haemorrhage with dead fetus; septic/unsafe abortion; anaesthetic complications; anaesthetic high risk patients; cardiac patients; uncontrolled epilepsy; uncontrolled asthma; and ectopic pregnancy with coagulopathy. These lists are not exhaustive but illustrative and based on common causes of maternal death.

5.3.6. Standard antenatal care at Northdale Hospital [49]

The ANC at NDH provides care for all low risk antenatal patients who book for maternity care. The standard package of care provided at a district hospital expected by any patient without complications will include the following:

- **First visit:**
  Booking for maternity care at NDH; confirmation of pregnancy; assessment of risk factors; determination of gestational age (by date of the last menstrual period, ultrasound, symphisis-fundal height and/or palpation); full patient medical history; relevant physical examination; screening tests (rhesus status, haemoglobin, syphilis, HIV, proteinuria and glucosuria); and health education with regard to pregnancy.
  Other tests that are not routinely offered may include ABO blood group, glucose tolerance test, Papanicolau cervical smear, and genetic screening.

After this first visit the patient is given a review date for subsequent visits at a 4-weekly intervals until the 36th week of gestation, thereafter at 2-weekly intervals until the 40th week of gestation followed by weekly visits up to 42 weeks.

- **Second visit:**
  Assessment of all test results and categorisation of patient as low risk or high risk

- **Subsequent visit:**
  Subsequent visits are meant to monitor the condition of the mother and the growth of the fetus.

5.3.7. Standard intrapartum care at Northdale Hospital [49]

A pregnant woman who presents in the labour ward is assessed by the midwife who takes vital signs, history of the presenting complaints, and risk factors. She is later on assessed by the doctor who determines whether the patient is in labour or not. The doctor institutes a management plan for the patient with regard to labour-related and labour-unrelated problems. Low risk uncomplicated patients in latent phase of labour are sent to antenatal ward for monitoring. Low risk patients not in labour, consulting for minor ailments, are given treatment and sent home. High risk patients are stabilised then transferred to Grey's Hospital. Low risk patients in active labour are kept in the labour ward. They are assessed 2-hourly and managed accordingly. Patients who have no test results for HIV or syphilis are counselled and tested accordingly.

5.4. TARGET POPULATION

The target population is defined as the population to which the results may be generalised. In this study we intend to generalise the findings to all pregnant women who seek care at a district hospital in KZN.

5.5. STUDY POPULATION

The study population is the population from which the sample will be drawn. Therefore all pregnant women who died during pregnancy or 42 days after delivery or termination of pregnancy at NDH during the study period constitute the study population.

5.6. SAMPLE SIZE

All the records that met the inclusion criteria were considered for the study. There were 61 pregnancy related deaths at NDH for the five-year period under review. All these 61 deaths met the criteria of maternal death and were therefore notified and included in the study.

5.6.1. Inclusion criteria

All patients' records for maternal deaths (see chapter 3 for definition of maternal death) that occurred from January 2006 to December 2010 were included.

5.6.2. Exclusion criteria

A case of maternal death is to be excluded only if its records are missing or destroyed to the extent that meaningful assessment is not possible. Because no maternal death record was missing and no maternal death record was destroyed to prevent assessment; all the 61 maternal deaths were notified and included in the study.

5.7. DATA SOURCES

Data was collected from patients' medical records comprised of:
- Clerk admission sheets;
- Doctors clinical notes;
- Nursing care and observation records;
- Prescription charts;
- Anaesthetic records forms;
- Operative notes;

- Fluid balance charts;
- Clinical incidence reports;
- MDNF and
- Any other document of significance.

5.8.   LIST OF VARIABLES

The complete list of variables is found in the data collection sheet (see annexure 1).
Some of the variables are listed below:
- Case number
- Date of death
- Age
- Gravidity
- Parity
- Number of antenatal visits attended
- Mode of delivery
- Pregnancy outcome
- HIV status
- Referral issues
- Anaesthesia issues
- History of prolonged labour
- Anaemia
- Primary cause of death
- Final cause of death
- Adverse events or factors
- Favourable events or factors
- Pregnancy outcome
- Classification of death
- Quality of medical records
- etc.

5.9. MEASUREMENT TOOL

A data collection sheet was developed based on the "TRACE" tool designed by Aberdeen University in Scotland and the South African MDNF. Some adaptations have been introduced in the tool to suit the objectives of the study in a South African setting (See annexure 1). The South African Assessor's form was not used because it is copyrighted and permission to use some of its aspects was not obtained.

The data collection tool has three main sections. The first section dealt with demographic and clinical data of patients. The second section investigated the causes of the deaths. The last section dealt with the quality of care with an emphasis on some recommendations of the "Saving Mothers Report".

5.10. VALIDITY OF MEASUREMENTS / VALIDITY OF THE TOOL

5.10.1.   Internal validity

The TRACE tool has been successfully used in studies in Ghana and Indonesia. [42, 50] It does not include much information with regard to demographic and socio-economic characteristics of the patients. The South African MDNF has been successfully used for more than a decade in South Africa for the purpose of maternal death reporting; however it does not collect favourable or positive incidents that occurred during the patient's management. The adjustments effected to the tool deal with these shortcomings on both the TRACE tool and the South African MDNF.

The tool was discussed with the researcher's supervisor, who is an obstetrician with expertise in maternal health. It was also piloted on a limited number of patients' medical records before its use. Minor adjustments to the data collection sheet were carried out before data collection.

5.10.1.1. Reduction of selection bias

All 61 maternal deaths were notified to the NCCEMD and were included in the study; therefore there was no selection bias.

5.10.1.2. Reduction of information bias

The investigator carried out the initial evaluation of the patient's medical record, and collected all demographic and clinical characteristics of patients. With regard to the cause of death and the quality or care, the investigator and two experienced obstetricians independently, assessed the patient's management. A meeting of all three assessors was later convened to discuss cases where there was a discrepancy in the findings.

5.10.2.   External validity

The primary purpose of the study is to inform policies at the NDH O&G unit. The results of this study can be generalised to other district hospitals in KZN province. The generalisation of the study's findings beyond the KZN district hospitals cannot be guaranteed.

5.11. DATA COLLECTION

There is a good maternal deaths patients' record keeping system in this institution. During this study copies of the patients' files kept by the Head of O&G were used after necessary approval by the hospital management and the KZN Department of Health. Demographic and clinical data were extracted and noted in the data collection sheet. Thereafter, analysis of the cause of death and the quality of care was carried out by the three assessors independently; looking for both adverse and favourable events/interventions. A meeting to discuss discordant findings was convened.

5.12. COMPOSITION OF THE ASSESSORS' PANEL

The assessors' panel was constituted by Professor J Moodley (Professor Emeritus of O&G, Women's Heath and HIV Research Group - Nelson R Mandela School of Medicine, UKZN), Dr MJ Titus (Chief Specialist and Head of O&G Department in the Pietermaritzburg Hospitals Complex), and Dr PN Makinga (the Investigator and Head of O&G at NDH). Professor J Moodley and Dr MJ Titus are experienced maternal death assessors who have had initial training on maternal death assessment through the

NCCEMD. The investigator has had formal training and long practical experience in Obstetrics.

5.13. DATA HANDLING

After the identification of all medical records to be included in the study, data was collected, captured, cleaned and analysed.

5.13.1.   Data capturing and data cleaning

5.13.1.1. Demographic and clinical data:

Collected data with regard to demographic and clinical characteristics was captured in the IBM SSPS (version 19) ‡ data file. A quick run through was done to check for data inconsistencies. Where inconsistencies were discovered, data cleaning was done by referring back to the data collection sheet. Findings from all three assessors were reconciled before data entry.

5.13.1.2. Quality of care data

Data related to quality of care was grouped into themes and recorded in a word processing file. These themes were created based on issues that were picked up more repeatedly during the process of maternal cases assessment.

5.13.2.   Data analysis

Data for demographic and clinical characteristics were entered and analysed using IBM SPSS (version 19.0). The following descriptive statistics were computed:

- Frequencies and percentages of some categorical variables;
- Means for continuous normally distributed variables and
- Medians and modes for non-normally distributed variables in the study population.

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‡ IBM SPSS (version 19) is a statistical software from the IBM corporation, which headquarters is situated at 1, New Orchard Road, Armonk-NewYork 10504-1722, United States 914-499-1900

No inferential statistics were computed as this is a purely descriptive study. However chi-square tests of association were computed to evaluate the strength of association between primary causes of deaths or death category on one hand and all other variables on the other hand.

The determination of cause of death and the assessment of quality of care were carried out by the panel of assessors referred to above. In order to avoid one member of the panel influencing the assessment of another, each member of the panel examined all medical records included in the study independently. Where two or all three members of the panel agreed on the cause of a particular death, that cause was retained as final assessment. However for cases where disagreement of all three members of the panel emerged, these cases were referred for further assessment by all the three members of the panel together. The same approach was used for categorising deaths.

Maternal deaths were therefore categorised into "avoidable deaths" and "non-avoidable deaths" as per the diagram below.

Figure 3: Categorisation of maternal deaths into five working categories
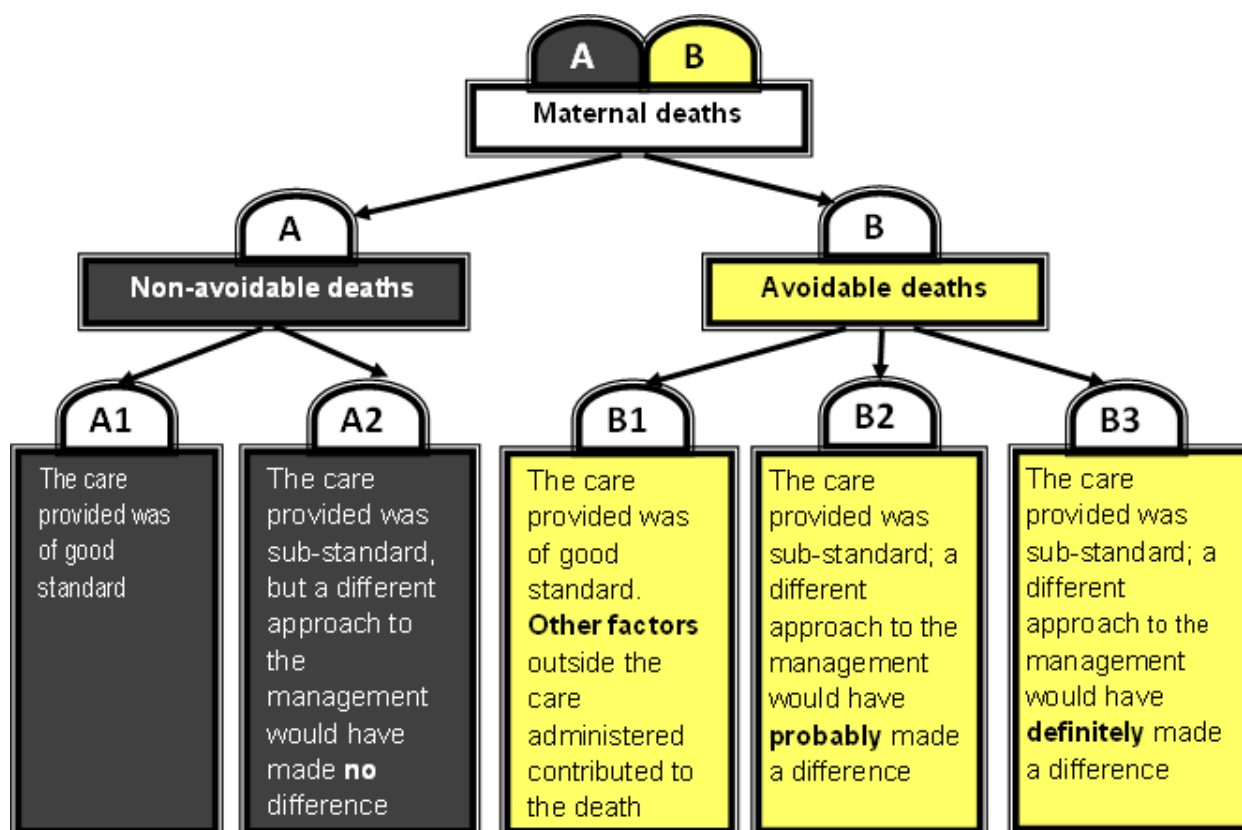
In categories A1 and A2 there are no avoidable factors identified. The only difference is that the care was of good standard for category A1 but substandard in category A2.

In categories B1, B2 and B3, there were avoidable factors: In Category B1, the avoidable factors are mainly patient-related; for instance a patient who presents him/herself late at the hospital with very low CD4 count may still die despite good management, a patient who refuses treatment, etc.

In categories B2 and B3, the avoidable factors are mainly healthcare worker- or administrative-related as referred to in section 3.11 above.

Substandard care referred here above means care that is judged to suboptimal care with regard to clinical and administrative management of patients.

5.14. ETHICAL CONSIDERATIONS

There were no major ethical issues related to this retrospective patients' charts review study. Issues regarding consent, confidentiality and ethical approval were addressed in the following manner:

5.14.1. Institutional review board

This protocol was submitted to the Biomedical Research Ethics Committee of the University of KwaZulu-Natal for ethical scrutiny and advice. Recommendations from this committee were taken into consideration and the protocol was approved on 12 July 2010 and re-certified on 15 September 2011. **(Ethics Reference number: BE218/09)**

5.14.2. Consent

As the study is a retrospective review of the records of maternal death patients, the consent to use these records was obtained from the hospital management.

5.14.3. Confidentiality

Information collected from these records was kept confidential. Data was collected in a manner that de-linked all patients' identifiers from the data collection sheet. During data collection, patients' records were kept in a secure cupboard, under lock-and-key.

5.14.4. Department of Health and hospital permissions

The investigator obtained authorisation to conduct the study from the Bio-ethics Committee of the KZN Department of Health and from the management of NDH.

5.14.5. Conflict of interest

No conflict of interest that warrants disclosure arose prior or during the execution of this study.

6. RESULTS

The results of the study will be presented in three main sections:

- Section 6.1: demographic and clinical characteristics of maternal deaths
- Section 6.2: primary and final causes of deaths.
- Section 6.3: Issues concerning quality of care

6.1. DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

The number of maternal deaths, the number of live births and the MMRo for each of the five years under review are shown in Table 1 below.

Table 1: Maternal deaths, live births and Maternal Mortality Ratio: 2006-2010

Year	Maternal deaths	Live births	MMRo*
2006	14	6796	206
2007	12	5678	211
2008	14	6400	219
2009	12	5665	212
2010	09	5344	168
Total	**61**	**29883**	**204**

* MMRo = Maternal Mortality Ratio

The mean age of cases was 28 years (SD = 6.4 years). The age range varied from 14 to 42 years. The majority of deaths were between 20 and 34 years old (70.5%); those between 25 and 29 years old contributing for 29.5% of the deaths. The prevalence of teenage pregnancy in this population was 11.5% and the prevalence of advanced maternal age was 18.0%. Figure 4 below summarises the number of deaths per age category.

Figure 4: Maternal deaths per age categories
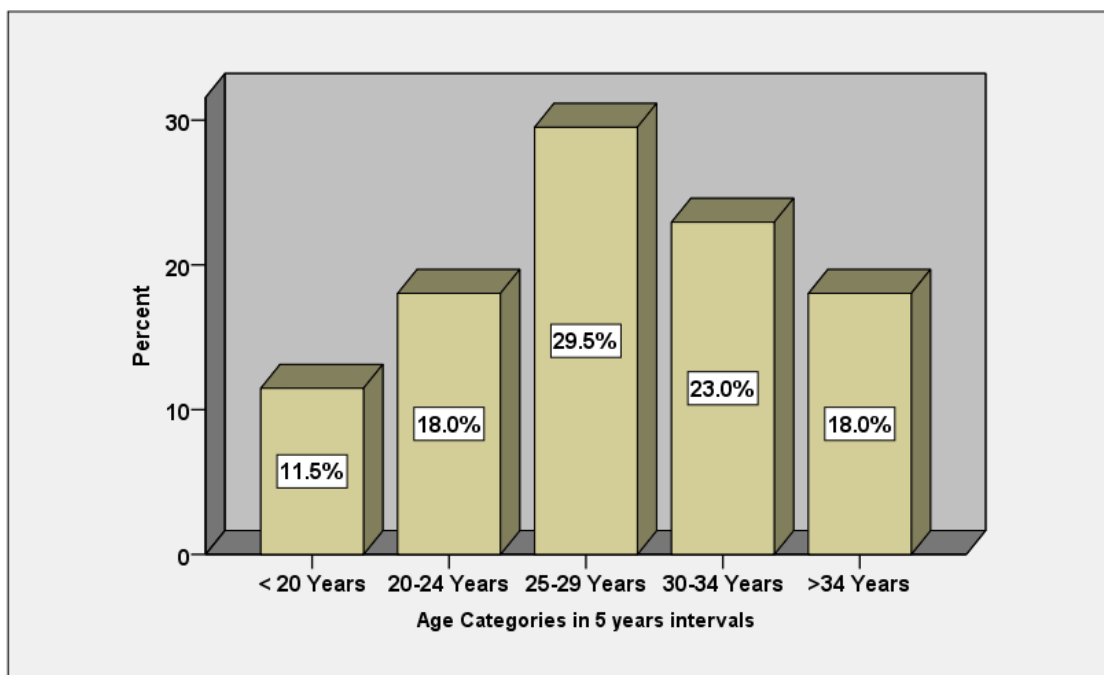
Of the 61 maternal deaths, 96.7% were of African descent and 3.3% were of Indian descent. Figure 5 represents the distribution of maternal deaths per race group.

