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The epidemiology of stillbirths according to the perinatal problems identification program (PPIPP), at Rahima Moosa Mother and Child Hospital, from August 2016 to July 2017

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THE EPIDEMIOLOGY OF STILLBIRTHS ACCORDING TO THE PERINATAL PROBLEMS IDENTIFICATION PROGRAM (PPIP), AT RAHIMA MOOSA MOTHER AND CHILD HOSPITAL, FROM AUGUST 2016 TO JULY 2017.

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg in partial fulfilment of the requirements for the degree of Masters of Medicine in Obstetrics and Gynaecology.

Completion of this research report: Johannesburg, June 2020

DECLARATION

I, Oburota Uchenna Onwuagbu, declare that this Research Report is my own, unaided work. It is being submitted for the Degree of Masters of Medicine in Obstetrics and Gynaecology at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



_____

(Signature of candidate)

08 June 2020

Dedicated to my daughter

Awande Zoey

Ota's Angel and Morning star

Dedicated to my parents

Ambassador CE Onwuagbu and Mrs NK Onwuagbu

Thank you for your motivation and prayers though my years of study

Dedicated to my siblings

Chogo, IK and Pappy

Ekene dili Chukwu bi nen'igwe, all thanks to God in heaven

ABSTRACT

Background

The occurrence of stillbirth is an adverse outcome of pregnancy that could reflect the quality of antenatal and intrapartum care that pregnant women receive. Some stillbirths can be averted by addressing avoidable risk factors.

Methods

A retrospective, observational study was undertaken at Rahima Moosa Mother and Child Hospital (RMMCH). This is a regional academic hospital located in Coronationville, Johannesburg, South Africa. At RMMCH approximately thirteen thousand deliveries occur annually. This study reviewed medical records of women who delivered stillbirths weighing more than 500g from August 2016 to July 2017. Avoidable attributable factors as well as obstetrical causes of stillbirth were evaluated for each case using the third version of the perinatal problems identification program (PPIP v3). The stillbirth rate was calculated for the time period of August 2016 to July 2017. A five year trend in the stillbirth rate was also calculated for the period of 2011 to 2015. The stillbirth rate amongst non-South African citizens was also ascertained.

Results

A total of 206 medical records of women who delivered stillbirths were reviewed. The stillbirth rate was 21.9/1 000 births for the time period of August 2016 to July 2017; which was higher than observed in the preceding five years, between 2011 to 2015 (12.0/1 000). For the study-period, most stillbirths (71.9%) were late foetal deaths (LFD). The stillbirth rate between South African and non-South African citizens was similar at 13.7 and 14.8 per 1000 birth rate, respectively. In terms of maternal conditions, 62.6% of women in this study were healthy mothers. The leading cause of death (35.4%) were macerated stillbirths with unexplained intrauterine foetal death. The main avoidable risk factor was a delay in seeking medical attention in 125 cases (60.7%); being possible in 74 (35.9%) and probable in 51 (24.7%). Among administrative related avoidable factors, a lack of transport from home to institution was evaluated as a contributing factor in 167 cases (72.3%); being possible in 128 (62.1%) and probable in 39 (10.2%). No medical response to poor fundal growth by a medical personnel was possible in 5 cases (2.4%) and probable in 16 (7.8%) with regard to health worker related avoidable factors. Placental histological analysis (190/206; 92.2%) showed that up to 40% of placentae showed vascular flow compromise, 13.6% displaying infection

and 6.3% displaying a combination of the two. There was a statistically significant association between abnormal placental findings and stillbirths ($p<0.001$).

Conclusion

Most stillbirths evaluated in this study could have been averted if there was more timeous health seeking behaviour, improved logistical issues related to transport to the hospital, and better antenatal care in monitoring for adequate fundal growth were addressed. There is a strong correlation between stillbirths and abnormal placental pathologies.

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NOMENCLATURE

ANOVA: Analysis Of Variance

APL: Antiphospholipid

BANC: Basic Antenatal Care

BBA: Birth Before Arrival

BEmOC: Basic Emergency Obstetric Care

BMI: Body Mass Index

BPD: Biparietal Diameter

CEmOC: Comprehensive Emergency Obstetric Care

CEO: Chief Executive Officer

CODAC: Cause Of Death and Associated Conditions classification

CRL: Crown Rump Length

DHIS: District Health Information Systems

EFD: Early Foetal Death

ESMOE: Emergency Steps in Management of Obstetric Emergencies

ESOT: Emergency Simulation in Obstetric Training

FSB: Fresh Stillbirth

HC Head Circumference

HELLP: Haemolysis with Elevated Liver enzymes and Low Platelets

HIC's: High Income Countries

HIV: Human Immunodeficiency Virus

HREC: Human Research and Ethics Committee

ICD-10: the tenth International Classification of Disease

ICD-PM: International Classification of Disease applied to Perinatal Mortality

INCODE: Initial Causes Of Death Classification

IUGR: Intrauterine Growth Restriction

LFD: Late Foetal Death

LMIC's: Low to Middle Income Countries

LNMP: Last Normal Menstrual Period

MRI: Magnetic Resonance Imaging.

MSB: Macerated Stillbirth

MTOP: Medical Termination Of Pregnancy

n: Number

NHLS: National Health Laboratory Services

NICE: Neonatal and Intrauterine death Classification according to Etiology

non-SA: non South African

OR: Odds Ratio

PPIP: Perinatal Problems Identification Program

REDCap: Research Electronic Data Capture

RMMCH: Rahima Moosa Mother and Child Hospital

RR: Relative Risk

SA: South African

SBR: Stillbirth Rate

SFH: Symphysiofundal Height

TORCHES: Toxoplasmosis, Rubella, Cytomegalovirus, Herpes, Epstein bar virus, Syphilis

UNAIDS: United Nations Program on HIV/AIDS

WHO: World Health Organisation

1. INTRODUCTION

A noticeable rise in stillbirths has been observed at Rahima Moosa Mother and Child Hospital (RMMCH). Departmental administrative data indicates an increase in perinatal mortality rates from approximately 20/1 000 births in 2010 to 39/1 000 births in 2016/7. There has been an increase in the number of non-South African citizens accessing obstetric services.

This retrospective study aimed to identify the incidence of stillbirths and the main obstetric and other avoidable factors associated with stillbirths, for the period of 1 August 2016 to 31 July 2017 as well as to ascertain the incidence of stillbirths in the non-South African population group at RMMCH during the same period in order to determine if there is a difference the relevant factors.

2. BACKGROUND LITERATURE

2.1 DEFINITIONS

2.1.1 Stillbirth

A stillbirth refers to a foetus that is delivered with no signs of life. Death may have occurred antepartum: before the onset of labour, or intrapartum: during labour (1). The tenth international classification of disease (ICD-10) defines a stillbirth as death prior to complete expulsion or extraction of a foetus from the mother as evidenced by absence of signs of life (2). This affects foetuses that have achieved viability as defined by reaching:

1. a gestation of 22 weeks or more
2. a birth weight of 500g or more
3. a length of 25cm or more (1)

The gestational cut off for stillbirth varies according to region. High income countries (HIC's) use a gestational age of 20-22 weeks and low to middle income countries (LMIC's) use a cut off of more than 28 weeks (3).

2.1.2 WHO definition

The World Health Organisation (WHO) has defined the viable gestational age:

1. at 28 weeks or more
2. having reached a birth weight of 1 000g or more
3. having reached a length of 35cm or more.

This definition is recommended by WHO for LMIC's and for international comparisons. Deaths occurring in foetuses ≥28 weeks of gestational age are referred to as late foetal deaths (LFD) and those in the 22-27 gestational age category as early foetal death (EFD) (3–5).

2.1.3 Macerated vs Fresh stillborn

Stillbirths can be divided into two groups: macerated or fresh stillborn. A macerated stillborn (MSB) foetus is defined as one with skin and soft tissue changes such as discoloration peeling and breakdown. It is presumed to have died antepartum or before the onset of labour. A fresh stillbirth (FSB) foetus is one without these changes and is presumed to have died recently, intrapartum or during labour and delivery (6).

2.2 INCIDENCE OF STILLBIRTHS

2.2.1 Global, regional and national statistics

It has been estimated that 2.6 million stillbirths occurred globally in 2015 and 98% of these occurred in LMIC's. The global stillbirth rate was estimated at 18.4/1 000 for 2015 (4). The national stillbirth rate (SBR) in South Africa in 2014 was 17.6/1 000. Two thirds of these were antepartum and 50% of the cases had no identifiable causes (4,7). The stillbirth rate in South Africa is comparable to the rest of Southern Africa (see Table 1.1).