Figure 5: Race groups of participants
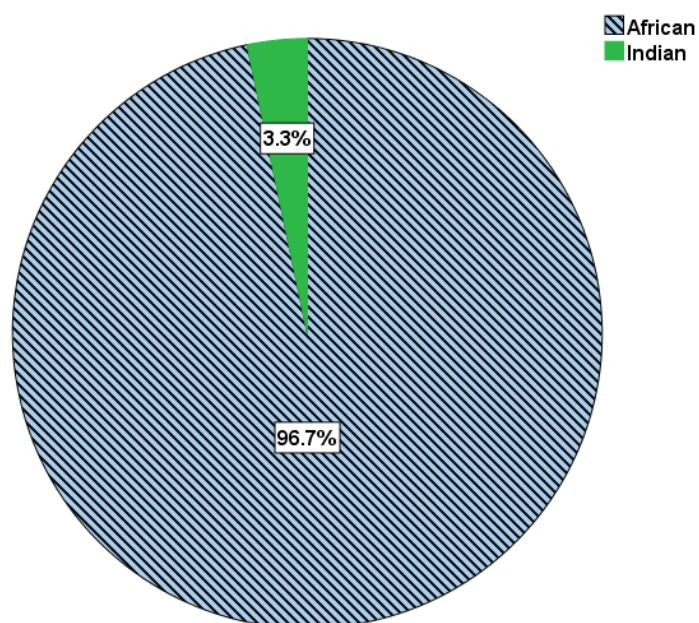
Most patients were either gravida 2 or gravida 3. The median and mean number of pregnancies per patient was 2 and 2.35 (SD=0.95) pregnancies. Figure 6 shows that the gravidity was normally distributed among maternal deaths.

Figure 6: Histogram of the distribution of the variable gravidity among participants
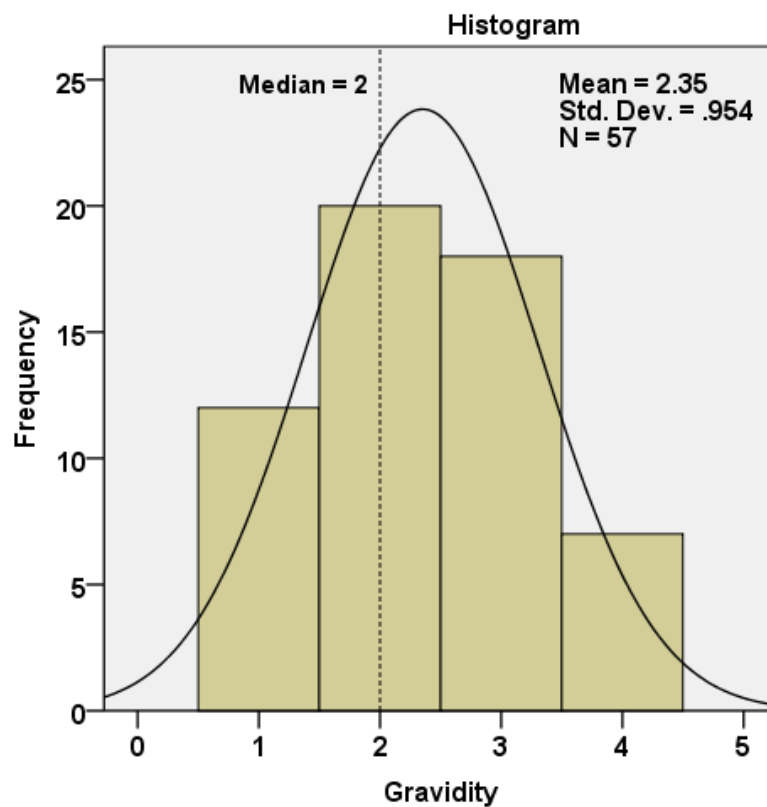
The mode, mean and median for parity were 1, 1.72 and 2 respectively. Figure 7 below shows that the variable parity was normally distributed among maternal deaths.

Figure 7: Histogram of the distribution of the variable parity among participants
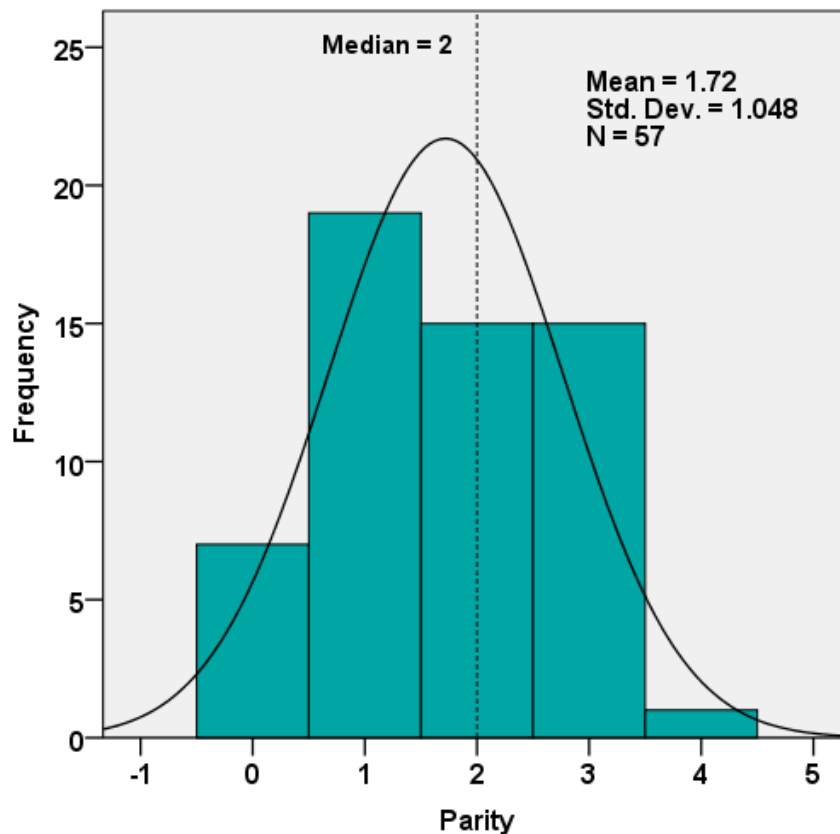
Of the 61 maternal deaths that occurred in the five years under review, only 33 patients (54.1%) attended ANC. Twenty one patients (34.4%) did not attended ANC. It was not possible to determine the antennal clinic attendance status of seven (11.5%) patients due to lack of documentation. Of the 33 patients who attended ANC, 19 patients (57.6%) booked at 20 weeks of gestation age or earlier. The above information is summarised in Figure 8 below.

Figure 8: Attendance of antenatal clinic of participants
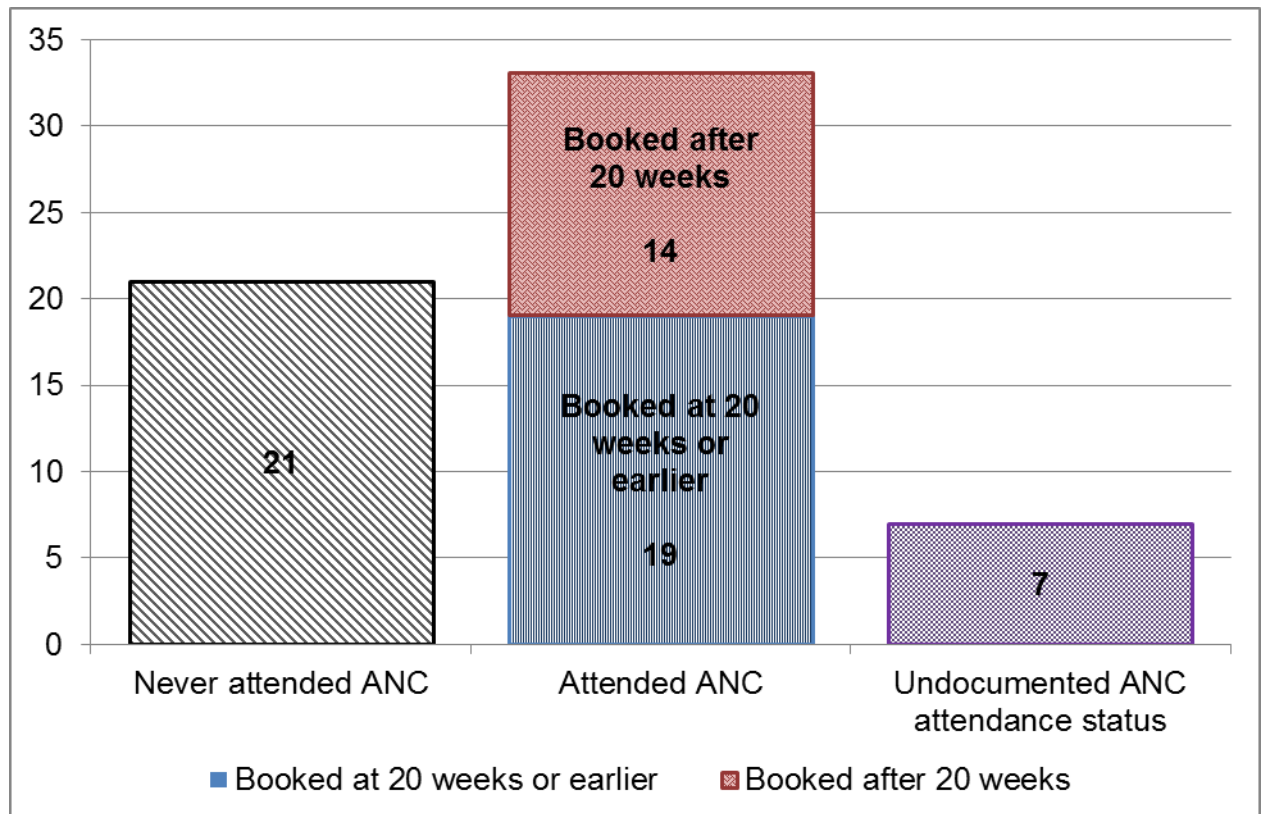
The number of antenatal care visits per patient varied widely as shown by the following measures of central tendency and spread: minimum = 1 visit; maximum = 10 visits; median = 4 visits; mean = 4.24 visits (SD = 2.6); mode = 3 visits and Skewness coefficient = 0.59 (SE = 0.41).

Figure 9: Histogram of the distribution of number of antenatal visits per participants
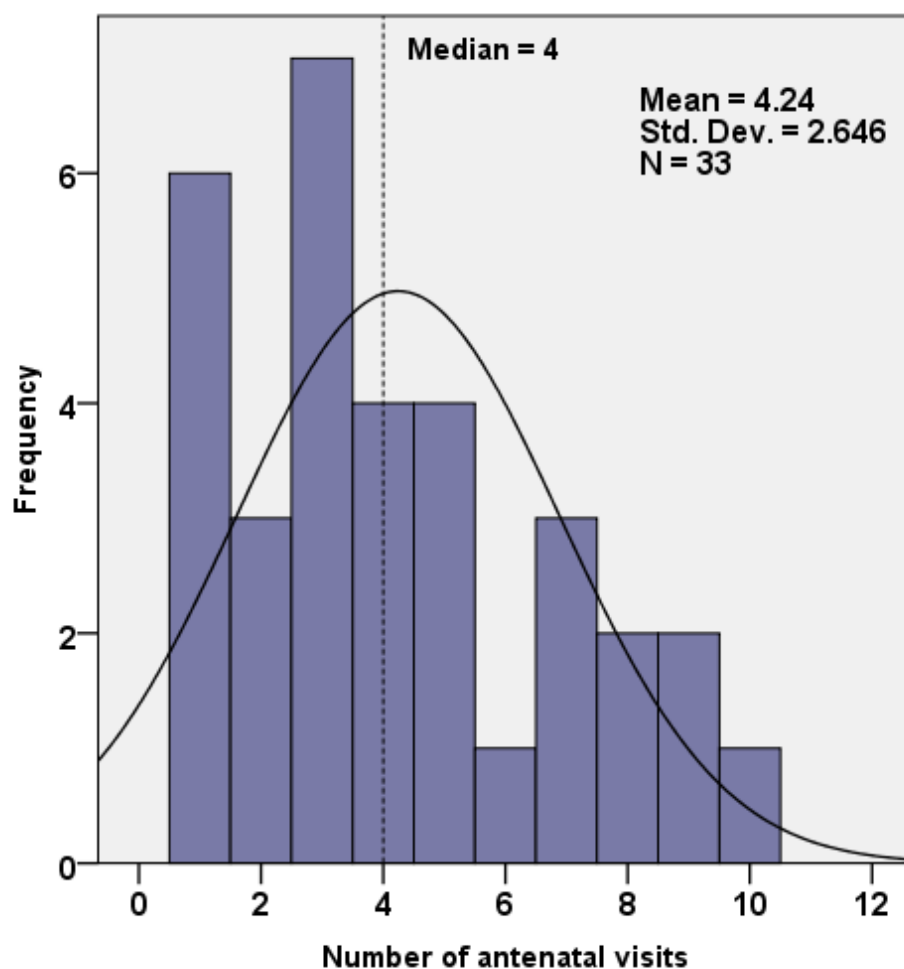
The majority of maternal deaths, 41 out of 61patients (67.2%) occurred during the third trimester of pregnancy as shown in Table 2 below.

Table 2: Gestational age by trimester at the time of the participant's deaths

Gestational trimester	N	%
Trimester 1	3	4.9%
Trimester 2	16	26.2%
Trimester 3	41	67.2%
Unknown	1	1.6%
Total	**61**	**100.0%**

The study also investigated the outcome of the last pregnancy at the time of the patient's death. It was revealed that at the time of death, 27.9% of patients were undelivered, 45.9% had delivered, 1.1% had an illegal TOP and 24.6% had a "presumed" spontaneous abortion. Details about the mode and place of delivery are shown in Table 3 below.

Table 3: Pregnancy outcome and mode and place of delivery

Pregnancy outcome	N	%
Undelivered	**17**	**27.9%**
Delivered	**28**	**45.9%**
Mode of delivery		
Vaginal delivery (N=28)	*22*	*78.6%*
Caesarean section (N=28)	*6*	*21.4%*
Place of delivery		
Hospital/clinic delivery(N=28)	*21*	*75.0%*
Home delivery(N=28)	*7*	*25.0%*
Presumed spontaneous abortion	**15**	**24.6%**
Illegal termination of pregnancy	**1**	**1.6%**

Some of the underlying factors investigated include anaemia during the last admission. Anaemia was defined as documented formal haemoglobin of less than 10g/dl. The cross-tabulation between anaemia and primary cause of death is shown in Table 4 below. (Chi-square = 39.3; df = 20; p-value = 0.006).

Table 4: Distribution of anaemia in each cause of death

| | | Haemoglobin < 10g/dl at last admission? | | | Total |
		Yes	No	Unknown	
Abortion	Count	7	2	0	9
	% within cause of death	77.8%	22.2%	.0%	100.0%
	% within Hb. status	19.4%	9.5%	.0%	14.8%
	% of Total	11.5%	3.3%	.0%	14.8%
Pregnancy related Sepsis	Count	2	2	0	4
	% within cause of death	50.0%	50.0%	.0%	100.0%
	% within Hb. status	5.6%	9.5%	.0%	6.6%
	% of Total	3.3%	3.3%	.0%	6.6%
Postpartum Haemorrhage	Count	0	0	1	1
	% within cause of death	.0%	.0%	100.0%	100.0%
	% within Hb. status	.0%	.0%	25.0%	1.6%
	% of Total	.0%	.0%	1.6%	1.6%
Acute collapse	Count	3	1	1	5
	% within cause of death	60.0%	20.0%	20.0%	100.0%
	% within Hb. status	8.3%	4.8%	25.0%	8.2%
	% of Total	4.9%	1.6%	1.6%	8.2%
Anaesthetic related	Count	1	2	0	3
	% within cause of death	33.3%	66.7%	.0%	100.0%
	% within Hb. status	2.8%	9.5%	.0%	4.9%
	% of Total	1.6%	3.3%	.0%	4.9%
Antepartum Haemorrhage	Count	1	0	0	1
	% within cause of death	100.0%	.0%	.0%	100.0%
	% within Hb. status	2.8%	.0%	.0%	1.6%
	% of Total	1.6%	.0%	.0%	1.6%
Embolism	Count	0	1	0	1
	% within cause of death	.0%	100.0%	.0%	100.0%
	% within Hb. status	.0%	4.8%	.0%	1.6%
	% of Total	.0%	1.6%	.0%	1.6%
Hypertension	Count	0	0	1	1
	% within cause of death	.0%	.0%	100.0%	100.0%
	% within Hb. status	.0%	.0%	25.0%	1.6%
	% of Total	.0%	.0%	1.6%	1.6%
Non-Pregnancy Related Sepsis	Count	21	11	1	33
	% within cause of death	63.6%	33.3%	3.0%	100.0%
	% within Hb. status	58.3%	52.4%	25.0%	54.1%
	% of Total	34.4%	18.0%	1.6%	54.1%
Pre-existing maternal conditions	Count	1	1	0	1
	% within cause of death	50.0%	50.0%	.0%	100.0%
	% within Hb. status	2.8%	4.8%	.0%	3.3%
	% of Total	1.6%	1.6%	.0%	3.3%
Unknown	Count	0	1	0	1
	% within cause of death	.0%	100.0%	.0%	100.0%
	% within Hb. status	.0%	4.8%	.0%	1.6%
	% of Total	.0%	1.6%	.0%	1.6%
Totals	**Count**	**36**	**21**	**4**	**61**
	% within cause of death	**59.0%**	**34.4%**	**6.6%**	**100.0%**
	% within Hb. status	**100.0%**	**100.0%**	**100.0%**	**100.0%**
	% of Total	**59.0%**	**34.4%**	**6.6%**	**100.0%**

Taking acute collapse as an example data in this table can be understood in the following manner: there were five deaths due to acute collapse; of which three had anaemia, one had no anaemia and one had unknown anaemia status. The 3 patients who had anaemia among acute collapse deaths represent 60% of deaths due acute collapse, or 8.3% of all deaths that had anaemia, or 4.9% of all 61 deaths.

Of the 61 maternal deaths, eight patients (13.1%) underwent procedures under anaesthesia; six had a caesarean section and two had an evacuation of retained products of conception (ERPOC). Half of those who had caesarean section had unsatisfactory outcomes of the procedure. Table 5 below represents the cross-tabulation between the surgical procedure and primary cause of death. (Chi-square = 41.11; df = 20; p-value = 0.004).

Table 5: Cause of death versus surgical procedure undergone by the patient

		Surgical procedure			Total
		None	Caesar. section	ERPOC*	
Abortion	Count	8	0	1	9
	% within cause of death	88.9%	.0%	11.1%	100.0%
	% within surgical procedure	15.1%	.0%	50.0%	14.8%
	% of Total	13.1%	.0%	1.6%	14.8%
Pregnancy related Sepsis	Count	3	1	0	4
	% within cause of death	75.0%	25.0%	.0%	100.0%
	% within surgical procedure	5.7%	16.7%	.0%	6.6%
	% of Total	4.9%	1.6%	.0%	6.6%
Postpartum Haemorrhage	Count	1	0	0	1
	% within cause of death	100.0%	.0%	.0%	100.0%
	% within surgical procedure	1.9%	.0%	.0%	1.6%
	% of Total	1.6%	.0%	.0%	1.6%
Acute collapse	Count	3	2	0	5
	% within cause of death	60.0%	40.0%	.0%	100.0%
	% within surgical procedure	5.7%	33.3%	.0%	8.2%
	% of Total	4.9%	3.3%	.0%	8.2%
Anaesthetic related	Count	0	3	0	3
	% within cause of death	.0%	100.0%	.0%	100.0%
	% within surgical procedure	.0%	50.0%	.0%	4.9%
	% of Total	.0%	4.9%	.0%	4.9%
Antepartum Haemorrhage	Count	1	0	0	1
	% within cause of death	100.0%	.0%	.0%	100.0%
	% within surgical procedure	1.9%	.0%	.0%	1.6%
	% of Total	1.6%	.0%	.0%	1.6%
Embolism	Count	1	0	0	1
	% within cause of death	100.0%	.0%	.0%	100.0%
	% within surgical procedure	1.9%	.0%	.0%	1.6%
	% of Total	1.6%	.0%	.0%	1.6%
Hypertension	Count	1	0	0	1
	% within cause of death	100.0%	.0%	.0%	100.0%
	% within surgical procedure	1.9%	.0%	.0%	1.6%
	% of Total	1.6%	.0%	.0%	1.6%
Non-Pregnancy Related Sepsis	Count	32	0	1	33
	% within cause of death	97.0%	.0%	3.0%	100.0%
	% within surgical procedure	60.4%	.0%	50.0%	54.1%
	% of Total	52.5%	.0%	1.6%	54.1%
Pre-existing maternal conditions	Count	2	0	0	2
	% within cause of death	100.0%	.0%	.0%	100.0%
	% within surgical procedure	3.8%	.0%	.0%	3.3%
	% of Total	3.3%	.0%	.0%	3.3%
Unknown	Count	1	0	0	1
	% within cause of death	100.0%	.0%	.0%	100.0%
	% within surgical procedure	1.9%	.0%	.0%	1.6%
	% of Total	1.6%	.0%	.0%	1.6%
Total	**Count**	**53**	**6**	**2**	**61**
	% within cause of death	**86.9%**	**9.8%**	**3.3%**	**100.0%**
	% within surgical procedure	**100.0%**	**100.0%**	**100.0%**	**100.0%**
	% of Total	**86.9%**	**9.8%**	**3.3%**	**100.0%**

* ERPOC = Evacuation of Retained Product of Conception
Taking abortion as an example data in this table can be understood in the following manner: there were 9 deaths due to abortion; of which 8 had no surgical procedure, none had caesarean section and one had ERPOC. The 1 patient who had ERPOC among abortion deaths represents 11.1% of deaths due abortion, or 50% of all deaths that had ERPOC, or 1.6% of all 61 deaths.

Only 45 patients out of 61 maternal deaths were tested for HIV. This implies a 73.8% HIV test coverage among all maternal deaths. Of the 45 patients who were tested, 39 tested positive. This implies an HIV prevalence rate of 86.7% in the tested population. The syphilis and diabetes screening test coverages were 37.7% and 3.3% respectively. Table 6 below indicates how many patients were screened for these conditions as recommended by the "Saving Mothers Reports".

Table 6: Screening for HIV, syphilis, and diabetes among all maternal deaths

	HIV		Syphilis		Diabetes	
	N	%	N	%	N	%
Tested / screened	45	73.8%	23	37.7%	2	3.3%
Tested positive	*39*	*86.7%*	*2*	*8.7%*	*0*	*0.0%*
Tested negative	*6*	*13.3%*	*19*	*82.6%*	*2*	*100%*
Results not available	*0*	*0.0%*	*2*	*8.7%*	*0*	*0.0%*
Not tested	16	26.2%	38	62.3%	59	96.7%
Total	**61**	**100.0%**	**61**	**100.0%**	**61**	**100.0%**

The screening rates for HIV and syphilis look much improved when computed on those who attended antenatal care only as shown in Table 7 below.

Table 7: HIV, syphilis, and diabetes screening among those who had antenatal care

	HIV		Syphilis		Diabetes	
	N	%	N	%	N	%
Tested / screened	31	93.9%	22	66.7%	2	6.1%
Tested positive	*26*	*83.9%*	*1*	*4.5%*	*0*	*0.0%*
Tested negative	*5*	*16.1%*	*19*	*86.4%*	*2*	*100%*
Results not available	*0*	*0.0%*	*2*	*9.1%*	*0*	*0.0%*
Not tested	2	6.1%	11	33.3%	31	93.9%
Total	**33**	**100.0%**	**33**	**100.0%**	**33**	**100.0%**

The HIV test coverage on all maternal death patients remained more or less the same between 2006 and 2009 but dropped in 2010 as shown in the table below.

Table 8: HIV test coverage on all maternal death patients: 2006-2010

Year	All maternal deaths	Patients tested	
		N	%
2006	14	10	71.4%
2007	12	9	75.0%
2008	14	11	78.6%
2009	12	9	75.0%
2010	09	6	66.7%
Total	**61**	**45**	**73.8%**

Only 33 patients attended antenatal care. The HIV test coverage for each year on only those patients who attended antenatal care shows that the proportions of those who tested range from 88.9% to 100%. See Table 9 below

Table 9: HIV test coverage on maternal death patients who attended antenatal care

Year	Maternal deaths who attended ANC	Patients tested	
		N	%
2006	9	8	88.9%
2007	9	8	88.9%
2008	5	5	100.0%
2009	7	7	100.0%
2010	3	3	100.0%
Total	**33**	**31**	**93.9%**

Of the 39 patients tested positive for HIV infection, only 17 (43.6%) patients had their CD4+ cell count results. The mean CD4+ cell count was 187 cells per ml with the lowest CD4 cell count recorded of 3 cells per ml and the highest being 905 cells per ml. Two patients were on antiretroviral drugs yet there were no documented CD4 cell count results in their available records. Of the 17 patients who had their CD4 cell count results, 14 (82.4%) patients had a CD4 cell count of less than 200 cells / ml. The cut-off point of 200 cells /ml was used for eligibility for treatment from the time of the official launch of the ARV roll out in the public sector on 1st April 2004. [51] This cut-off point was moved from 200 to 350 cells /ml only on 1st April 2010. [52] Therefore, participants' status with regard to HIV test results, CD4 cell count results and treatment regimen is sketched in Figure 10 below using the cut-off point of 200 cells /ml.

Figure 10: Participants' HIV status, CD4 count results and treatment regimen
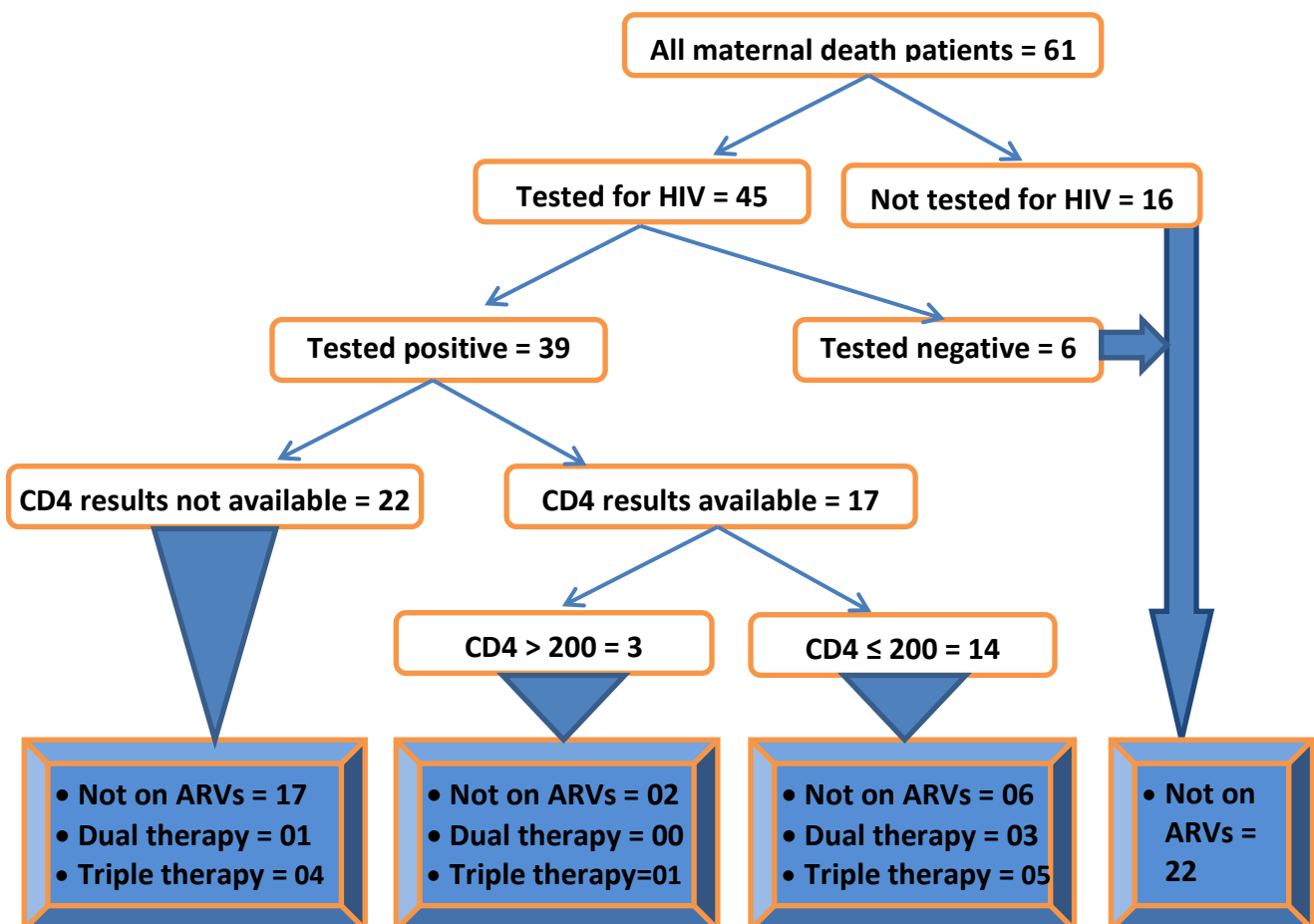
The length of hospital stay, excluding the patient who died before arrival at the hospital, varied widely from 30 minutes to 497 hours (which is equivalent to just under 21 days). The mean and the median length of hospital stay were 72.6 hours (SD= 96.35) and 41 hours respectively.

Figure 11: Distribution of the length of hospital stay (in hours) among participants
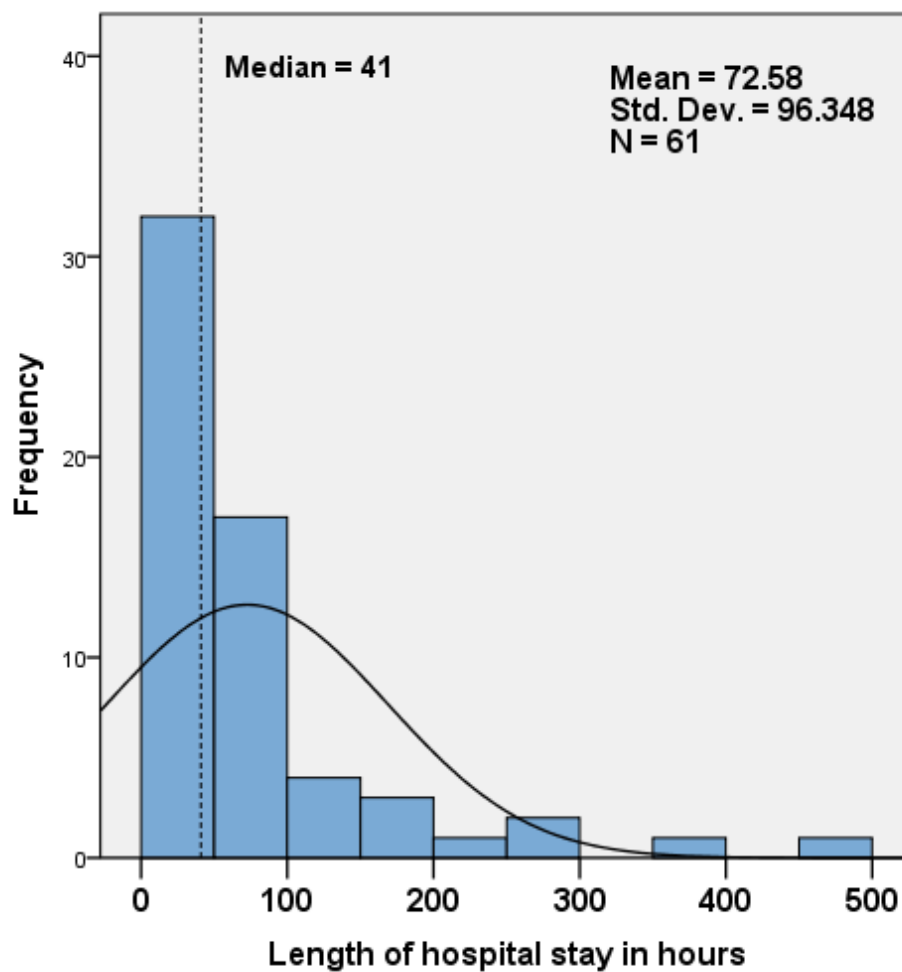
6.2. CAUSE OF DEATH

Primary and final causes of death were explored in all 61 cases of maternal deaths.

6.2.1. Primary causes of deaths

The five most common primary causes of maternal deaths at NDH were non-pregnancy related sepsis, which accounted for more than half of the deaths (54.1%), abortion (14.8%), acute collapse (8.2%), pregnancy related sepsis (6.6%), and anaesthetic complications (4.9%). Pre-existing maternal conditions contributed for 3.3% of deaths. Antepartum haemorrhage, postpartum haemorrhage, hypertension, embolism and unknown causes contributed 1.6% each. The chart below depicts to which extent each condition contributed to maternal deaths.