Table 1.1 A global, regional and national comparison of rates of stillbirths (8)

	Less Developed regions (globally)	Least developed regions (globally)	Southern Africa	South Africa
Still birth rate	26/1 000	31/1 000	21/1 000	18/1 000

2.3 BIRTH WEIGHT

The birth weight of the foetus is used to categorise stillbirths in the instance that the gestational age cannot be accurately determined by dating methods such as ultrasound (4). The birth weight categories are used for statistical purposes and for presentation at audit meetings to demonstrate the extent of the burden of stillbirths. The birth weight categories are:

1. Less than 500g- *Abortions*
2. 500g-999g (extreme low birth weight) } *Early foetal deaths*
3. 1 000g-1 999g (very low birth weight) } *Late foetal deaths*
4. 2 000-2 499g (low birth weight)
5. Greater than 2 500g

Most stillbirths occur in the very low birth weight category followed by the low birth weight category. Stillbirths occurring in the 500g-999g category are the EFD's and those in the categories from 1 000g or more are the LFD's (4)(1).

2.4 FACTORS ASSOCIATED WITH STILLBIRTH

2.4.1 Gestational age

An accurate estimation of the gestational age is essential for appropriate care during pregnancy. This includes detecting growth restricted foetuses, post term pregnancies as well as proper management of pregnancies at risk of preterm deliveries. Prematurity has been

found to be a major risk factor for stillbirth with an odds ratio (OR) of 6.05. Post term pregnancy is also a risk factor for stillbirth (3)(9) .

Various methods exist for estimating the gestational age:

2.4.1.1 Ultrasound

An early ultrasound scan measuring the foetal crown rump length (CRL) between 7 weeks and 13 weeks 6 days is the accepted method for precise dating of pregnancy. After 14 weeks, the upper limit for accurate ultrasound assessment of gestational age is 24 weeks using foetal biometry measurements of the head circumference (HC) and the biparietal diameter (BPD). However in settings with limited resources, routine ultrasound is often not available (9).

2.4.1.2 Symphysis fundal height measurements (SFH)

This is a very easy and inexpensive method of estimating gestational age, using a simple flexible measuring tape and plotting the measurement on a SFH growth chart. It is useful in resource limited settings (9). However, it has a sensitivity of 35% and a specificity of >90% in detection of abnormal foetal growth (10).

2.4.1.3 The last normal menstrual period (LNMP)

The first day of the last normal menstrual period is used to calculate the gestational age but this is subject to how well a woman recalls the date of her last period. The accuracy can also be influenced by her literacy level and cultural background (9).

2.4.2 Birth weight

Birth weights less than 1 500g and more than 4 000g have been found to be associated with an increase in the risk of stillbirth with an OR of 56.13 and 2.08 respectively (3).

2.4.3 Antenatal care

Antenatal care is the health care of a pregnant woman in the period before she gives birth. The aim of antenatal care is to detect pre-existing conditions and arising problems which can then be treated. The earlier antenatal care can be initiated i.e. the first trimester which is the first 12 weeks of pregnancy, the earlier problems can be detected, treatment can be instituted and there is a better chance of treatment success (11). Good quality antenatal care can identify and address many issues that arise during pregnancy and it is essential to optimise antenatal visits. A common factor in LMIC's is an absence or low quality of antenatal care (12). Where there

is lack of antenatal care or a patient's residence is remote from health care facilities the risk of stillbirth is increased (OR 2-7.23) (3).

2.4.3.1 Timing of antenatal care

In the year 2001, the WHO conducted an Antenatal Care Trial which suggested that 5 focused antenatal visits for patients without comorbidities are adequate to ensure good delivery outcomes for both mother and baby (13). These visits where scheduled at first antenatal visit then at 20, 26, 32 and 38 weeks, if needed a visit at 41 weeks was recommended.

A review of the WHO Antenatal Care Trial observed an increased relative risk of stillbirth between 32 and 36 weeks gestation. In South Africa 8 of the provinces adopted the 5 antenatal visit schedules except the Western Cape Province; in which antenatal visits were scheduled at first antenatal visit then at 20, 26, 32, 34, 36, 38 weeks and 41 weeks if needed.

A comparison between the two schedules was made in 2008. It was found that there was a rise in the risk of still births in the third trimester that coincided with the absence of antenatal care at 38 weeks and again at 41 or more weeks of gestation. Therefore, having three or more visits in the third trimester will aid in identifying the foetus at risk and allow for enough time to institute measures to prevent a stillbirth (13).

2.4.3.2 Maternal age

Patients with extreme maternal ages of less than 20 years (OR 2.5) or more than 40 years (O.R 2.98) are at risk of having a stillbirth (3).

2.4.3.3 Parity

Primiparity has a relative risk (RR) of 1.3 and multiparty of 5 or more has a RR of 1.2. Both instances are associated with a risk of stillbirth (3).

2.4.3.4 Level of education and socioeconomic status

Mothers with a low level of education (RR 1.6) and those from a low socioeconomic background (OR 1.81) are found to be at increased risk of having a stillborn (3).
A majority of the patients presenting at RMMCH for obstetric care are from a lower income/socioeconomic background and this includes non-South African patients. The stillbirth rate has been shown to be highest among LMIC's mainly due to a substandard educational background and a lower income status. Preterm infection, hypertensive disease

and birth asphyxia are the main contributors to the high rate of perinatal mortality in populations with a lower socioeconomic status (4,14,15).

2.5 CAUSES OF STILLBIRTH

Determination of the cause of stillbirth has been historically challenging as a foetus is not observed when death occurs and the pathophysiological pathway is unclear. The causes of stillbirths are grouped into the following categories (14).

2.5.1 Placental conditions

Poor placental conditions are recognised as a major cause of stillbirth. Various pathologies of the placenta account for 26% of the causes of stillbirths (16). Placental abruption accounts for between 7.5% and 42% of stillbirths (3). This usually presents with antepartum haemorrhaging. Uteroplacental insufficiency accounts for up to 31% of MSB (3).

2.5.2 Obstetric complications

Obstetric complications such as cervical incompetence, preterm labour and preterm rupture of membranes are found to account for approximately 17% of the causes of stillbirths (3).

2.5.3 Foetal conditions

Foetal congenital structural and chromosomal abnormalities have been described as causes of stillbirths (3). Renal, pulmonary, anencephaly, diaphragmatic hernias, and thanatophoric skeletal dysplasia are the common structural causes of stillbirths (3). Cord abnormalities have also been found to be associated with stillbirths. Congenital malformations are reported to account for 2.1-33.3% of stillbirths (3,16).

2.5.4 Maternal conditions

2.5.4.1 Maternal conditions in LMIC's

Maternal medical conditions have been identified as a cause of stillbirths, attributing 8-50% of stillbirths. Conditions such as diabetes, HIV, syphilis, hypertensive disorders (chronic hypertension and/or preeclampsia) and antiphospholipid syndrome are commonly reported as causes of stillbirths. Malaria and anaemia have been reported in certain parts of Africa as conditions that are related to stillbirths. It is noted that there is a statistically significant link between hypertension and diabetes and MSB. Among HIV infected women, it has been found that there is an increased risk of stillbirth in those with a higher viral load and in those who

were symptomatic (OR 3.19). Various conditions may cause or contribute to the pathophysiological process that led to a stillbirth (3,16).

2.5.4.2 Maternal conditions in South Africa

In South Africa maternal conditions that are related to perinatal mortality are (15):

1. non-pregnancy related infections
2. obstetric haemorrhage (antepartum haemorrhage and postpartum haemorrhage)
3. hypertension
4. medical and surgical complications
5. pregnancy related sepsis
6. extrauterine pregnancy
7. anaesthetic complications
8. embolism and acute collapse

The most common maternal conditions are hypertension and obstetric haemorrhage (15).

2.5.4.3 Maternal wellbeing and care throughout pregnancy

Maintaining maternal health, preventing complications and preserving perinatal survival are intimately linked to maternal care throughout pregnancy. A vast majority of perinatal deaths occur in the presence of maternal complications that are undiagnosed or undertreated. Improved antenatal care will prevent antepartum stillbirths and improved intrapartum care (during labour and delivery) will prevent intrapartum stillbirths. The presence of skilled birth attendants and skilled emergency obstetric carers are effective in reducing intrapartum related stillbirths (2).

2.5.5 Infections

Infections are found to account for 14-19% of the causes of stillbirths (16). The source of infection could arise from maternal systemic infection, the placenta or the foetus.

2.5.5.1 Intrauterine infections

Infections can arise from the cervicovaginal flora which cause intrauterine infection and inflammation. There are over one hundred bacterial species that cause intrauterine infection. The most common are *Ureaplasma urealyticum*, *Mycoplasma hominis*, *Bacteroides species* and *Gardnerella species*. The Group B streptococcus species, *Streptococcus agalactae*, is found in the rectum or vagina of 10-30% of pregnant women and spreads to the placenta by ascending spread. *Listeria monocytogenes* is a facultative intracellular bacillus that is food

borne and colonises the maternal gastrointestinal tract and spreads to the placenta as either ascending infection or haematogenous spread. These cause placental infection which can lead to stillbirth (17).

2.5.5.2 Maternal sepsis

Bacterial infection of the placenta with *Escherichia coli* may arise from maternal urinary tract infection and cause an overwhelming lethal infection in the foetus. Such organisms can be seen in foetal circulation (17).