Figure 12: Primary causes of maternal death at Northdale Hospital: 2006-2010
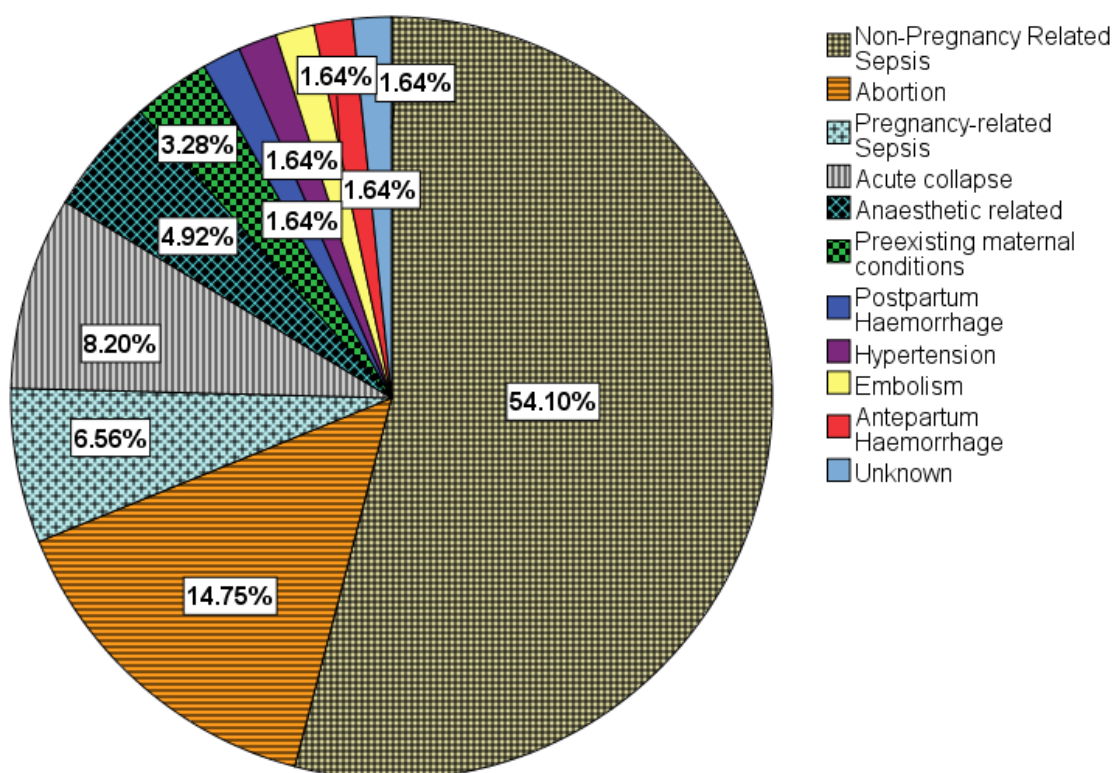
In comparing the profile of maternal deaths at national level to that at NDH, the table below displays the proportion of deaths due to each cause at NDH against the

proportion of deaths at provincial and national levels as presented in the fourth Saving Mothers Report. [4] See Table 10 below

Table 10: Primary causes of deaths at facility, provincial and national levels

Primary cause of deaths	Northdale Hospital 2006-2010		KwaZulu-Natal Saving Mothers 2005-2007 [¥]		South Africa Saving Mothers 2005-2007	
	N	%	N	%	N	%
Direct causes	**25**	**41.0%**	**361**	**38.6%**	**1819**	**45.9%**
Hypertension	*1*	*1.6%*	*113*	*12.1%*	*622*	*15.7%*
Postpartum haemorrhage	*1*	*1.6%*	*68*	*7.3%*	*383*	*9.7%*
Antepartum haemorrhage	*1*	*1.6%*	*13*	*1.4%*	*108*	*2.7%*
Ectopic pregnancy	*0*	*0.0%*	*12*	*1.3%*	*55*	*1.4%*
Abortion	*9*	*14.8%*	*34*	*3.6%*	*136*	*3.4%*
Pregnancy related sepsis	*4*	*6.6%*	*66*	*7.1%*	*223*	*5.6%*
Anaesthetic related	*3*	*4.9%*	*21*	*2.2%*	*107*	*2.7%*
Embolism	*1*	*1.6%*	*5*	*0.5%*	*57*	*1.4%*
Acute collapse	*5*	*8.2%*	*29*	*3.1%*	*128*	*3.2%*
Indirect causes	**35**	**57.4%**	**508**	**54.3%**	**1966**	**49.7%**
Non pregnancy-related infections	*33*	*54.1%*	*474*	*50.7*	*1729*	*43.7%*
*(AIDS included)**	*(32)*	*(52.5%)*	*(185)*	*(19.1%)*	*(915)*	*(23.1%)*
Pre-existing maternal diseases	*2*	*3.3%*	*34*	*3.6%*	*237*	*6.0%*
Unknown cause	**1**	**1.6%**	**66**	**7.1%**	**174**	**4.4%**
Total[¥]	**61**	**100.0%**	**935**	**100.0%**	**3959**	**100%**

* The figures referred to as AIDS indicate those patients who had an AIDS defining condition. These figures are a subgroup of the category of "Non pregnancy related infections" and should not be double counted

[¥] Data for KwaZulu-Natal and South Africa is taken from page 229 of the 2005-2007 Saving Mothers Report. It excludes coincidental deaths.

The analysis of indirect causes of deaths at the hospital reveals that, of the 35 patients who died of indirect causes, 32 died of an HIV/AIDS defining condition, one of hypoglycaemia, one of suicide and one of pneumonia/tuberculosis. See Table 11 below.

Table 11: Breakdown of indirect causes

Indirect cause of deaths	N	%
HIV/AIDS	32	91.4%
Pneumonia/Tuberculosis	1	2.9%
Diabetic hypoglycaemia	1	2.9%
Suicide	1	2.9%
Total	**35**	**100.0%**

Pearson Chi-square test of association were computed to test the strength of association between various variables and primary causes of death. Table 12 displays chi-square values of variables for which the p-value was statistically significant ($p<0.05$). The larger the chi-square value, the stronger the association between that variable and primary causes of deaths. The association between primary causes of deaths and gestational age was the strongest while the association between primary causes of deaths and racial group was the weakest.

Table 12: Strength of association between primary causes of deaths and various variables

	Chi-square	Degree of freedom	p-value
Racial group	24.31	10	0.00
Gestation age	194.69	162	0.04
Anaemia (Hb<10g/dl)	39.29	20	0.00
Pregnancy outcome	49.93	30	0.02
Mode of delivery	51.43	20	0.00
Was the patient tested for HIV	28.56	10	0.00
HIV test result	48.17	20	0.00
Results of RPR	60.94	30	0.00
Was the patient anaesthetised?	27.57	10	0.00
Surgical procedure	41.11	20	0.00
Outcome of the procedure	71.15	20	0.00

6.2.2. Final causes of deaths

Taking into account the failing organ or body system that ultimately led to death, the following were identified as final causes of deaths: cardiac arrest, cardiorespiratory failure, respiratory failure, cerebral complications, liver failure and multi-organs failure.

Figure 13: Final causes of maternal death at Northdale Hospital: 2006-2010
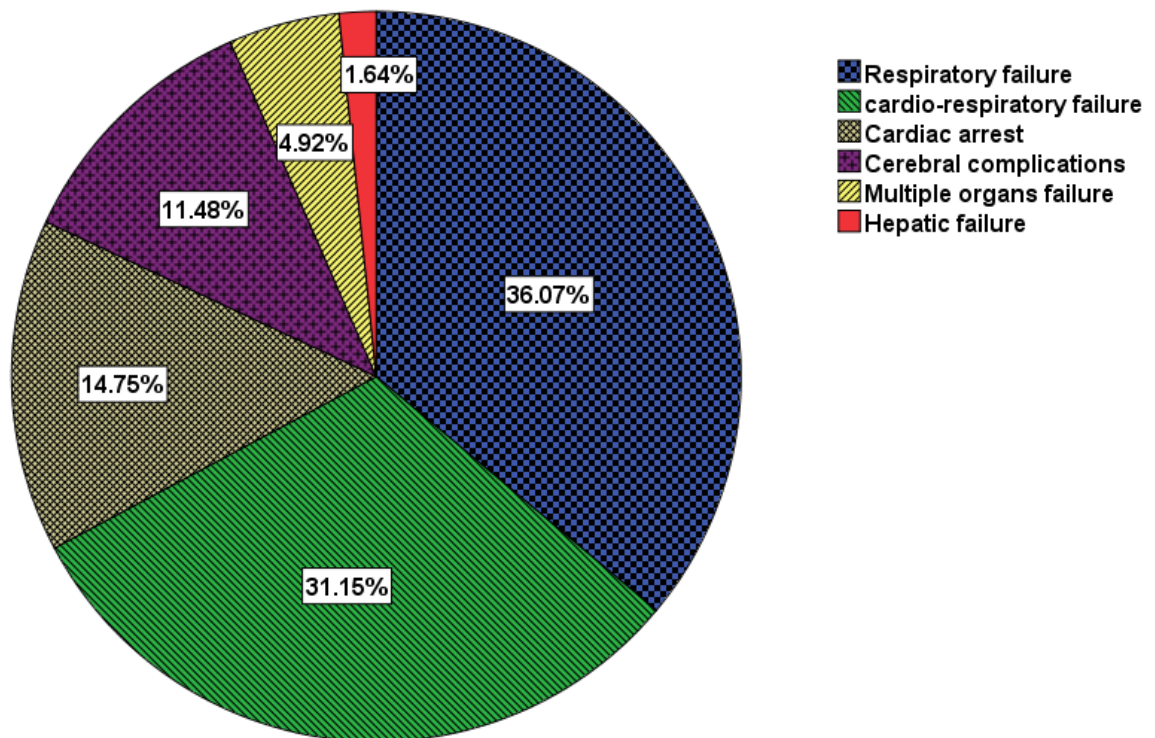
6.3. QUALITY OF CARE

The quality of care was assessed at three different dimensions:
  (1) For patients who were referred from other facilities, the reasons for referral were listed and some vignettes presented.
  (2) All cases were classified into two major categories depending on whether the death was avoidable or non-avoidable, these two major categories were further subdivided in five sub-categories depending whether the care was substandard on not. For those patients who had substandard care, it was also determined

whether or not a different approach to the management would have made a difference.

(3) Favourable and adverse incidents occurring during the patients' management were also analysed.

6.3.1. Reasons for referrals

Twenty two patients (36.1%) were referred to NDH from other health facilities. Out of the 22 referred patients, five (22.7%) were referred for complaints related to per vaginal bleeding, four (18.2%) for conditions related to central nervous systems, four (18.2%) for respiratory system related symptoms, two (9.1%) for hypertension in pregnancy and the rest for various indications. The complete list of reasons for referral is presented below:

- Confusion, memory loss, fever and poor appetite
- Dizziness, history of collapse, chest pains
- Coughing, fever, dyspnoea, night sweats
- Severe vaginal bleeding post TOP
- Hypertension, history of previous caesarean section
- Boarder mother whose neonate was referred to NDH for prematurity
- Coma
- Difficulties in breathing, coughing, vomiting
- Bleeding in pregnancy
- Twin pregnancy
- Confusion
- Renal failure
- Rectal sores, genital warts
- Poor progress of labour
- Low BP, fever, cough, oedema, distended and tender abdomen
- Incomplete abortion
- Burning on micturition, lower abdominal pains, urine retention, vaginal discharge
- Proteinuric hypertension
- Hypoglycemia and coma

- Vaginal bleeding, cough, dyspnoea, night sweats, oral thrush and loss of weight
- Vaginal bleeding
- Gastroenteritis

6.3.2. Classification of deaths: avoidable versus non-avoidable deaths

As indicated in the methodology section, each member of the panel assessed all 61 medical records independently with no undue influence of the other assessors. Each assessor was asked to categorise each case in one of the five sub-categories. After this first round of assessment there were cases where there was agreement among assessors and cases where there was no agreement. The level of agreement after the first round of assessment is summarised as follows: all three assessors agreed on 8 cases (13.1%) but disagreed on 11 cases (18.0%); on the remaining 42 cases (68.9%), two of the three assessors agreed. Where 2 assessors agreed their assessment was considered as final. In cases where all three assessors disagreed (11 cases), a meeting was convened where all the three assessors reassessed these cases together in order to reach a consensus.

Table 13: Level of agreement between assessors after independent assessment

Levels of agreement	N	%
All three assessors agree (A)	8	13.1%
All three assessors disagree (B)	11	18.0%
Two of the three assessors agree (C)	42	68.9%
Assessors 1 & 2 agree	*16*	*26.2%*
Assessors 1 & 3 agree	*12*	*19.7%*
Assessors 2 & 3 agree	*14*	*23.0%*
At least two assessors agree (A+C)	50	82.0%
Total (A+B+C)	61	100.0%

As stated earlier, all maternal deaths were categorised into two major categories: avoidable deaths versus unavoidable deaths. These two major categories were further

subdivided into subcategories based on whether the care provided was of good standard or substandard.

Thirty deaths (49.3%) were found to be avoidable. Thirty patients (49.3%) received substandard health care some from the group of the avoidable deaths and others from the group of unavoidable deaths. Of these 30 patients who received substandard care, a different approach in the management would have:

- Made **no** difference for eight patients (13.1%),
- **Probably** made a difference for 15 patients (24.6%), and
- **Definitely** made a difference for the remaining seven patients (11.5%).

Figure 14: Distribution of cases in five sub-categories of quality of care
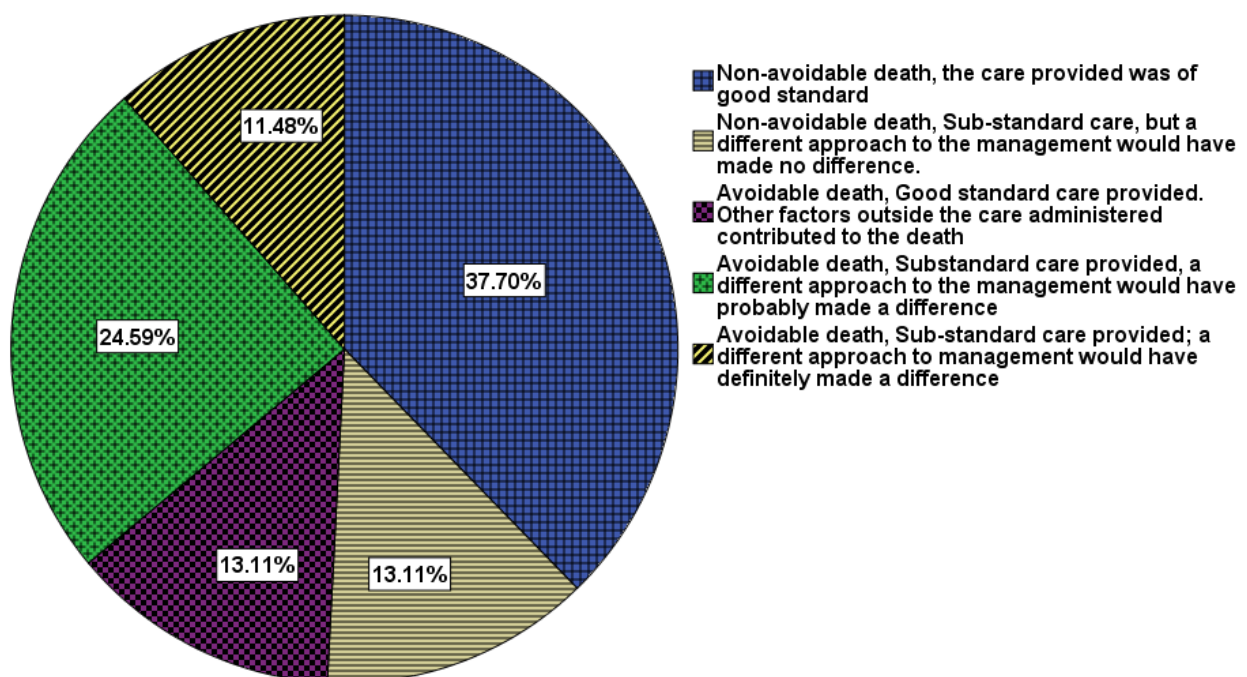
Substandard care was provided across the board: on some of the patients whose deaths were assessed as avoidable and on some of the patients whose deaths were assessed as unavoidable.

Table 14: Substandard care among avoidable and unavoidable deaths groups

		Avoidable deaths?		
		Yes	**No**	**Totals**
Sub-standard care?	**Yes**	22	8	30
	No	8	23	31
	Totals	30	31	**61**

Figures are absolute numbers

The causes of death for the seven patients whom the assessors thought that a different approach would have definitely made a difference included the following: non-pregnancy related sepsis - AIDS (3/7); embolism (1/7); abortion (1/7); postpartum haemorrhage (1/7); and acute collapse (1/7); (see table below).

Table 15: Causes of deaths for patients whom a different approach to management would have definitely made a difference

	N	**%**
Non-Pregnancy Related Sepsis	3	42.9
Abortion	1	14.3
Acute collapse	1	14.3
Embolism	1	14.3
Postpartum Haemorrhage	1	14.3
Total	**7**	**100.0**

The causes of death for the 15 patients whom the assessors thought that a different approach would have probably made a difference included the following: non-pregnancy related sepsis - AIDS (7/15); anaesthetic complications (3/15); pregnancy related sepsis (2/15); abortion (1/15); hypertensive disorders (1/15); and acute collapse (1/15); (see Table 16 below).

Table 16: Causes of deaths for patients whom a different approach to management would have probably made a difference

	N	%
Non-pregnancy related sepsis	7	46.7
Anaesthetic related	3	20.0
Pregnancy-related sepsis	2	13.3
Abortion	1	6.7
Acute collapse	1	6.7
Hypertension	1	6.7
Total	**15**	**100.0**

Pearson Chi-square tests of association were computed to test the strength of association between various variables and category of death. Table 17 displays chi-square values of variables for which the p-values were statistically significant (p <0.05). The larger the chi-square value, the stronger the association between that variable and. The association between category of death and the parity was the strongest while the association between category of death and the ARV therapy regimen was the weakest.

Table 17: Chi-square test of association between category of death and various variables

	Chi-square	Degree of freedom	p-value
Parity	26.99	16	0.04
Mode of delivery	17.70	8	0.02
Regimen of ARV therapy	15.77	8	0.04
Anaesthetised for which procedure?	18.62	8	0.01

6.3.3. Positive and negative incidents that occurred during patients' care

In the course of the management of these patients, favourable and adverse incidents occurred. This section presents both favourable and adverse events that occurred

during the management of the patients. Issues picked up during assessment (section C and D of the data collection form) were group into the following nine themes which were found to be common:

- Professional behaviour of health care workers
- Clinical management of patients
- Learning and quality improvement
- Availability of blood, blood products and emergency medications
- Referral to the regional hospital
- Private-public sectors partnership
- Quality of clinical and nursing records
- Anaesthesia and safety
- Patients' health-seeking behaviour

Information Box 1: Professional behaviour of health care workers

Positive incidents / Actions

- A multidisciplinary approach in managing a limited number of patients: medical officers in O&G received help from family physicians or the anaesthetic department.
- Most medical officers summoned for help responded positively to the call.
- Consultant anaesthetists came to NDH every time the anaesthetic medical officer called for help.
- Family physicians responded to two requests for consultation.
- In one instance a medical officer not on duty came to assist with resuscitation in the early hours of the morning as the medical officer on duty was occupied in theatre.
- In general the communication between NDH O&G medical officers and consultant obstetricians at Grey's Hospital has been excellent whenever advice was needed.
- On two occasions medical interns had to drive their personal cars to the blood bank to collect blood due to unavailability of drivers

Negative incidents / Actions

- In five instances senior doctors were not available when they were needed to review critically ill patients. Either they were busy in theatre, or refused to come and assess the patient or simply their phones were out of reach.
- The communication between casualty officers and the O&G medical officers leaves much to be desired. Emergency cases received by the casualty officers are not communicated to the O&G officers with the much needed sense of urgency. Cases are communicated to the O&G medical interns with no emphasis on the urgency and gravity of the case.
- Prolonged delays were noticed when family physicians were asked to review patients having medical conditions such as tuberculosis (TB), pneumocystis (carinii) jiroveci pneumonia, AIDS, renal failure, etc.
- Drivers were unavailable to take blood specimens to or collect blood products from the blood bank on a number of occasions.

Information Box 2: Clinical management of patients

Positive incidents / Actions	Negative incidents / Actions
• Most patients were properly assessed on admission and put on treatment such as IV antibiotics and anti TB treatment as required. Ceftriaxone and amphotericin-B were prescribed for bacterial or Cryptococcus meningitis. Hypertensive disorders in pregnancy were also properly treated with Magnesium sulphate and labetalol. • Baseline blood investigations were ordered for almost all patients. Lumbar punctures were performed on suspected cases of meningitis. • In most cases Interventions such as ERPOC were performed as required. • There were records of good patient monitoring for 10 cases • A number of patients were screened for one or more of the following conditions: diabetes, HIV, syphilis, anaemia and TB. • Only a few patients were started on HAART probably because the majority of HIV positive patients did not have their CD4 cell count results or were not clinically staged for	• In very few selected cases the diagnoses were not accurate: for instance a diagnosis of incomplete abortion (ICA) instead of septic ICA, asthma instead of pneumonia. On one case the diagnosis was unknown. Pulmonary embolism was not considered in severely distressed patients. In five cases no definitive diagnosis was made. WHO clinical staging was not routinely done in all HIV positive patients. • Crucial investigations were not done in 4 cases: arterial blood gas, chest X-Rays, liver function tests. A failed lumbar puncture by the medical intern was not attempted by a senior doctor. • Inappropriate management led to the deaths of some patients: conservative management instead of hysterectomy, use of oral antibiotics instead of intravenous antibiotics and delay in performing ERPOC. • One patient had a normal vaginal delivery and came back with secondary postpartum haemorrhage (PPH). • One patient died because of blood transfusion delays. The doctor waited for more than 24 hours for blood from blood bank

HIV/AIDS.

- Resuscitation was attempted in 17 cases with no success. "Do Not Resuscitate" directives were given by senior doctors in three instances due poor prognosis.
- The partogram was used in almost all cases that were in labour except where the patient was fully dilated on admission.

instead of using emergency blood.

- Resuscitation was not attempted in 22 cases: no reasons indicated in 20 cases but the other two were found already dead.
- One boarder mother waiting for her hospitalised neonate in the nursery died because of lack of regular check-up.
- Most patients were not screened for TB and sexually transmitted infections
- In two cases where patients were deteriorating the medical officer did not seek advice from the consultant.
- There was evidence of poor patient's monitoring. Patient's monitoring was left to junior staff in 6 cases.
- No action taken in a case of suspected pericarditis

Information Box 3: Learning and quality improvement

Positive incidents / Actions	Negative incidents / Actions
- All deaths were notified to NCCEMD - Perinatal mortality and morbidity meeting are held monthly	- Post-mortems should have been ordered on all three anaesthetic deaths and on a patient who was 32 weeks pregnant with history of one previous caesarean section, not in labour, where ruptured uterus was suspected.

Information Box 4: Availability of blood, blood products and emergency medications

Positive incidents / Actions	Negative incidents / Actions
• The availability of blood and blood products was satisfactory most of the times. Ten patients requiring blood transfusion received blood. • Resuscitation medications were available all the times.	• On one occasion there was only one pack of red blood cells in the emergency blood fridge. The patient needed more blood urgently. Patient died before more blood could be obtained from the blood bank.

Information Box 5: Referral to regional hospital

Positive incidents / Actions	Negative incidents / Actions
• Patients who were successfully referred to the regional hospital do not constitute part of the 61 maternal deaths being evaluated in this enquiry. • Two patients were accepted but died before the transfers took effect. • Two other patients were accepted but the transfers were called off because the patients were too unstable for transfer.	• Referral was declined for 11 patients due to the following reasons: Glasgow Coma Scale too low (1 case), HIV positive cannot be ventilated (2 cases), no beds available (2 cases), poor prognosis (1case), no obstetric problem (1case), no reasons found (4 cases). • There were 16 more cases that could have benefited from referral to the regional hospital but no attempts were made to refer these cases. These patients could not be nursed in NDH high care ward too due to lack of beds.

Information Box 6: Private-public sectors partnership

Positive incidents / Actions	Negative incidents / Actions
• No positive incident encountered	• One patient who attended ANC at a private general practitioner, presented to the hospital without antenatal records. Valuable information was therefore not available for the hospital staff use. • A patient was transferred from a private hospital in an unstable state with no prior attempt at resuscitation. Glasgow Coma Scale of 3/15 with severe hypoglycaemia. • Another private hospital sent a patient with no referral letter.

Information Box 7: Quality of clinical and nursing records

Positive incidents / Actions	Negative incidents / Actions
• All nursing notes were found to be of good quality: they were complete, dated and timed in chronological order. • Most medical progress notes were fairly good • Investigation results were all computer-printed: legible and clear for interpretation	• There was a comprehensive poor clinical note making in three cases. • Resuscitation efforts were poorly, sometime not all, recorded except in cases where the anaesthetists were involved (four cases). Notes about certification of death were also notoriously not made in most cases.

Information Box 8: Anaesthesia and safety

Positive incidents / Actions	Negative incidents / Actions
• Adequate resuscitation efforts were evident in all anaesthetic deaths.	• In one case the anaesthetist transferred a patient to the ward while still unstable; with a persistent high pulse rate. • There was also a case of fluid overload, and • A case where a patient arrested after being given midazolam in the waiting room with no staff monitoring the patient.

Information Box 9: Patients' health-seeking behaviour

Positive incidents / Actions	Negative incidents / Actions
• A limited number of patients showed positive behaviour such as early presentation to the hospital, good help-seeking behaviour every time they were ill, and good ANC attendance. Unfortunately these were in the minority.	• Several patients presented late at the hospital in critical condition. • Three patients arrived fully dilated in labour ward. • Several patients either did not attend ANC or booked late or attended antenatal care poorly. • Seven patients had home deliveries; one of these lived with a 7-year old girl only. She died before arrival.

7. DISCUSSION

7.1. DISCUSSING DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

Northdale Hospital has a good maternal deaths' reporting system. All maternal death medical records were located and included in the study. It is believed that there was no under-reporting of maternal deaths in this facility unless due to misclassification. Under-registration/under-reporting is more prevalent in population-based than in facility-based studies. [53, 54] Generally underreporting rate can be as high as 40% as suggested by Karimian-Teherani et al. and others studies. [53, 55, 56] By contrast a population-based study conducted in Argentina in 2002, found very low under-registration rates for maternal deaths (9.5%) and late maternal deaths (15.4%). [28]

Because of lack of previous audit in this facility, this study data will be compared with data at provincial and national level, and data of other facility-based studies conducted in other countries.

The number of maternal deaths at NDH has remained more or less the same over the past five years, showing a slight decline in 2010. Maternal deaths have declined from 14 deaths in 2006 and 2008 to 9 deaths in 2010. Considering that only eight deaths have occurred from January to October 2011, it is projected that the number of maternal deaths for 2011 will be more or less the same as for 2010. MMRo have also dropped from 219 in 2008 to 168 deaths per 100,000 live births in 2010. This decline of MMRo and the number of maternal deaths should be treated with caution as it may just be the effect of annual fluctuation in number of deaths and live births. This finding is in contrast to figures at the national and global levels where MMRo and absolute numbers of maternal deaths have increased. In its 4th Saving Mothers Report, the NCCEMD in South Africa found that there was an increase in "facility-based" reported maternal deaths: from 3296 deaths in the triennium 2002-2004 to 3959 deaths for the triennium 2005-2007 (coincidental deaths excluded). [4]

The average MMRo for the five-year period of study at NDH was 204 deaths per 100000 live births. This ratio is slightly higher than the KZN MMRo of 188 and 182 based on the number of maternal deaths reported to the NCCEMD for 2006 and 2007 respectively.[5] When compared with other facility-based ratios, NDH's ratio is lower than those observed in Nigerian towns of Sagamu (2989 deaths per 100000 live births for 2000 - 2005) and Benin City (518 deaths per 100000 live births for 1994 - 2003).[57, 58]

The estimates of UN-interagency also indicate that there has been an increase in maternal mortality in South Africa: from an MMRo of 230 in 1990 to 410 (uncertainty level: 240 to 610) in 2008.[2] A recent report on progress towards achieving the MDG5 published by the Human Rights Watch and a study by Hogan et al. suggest that there is an increase in MMRo in South Africa.[10, 59] Brazil and Argentina, two Southern American middle income countries, with similar levels of development as South Africa had much lower UN-interagency estimates of MMRo in 2008: 58 and 70 respectively.[60, 61] The prevalence of HIV/AIDS in adult population of 15 to 49 years in Argentina and South Africa in 2009 was 0.5% and 17.8% respectively. This huge difference in the prevalence of HIV in adults of reproductive age may explain the difference in MMRo.[31, 61-63]

Notwithstanding the fact that the increase may be due to a combination of a maturing reporting system and the actual increase in HIV/AIDS-related deaths, the number of maternal deaths reported to the NCCEMD may be even higher taking into account the issue of underreporting.

The mean age of cases of 28 ± 6.4 years is in keeping with what has been found in many others facility-based studies: in Argentina (29.1 ± 8 years),[28] Malawi (25.0 ± 6.8 years)[34] and Nigeria (28.9 ± 6.2 years).[57] Forty three maternal deaths (70.5%) were aged 20 to 34 years; this was the most affected group as supported by findings in other studies: 69.2% and >70% in studies done in Argentina and Uruguay,[44] and Nigeria[57, 58] respectively . The proportion of deaths in teenage (less than 20 years) and advanced maternal age patients (≥35 years) were 11.5% and 18.0% respectively. The fact that the number of deaths in the teenage category was less than in the other age categories can only be explained by the fact that, on one hand there are fewer teenagers getting pregnant than older women, and on the other hand, the lifetime risk of dying as a result

of childbearing increases as the parity or gravida status increases. Parity or gravida status increases with age. This finding is similar to what is found in other studies. In Mozambique and Nigeria ± 51% of maternal deaths were aged between 20 and34 years. [37, 58]

The majority (96.7%) of maternal deaths at NDH were of African descent with the remaining being of Indian descent. The racial distribution of maternal deaths in this study population is in keeping with the racial make-up of patients admitted to our labour ward.

The gravidity and parity status were normally distributed among maternal deaths at NDH with means of 2.35 (SD = 0.95) and 1.72 (SD=1.05) for gravidity and parity respectively. The majority of patients who are dying are either gravida 2- para 1 or gravida 3- para 2. These findings are similar to those of a study done in Afghanistan in 2008. [64] There were less gravida 4 or para 4 dying as a result of childbirth in the study population. This fact does not imply that the more children a woman has the less chance she has of suffering maternal death. Low figures in this parity or gravidity category only indicate that fewer women are getting pregnant after their third child due to the current socio-economic conditions.

The median and the mode of number of antenatal visits per participants were 4 and 3 visits respectively. This finding is similar to what was found by Karolinski et al. in Argentina and Uruguay. [44] Antenatal clinic attendance was poor among maternal deaths at NDH. Only 54.1% of patients had antenatal care. Of these; only 57.6% "booked" at 20 weeks or earlier. This discouraging finding, in a country where antenatal care is free in public sector, is in contrast to the finding on antenatal care attendance in the general population of South Africa. In a nation-wide multistage stratified sample survey done in South Africa, Shisana & colleagues [65] found that ANC attendance was 97.1% with an early booking (≤20 week-gestation) of 46.5% versus 57.6% in our study. It is likely that poor health seeking behaviour, which includes ANC non-attendance, contributed to the deaths of some of these patients. What is not clear though is the cause or factors associated with poor ANC attendance in this community. Further studies are needed to explore determinants of poor ANC attendance. Such low ANC attendance among

maternal deaths was also found in Afghanistan in 2005, [64] a country in a war situation since 2001.

The majority of deaths occurred during the third trimester of pregnancy (67.2%) or in the postpartum period (45.9%). The likelihood of dying during the third trimester may be linked to worsening physiological changes and immune systems as the pregnancy advances. This implies that clinicians should be very careful when treating very ill pregnant patients especially when they are in their third trimester gestational age. Romans et al. found that, generally, most maternal deaths occur between the third trimester and the first week following the end of pregnancy. [66] This finding is supported by data from Matlab, Bangladesh, where MMRe was more than 100 times higher on the first day after birth and 30 times higher on the second day after birth than in the second year postpartum. [67]

Twenty eight patients (45.9%) died during the postpartum period. Of these 28 patients who died after they had delivered, seven patients (25.0%) delivered at home. This figure is high for a country where health care and ambulance services for pregnant women are free. Further studies are needed to explore the determinants of place of delivery in this community. A study in Nigeria found that the woman's education level and employment status of the husband were determinants for a woman to deliver at the hospital. [68]

The prevalence of anaemia among maternal deaths was 59.0%. Of the 36 patients who had low haemoglobin during their last admission (<10g/dl), 21 patients (58.3%) died of non-pregnancy related sepsis, 7 (19.4%) of presumed spontaneous abortion, 3 (8.3%) of acute collapse, 2 (5.6%) of pregnancy related sepsis and 1 (2.8%) of each of the following: anaesthetic complications; antepartum haemorrhage; and pre-existing maternal conditions. Among these patients who had low haemoglobin, 21 (58.3%) attended ANC. Ideally anaemia should be corrected during antenatal care. Correction of anaemia is one of the measures that are used to prevent complications of postpartum haemorrhage. Anaemia may be caused by inadequate supplementation of iron and folates, mal-absorption of iron, drug induced bone marrow suppression, etc.

Out of the 11 patients who had a history of previous caesarean section, six were delivered by caesarean during their last pregnancy. The outcome of the procedure was unsatisfactory in three patients, leading to anaesthetic deaths. The proportion of caesarean sections that were complicated into death at NDH during the study period was 39 deaths per 100 000 caesarean sections (3 deaths for 7719 caesarean sections), which is 27 times lower than 1053 deaths per 100 000 caesarean sections (85 deaths for 8070 caesarean sections) observed in Malawi between 1998 and 2000, [69] but 40 times higher than 1 death per 100 000 caesarean sections (4 death for 425 000 caesarean sections) observed in the UK during the 2000-2002 triennium. [70] Various factors such as the pre-operative condition of the patient; the indication of caesarean section; the surgeon's and the anaesthetist's skills; and the availability of a critical care unit may confound the outcome. A case control study by Deneux-Tharaux et al. reveals that after adjustment for potential confounders, the risk of dying after caesarean section was 3.6 times higher than after vaginal delivery (odds ratio 3.64; 95% CI: 2.15– 6.19). [71]

The aim of the Prevention of Mother-to-Child Transmission (PMTCT) of HIV programme is to test every pregnant woman for HIV with the view of providing antiretroviral dual or triple therapy to those who are eligible in order to prevent the transmission of HIV to the fetus. This study has found that the rate of HIV testing was low among all maternal deaths at NDH. Only 45 out of 61 patients (73.8%) were tested for HIV. However the HIV test coverage rate was higher among those who attended antenatal care. Of the 33 patients who attended antenatal care, 21 (93.9%) were tested for HIV.

Of the 45 patients who were tested among all maternal deaths, 86.7% were tested positive; but of the 21 patients who were tested among those who attended antenatal care, 83.9% tested positive. This HIV prevalence rate is higher than the 29.4% and 39.5% prevalence rate observed in 2009 in the general population of ANC attendees survey nationally and provincially respectively, or the 47.3% HIV prevalence rate observed in maternal deaths reported nationally to the NCCEMD for the 2005-2007 triennium. [4]

There is a need to improve on the number of women tested for HIV. It is worth noting that the policy of Voluntary Counselling and Testing (VCT) may have contributed to this

low rate of women tested for HIV. Under the policy of VCT, a patient had to volunteer to be tested, and only then will she be counselled and tested for HIV. Currently the policy of VCT has been replaced by that of provider-initiated HIV Counselling and Testing (HCT), where the patient is offered counselling and is encouraged to test as for any other blood test; it is up to the patient to opt out of the HIV test if she so desires. The introduction of the provider-initiated HCT is expected to maintain the test coverage to above 95% for 2011. Already the HIV test coverage rate improved to 100% among maternal death patients who attended antenatal care for 2008, 2009, and 2010 at NDH.

The test coverage for syphilis is very low, yet antenatal screening for syphilis is one of the most effective ways of preventing congenital syphilis. [72-75] Only 37.7% of all maternal deaths or 66.7% of those who attended antenatal care were tested for syphilis. Currently local clinics send blood specimens to - and collect results from - the hospital. At times, results are lost or not collected from the hospital laboratories. The introduction of on-site rapid syphilis screening test kits at the beginning of 2011 will certainly eliminate result delays due to turnaround time. Some of these patients, who were not tested for HIV, were actually transferred from local community clinics. They should have been tested at these local clinics. Of the 22 patients who were referred from the other facilities, only 10 and 17 were tested for syphilis and HIV respectively.

The low rate of screening for diabetes mellitus may be explained by the fact that the prevalence of diabetes is less than 5% in African communities. Only patients who have glucosuria, excessive height of fundus, obesity (Body Mass Index > 29), history of macrosomic fetus or any other risk factors are screened for diabetes mellitus.

The mean length of hospital stay was 72.6 ± 96.4 hours. The fact that the median was only 41 hours and the distribution of the length of hospital stay presented a skewness coefficient of 2.46 (SE = 0.306) indicates that most patients were acutely ill or presented themselves in an emergency situation and died within 41 hours of the time of admission. It is therefore reasonable to state that patients should improve on their help-seeking behaviour and healthcare workers should improve their abilities and skills in dealing with emergency cases and acutely ill patients. Making sure that patients survive the first two days of hospitalisation may improve the survival rate.