2.5.5.3 TORCH Infections

TORCH is a mnemonic for a group of pathogens that are known to be transmitted vertically from mother to foetus and affect the foetus. Infection of the foetus and placenta occur via the haematogenous route. The pathogens are:

1. *Toxoplasma gondii*
2. Other- *Treponema pallidum* (syphilis), Human Immunodeficiency Virus (HIV), varicella virus (chicken pox), parvovirus B19, *Mycobacterium tuberculosis*, *Plasmodium species* (malaria)
3. Rubella virus
4. Cytomegalovirus
5. Herpes simplex virus (17)

2.5.6 Abnormalities of the umbilical cord

Umbilical cord accidents such as cord prolapse are strongly associated with stillbirths (3). Strictures and thrombosis of the umbilical cord attributed to 10% of causes of stillbirths (3,16).

2.5.7 Causes of stillbirths in LMIC's

In LMIC's, the placental causes considered include placental abruption which attributes 7.5-42% of major causes of stillbirth, and placental insufficiency which is found as a cause of death in 31% of all MSB. Intrapartum asphyxia and trauma were also found to be causes of stillbirths. Less frequently, amniotic fluid issues and uterine rupture are reported as causes of stillbirths. These have accounted for 6.5% and 10.7% respectively. Maternal disease conditions that were identified and commonly reported as causes of stillbirth were diabetes, HIV (with a high viral load), syphilis and hypertensive disorders. These accounted for 8-50%

of stillbirth causes. A large proportion of stillbirths in LMIC's are reported to have unknown causes (range 3.8-57.4%) (3).

2.5.8 Causes of stillbirth according to weight category

Table 2.1 Causes of perinatal morality per weight category (18)

	500g – 999g	1 000g+
Primary obstetric cause: the main obstetric condition that led to perinatal death	Macerated still born: Unexplained	Macerated still born: Unexplained
	Fresh still born: Antepartum haemorrhage Intrapartum asphyxia	Fresh still born: Intrapartum asphyxia

In the 500g or more weight categories, MSB is found to be caused by unknown factors while FSB are mainly caused by antepartum haemorrhage and intrapartum asphyxia. Further, in the 1 000g or more weight category, MSB were reported as being caused by unknown factors while FSB were caused by intrapartum asphyxia (18). FSB of foetuses more than 2 500g were found to be associated with substandard intrapartum care due to poor foetal monitoring and/or misinterpretation of the foetal monitoring tool, the cardiotocography machine (CTG), in diagnosis of foetal distress. Catastrophic events such as placental abruption, cord prolapse, uterine rupture and entrapment of the aftercoming foetal head of a breech during vaginal delivery were other causes of stillbirths found in foetuses in this weight category (19).

2.6 CLASSIFICATION OF STILLBIRTHS

A number of classification systems are used in various geographical regions around the world but there is no global consensus on which one system should be adopted. Stillbirths are commonly classified as 'fresh' or 'macerated' but this only helps in defining the approximate time of death and is not helpful in determining the precise cause of death associated factors (3).

2.6.1 The Neonatal and Intrauterine death Classification according to Etiology (NICE)

This is a classification system that stratifies stillbirths according to etiology. It utilises one of thirteen causes of death subgroups:

1. Congenital abnormalities which are either lethal or potentially lethal malformations

2. Multiple births, with immaturity
3. Maternal disease including preeclampsia, renal disease, liver disease, epilepsy, systemic lupus erythematosus and diabetes
4. Specific foetal conditions such as isoimmunisation, hydrops, tumours, and foetal infections
5. Unexplained small size in comparison with gestational dates, foetus without maternal condition
6. Placental abruption with asphyxia or prematurity
7. Obstetric complications including uterine rupture, disproportion, malpresentation, cord prolapse, cord compression, placenta praevia, foetal blood loss and precipitate labour
8. Unexplained antepartum stillbirth >37 weeks
9. Unexplained stillbirth <37 weeks
10. Specific infant conditions (applicable to neonatal deaths)
11. Unexplained asphyxia
12. Unexplained immaturity: <33weeks or <2 500g or <1 000g
13. Unclassifiable causes

This system had been validated and found to have a specificity of 95-100% in determining the cause of stillbirth and is directed at identifying the underlying biological causes of death. The system relies on detailed information from medical records, therefore improperly kept medical records could be a potential limiting factor (20).

2.6.2 The Initial Causes Of Death (INCODE) classification

This research tool classifies causes of death into:

1. probable cause – meaning there is a high likelihood that a certain condition directly caused the stillbirth (16).
2. possible cause – indicating that the condition might not have caused the stillbirth directly but may have been involved in the pathophysiologic sequence that led to the stillbirth (16).
3. condition present – the disease condition was present but did not meet the criteria for probable or possible cause (16).

2.6.3 The Cause Of Death and Associated Conditions (CODAC) classification

This classification system was developed for use in LMIC's and focuses on perinatal deaths. It aims to determine the cause of death (21). It defines 10 rules for causes of death and does not make use of the mechanisms and pathophysiological chain of events that led to a stillbirth. The following 10 categories are described: (21).

1. infectious causes affecting the mother and intrauterine structures, causing congenital abnormality, causing failure of the placenta or maternal organs or foetal organs, causing preterm labour and delivery
2. conditions and disease specific to neonatal life
3. events of parturition or its complications, involving deaths that occurred after the onset of labour as a result of the onset of or the progress of labour
4. congenital abnormalities including structural and chromosomal abnormalities, placental and umbilical cord malformations
5. foetal conditions and diseases involving placental transfer of toxins and maternal antibodies against foetal tissues (alloimmunisation)
6. cord conditions, diseases and events affecting the umbilical cord and its insertion.
7. conditions and disease of the placenta and membranes
8. maternal conditions, diseases and events that significantly increase the risk of perinatal death, conditions unrelated to the pregnancy or that are exacerbated by the normal physiology of pregnancy and conditions that pose a significant risk to maternal and foetal health
9. unknown, unexplained and unclassifiable with no definite or probable cause
10. terminations of pregnancy irrespective of the indication (22)

2.6.4 The International Classification of Disease application to Perinatal Mortality (ICD PM)

This is based on the ICD-10. The WHO adopted this classification system for perinatal deaths, including stillbirths. It identifies time of death as antepartum or intrapartum. It is multi-layered as it takes into consideration the intensity of locally available investigations and it takes into account the contributing maternal condition. This classification system allows for easy identification of points of target of interventions to improve maternal and perinatal outcomes and it allows local facilities, districts and countries to investigate stillbirths based on local priorities (23). This classification system offers broad applicability and facilitates standardised comparison of data internationally. It is globally applicable and places emphasis on the mother-baby dyad (24).

2.6.4.1 Antepartum perinatal deaths

These include congenital abnormalities (chromosomal abnormalities and malformations), infections, antepartum asphyxia, disorders of foetal growth and unspecified causes (23).

2.6.4.2 Intrapartum perinatal deaths

This subgroup accounts for deaths related to birth trauma, acute intrapartum events, infections and unspecified intrapartum deaths (23).

2.6.4.3 Maternal conditions

Complications of pregnancy such as cervical incompetence, premature rupture of membranes and having a multiple pregnancy are included in this subgroup. Other complications of labour and delivery such as breech presentations, malpresentations, caesarean sections and instrumental delivery are accounted for here. Maternal medical and surgical conditions such as preeclampsia, eclampsia, gestational hypertension, renal and urinary conditions, infections, medical and surgical procedures, pregestational or gestational diabetes, tobacco use, alcohol use, and recreational drug use are all considered here (23). Obesity is also a risk factor for stillbirths with a 2-5 fold increased risk association. The higher the body mass index (BMI) and the later the gestation in obese patients, the higher the risk of stillbirth (25).

2.7 AVOIDABLE FACTORS AND OPPORTUNITIES FOR PREVENTION OF STILLBIRTHS

2.7.1 Broadly classifying avoidable factors and missed opportunities

These could be put into three categories which are:

1. patient and family associated
2. health care provider associated
3. administration associated

Unexplained stillbirths are patient and family associated which implies the possibility or a probability of inappropriate response to decreased or abnormal foetal movement. Intrapartum asphyxia is avoidable if the health care provider appropriately uses and interprets foetal monitoring tools, uses the partogram well and competently manages the second stage of labour. Complications of hypertension where an elevated blood pressure is detected but no remedial action is taken by the health care provider can also be avoided (18). Administrative factors are implicated when there are logistical issues such as:

1. the lack of transport to or between health facilities
2. the lack of equipment
3. a shortage of adequately trained staff who are capable detecting abnormalities during antenatal care and are competent in managing deliveries and obstetric complications (18)

2.7.2 Opportunities to prevent stillbirths

2.7.2.1 Treat infections

Screening for syphilis is one of the mandatory tests done during the antenatal period. In sub-Saharan Africa, it accounts for 11.2% of stillbirths (11,12). HIV testing is also encouraged during pregnancy. Up to 0.7% of stillbirths are attributable to HIV infection in sub-Saharan Africa according to data from the PPIP (11,12). Bacterial infection causes chorioamnionitis (12). Various infections can be treated according to local protocols.