7.2. DISCUSSING CAUSES OF DEATH

The five leading causes of death at the hospital are: non-pregnancy related sepsis; miscarriage; acute collapse; pregnancy related sepsis; and anaesthetic complications. As we suspected, this picture is different from what is found at national level; where non-pregnancy related sepsis remains the leading cause of death followed by hypertensive disorders, postpartum haemorrhage, pre-existing maternal diseases, and pregnancy related sepsis. The make-up of major causes at provincial level is more or less the same as at national level. Efforts should therefore be made to fight the leading causes at the local level if maternal death numbers are to be reduced. An effective PMTCT programme that provides highly active antiretroviral therapy (HAART) to the mothers who require it will be a key factor in reducing HIV/AIDS related deaths which accounted for more than half of all maternal deaths at NDH.

The proportions of each cause of death found in this study are different from those found in the hospital PPIP database. This difference is explained by the fact that PPIP data forms are completed by nurses and some time by doctors, junior or otherwise. By contrast the assessment of cause of deaths in this study was conducted by three doctors with vast experience in obstetrics.

Sepsis, haemorrhage, and hypertensive disorders are the leading causes of maternal deaths in Nigerian health facilities, [57, 58] as are haemorrhage, sepsis and HIV/AIDS in Malawi. [34, 76] One facility-based study found miscarriage to be the leading cause of maternal deaths in Argentina. [28] Globally, haemorrhage remains the leading cause. [66, 76]

The importance of having CD4 cell count results on time can never be sufficiently emphasised especially as the cut-off point of eligibility for treatment has been moved from 200 to 350 cells /ml. Some patients who are eligible for HAART on the basis of their CD4 cell count (≤350) may not show any signs of overt AIDS. Lack of CD4 cell count for such patients may considerably delay the initiation of HAART. Starting treatment early improves quality of life and prevents not only mother-to-child transmission of HIV but also transmission in sero discordant couples and acquisition of opportunistic infections. Of the 39 patients who tested positive for HIV, 27 were not on

HAART triple therapy yet they had either a CD4 cell count ≤ 200 or no CD4 cell count results at all. When analysing the cause of deaths in these 27 patients, it was found that 66.7% died of AIDS. Had CD4 cell count results been available and treatment started earlier, some of these lives could have been saved.

In comparison with the national level, there is an overrepresentation of miscarriage, acute collapse and anaesthetic related deaths at NDH: 14.8% versus 3.4% for miscarriage; 8.2% versus 3.2% for acute collapse; and 4.9% versus 2.7% for anaesthetic complications.

The overrepresentation of deaths due to presumed spontaneous miscarriage is a cause for concerns. Miscarriage has been cited as a leading cause of maternal death in Argentina. [28] A substantial number of miscarriages that are classified as "spontaneous" may actually be "illegal" abortions. No effort is made by health care workers to question the patients whether they have procured a TOP from individuals or institutions that are not designated to provide TOP services. Efforts need to be made to find out why there are so many deaths due to miscarriage. These cases were complicated with sepsis and haemorrhagic shock; being the major causes of death. Contributing factors to the deaths of those who had presumed spontaneous abortion or TOP included: late presentation to the hospital and inability of medical staff to manage these cases appropriately.

Medical staff need to be trained on how to manage these cases appropriately and detect early signs of likely complications. Current efforts that include referral of all septic miscarriage cases to the regional hospital are expected to pay dividends too. Hindrances to access to TOP services may be the cause of late presentation to the hospital. Access to care may be hindered by the limited number of facilities that offer TOP services, the geographic location of the facilities providing these services, the cost (which is not the issue in South African public sector), staff attitude (being judgemental towards patients), and poor health education given to the patient (it is believed that many general practitioners in the private sector initiate TOP but do not inform patients at what point they should go to the hospital for continuation of care). Only Edendale Hospital (public service regional hospital in Pietermaritzburg) and Marie stoppes clinic

(private reproductive health clinic) provide TOP services in the Msunduzi health subdistrict. All other health facilities are expected to provide family planning services.

In contrast; obstetrical haemorrhages, hypertensive disorders in pregnancy and ectopic pregnancy are under-represented in the study population. Of note there were no deaths secondary to ectopic pregnancy.

Factors that may explain the underrepresentation of deaths due obstetrical haemorrhages and ectopic pregnancy in the study may include the availability of blood and blood products, a high suspicion index for the diagnosis of these conditions and their early and appropriate management, and the emphasis placed on active management of the third stage of labour at NDH. These factors are key issues in eradicating haemorrhage related deaths.

Hypertensive disorders of pregnancy accounted for 1.6% of deaths (one death out of 61). Avoidable factors implicated in this death were mainly patient related. The patient was 28 weeks pregnant, never attended antenatal clinic and her HIV status was unknown. She was admitted in critical condition and demised after three hours only. Fewer deaths due to hypertensive disorders in pregnancy may be explained by the fact that all such cases presenting early are referred to the regional hospital. Current literature suggests that clinicians should be equally attentive to systolic BP as they are for diastolic BP. [77] Long standing high systolic BP has been associated with cerebral haemorrhages and maternal deaths. Clinical guidelines should be amended to include systolic BP of >160 mmHg as the cut-off point from which a rapid acting antihypertensive agent should be given, as it is the case with a diastolic BP of ≥ 110 mmHg.

More than 80% of deaths developed respiratory, cardiac or cardio-respiratory failure before dying. Another 4.9% developed multiple organ failure which included renal failure.

Based on chi-square test of association, the primary cause of death was found to be associated with racial group, gestational age, anaemia, pregnancy outcome, whether

the patient was tested for HIV or not, HIV test result, mode of delivery, syphilis test result, whether the patient was anaesthetised or not, for which procedure the patient was anaesthetised, and the outcome of the procedure.

7.3. DISCUSSING QUALITY OF CARE

The commonest causes of referral included per vaginal bleeding, central nervous system complications and respiratory related problems. Patients referred with these conditions should be assessed promptly and referred to the regional hospital or to the physician for advice as appropriate.

There was a high level of agreement among panel members with regard to classification of deaths. At least 2 assessors agreed in the majority (82.0%) of cases. All three disagreed in only 18.0% (11/61) of cases. This negligible level of disagreement may be attributed to the following factors:

- Assessors were left to make independent decisions when categorising these deaths without being influenced by the other members of the panel.
- There were five categories into which deaths were supposed to be classified. A limited number of categories, for instance two or three could have yielded a much higher lever of agreement.
- It was difficult to dissociate the care received by referred patients at the referring facility from the care rendered at NDH. There were cases where one assessor thought we cannot dissociate the care received at the clinic to that rendered at the hospital; because the hospital and the clinic are elements of a single health system. The other assessor thought that only care rendered at the hospital should be assessed. This led to the two assessors categorising some deaths differently.

The proportion of avoidable deaths was as high as 49.2% and the same proportion of patients received sub-standard care in one way or the other. Concerted efforts should be made to reduce both the number of avoidable deaths and the incidence of substandard care. Further research is needed to determine the contributing factors to the high proportion of sub-standard care. Some areas to be explored include:

understaffing; staff skills; staff attitude; equipment needs; availability of essential drugs and other consumables; etc.

The assessors thought that a different approach to management would have **definitely** made a difference for seven patients. Three of these patients died of HIV/AIDS and the other four patients in this category died of abortion, embolism, acute collapse and postpartum haemorrhage. Patients for whom the assessors thought a different approach to the management would have **probably** made a difference died of non-pregnancy related sepsis; pregnancy related sepsis; anaesthetic complications; abortion and acute collapse. These are treatable obstetrical emergencies that need to be taught to medical and nursing staff. Even in case of HIV/AIDS clinicians should not just surrender. Lives can be saved if sufficient efforts are made to provide quality health care at early stages.

Based on Chi-square test of association, the variable "category of death" was found to be significantly associated with parity, mode of delivery, surgical procedure done on the patient, and the ARV regimen received by the patient.

Northdale Hospital should capitalise on the already existing strengths in its systems. These strengths include:
- The multidisciplinary approach in dealing with emergencies: anaesthetists joined forces with O&G doctors to attend to patients who needed resuscitation.
- The professionalism of its medical and nursing staff: most of the time, doctors and nurses were available whenever they were needed.
- Good communication existing between medical officers at NDH and Grey's Hospital consultants: complicated cases were discussed telephonically with consultants.
- Good laboratory services: laboratory services were of good quality.
- Doctors were able to diagnose and manage common conditions correctly.
- The partograph was used for all patients admitted in labour except for those who came fully dilated.
- Availability of emergency drugs, blood and blood products at all times rendered the management of obstetrical emergencies feasible at NDH, and

- Good record making by the nursing staff, facilitating therefore meaningful review of cases for both learning and improvement of care.

The following are the weaknesses that the hospital system needs to improve on:
- Poor help-seeking behaviour among the patients, evidenced by poor ANC attendance; late ANC bookings; high number of home deliveries; and late presentation to the hospital.
- Poor communication between O&G medical officers and casualty officers. In case of an emergency, the message should be communicated to the O&G medical officer directly with a sense of urgency.
- Delays in physicians responding to requests for consultation from the O&G department may be detrimental to patient care.
- Erratic availability of drivers compromises quality of care. Doctors rely on drivers to transport blood specimens to the blood bank.
- Inability of some medical officers to diagnose accurately and manage appropriately certain critically ill patients. Doctors need to discuss difficult cases with a senior colleague sooner rather than later. Aggressive management in emergencies and critically ill patients should be preferred to conservative management.
- Lack of regular monitoring of critically ill patients and boarder mothers.
- Poor medical record making: for instance notes of death certification are not made in patients' file; doctors' notes are dated but not timed nor legibly signed by the attending doctor. Resuscitation efforts are not well documented
- Unnatural deaths are not referred for post-mortem to determine the cause of death, and
- The poor relationship between private and public practitioners is regrettable. Private General Practitioners and private hospitals that transfer unstable patients or patients without referral letters or ANC records provide poor quality of care. Good communication between healthcare workers and or between facilities is essential for good continuity of care. [78]

7.4.   LIMITATIONS OF THE STUDY

Some of the limitations of this study include the following:

1. This study is a retrospective chart review. Inherent weaknesses of retrospective charts review emerged:
   - There was a lack of information in certain charts because these patients were assessed by different clinicians and midwives at different periods. Assessment of patients and recording of findings differed from one healthcare worker to another.
   - In retrospective chart reviews, some charts may be missing. If the missing charts differ from the charts that are available on the basis their characteristics, this may introduce bias. However in the case of this study the investigator is sure that all medical records of reported maternal deaths occurring during the study period were located and included in the study. The number of medical records included was also checked against the number of MDNF sent to the NCCEMD.

2. Under-reporting of maternal deaths is common especially in population based surveys or verbal autopsies. The common cause of under-reporting in facility-based surveys is misclassification of maternal deaths. This happens when a maternal death is given a cause of death that does not relate to the pregnancy status or when the time of death is judged to be beyond 42 days from the time of delivery or miscarriage/TOP. One way of dealing with misclassification is to assess all medical records (or death certificates) of all deaths of females of reproductive age and check if they were pregnant before or during the time of death. Because this was not done in this study it is considered to be a limitation.

3. In assessing some cases, it was difficult to dissociate the care received from the referring clinic to that rendered at NDH. The outcome of care rendered at the hospital was at times confounded by the care rendered at the referring facility. Since this study is a facility based and this facility is one part of the referral system, many patients may arrive at NDH having experienced substandard care at the referring institution. In turn NDH may refer critically ill women to the regional hospital who may

die there after having been mismanaged at NDH. The substandard care received at NDH will not be uncovered by this audit.

4. Because the study covers a period of five years, it is believed that some of practices/protocols have changed during this time (for instance the CD4 cell count cut off level for eligibility for treatment). Some of the findings of the first years (e.g. 2006 & 2007) may no longer be relevant, while findings of the last years (2009 & 2010) may still be relevant. This may be the reason why most CEMD are done on a triennium basis.

8. CONCLUSION AND RECOMMENDATIONS

8.1. CONCLUSION

This facility-based maternal mortality study has confirmed our prior hypothesis that the profile of maternal deaths at facility level may paint a totally different picture to what is seen at the national level, hence the relevance of conducting a maternal mortality audit at local level in order to improve care. While there is an increase at the national level, the number of maternal deaths and MMRo are on the decrease at NDH. This slight decline in maternal mortality should be taken with caution as it may just the yearly fluctuation in the number of maternal deaths and the number of live births. While non-pregnancy related sepsis remains the leading cause at both national and district hospital (NDH) level, the other four major causes of maternal deaths are somewhat different.

The quality of care received by the patients leaves much to be desired. Almost half of patients received substandard care. A different approach to their management;

- Would have made no difference for eight (13.1%) patients because their deaths were unavoidable anyway,
- Would have probably made a difference for 15 patients (24.6%), and
- Would definitely have made a difference to the remaining seven patients (11.5%).

This study has found that NDH has some strengths on which it should capitalise, weaknesses that need to be improved upon, and outside threats that require attention:

- Some of its strengths include the following:
  - a multidisciplinary approach in dealing with emergencies;
  - the availability of emergency drugs, blood and blood products at all times;
  - good communication between medical officers at NDH and consultants at the regional hospital viz Grey's Hospital;
  - the universal use of the partograph for monitoring of labour; and
  - good nursing record making.
- Weaknesses include the following:
  - poor communication between O&G medical officers and casualty officers;

- delays in a family physician responding to requests for consultation from the O&G department;
  - erratic availability of drivers;
  - poor capacity building and supervision of medical interns; and
  - poor clinical note making by doctors.
- Outside threats to NDH's systems include the following:
  - poor help-seeking behaviour among the patients,
  - referral problems between NDH and Grey's Hospital despite good communication among medical staff; and
  - poor collaboration and communication between the public and the private sectors.

8.2. ECOMMENDATIONS

The findings of this study call for the following recommendations in order to improve the care of pregnant and postpartum patients that seek care at the hospital:

8.2.1. The PMTCT programme

Recommendation

The PMTCT programme needs to be strengthened. All pregnant women who are eligible for antiretroviral therapy (ART) should be rapidly assessed and initiated on HAART within two weeks, not only for the purpose of preventing the transmission of HIV to the fetus, but also for their own health. Initiating ART at the ANC instead of the main ARV clinic may result in fast tracking these patients. Local clinics should ensure that referred patients are sent to the hospital with their HIV test and CD4 cell count results.

Supporting findings

HIV/AIDS was the leading cause of maternal deaths, accounting for 52.5% of deaths. Only 73.8% of all maternal deaths but 93.9% of all those who attended antenatal care were tested for HIV. Of the 39 patients who were tested positive for

HIV, only 17 (43.6%) had their CD4 cell count results. Out of 14 patients whose CD4 cell counts were ≤ 200, only five (35.7%) patients were on ARV triple therapy.

Illustrative case

A 23 years old patient, para 1, gravida 2, at 34 weeks gestation, booked before 20 weeks, attended ANC seven times, had a CD4 cell count of 111. Although she was started on anti-tuberculosis treatment pending antiretroviral treatment, it is noted that the antiretroviral treatment was seriously delayed despite the patient being a good ANC attendee.

Implication for hospital policy

The PMTCT policy should be applied strictly in all ANC. All pregnant women should be offered HIV test at the first visit. Those who test positive should have their blood taken for CD4 cell count the same day. The results of CD4 cell count should be written in the patient's file at the second ANC visit for all patients.

Indicators for monitoring

- The number of ANC clients who have been tested for HIV.
- The proportion of HIV positive patients who have their CD4 cell count results.
- The number of patients who have been initiated on ART timely.

8.2.2. Management of incomplete abortion

Recommendation

Medical staff should be trained in recognising and managing septic miscarriage/abortion correctly. All unsafe abortions, as defined in the second Saving Mothers Report, should be referred to the regional hospital as soon as the diagnosis is made and adequate resuscitation achieved.

Supporting findings

Abortion was the second leading cause of maternal deaths, contributing for 14.8%. In at least two cases of septic abortion there was a delay in performing an ERPOC and in two more cases patients were managed at NDH instead of being referred.

One patient was treated with oral antibiotic instead of intravenous antibiotics because she was diagnosed as ICA instead of septic ICA.

Illustrative case

A 34 year old patient para 3, gravida 4, at 22 weeks gestation with unknown HIV status, was admitted for per vagina bleeding for 2 days. Physical examination revealed a BP = 80/60, Temperature = 38.5^0 C, Cervix os open (2 cm) and diffuse tenderness on the lower abdomen. The patient was diagnosed as ICA and put on oral antibiotics. On the second day post ERPOC, the patient was still tender on the lower abdomen but the doctor ruled out the diagnosis of peritonitis. The patient developped seizures and demised after 92 hours of hospitalisation. This patient needed aggressive management including IV antibiotics, referral to regional hospital and probably hysterectomy.

Implication for hospital policy

All staff should have refresher courses on referral criteria with regard to septic abortion and the management of ICA twice per year. Special attention on referral criteria / indicators should be given to new staff.

Indicators for monitoring

- The number of medical and nursing staff trained in the management of ICA.
- The availability of referral criteria in all O&G wards.
- The proportion of septic and unsafe ICA cases referred to the regional hospital.

8.2.3. Contraceptive use and sterilisation

Recommendation

All women and in particular HIV positive women, should be encouraged to utilise family planning services. Immediate postpartum tubal ligation services for women who request it must be provided.

Supporting findings

There were 23 patients (37.7%) who were HIV positive and who were gravida 3 or higher and para 2 or higher. The proportion of advanced maternal age patients was 18.0%. Probably some of these patients were already HIV positive in their previous pregnancies. Tubal ligation or the use of reliable contraceptive methods could have been strongly advised or considered for these patients.

Illustrative case

A 38 year old, HIV positive patient, gravida 3, para 3, had already two live children but conceived again for the third time despite her HIV status and advanced maternal age. CD4 cell count unknown. She developed respiratory distress and died of HIV/AIDS and chest infection.

Implication for hospital policy

Make counselling for tubal ligation mandatory for all women who may need it and in particular HIV positive patients.

Indicators for monitoring

- The number of bilateral tubal ligations done every month
- The number of women being offered contraceptive products/methods on a monthly basis

8.2.4. Health-seeking behaviour of patients

Recommendation

The PHC coordinator should be requested to educate the community on the importance of good health-seeking behaviour such as early presentation to the hospital and ANC attendance.

Supporting findings

Of the 61 maternal death patients, 21 did not attend ANC and 14 booked after 20 weeks for antenatal care. Seven patients had home deliveries and three patients were admitted to the labour ward fully dilated.

Illustrative case

A 42 years old patient, para 2, gravida 2 at 32 weeks gestation, with low haemoglobin (9.8g/dl), never attended ANC, never tested for HIV, was admitted with signs and symptoms of meningitis. Cryptococcal meningitis was confirmed after a lumbar puncture. Referral to regional hospital was attempted but declined. Patient demised after 21 days in the hospital. This case illustrates poor help-seeking behaviour.

Implication for hospital policy

The role of community health worker may be extended to include visits to all pregnant women's homes in the community, encouraging them to attend ANC and raising awareness about the importance of early presentation to the hospital in times of ill health.

Indicators for monitoring

- The monthly proportion of unbooked patients received in the hospital
- The monthly proportion of women booking for antenatal care at 20-week gestation or earlier.
- The number of PHC coordinator's visits in the community per year.

8.2.5. Anaesthetic safety issues

Recommendation

All anaesthetic medical officers should be offered regular refresher courses on Essential Steps in the Management of Obstetrical Emergencies, a course which should include criteria that a postoperative patient should fulfil before she could be transferred to the ward and other safety measures in obstetrics anaesthesia.

Supporting findings

Among the three anaesthetic deaths, there was a case where a patient was clearly unstable post-operatively, with low BP and elevated pulse. This unstable patient was transferred from the recovery room to the general ward. She complicated and

died in the ward. Another patient arrested after being given Midazolam in the waiting room.

Illustrative cases

- A 31 years old patient, para 1, gravida 2, at term admitted for elective caesarean section, early ANC booking, 7 visits, HIV positive with unknown CD4 cell count. Under spinal anaesthesia, the patient developed low BP intra-operatively. She was given three litres of intravenous fluid in a short space of time and was transferred to the ward where she developed pulmonary oedema and demised.

- In the other case, a 27 year old patient admitted for elective caesarean section, HIV positive, unknown CD4 cell count, was given midazolam for anxiety and was left unmonitored. She stopped breathing and was found unresponsive several minutes later. She died despite intensive resuscitation measures.

Implication for hospital policy

- Post-operative patients who are unstable in theatre should not be transferred to the ward. Patients, who are hypotensive intra-operatively for caesarean section, should not have their abdomen closed until the systolic BP is brought up to 100 mmHg.

- The discharge criteria from the recovery room should be drafted and displayed in the recovery room. The anaesthetist, the surgeon and the recovery sister should all sign the patient out of the recovery room only if they are all satisfied with the patient's vital signs. This should be a joint decision.

- Patients who have been given drugs that may depress the respiratory, cardiovascular or central nervous system should be observed for at least 15 minutes before being left alone.

Indicators for monitoring

- The attendance register for the above compulsory refresher course which should be offered to all new recruits and repeated annually

- Have a specifically designed form where surgeon, anaesthetist and recovery nurse should sign out the patient if all of them are satisfied that the patient is stable enough to be transferred to the ward.

8.2.6. Communication between casualty and O&G medical officers

Recommendation

All O&G emergencies received in casualty should be communicated to the O&G medical officer directly and not to the medical interns. The degree of urgency should be communicated to the O&G medical officer by the casualty officer; if not, then the O&G medical officer should enquire about how urgent the case is.

Supporting findings

In one case of emergency included in this study, the medical officer in casualty called the O&G medical intern to go and attend to the patient after several hours of delay in casualty. The case was not communicated to the senior medical officer with the urgency that it required.

Illustrative case

A 19 years old patient presented to casualty department with vagina bleeding and haemorrhagic shock, with history of illegal abortion from a private practitioner. The patient was assessed by the casualty officer at 13:30 hours and sent for ultrasound despite the state of shock. The case was communicated to the O&G medical intern only at 15:00 hours after the ultrasound examination as a case of ICA with no mention of "septic ICA" or "patient is in shock". The O&G medical intern goes to see the patient at 15:20 and found the patient gasping. He calls for the senior medical officer at 15:45 hours. Resuscitation commenced with the help of other medical officers (from O&G and Anaesthetic departments). The patient is taken to theatre at 16:20 hours but demised before the procedure could be commenced.

Implication for hospital policy

All O&G cases admitted to casualty must be colour-coded based on the urgency level of the case. When referring cases to the O&G, casualty officers must inform the O&G medical officer whether the case is red code (to be seen immediately), yellow code (to be seen within one hour) or green code (to be seen within four

hours). The time of call and the name of the O&G medical officer spoken to should be written on the patient file.

Indicators for monitoring

- A policy to this effect should be drafted by the Heads of Casualty and O&G
- The availability of the above policy in both departments (O&G & casualty)
- Monthly monitoring of the lag time between the casualty officer's call and the O&G medical officer's arrival to assess the patient.

8.2.7. The contribution of family physicians

Recommendation

The Department of Internal/Family Medicine should actively assist the Department of O&G in managing pregnant women who are admitted for medical conditions. Requests for consultation sent to physicians should be attended to on time and patients who have confirmed acute medical problems should be reviewed on a daily basis by medical officers from both the O&G and the Internal/Family Medicine Departments.

Supporting findings

The breakdown of causes of death reveals that 57.4% of patients died of indirect causes; mainly medical problems aggravated or not by pregnancy. Of the 35 patients who died of indirect causes, 91.4% died of HIV/AIDS, 2.9% of pneumonia/tuberculosis, 2.9% of suicide, and 2.9% of diabetic hypoglycaemic coma. Of the several requests for consultations sent to physicians, only two were responded to on time.

Illustrative case

A 16 year old patient, para 0, gravida 1, admitted for hyperemesis gravidarum, was unable to give a proper history and remained mute most of the time. She was treated with intravenous fluid and antiemetic but did not respond to the treatment. After four days of hospitalisation she developed fever. The family physician was

consulted but he only came to see the patient after 72 hours. The patient demised the following day.

Implication for hospital policy

The Head of Internal/Family Medicine should allocate, on a monthly basis, one medical officer or registrar who will be reviewing all critically ill O&G patients who are admitted for medical conditions such as pneumonia, tuberculosis, HIV/AIDS, etc.

Indicators for monitoring

- The availability of the monthly roster of medical officers/registrars of Internal/Family Medicine who are allocated to assist O&G medical officers in managing critically ill patients with medical conditions.
- Percentage of patients with medical conditions that are reviewed on a daily basis by doctors from Internal/Family Medicine Department.

8.2.8. Supervision of junior doctors

Recommendation

It is recommended that the issue of medical interns and community service doctors' supervision be addressed as a matter of urgency. It is essential that nursing staff call the senior doctor directly if the condition of a patient necessitates an experienced medical personnel's attention. Medical interns must be informed that all high risk patients warrant the attention of an experienced or senior medical officer. Attitudes of senior doctors who decline to "come out" and attend to patients when requested to by a medical intern should be castigated

Supporting findings

The study found that each time a patient changed condition for the worse, junior doctors were called first. In one case the senior doctor refused to come and assess a patient.

Illustrative case

A 32 year old patient, para 2, gravida 3, at 40 weeks gestation, obese, admitted in labour developed severe respiratory distress. Doctors were called to assess the patient but only the medical intern responded to the call. The medical officer failed to do so. He only came when he was told that the patient is gasping. The patient demised minutes later and post-mortem caesarean section was done to deliver an asphyxiated fetus.

Implication for hospital policy

The Head of O&G should inform the medical officers that nursing staff are authorised to call the senior doctor first in cases where resuscitation is needed or a critically ill patient requires the expertise of an experienced medical staff.

Indicators for monitoring

- The availability of the above policy in all wards of the O&G department.
- All new medical officers to be told about this policy during the orientation session. A signed attendance register of orientation sessions should be kept by the Head of O&G.

8.2.9. Referral issues

Recommendation

- Critically ill patients should be referred to the regional hospital. Medical officers should attempt to refer all critically ill patients whose prognosis is probably hpeful. The referral hospital should accept more patients. The alternative would be to have a high care ward at NDH where a consultant from Grey's Hospital can do a ward round at least once per day as these patients are regional patients. During these ward rounds the consultant may decide to keep a patient at NDH or transfer her to Grey's Hospital. This arrangement will solve the issues of unavailability of beds at the regional hospital. Grey's Hospital is also situated in Pietermaritzburg, only five kilometres away from NDH.

- The hospital management should engage in discussion with private institutions referring patients to NDH in order to reach an understanding on referral requirements to NDH.

Supporting findings

- This study found that fewer patients are accepted at the regional hospital. Eleven attempted referrals among maternal deaths were declined for various reasons. In another 16 maternal deaths, referral to the region hospital was not even attempted.
- One patient was referred from a private hospital in unstable condition, another with no referral letter, and a third one with no antenatal records.

Illustrative cases

- A 35 year old patient, para 2, gravida 3, miscarriage 1, at 30 weeks gestation, HIV positive with CD4 cell count of 200, was admitted for chest related complaints. Patient was critically ill and needed to be referred to the regional hospital but referral was declined by the obstetrician, the physician and the Intensivist; all citing unavailability of beds.
- A 29 year old patient, referred from a private hospital for puerperal psychosis with no referral letter. Another patient, 26 years old, referred to NDH on the eighth post-delivery day, with a Glasgow Coma Scale of 3/15, generalised purpura and jaundice. Resuscitation was started immediately but the patient demised within one hour of arrival.

Implication for hospital policy

- The Medical Manager should have a discussion with the regional hospital management about the referral difficulties between NDH and Grey's Hospital in order to find innovative ways of solving this problem. Referral criteria should be clearly outlined and implemented or abide to by both parties.
- Requirements for referral from private sector to be drafted and circulated.

Indicators for monitoring

- The minutes of the meeting between the management of the two hospitals.
- The availability of the new referral criteria negotiated between the two hospitals.

- The proportion of successful referrals to and from NDH should also be monitored on a monthly basis.
- A memorandum of understanding between the Association of Independent Practitioners and NDH's management.

8.2.10.   Criteria for admission to the Intensive Care Unit

Recommendation

The criteria for admission to Intensive Care Unit (ICU) at the regional hospital should be disseminated widely and all O&G medical officers at NDH should familiarise themselves with these criteria.

Supporting findings

Three immune-compromised patients in severe respiratory distress secondary to pneumocystis jiroveci pneumonia were denied referral to the regional hospital because they could not be ventilated due to their HIV status and possible poor prognosis.

Illustrative case

A 27 year old patient, para 1, gravida 2, at 33 week gestation, HIV positive with CD4 cells count of 125, not on ARV, was admitted for respiratory distress. Attempt to refer patient to the ICU unit at regional hospital for ventilation was declined, citing as reasons poor prognosis secondary to her HIV status and low CD4 count. Patient demised after 96 hours in the district hospital with no advanced life support.

Implication for hospital policy

The Head of the ICU at the regional hospital should be requested to draft a policy outlining criteria for admission to the unit for medical conditions.

Indicators for monitoring

- The availability of the ICU admission criteria policy

- The evaluation of the extent to which the above protocol is adhered to by all parties.

8.2.11.   The establishment of mothers' waiting lodge

Recommendation

It is recommended that the hospital considers the establishment of a waiting lodge for expectant mothers. This facility can house pregnant women who live far away from hospital and have no reliable means of transport, from 37th week of gestation.

Supporting findings

Eleven per cent of patients delivered at home. One of these patients died before arrival to the hospital. Delivering at home puts both the mother and the fetus at risk of several complications.

Illustrative case

A 26 year old patient, staying at home with her 7-year old daughter only, was brought in by a neighbour who was called by this 7 year old girl. The neighbour gives history of home delivery with no further details. The patient was dead before arrival with placenta undelivered. The cause of death was unknown. PPH and haemorrhagic shock were suspected.

Implication for hospital policy

The hospital management should write a motivation letter to the Head Office with regard to the establishment of a mothers' waiting lodge.

Indicators for monitoring

To monitor the progress of the request/ motivation letter quarterly

8.2.12.   An ambulance dedicated to mothers and babies

Recommendation

The hospital should consider also having an ambulance that is based at the hospital dedicated to mothers and babies transfer to the regional hospital.

Supporting findings

Two patients who were supposed to be transferred urgently to the regional hospital died before the arrival of the ambulance.

Illustrative case

A 33 year old patient para 1, gravida 2, at 24 weeks twin pregnancy aborted the first fetus at home and came to the hospital in respiratory distress with the second twin still in situ. HIV positive on ARV, diagnosed as lactic acidosis and incomplete abortion. Referral to regional hospital accepted but the patient died 11 hours after admission, waiting for the ambulance.

Implication for hospital policy

The hospital management should motivate to the Head Office with regard to the acquisition of an ambulance, stationed at NDH, dedicated to mothers and babies.

Indicators for monitoring

- To monitor the progress of the request/motivation letter quarterly

8.2.13.   Monitoring boarder mothers

Recommendation

Boarder mothers – defined as women who have delivered and are discharged but are still kept in the hospital for one reason or the other – should not be forgotten. Regular assessment should be done at least once alternative days. Boarder mothers who are HIV positive but not yet on ARV should be investigated and fast-tracked for ART during this period.

Supporting findings

One boarder mother developed gastroenteritis and died. These boarder mothers are not considered as patients and therefore are not reviewed on daily basis.

Illustrative case

A 35 years old patient, para 3 gravida 3, who was 28 weeks pregnant, delivered a preterm fetus at the regional hospital. She was transferred as a boarder mother to NDH because the baby was transferred from Grey's Hospital's to NDH's nursery for further care. Her haemoglobin was low (6.9g/dl). She developed severe gastroenteritis for 2 days and demised.

Implication for hospital policy

A policy on management of boarder mothers should be drafted and disseminated. Any unfinished care should continue to be provided to thes mothers as if they are in-patients. Those who were discharged on medication should be monitored ensuring that they take their medication as prescribed.

Indicators for monitoring

- A roster of doctors who will be reviewing boarder mothers should be available.
- Daily report on the status of boarder mothers to be given to the executive management.

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10. ADDENDA

10.1. DATA COLLECTION SHEET

<table>
<tr><td></td><td>MATERNAL DEATH ASSESSMENT FORM
(An adaptation of the South African Maternal Death Notification Form and the University of Aberdeen's TRACE version 2.0 form)</td><td>UNIVERSITY OF KWAZULU-NATAL
Nelson R Mandela School of Medicine</td></tr>
</table>

HEALTH KwaZulu-Natal

SECTION A: DEMOGRAPHIC & CLINICAL DATA

1. Case No.	2. Hospital Stay	3. Age	4. Gravidity	5. Parity	6. TOP/Miscar/Ectopic	7. Gest. age

8. Race group				9. Booked patient		10. Time of Booking				11. No. of ANC visits
AFR	ASI	COL	WHI	Yes	No	≤20 wks	>20 wks	Not sure		No record available

12. Documented Haemoglobin		13. Previous Caesar		14. Outcome of current pregnancy			
		Yes	No	Undelivered	TOP	Miscarriage	Delivered

15. Mode of delivery				16. Place of delivery/abortion			17. Pregnancy order	
Vertex vaginal	Breech vaginal	Assisted vaginal	Caesarean Section	Home	Clinic	Hospital	Single	Multiple

18. Screened for Diabetes		19. 1-hour GTT Result	20. Screened for Syphilis		21. RPR results
Yes	No		Yes	No	

22. Screened for HIV (HIV Status)			23. If positive, ?CD4 count		24. Was patient on ARVs?		
Negative	Unknown	Positive		Unknown	Dual therapy	Triple therapy	Not on ARVs

25. If Patient was referred from the another facility please specify and give reason for referral

26. History of prolonged labour		27. Was the patient anaesthetised (general or regional)?		28. If yes, for which intervention?
Yes	No	Yes	No	

29. The outcome of the intervention?			30. Specify the complication
No complication	Surgical complication	Anaesthetic complication	

SECTION B: CAUSE OF DEATH

31. Primary (underlying) cause of death	
32. Final cause of death (failing organ/system)	
33. Contributory (or antecedent) cause/s	

SECTION C: ADVERSE or POSITIVE INCIDENTS/INTERVENTIONS

1. PATIENT-RELATED FACTORS

	Adverse factors/events	*Favourable factors/events*
34. Health seeking behaviour		
35. Adherence / Compliance		
36. Community involvement		

2. ADMINISTRATIVE / HEALTH SYSTEM-RELATED FACTORS

	Adverse factors/events	*Favourable factors/events*
37. Referral to regional hospital		
38. Transport between home and health facility		
39. Availability of life saving medications or equipment		
40. Availability of blood or blood products		
41. Staff (quality and quantity)		
42. Communication within or between health facilities		

3. MEDICAL & NURSING CARE-RELATED FACTORS

	Adverse factors/events	*Favourable factors/events*
43. Adherence to clinical protocol for patient management		
44. Screening & management for HIV, Syphilis, Anaemia, DM, HPT, TB, STD, etc		
45. TOP or Family planning		
46. Partogram use		
47. Initial assessment & diagnosis		
48. Antenatal care		
49. Intrapartum care		
50. Postpartum care		
51. Intra-operative care (surgical and anaesthetic)		
52. Post-operative care		
53. Continued monitoring		
54. Resuscitation		

SECTION D: EVALUATION OF CLINCAL NOTES

State what sort of information was missing from the case notes, or if you think the records available are of good or poor quality (illegible, incomplete, not dated/timed), etc.