2.7.2.2 Modifying conditions associated with lifestyle

Obesity, hypertension and diabetes are well known to be linked to stillbirth. Primary prevention by making healthy lifestyle choices preferably preconception is essential. If detected during pregnancy, appropriate monitoring and treatment could prevent a stillbirth (12).

2.7.2.3 Decrease substance use

The use of tobacco increases the risk of stillbirth compared to non-users (12). Smoking increases the risk of placental abruption which can cause stillbirth. The OR of stillbirth in smokers is 1.77-2.17 (26,27). The use of illicit drugs such as cocaine also increases the risk of stillbirth by causing placental abruption and preterm prelabour rupture of membranes. The OR for stillbirth with illicit drug use is 2.3 (26,27). Heavy use of alcohol during pregnancy is associated with negative birth outcomes including stillbirth (26).

2.7.2.4 Detection of maternal disease arising during pregnancy

Preeclampsia and eclampsia detection and treatment during pregnancy and appropriate intrapartum care will reduce the risk of stillbirth (12). In patients with diabetes, strict glycaemic control with diet and antidiabetic medication as well as surveillance of glucose levels throughout the day together with appropriate timing of delivery will reduce the risk of stillbirth (28).

2.7.2.5 Estimation of gestational age

Accurate estimation of the gestational age and detection of post term pregnancy with timeous induction of labour for pregnancies >42 weeks will help prevent associated stillbirths. Identifying preterm labour and instituting appropriate management according to local protocols in pregnancies that are preterm can prevent stillbirths (12).

2.8 IDENTIFICATION OF STILLBIRTHS

The Perinatal Problem Identification Program (PPIP) version 3 developed by Johan Coetzee; records perinatal mortalities in hospitals using the District Health Information Systems (DHIS). The information is extracted from clinical records and death notifications done by health practitioners (18). This information is entered into the PPIP form version 3, and captured as data (Appendix A).

The third version of the PPIP coding system categorises any data that has been collected into obstetric conditions and avoidable factors. The avoidable factors are then sub classified into patient related, health worker related and administration related factors. This coding system is used to standardise such data collected for the PPIP data base (29) (Appendix C).

2.9 INVESTIGATING STILLBIRTHS

Investigations are carried out to ascertain or confirm the cause of stillbirths. This usually begins with a thorough medical and obstetric history in order to identify associated risk factors and causes (30).

2.9.1 Foetal autopsy

This is the gold standard for cause of death determination (31). Upon delivery of the foetus and with the consent of the parents, a foetal autopsy should be performed. Parents will have an opportunity to know the cause of the baby's demise and the number of unexplained stillbirths will be reduced. The autopsy will identify any morphological anomalies, birth defects and can detect the presence of foetal infection, anaemia, hypoxia and metabolic abnormalities (5,25).

2.9.1.1 Barriers to foetal autopsy

Various misconceptions exist about the logistics of foetal autopsy. However ideal, foetal autopsies are not feasible in LMIC's owing to the lack of skilled perinatal pathologists and resources. Another reason an autopsy might not be carried out is that the parents may have personal beliefs that are against the notion of an autopsy (5,30).

2.9.1.2 Alternatives to foetal autopsy

1. Minimally invasive autopsy

   This involves collection of various tissue and blood samples from the foetus for pathological analysis to determine the cause of foetal death. Blood and cerebrospinal fluid are collected in addition to needle biopsy specimens of the liver, lungs, kidneys, central nervous system, heart and spleen. It has been demonstrated that this is substantially concordant with a full foetal autopsy and it has a high sensitivity and specificity in determining the cause of death (31).

2. Radiological imaging

   Families that decline foetal autopsy may be offered a foetogram (X-Ray of the foetus) or a post-mortem MRI (magnetic resonance imaging) (5).

2.9.2 Placental histopathological assessment

Histopathological evaluation of the placenta, membranes and umbilical cord is a useful component of the autopsy process, in the event that a full foetal autopsy cannot be performed. This provides insight into potential causes of stillbirth as placental pathology represents a major category of causes of stillbirth, especially when the stillbirth is unexplained. Placental abruption, infection and other lesions such as vascular occlusion and fibrin deposition are detectable in the placental histopathological assessment (32). Histological evaluation of the placenta confirms 64% and excludes 42.4% of potential causes of stillbirth. The combination of foetal autopsy and placental histological evaluation increases the identification of the cause of stillbirths (33).

2.9.3 Genetic testing

2.9.3.1 Karyotyping

Foetal karyotype testing is valuable in cases of foetuses with congenital malformations and structural abnormalities (30). This investigation is reliant on the presence of viable foetal tissue and its use might be limited in macerated foetuses with nonviable tissue.

2.9.3.2 Chromosomal microarray

Chromosomal microarray represents an advancement in genetic testing. It is the preferred method as it can be carried out on nonviable tissue and can detect microdeletions and microduplications on chromosomes. It has the ability to detect changes that are not apparent on conventional cytogenetic analysis (5).

2.9.4 Testing for specific maternal conditions

Specific testing for overt maternal disease such as diabetes mellitus, thyroid disease and syphilis is essential. An indirect Coombs test will confirm or exclude Rhesus isoimmunisation in patients who are Rhesus negative (30). Testing for antiphospholipid antibodies (APL) is recommended in patients with a previous history of stillbirths (33,34). Testing for APL is an important component of the work up for unexplained intrauterine demise. The antibodies tested are anticardiolipin antibodies (IgM, IgG), the anti B2 glycoprotein 1 antibodies (IgG). Testing is done on two occasions which are twelve weeks apart (35,36).

2.9.5 Recommendations for investigating stillbirths

The work up for the cause of stillbirths should begin with a maternal interview to ascertain previous medical and obstetrical history and to assess risk factors of stillbirth. This is followed by medical record abstractions and biospecimen collection from both the mother and foetus for toxicology testing and serological analysis. If permitted, a foetal autopsy is performed as well as placental histological analysis. Cytogenetic testing and APL tests are done based on the clinical scenario. Additional tests for specific conditions can be requested based on availability of resources (33).

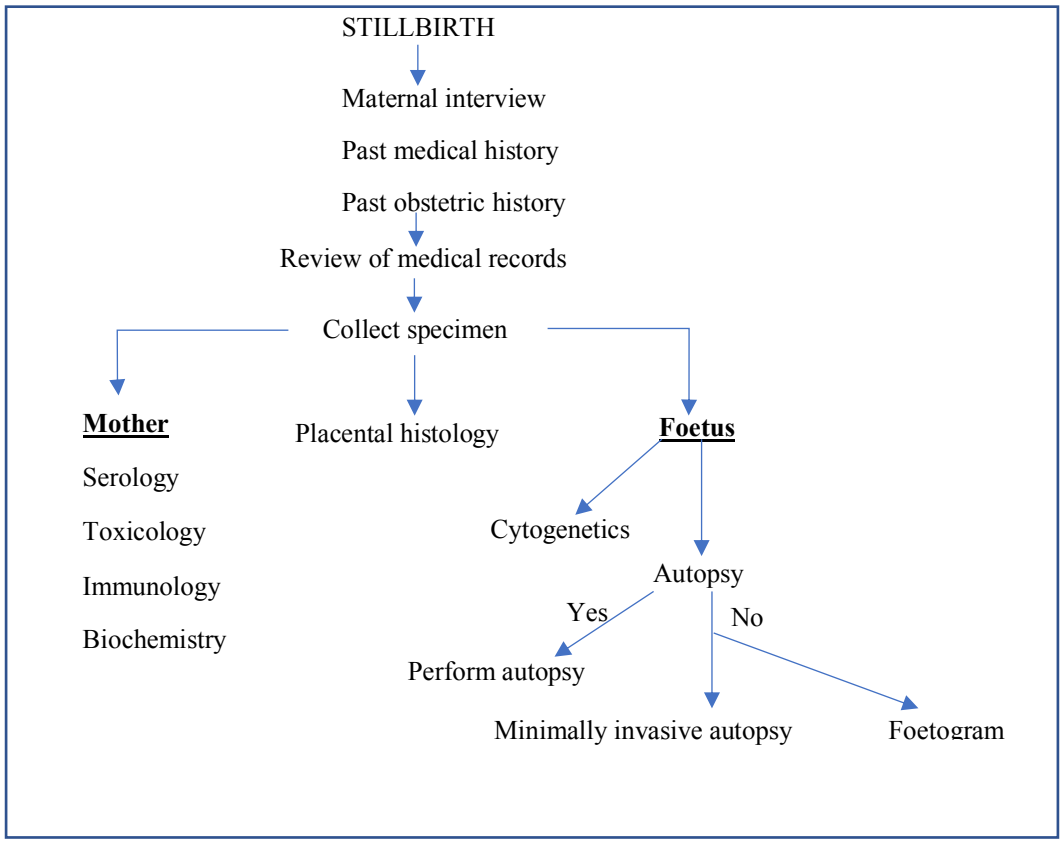


Figure 2.1 Investigating stillbirths

Examples of specific conditions:

1. Hypertension: Placental histological analysis and foetal autopsy. Add tests for APL if there is associated early onset hypertension before 34 weeks (33).
2. Congenital abnormalities: Foetal autopsy and cytogenetic analysis (33).
3. Preterm labour, preterm rupture of membranes, chorioamnionitis: Placental histology and foetal autopsy (33).