	Absent	N/A	Present	Comments
55. Antenatal card				
56. Doctor's progress notes				
57. Nursing notes				
58. Lab, radiology, other investigations				
59. Operative notes				
60. Anaesthesia records				
61. Observation chart				
62. Drug charts				
63. Fluid balance sheet				
64. Maternal death notification form				

SECTION E: QUALITY OF CARE

65. The death is classified as:	A1	A2	B1	B2	B3

A = the death was non-avoidable.
- **A1 =** the care provided was of good standard.
- **A2 =** the care provided was sub-standard, but a different approach to the management would have made **no** difference.

B = **the death was avoidable**
- **B1 =** the care provided was of good standard. Other factors outside the care administered contributed to the death
- **B2 =** the care provided was sub-standard; a different approach to the management would have **probably** made a difference.
- **B3 =** the care provided was sub-standard; a different approach to the management would have **definitely** made a difference.

66. Panel's views harmonised on	…………… **/** …………….. **/ 20** ……….

10.2. THE SOUTH AFRICAN MATERNAL DEATH NOTIFICATION FORM

DEPARTMENT OF HEALTH
CONFIDENTIAL

MATERNAL DEATH NOTIFICATION FORM

For office use only: Department of Health Office case number										

NOTE:
1. *This form must be completed for all deaths in pregnant women or within 42 days after termination of pregnancy, including abortions, ectopic gestations, motor vehicle accidents, and suicide related deaths irrespective of duration or site of pregnancy.*
2. *Mark with an (X) where applicable (? means unknown)*
3. *Attach a copy of the complete case records and anaesthetic forms to this form*
4. *Complete the form within 7 days of a maternal death. The completed form is sent to the person responsible for maternal health in the province*
5. *All maternal deaths must be discussed at an institutional mortality meeting. Such meetings will assist in the completion of sections 10,11 and 12 of this form*

Address of contact person (Person responsible for Maternal Health in the Province)

Case discussed at Institutional mortality meeting? **YES** ☐ **NO** ☐ If YES: Date _____

1. LOCALITY WHERE DEATH OCCURRED

Province _____   Health District _____

Institution _____   Locality

CHC clinic	Level 1 Hospital	Level 2 Hospital	Level 3 Hospital	Private Hospital	Other-Specify

2. DETAILS OF DECEASED

Name _____   Inpatient No. _____

Address _____

Age (yr) ☐☐   Race ☐☐   AF = African; CO = Coloured; In = Indian; WH = White; OT=Other

At time of death
Gravida ☐☐   Para ☐☐   Gestation (weeks) (or at delivery) ☐☐   Days since delivery/miscarriage (if not applicable enter 99) ☐☐

3. ADMISSION AT INSTITUTION WHERE DEATH OCCURRED OR FROM WHERE IT WAS REPORTED

	d	d	m	m	y	y			24h	min
Date of admission:							Time of admission:			
Date of death:							Time of death:			

On admission	Miscarriage/Ectopic		Antenatal		Intrapartum		Postpartum	
Condition on admission:	Stable		Critically ill		Dead on arrival		Other – specify	
Diagnosis at moment of death:	Miscarriage	Ectopic pregnancy		Not in labour		In labour	Postpartum	

Reason for admission: _____

Referral from another centre? | Y | N | **If Yes from** _____

4. ANTENATAL CARE

Did she receive antenatal care?	Y	N	?	If "Y" at what locality	?	Primary	Secondary	Tertiary	Private	Other

Antenatal care provider	Specialist	Med.Off/GP	Adv. Midwife	Midwife/Reg. nurse	Other - Specify

Was the gestational age at booking<20wks? | **Y** | **N** |

Total number visits. | | |

Antenatal Risk Factors	Risk	Y	N	?	
	Past Medical History				Specify:
	Hypertension				
	Proteinuria				Other -Specify
	Glycosuria				
	Anaemia				
	Abnormal lie				
	Previous C/Section				

Comments on antenatal complications and management - List any medication (if block insufficient, use an extra sheet of paper)

5. HIV status: (Make a cross in one box only)

Unknown	Declined	HIV neg.	HIV pos. (not AIDS)	AIDS (on HAART)	AIDS (not on HAART)

(Note: AIDS =CD4<200 &/or AIDS defining illness) CD4 count = _____ / not done/ unknown

6. DELIVERY, PUERPERIUM AND NEONATAL INFORMATION

Did Labour occur?	Y	N	If "Y", was a partogram used	Y	N	?	Labour	Short	Normal	Prolonged	CPD present

Delivery (Tick appropriate box)	Undelivered	Vaginal (unassisted)	Vaginal Vacuum/forceps	Caesarean section

Baby   Birth weight (g) | | | | | 5min Apgar | | | Outcome | Stillborn | Neonatal death | Alive |

Comments on labour delivery and puerperium (if block insufficient, use an extra sheet of paper)

7. INTERVENTIONS (Tick appropriate box)

Early pregnancy		Antenatal		Intrapartum		Postpartum		Other	
Evacuation		Transfusion		Instrumental del.		Evacuation		Anaesthesia - GA	
Laparotomy		Version		Symphysiotomy		Laparotomy		Epidural	
Hysterectomy				Caesarean section		Hysterectomy		Spinal	
Transfusion				Hysterectomy		Transfusion		Local	
				Transfusion		Manual removal		Invasive monitoring	
Other - specify								ICU ventilation	

Comments on interventions (if bloc insufficient, use an extra sheet of paper)

8. CASE SUMMARY (please supply a short summary of the events surrounding the death)

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9. AUTOPSY: Performed ☐   Not Performed ☐

If performed: date_____, Place_____, Ref. No._____

Please report the gross findings and send the detailed report later

10. CAUSE OF DEATH (See Guidelines)

(Note: If the woman has AIDS please give the specific cause of death (disease entity) e.g. TB, pneumonia, meningitis, malaria, abortion, puerperal sepsis etc. HIV/AIDS is a contributory condition.)

Cause of death: Specify disease entity:

Final cause and other complications: Specify organ systems that failed:
(There can be more than one)

Please mark **contributory conditions below** (Note: HIV status has already been captured)

Was there prolonged/obstructed labour?		N	N/A	What was the Mid-upper arm circumference (in cm)?			
Was there a previous caesarean section?		N	?	Was the woman anaemic during pregnancy?		N	?

11. IN YOUR OPINION DID ANY OF THE FOLLOWING FACTORS CONTRIBUTE TO THE DEATH OF THIS PATIENT?

System	Example	Y	N	?	Specify
Personal/Family	Delay in woman seeking help				
	Declined treatment or admission				
	Other; specify				
Logistical systems	Lack of transport from home to health care facility				
	Lack of transport between health care facilities				
	Health service - Health service communication breakdown				
Facilities	Lack of facilities, equipment, or consumables (drugs, infusion sets, blood, fluids etc.)				
Health personnel problems	Lack of human resources				
	Lack of expertise, training or education				
	Delays in Referral				
	Delays in appropriate action				

Comments on potential avoidable factors, missed opportunities, and substandard care

Please note that substandard care includes inadequate monitoring as well as substandard management.

12. WHAT HAS YOUR INSTITUTION LEARNT FROM THIS CASE AND WHAT ACTIONS DO YOU ENVISAGE FROM THIS LEARNING PROCESS? (If applicable)

13. THIS FORM COMPLETED BY:

Name (print)	Dr. PN Makinga	Rank	Chief Medical Officer
Telephone	033 387 9000	Fax	033 397 9768

Date: d d m m y y

Signature: ....

10.3. THE UNIVERSITY OF ABERDEEN'S TRACE TOOL

TRACE Maternal Death Assessment Form

TRACE Maternal Death Assessment Form

CASE NUMBER:

CAUSE OF DEATH:

Primary (underlying) cause of death	Specify:
Final cause of death	Specify:
Contributory (or antecedent) cause/s	Specify:

ADVERSE/FAVOURABLE FACTORS/EVENTS:

1. PATIENT ORIENTED

	Adverse factors	*Favourable factors*
a) Personal circumstances		
b) Family		
c) Community		

2. ADMINISTRATIVE / HEALTH SYSTEM FACTORS

	Adverse factors	Favourable factors
a) Transport		
Give explanation for factors related to transport		
b) Means of entry to facility		
Give explanation for factors related to means of entry		
c) Access to health care facility		
Give explanation for factors related to access		
d) Availability of health care facilities		
Give explanation for factors related to availability of facilities		

TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE

2. ADMINISTRATIVE / HEALTH SYSTEM FACTORS (continued)

	Adverse factors	Favourable factors
e) Availability of personnel		
Give explanation for factors related to availability of personnel		
f) Appropriately trained staff		
Give explanation for factors related to training		
g) Communication		
Give explanation for factors related to communication		

TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE

3. MEDICAL CARE		
	Adverse factors	*Favourable factors*
Antenatal care		
Intrapartum care		
Intra-operative care (if applicable)		
Postpartum care		
Did an emergency occur? If so, when? (early pregnancy, antenatal, intrapartum or postpartum)		
Emergency event during:		
Initial assessment		
Problem identification or diagnosis		
Management plan		
Continued monitoring		
Resuscitation		
Anaesthesia		
Professional conduct of health providers		

TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE

4. AVAILABILITY OF INFORMATION

State what sort of information was missing from the case notes, or if you think the records available are illegible, missing, good, complete, incomplete, timely etc.

	Comments
History taking	
Clinical examination	
Lab, radiology, etc investigations	
Diagnosis	
Post mortem reports	
Antenatal card	
Anaesthesia records	
Nursing notes	
Maternal death audit	
Operation notes	
Observation chart	
Drug charts	
Fluid input/output	
Front index sheet	
Any others (please state)	

TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE

5. GENERAL COMMENTS AND SUMMARY
Provide a summary of your opinion on your case and comment on any other positive or negative issues related to the case.
Date:	
Name of assessor: (one for individually completed forms, names of all committee members present if a committee completes the form)	

TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE   TRACE

10.4. NORTHDALE HOSPITAL MANAGEMENT TEAM PERMISSION

PERMISSION TO CONDUCT A RESEARCH STUDY/TRIAL

This must be completed and submitted to the Medical Superintendent/s / Hospital Manager/s for signature.

For **King Edward VIII Hospital (KEH)** and **Inkosi Albert Luthuli Central Hospital (IALCH)** studies please submit the document together with the following:

1. Research proposal and protocol.
2. Letter giving provisional ethical approval.
3. Details of other research presently being performed by yourself if in the employ of KEH, (individually or as a collaborator).
4. Details of any financial or human resource implications to KEH, including all laboratory tests, EEGs, X-rays, use of nurses, etc. (See Addendum 1)
5. Declaration of all funding applications / grants, please supply substantiating documentation.
6. Complete the attached KEH Form – *"Research Details"*

Once the document has been signed it should be returned to **Mrs Patricia Ngwenya:** Biomedical Research Ethics Administrator, Room N40, Govan Mbeki Building, Westville Campus, University of KwaZulu-Natal.

To: Chief Medical Superintendent / Hospital Manager

Permission is requested to conduct the above research study at the hospital/s indicated

below:

Site 1 address:

NORTHDALE HOSPITAL
P/BAG X9006
PIETERMARITZBURG 3200

Investigator/s:

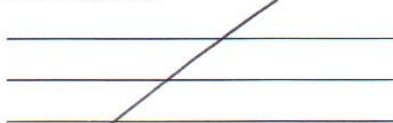Principal: PN MAKINGA
Co-investigator: N/A
Co-Investigator: N/

Signature of Chief Medical Superintendent/Hospital Manager:

Date: 26 MAR 2010

MEDICAL MANAGER
2010 -03- 2 6
NORTHDALE HOSPITAL
PRIVATE BAG X9006
PIETERMARITZBURG 3200

Site 2 address:

Investigator/s

Principal:
Co-investigator:
Co-Investigator:

Signature of Chief Medical Superintendent / Hospital Manager:

Date:

NB: Medical Superintendent/s / Hospital Manager/s to send a copy of this document to Natalia

10.5. POSTGRADUATE APPROVAL

6 July 2010

Professor J Moodley
Department of Family Medicine
NRMSM
UKZN

UNIVERSITY OF
KWAZULU-NATAL

Dear Professor Moodley

**PROTOCOL: "The profile of maternal deaths in a district hospital: a five-year review of maternal deaths at Northdale Hospital (2006 to 2010)."
Student: P Makinga, student number: 207525143. (Family Medicine)**

The Postgraduate Education Committee ratified the approval of the abovementioned study on 06 July 2010

Please note:

- The Postgraduate Education Committee must review any changes made to this study.

- The study may not begin without the approval of the Biomedical Research Ethics Committee.

May I take this opportunity to wish the student every success with the study.

Yours sincerely

Professor SR Thomson
Dean's Assistant: MMed Programmes
Postgraduate Education Committee

CC. Dr P Makinga

Ms D Ramnarain
Biomedical Research Ethics Committee
Westville Campus

Postgraduate Education Administration,
Medical School Campus

Postal Address: Private Bag 7, Congella, 4013, South Africa

Telephone: +27 (0)31 260 4745   Facsimile: +27 (0)31 260 4723   Email: Janiljies@ukzn.ac.za   Website: www.ukzn.ac.za

Founding Campuses: ▄▄ Edgewood   Howard College   Medical School   Pietermaritzburg   Westville

10.6. BIOMEDICAL RESEARCH ETHICS COMMITTEE APPROVAL

UNIVERSITY OF KWAZULU-NATAL

RESEARCH OFFICE
Biomedical Research Ethics Administration
Westville Campus, Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604769 - Fax: 27 31 2604609
Email: BREC@ukzn.ac.za
Website: http://research.ukzn.ac.za/ResearchEthics/BiomedicalResearchEthics.aspx

12 July 2010

Dr Polycarpe Makinga
PO Box 559
Msunduzi
3231

PROTOCOL: The profile of maternal deaths in a district hospital: a five-year review of maternal deaths at Northdale Hospital (2006-2010).
REF: BE218/09.

EXPEDITED APPLICATION

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your application dated 29 September 2009.

The study was approved pending appropriate responses to queries raised. Your responses dated 06 July 2010 to queries raised on 10 May 2010 have been noted by a sub-committee of the Biomedical Research Ethics Committee. The conditions have now been met and the study is given full ethics approval and may begin as from 12 July 2010.

This approval is valid for one year from 12 July 2010. To ensure uninterrupted approval of this study beyond the approval expiry date, an application for recertification must be submitted to BREC on the appropriate BREC form 2-3 months before the expiry date.

Any amendments to this study, unless urgently required to ensure safety of participants, must be approved by BREC prior to implementation.

Your acceptance of this approval denotes your compliance with South African National Research Ethics Guidelines (2004), South African National Good Clinical Practice Guidelines (2006) (if applicable) and with UKZN BREC ethics requirements as contained in the UKZN BREC Terms of Reference and Standard Operating Procedures, all available at http://research.ukzn.ac.za/ResearchEthics11415.aspx.

BREC is registered with the South African National Health Research Ethics Council (REC-290408-009). BREC has US Office for Human Research Protections (OHRP) Federal-wide Assurance (FWA 678).

The sub-committee's decision will be **RATIFIED** at a full sitting of the Biomedical Research Ethics Committee meeting to be held on **10 August 2010**.

We wish you well with this study. We would appreciate receiving copies of all publications arising out of this study.

Yours sincerely

Professor D.R Wassenaar
Chair: Biomedical Research Ethics Committee

10.7. KZN DEPARTMENT OF HEALTH APPROVAL

Health Research & Knowledge Management sub-component
10 – 103 Natalia Building, 330 Langalibalele Street
Private Bag x9051
Pietermaritzburg
3200
Tel.: 033 – 3953189
Fax.: 033 – 394 3782
Email.: hrkm@kznhealth.gov.za
www.kznhealth.gov.za

Reference	: HRKM131/10
Enquiries	: Mrs G Khumalo
Telephone	: 033 – 3953189

23 August 2010

Dear Dr PN Makinga

Subject: Approval of a Research Proposal

1. The research proposal titled **'The profile of maternal deaths in a district hospital: A 5 year review of maternal deaths at Northdale hospital (2006-2010)'** was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken at **Northdale Hospital**.

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the identified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mrs G Khumalo on 033-3953189.

Yours Sincerely

Dr S.S.S. Buthelezi
Date: 26/08/2010
Chairperson, Health Research Committee
KwaZulu-Natal Department of Health

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uMnyango Wezempilo . Departement van Gesondheid

Fighting Disease, Fighting Poverty, Giving Hope

10.8. RECERTIFICATION BY BIOMEDICAL RESEARCH ETHICS COMMITTEE

UNIVERSITY OF
KWAZULU-NATAL

INYUVESI
YAKWAZULU-NATALI

RESEARCH OFFICE
Biomedical Research Ethics Administration
Westville Campus, Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604769 - Fax: 27 31 2604609
Email: BREC@ukzn.ac.za
Website: http://research.ukzn.ac.za/ResearchEthics/BiomedicalResearchEthics.aspx

15 September 2011

Dr Polycarpe Makinga
PO Box 559
Msunduzi
3231

PROTOCOL: The profile of maternal deaths in a district hospital: a five-year review of maternal deaths at Northdale Hospital (2006-2010).
REF: BE218/09.

RECERTIFICATION APPLICATION APPROVAL NOTICE

Approved: 12 July 2011
Expiration of Ethical Approval: 11 July 2012

I wish to advise you that your application for Recertification dated August 2011 for the above protocol has been noted and approved by a sub-committee of the Biomedical Research Ethics Committee (BREC) for another approval period. The start and end dates of this period are indicated above.

If any modifications or adverse events occur in the project before your next scheduled review, you must submit them to BREC for review. Except in emergency situations, no change to the protocol may be implemented until you have received written BREC approval for the change.

The approval will be **ratified** by a full sitting of the Committee at a meeting to be held on **11 October 2011.**

Yours sincerely

Mrs A Marimuthu
Senior Administrator: Biomedical Research Ethics