2.10 ECONOMIC AND PSYCHOSOCIAL CONSEQUENCES OF STILLBIRTH

2.10.1 Economic consequences

The care costs for stillbirths are found to be greater than the care costs for a live birth.

2.10.1.1 Direct costs

The costs for the investigation of stillbirths, including the fees for additional hospital care immediately after the delivery of a stillborn baby, range from $1450-8067. The costs of subsequent pregnancy following a stillbirth are more than the costs of a preceding uncomplicated pregnancy; there are additional costs incurred for close monitoring and surveillance in subsequent pregnancies (37).

2.10.1.2 Indirect costs

The most common costs for parents after the delivery of a stillborn baby are for a funeral ($469-11719). Some parents have the additional costs for burial plots and memorials. In the long term there are financial consequences for the family due to reduced earnings and an inability to return immediately to gainful employment after having a stillbirth. Stillbirths affect employment indirectly because of the additional time taken off work for bereavement of the parents and even after a return to work, productivity is greatly reduced (37). Additionally time taken off work in subsequent pregnancies for additional surveillance further reduces parents' earnings which is coupled with increased costs for investigations and care.

2.10.2 Psychosocial consequences

2.10.2.1 Psychological consequences

The negative effects of grief, anxiety, fear and suffering after a stillbirth can affect patients and their families. The family is usually the main source of support for the mother during these times. Psychological distress can persist into subsequent pregnancies and present with changing emotions, ranging from relief and hopeful optimism to worry and panic attacks which can negatively affect a pregnancy. Mothers usually go through a volatile emotional state while partners tend to suppress their feelings or express outbursts of anger. Healthcare workers who attended a woman during the discovery, delivery and investigation for stillbirth experience negative psychological effects and often need debriefing and support (37).

2.10.2.2 Social consequences

Mothers who have experienced a stillbirth tend to have feelings of inadequacy and loss of self-confidence. They also tend to lose confidence in parenthood and their child rearing abilities. They go through social isolation by avoiding contact with babies, neighbours and the people who knew they were pregnant. Certain societal or cultural beliefs lead to them being devalued and rejected by their partners and families. Partners may feel unacknowledged as a legitimately grieving parent. Either of the grieving parents may take to substance abuse as a means of coping with the loss.

The experience of stillbirths can put a strain on the relationship between a mother and her partner resulting in spousal abuse, separation or forced divorce. There are adverse effects on the siblings of the stillborn baby, these affect the parent-child relationship and the siblings'

long term physical and mental wellbeing. Grandparents, aunts, uncles and cousins tend to also be affected (38).

There are some positive consequences of stillbirths. Some couples report that the experience strengthened their relationship. Some campaign for and contribute to improvement in health services to help other families. Many parents positively change the way they access health services in subsequent pregnancies (37).

2.11 MOVING FORWARD

Perinatal mortality is reduced with effective antenatal, intrapartum and postnatal care of mothers and babies. Stillbirths can be prevented by the same interventions (38).

2.11.1 Practice and implementation of interventions

Having the burden of stillbirths brought to the attention of policy makers and management of healthcare institutions will lead to creation and implementation of solutions for preventing stillbirths. Together with health promotion managers and the community, campaigns relevant for stillborn prevention will improve mothers' and communities' awareness of stillbirth risks and causes. The aim would be to increase awareness of and access to antenatal services (39). The main component of health development is the availability and accessibility to health care facilities.

The National Perinatal Morbidity and Mortality Committee's recommendations for reduction in perinatal mortality are: (40)

1. Health systems improvement
2. Health care provider training
3. Reduction in deaths due to intrauterine asphyxia
4. Reduction in deaths due to prematurity
5. Reduction in deaths due to sepsis

2.11.2 Improved antepartum care

There are no tests that can predict stillbirths (5). Therefore, with adequate antenatal surveillance the detection of risk factors and causes of stillbirths is improved and antepartum stillbirths are prevented. Interventions to reduce antepartum stillbirths would involve:

1. Treatment of mothers with positive syphilis testing

2. Treatment of hypertensive disorders
3. Treatment of diabetes in pregnancy
4. Administration of magnesium sulphate in patients with pre-eclampsia and eclampsia
5. Detection of intrauterine growth restriction and the management thereof
6. Induction of labour for a gestation that has exceeded 41 weeks (7)
7. Treatment of patients with preterm rupture of membranes reduces foetal demise due to sepsis (38).

2.11.3 Improved intrapartum care

Training of health care workers in the care of obstetric patients in labour is paramount and can be achieved by applying the Essential Steps in Management of Obstetric Emergencies-Emergency Obstetric Simulation Training (ESMOE - EOST) programme (40,41). This programme encompasses common obstetric and neonatal emergencies and provides information on identification and remediation of such emergencies. It is effective because it creates clinical scenarios and provides training through the use of fire drills. Interventionists will be able to improve obstetric care by implementing Basic Emergency Obstetric Care (BEmOC) and Comprehensive Emergency Obstetric Care (CEmOC) thereby reducing intrapartum mortality (38). BEmOC involves providing antibiotics, oxytocics, anticonvulsants, assisted delivery, removal of placenta and retained products and new born care. CEmOC involves providing blood transfusions, caesarean sections and care of the sick and low birth weight neonates.

Providing skilled attendants increases the capacity to provide comprehensive emergency obstetric care; it would improve the perinatal mortality rate and thus the stillbirth rate. Detection of foetal distress and timeous action to expedite delivery within 30 minutes, as recommended by the Royal College of Obstetricians and Gynaecologists, would aid in reducing intrapartum stillbirths. In the South African context, an interval of 30 minutes is not achievable owing to a the low availability of resources and therefore the recommendation is 60 minutes (19). In clinical practice, perinatal outcomes have not been shown to correlate with the decision-delivery interval; there are often delays, such as anaesthetic procedures, that tend to prolong the decision-delivery interval to as much as 106 minutes. However, in the face of catastrophic foetal or maternal conditions such as cord prolapse or placental abruption, expedient delivery is warranted (42).

Achieving the above would contribute to the attaining the second goal of the WHO's Every Newborn Action Plan, which is to end preventable stillbirths. The aim is for all countries to attain a stillbirth rate of 12/1 000 by the year 2030 and a rate of less than 10/1 000 by the year 2035 (43).

3. PROBLEM STATEMENT

Stillbirths are an unwanted outcome of pregnancy and it reflects the overall care that mothers receive both antenatally, during labour and delivery.

The number of patients accessing care during pregnancy has risen and it has been noticed that there seemed to be a rise in the numbers of stillbirths and possibly in the stillbirth rate at RMMCH since the year 2011. The hospital offers antenatal, intrapartum and postnatal care to all pregnant women of various nationalities accessing these services at the institution.

The study aims to ascertain if there has indeed been a rise in the stillbirth rate at RMMCH over the past years, especially over 2016 and 2017. The outcome is mainly informative and should aid in creating the necessary adjustments that are needed to cater for an increasing population of women consulting at and receiving obstetric services at RMMCH.

4. STUDY OBJECTIVES

1. To calculate the incidence of stillbirths among deliveries occurring at RMMCH, stratified for EFD and LFD.
2. To determine the trends in annual stillbirth rates at RMMCH over a five year period from August 2011 to July 2016.
3. To describe the main obstetrical and avoidable factors associated with stillbirths at RMMCH from August 2016 to July 2017.
    a. Determining the contribution of each obstetric factor which led to the stillbirths
    b. Classifying the avoidable factors
4. To define the incidence of stillbirths in the non-South African population that accesses the obstetric services at RMMCH.
5. To describe the common histopathological diagnoses on placental evaluation.

5. METHODS

This was a retrospective, cross-sectional and descriptive study.

5.1 IDENTIFICATION OF CASES

The sources in which patients' birthing details were found and checked:

1. The stillbirth record book in ward 9
2. The stillbirth record book in ward 10
3. The theatre delivery book
4. The born-before-arrival (BBA) book in ward 6
5. The labour ward registry
6. The labour ward stillbirth book, for those less than 1 000 grams

Patients' details that were extracted from these sources were used to trace their files in the hospital's records room in order to collect the data. Patients who delivered between the 1 August 2016 to 31 July 2017 were included. The data was then entered into the modified PPIP form (see Appendix B). Certain modifications to the PPIP form have been made to fully accommodate this study. The third version of the PPIP coding was used in order to standardise data collection and identify relevant data.

Modifications include the addition of the following:

1. indication whether a patient is a South African citizen or not
2. placental histological diagnosis
3. other investigations
4. haemoglobin count (Hb)
5. Rhesus Factor – indicating if positive or negative; if negative, whether there is a presence of antibodies
6. Body Mass Index (BMI)
7. social habits – drugs, smoking and alcohol use
8. other obstetric conditions present

Modifications include the elimination of the following:

1. "at this facility" and "at another facility"; as all the data used in this study is solely concerned with stillbirths that occurred at RMMCH
2. "born alive" and "final neonatal cause of death" categories is not included as this study only refers to stillbirths

The same sources of patients' details were checked for total deliveries and total stillbirths occurring at RMMCH per annum, over the five-year period from August 2011 to July 2016. The stillbirth rate for each of those years was calculated and compared for a trend.
The results of any investigations done, especially those of placental histopathological assessment were accessed through the National Health Laboratory Services (NHLS). These were entered into the modified PPIP form in order to determine the common placental histopathological diagnoses that are associated with stillbirths at RMMCH.

5.2 INCLUSION CRITERIA

1. all stillbirths occurring at Rahima Moosa Mother and Child Hospital
2. all stillbirths occurring during the time period of August 2016 to July 2017; including "births before arrival", births resulting from foeticide and termination of pregnancy
3. foetus' weighing more than 500g

5.3 EXCLUSION CRITERIA

1. any stillbirths that occurred in other health care facilities and referred to RMMCH
2. any stillbirths occurring out of the above time period of interest: August 2016 to July 2017
3. any foetus weighing less than 500g

5.4 PROCEDURE

All data was collected retrospectively by the researcher. The data was entered into the modified PPIP data collection sheet (see Appendix B), created on the REDCap (Research Electronic Data Capture) tool. REDCap is run by the University of Witwatersrand as a web based application which is used to save data for research purposes.

Permission was requested and granted from the hospital management of RMMCH in order to gain access to the ward registers and patient records. The registers were used to obtain the total number of births occurring in the time period of interest and to identify patients delivering stillbirths. These patient files were retrieved from the records room and relevant data was extracted that was applied the modified PPIP data sheet. The data was then collated and analysed to determine the outcomes of the objectives. The expertise of a statistician was enlisted in order to statistically analyse the data.

There were 290 files identified from all registers that were stillbirths. Upon review of the files, 9 of them were excluded because foetal weight was less than 500g and a further 13 were excluded because they were cases of early neonatal deaths where the neonate had showed some signs of life at birth. A total of 62 files could not be located as they were either missing or had been taken out by patients for consultation or for other administrative reasons. The files of 206 women who delivered stillbirths at RMMCH during the year of interest, were reviewed.

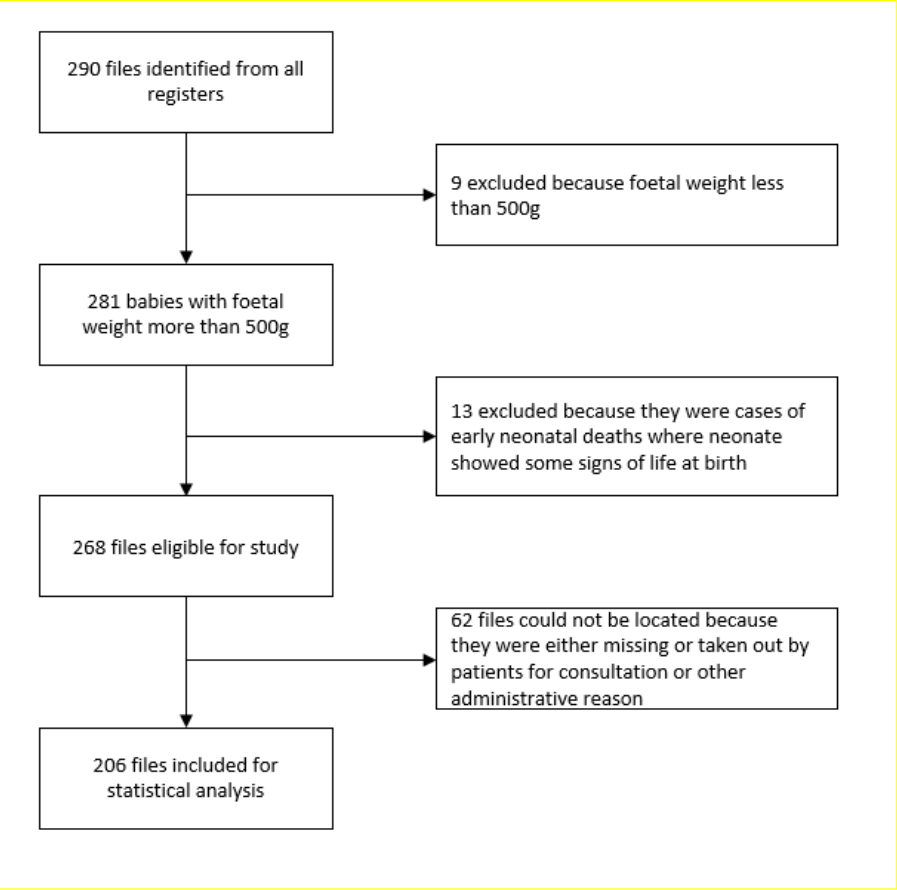


Figure 5.1: Cases that were eligible for this study

5.4.1 How stillbirths are investigated at RMMCH

Risk factors are identified based on clinical history. Upon delivery, the placenta is sent for histological analysis and a specimen of skin from the foetal popliteal fossa is sent for karyotyping. An X-ray (babygram) is ordered in foetuses that appear abnormal. Other blood tests are done based on indication, such as testing for antiphospholipid antibodies, thyroid stimulating hormone, glycosylated haemoglobin (HbA1c) and tests for TORCHES.

5.5 OUTCOMES

5.5.1 Calculating the stillbirth incidence rate and five year trend

The stillbirth rate is the number of stillbirths per one thousand deliveries. It is determined by dividing the number of stillbirths by the total number of deliveries then multiplying by one thousand. The trends over the five year period from 2011 to 2016 were determined by comparing the rates for each year on a line graph. The same calculations are used to deduce the incidence rate of stillbirths among non-South African citizens that accessed obstetric services at RMMCH during the time period of interest.

Table 5.1 Stillbirth rate calculations

Overall stillbirth rate	Stillbirth rate for EFD	Stillbirth rate foe LFD
Number Of Stillbirths ---------- X 1 000 Total Number Of Deliveries	Number Of EFD ---------- X 1 000 Total Number Of Deliveries	Number Of LFD ---------- X 1 000 Total Number Of Deliveries

5.5.2 Obstetric factors

5.5.2.1 Maternal factors

The details of patients' demographics were taken from the first few pages of the antenatal books of patients that received antenatal care. The age, citizenship/nationality, parity, gravidity and other relevant information was deduced from file reviews.

5.5.2.2 Stillbirth characteristics

The characteristics of the stillbirths were found within the main text of the files, among various practitioners' entries. Most details of the stillbirths such as condition at birth, birth weights and gestational age were found in the page reserved for details of the newborn.

5.2.2.3 Primary obstetric cause of death and other conditions present

This refers to the main obstetrical condition in the mother or the foetus that started the sequence of pathological events that led to the stillbirth; in addition to any other conditions present that may have contributed to the pathological pathway that led to the stillbirth. These were recorded in the files of patients and were thus determined by a review of the patients files.

5.5.3 Avoidable factors

Details of avoidable factors were deduced from the historical account entries of various practitioners in the files. These were classified into patient related, administrative related and health worker related avoidable factors. Each class is then further sub classified into probable or possible factors. Probable avoidable factors were those that if avoided, the stillbirth would not have occurred. Possible avoidable factors are those that if avoided, the stillbirth might not have occurred.

5.5.4 Placental histological diagnoses

The results of placental histological evaluation were made available from the NHLS and pathological diagnoses were then extracted.

5.6 LIMITATIONS

1. Approximately 30% of the records that were identified from the registers as stillbirths could not be retrieved. This means that the final results were skewed.
2. Poorly written records provided incomplete information resulting in some data sets having missing values.
3. Neither the PPIP data sheet nor the modified version used in this research cater for previous medical and obstetric histories of mothers which limits assessments of risk factors for stillbirths at RMMCH.
4. Avoidable factors were deduced retrospectively from the review of the historical accounts entered in each file and were subject to being biased.
5. The socioeconomic status and level of education of patients was not assessed.

5.7 DATA ANALYSIS

1. Categorical variables such as citizenship and serological test results were evaluated using frequencies, percentages and charts.
2. The proportions of stillbirths in the various categories were calculated in frequencies and percentages.
3. Numerical data such as age, parity and gestational age were tested for normality and, where appropriate, were summarised using the analysis of variance (ANOVA)Where data distribution was skewed, the Kruskal-Wallis test for numerical variables was used to determine the medians and interquartile ranges.
4. Stillbirth rates over the five year period 2011-2016 were plotted on a line graph.

5. A Chi square test was done to ascertain the significance of association of stillbirth with various variables. It was also used to determine if there were any significant differences between the two citizen groups.

5.8 PERMISSIONS AND ETHICS APPROVAL

Permission to carry out research was granted by the CEO of RMMCH in August 2017. Wits Human Research and Ethics Committee (HREC) clearance was gained in November 2017, clearance certificate number M170936 and permission to access patient laboratory data was granted by the National Health Laboratory Services (NHLS) in January 2018.

The PPIP developer requires that if one presents or publishes data analyses done with PPIP, it should be referred to in the following way: "The Perinatal Problems Identification Program (PPIP) version 3, developed by Johan Coetzee" {www.ppip.co.za}. Hence, no further permission was sought, but mention has been made in the background literature review (item 2.8).

5.9 FUNDING

All expenses for transport, copying and printing, internet, data and airtime were covered by the researcher.

6. FINDINGS

6.1 THE STILLBIRTH INCIDENCE RATE

The total number of deliveries for August 2016- July 2017 was 13 218, 5644 (42.7%) of which were non-South African citizens.

The actual stillbirth rate for the period of interest of this study was 21.9/1 000 deliveries. This study analysed the records of 206 stillbirths that occurred during the time period of interest. The total stillbirth rate based on this was 15.6/1 000 deliveries.

The stillbirth rate for early foetal deaths (EFD's) was 4.08/1 000 and that of late foetal deaths (LFD's) was 10.4/1 000.

Among patients indicated as SA citizens (n7 574), a total of 105 stillbirths were identified and the stillbirth rate was 13.7/1 000.

For patients indicated as non-SA citizens (n5 644), 85 stillbirths were identified and the stillbirth rate was 14.8/1 000.

6.2 THE FIVE YEAR TREND

The five year trend in annual stillbirth rates remained somewhat stable during the preceding five years, at a rate of approximately 12/1 000 with a sharp increase to 21.9/1 000 for the year of interest.

Table 6.1 Five year trend from 2011-2015

Year	Total births	Total stillbirths	Still birth rate (%)	Stillbirth rate/1 000	Non-SA	Non-SA (%)
2011	10 304	118	1.15	11.5	Not recorded	-----
2012	11 395	172	1.51	15.1	2 622	23.0
2013	11 853	152	1.28	12.8	4 229	35.6
2014	11 853	149	1.26	12.6	4 894	41.2
2015	12 348	149	1.20	12.0	4 894	39.6

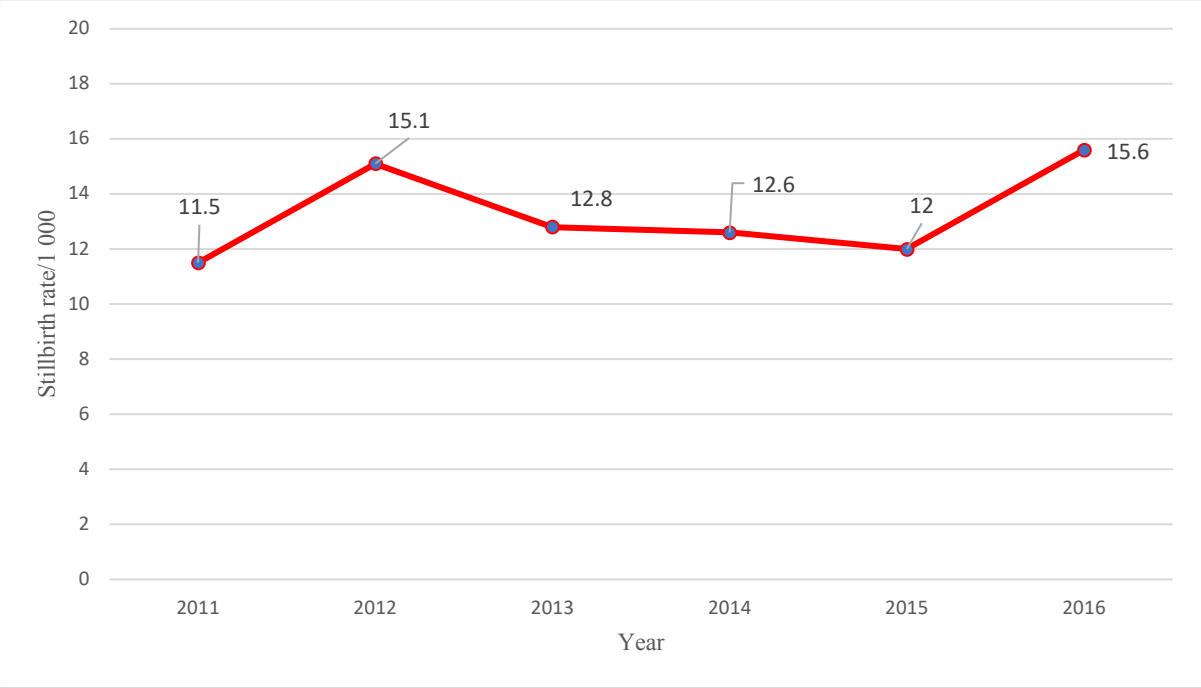


Figure 6.1 Trends in stillbirth rates at RMMCH over five years

6.3 OBSTETRICAL FACTORS

6.3.1 Maternal factors

6.3.1.1 Maternal demographics

Table 6.2 summarises the details of the demographics and categories among South African citizens and non-South African citizens in this study.

Citizenship

There were 105 patients (51%) whose citizenship was indicated as South African citizens and 85 (41.2%) as non-South African citizens. The citizenship was not indicated in 16 cases (7.8%).

Antenatal care

A majority (81.1%) of mothers attended/received antenatal care (booked) during the pregnancy, 33(16.0%) did not attend antenatal care. It is unknown in 6 (2.9%) cases if antenatal care was attended or not. Antenatal clinic booking occurred more among the non-South African citizen group at 84% compared to the South African citizen group at 76.2%. There were no significant differences in antenatal care booking between the two groups (p= 0.15)

Maternal age

The overall mean maternal age was 28.6 years (SD 5.9, p 0.12), with no significant difference in mean maternal age in both citizen groups. Teenage pregnancy, aged <18 years at 3.4% (n7), occurred more with South African citizens (3.9%) than with non-South African citizens (2.4%). Advanced maternal age, >35 years, was found in 27 (13.1%) of mothers with three times more South African citizens (19.0%) than non-South African Citizens (7.1%) being affected. However, there were so significant differences in maternal age between the two groups (p=0.23).

Gravidity

The gravidity in 72 cases (34.6%) was 2. The gravidity in 46 cases (22.4%) was 1. The gravidity in 39 cases (19.0%) was 3 and the gravidity in 36 cases (17.6%) was 4. There was no significant difference in gravidity among the two citizen groups (p= 0.63).

Parity

The parity of 73 cases (36.5%) was 1. 59 cases (28.8%) had a parity of zero. 38 cases (18.5%) had a parity of 2 and 30 cases (14.6%) had a parity of 3. The parity of 2 occurred in 21.9% South African citizens compared to 14.1% of non-South African citizens. The parity of 3 was found to be almost double in non-South African citizens (20.0%)than in South African Citizens (11.4%). No significant differences between the two groups (p= 0.55)

Syphilis

Syphilis serology testing was done, and 177 patients (86.3%) had negative syphilis serology testing, 9 patients (4.4%) had positive serology testing and 7 patients (3.4%) did not have any syphilis testing done. Of the patients with a positive syphilis serology, 2 (22.2%) of the patients received treatment but did not complete it and 4 (44.4%) did not receive any treatment at all. It is unknown in 2 cases (22.2%) if treatment was received or not. There was no significant difference in the overall syphilis serology results among the citizen groups, however differences were found between the groups of those whose results were positive. 50% of South African citizens compared to 20% of non-South African citizens received treatment but did not complete the course. 25% of South African citizens did not receive treatment at all compared to 60% of non-South African citizens. However, over all there were no significant differences between the two groups (p0.47)

HIV

HIV serology testing was done and 145 patients (70.6%) had negative HIV serology, 50 patients (24.0%) were positive for HIV and the results were not available for 7 patients (3.4%). The rate of positive results was higher in South African citizens (28.6%) than in non-South African citizens (17.7%). 76.5% of non-South African citizens tested negative and 66.7% of South African citizens tested negative. A majority of 91.2% (n46) of the patients that tested positive for HIV were on treatment. There were no significant differences in both citizen groups (p=0.47).

Haemoglobin counts

Haemoglobin counts were recorded for all patients and the mean haemoglobin was 11.5g/dL (SD 2.1). A total of 165 patients (80.1%) had a haemoglobin count of >10.0g/dL, 30 patients (14.6%) had haemoglobin counts between 8.0-9.9g/dL and 11 patients (5.3%) had haemoglobin counts of <8g/dL. Almost double the number of non-South African citizens were found to have a haemoglobin count of less than 8g/dL (7.1%) compared to South African citizens (3.8%).

Rhesus factor

Rhesus antigen D testing was done in 203 patients and found to be positive in 199 (98%) of patients whilst 2% were negative.

Body Mass Index

A total of 102 patients had BMI calculations with a median of 27.8kg/m^2 (range 24.4- 31.6). A total of 36 (35.3%) of these patients had a BMI of 25-29.9kg/m^2. 31 patients (30.4%) had a BMI of less than 25 and 25 patients (24.5%) had a BMI of 30-34.9kg/m^2 (obese). More South African citizens (41.9%) were found in the BMI category of 25-29.9kg/m^2 (overweight), than (34.1%) non-South African citizens. The mean height of patients was 1.6m (SD 0.08) and the median weight was 69kg (60-80kg). However, overall there were no significant differences between the two groups (p=0.9)

Social habits

The social habits of patients were recorded: 2.9% drank alcohol, 0.5% used recreational drugs and 0.5% consumed nicotine. No significant differences among the two citizen groups was noticeable.

Place of delivery

The place of delivery was recorded for all patients: 190 (92.0%) delivered in hospital while 11 (5.5%) delivered at home and 5 (2.5%) delivered in transit.

Table 6.2 Summary of maternal demographics

Characteristics	**South African n=105 (51.0%)**	**non-South African n=85 (41.2%)**	**Not indicated n=16 (7.8%)**	**Total n=206**	**p value (overall)**
Maternal age Mean (standard deviation)	29.1 (6.4)	28.5 (5.3)	26.3 (5.6)	28.6 (5.9)	0.23 (0.12)
Age (in categories)					
• Less than 18	4 (3.9)	2 (2.4)	1 (6.25)	7 (3.4)	
• 18 – 35	81 (77.1)	77 (90.6)	14 (87.5)	172 (83.5)	
• Older than 35	20 (19.0)	6 (7.1)	1 (6.25)	27 (13.1)	
Gravidity					
• 1	23 (21.9)	17 (20.0)	6 (37.5)	46 (22.4)	
• 2	34 (32.4)	33 (38.8)	5 (31.3)	72 (34.6)	0.63
• 3	23 (21.9)	13 (15.3)	3 (18.8)	39 (19.0)	(0.20)
• 4	17 (16.2)	17 (20.0)	2 (12.5)	36 (17.6)	
• 5	4 (3.8)	3 (3.5)	0 (0.0)	7(3.4)	
• 6	3.8)	0 (0.0)	0 (0.0)	4 (2.0)	
• 7	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
Parity					
• 0	27 (25.7)	26 (30.5)	6 (37.5)	59 (28.8)	
• 1	38 (36.2)	29 (34.1)	6 (37.5)	73 (35.6)	0.55
• 2	23 (21.9)	12 (14.1)	3 (18.8)	38 (18.5)	(0.05)
• 3	12 (11.4)	17 (20.0)	1 (6.3)	30 (14.6)	
• 4	4 (3.8)	0 (0.0)	0 (0.0)	4 (2.0)	
• 5	1 (0.95)	0 (0.0)	0 (0.0)	1 (0.5)	
• 6	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
Antenatal care					
• Yes	80 (76.2)	72 (84.7)	15 (93.8)	167 (81.1)	0.001
• No	22 (21.0)	11 (12.9)	0 (0.0)	33 (16.0)	(0.15)
• Unknown	3 (2.9)	2 (2.4)	1 (6.3)	6 (2.9)	
Syphilis Serology					0.47
• Positive	4 (3.8)	5 (5.9)	0 (0.0)	9 (4.4)	(0.24)

• Negative • Not done • Results not available	90 (85.7) 4 (3.8) 6 (5.7)	71 (83.5) 3 (3.5) 4 (4.7)	13 (81.3) 0 (0.0) 3 (18.8)	177 (86.3) 7 (3.4) 13 (6.4)	
Treatment received (for positive syphilis serology) • Completed • Not completed • Not received • Unknown	(n=4) 0 (0.0) 2 (50.0) 1 (25.0) 1 (25.0)	(n=5) 0 (0.0) 1 (20.0) 3 (60.0) 1 (20.0)	(n=0) 0 (0.0) 0 (0.0) 0 (0.0) 0 (0.0)	(n=9) 0 (0.0) 2 (22.2) 4 (44.4) 2 (22.2)	
HIV Serology • Positive • Negative • Not done • Results not available	 30 (28.6) 70 (66.7) 1 (1.0) 4 (3.8)	 15 (17.7) 65 (76.5) 3 (3.5) 2 (2.4)	 5 (31.3) 10 (62.5) 0 (0.0) 1 (6.3)	 50 (24.0) 145 (70.6) 4 (2.0) 7 (3.4)	0.47
Treatment received (for positive HIV serology) • Yes • No • Unknown	(n=30) 27 (90.0) 2 (6.7) 1 (3.3)	(n=15) 14 (93.3) 0 (0.0) 1 (6.7)	(n=5) 5 (100) 0 (0.0) 0 (0.0)	(n=50) 46 (91.2) 2 (4.4) 2 (4.4)	
Haemoglobin Mean (standard deviation)	11.5 (2.0)	11.7 (2.1)	11.0 (1.9)	11.5 (2.1)	0.02 (0.08)
Haemoglobin • Less than 8.0 • 8.0 – 9.9 • More than 10.0	 4 (3.8) 17 (16.2) 84 (80.0)	 6 (7.1) 7 (8.2) 72 (84.7)	 1 (6.3) 6 (37.5) 9 (56.3)	 11 (5.3) 30 (14.6) 165 (80.1)	
Rhesus factor • Positive • Negative	(n=102) 101 (99.0) 1 (1.0)	(n=84) 82 (97.6) 2 (2.4)	(=15) 14 (93.3) 1 (6.7)	(n=203) 199 (98.0) 4 (2.0)	
If Rhesus negative, are antibodies present? • Yes • No	(n=0) 0 (0.0) 0 (0.0)	(n=1) 0 (0.0) 1 (100.0)	(n=1) 0 (0.0) 1 (100.0)	(n=2) 0 (0.0) 2 (100.0)	
Height (metres) Mean (standard deviation)	1.6 (0.07)	1.6 (0.08)	1.6 (0.06)	1.6 (0.08)	
Weight (kilograms)	70 (59 – 80)	66 (60 – 78.5)	71 (58 – 87)	69 (60 – 80)	

Median (inter-quartile range)					
Body mass index Median (inter-quartile range)	27.8 (25 – 32)	27.9 (24 – 31)	27 (24 – 34)	27.8 (24.4 – 31.6)	0.90 (0.54)
BMI	(n=43)	(n=44)	(n=15)	(n=102)	
● <25.0	10 (23.3)	15 (34.1)	5 (33.3)	31 (30.4)	
● 25.0 – 29.9	18 (41.9)	15 (34.1)	3 (20.0)	36 (35.3)	
● 30.0 – 34.9	11 (25.6)	11 (25.0)	3 (20.0)	25 (24.5)	
● 35.0 – 39.9	2 (4.7)	2 (4.6)	1 (6.7)	5 (4.9)	
● >40	2 (4.7)	1 (2.3)	2 (13.3%)	5 (4.9%)	
Takes alcohol					
● No	102 (97.1)	83 (97.6.)	15 (93.8)	200 (97.1)	
● Yes	3 (2.9)	2 (2.4)	1 (6.3)	6 (2.9)	
Uses drugs					
● No	104 (99.0)	85 (100.0)	16 (100.0)	205 (99.5)	
● Yes	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
Smoker					
● No	104 (99.0)	85 (100.0)	16 (100.0)	205 (99.5)	
● Yes	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
Place of delivery					
● In hospital	96 (91.4)	79 (92.9)	15 (93.8)	190 (92.0)	0.67 (0.03)
● In transit	2 (1.9)	2 (2.4)	1 (6.3)	5 (2.5)	
● At home	7 (6.7)	4 (4.7)	0 (0.0)	11 (5.5)	

6.3.1.2 Maternal conditions

These are conditions in the mother that were present and thought to be the main event that led to the pathophysiological process that caused the stillbirth.

A total of 129 (62.6%) were classified as healthy mothers, 48 (23.3%) had proteinuric hypertension and 12 (5.8%) had chronic hypertension. Abruption with hypertension was found in 3.9% ($p < 0.001$) of cases and abruption without hypertension was found in another 3.9% ($p < 0.001$) of cases.

There were no significant differences in characteristics of maternal conditions between SA and non-SA citizens for proteinuric hypertension ($p = 0.29$), for chronic hypertension ($p=0.85$), for abruption with hypertension ($p=0.64$) and for abruption without hypertension ($p=0.16$). Table 6.3 summarises maternal obstetric conditions that were found among the stillbirths.

Table 6.3: Maternal obstetric condition

Characteristics	South African n=105 (51.0%)	non-South African n=85 (41.2%)	Not indicated n=16 (7.8%)	Total N=206	p value (overall)
Healthy mother	65 (61.9)	53 (62.4)	9 (56.3)	129 (62.6)	
Proteinuric hypertension	21 (20.0)	21 (24.7)	6 (37.5)	48 (23.3)	0.29
Chronic hypertension	7 (6.7)	4 (4.8)	1 (6.3)	12 (5.8)	0.85
Abruption without hypertension	4 (3.8)	2 (2.4)	2 (12.5)	8 (3.9)	0.16 (<0.001)
Abruption with hypertension	5 (4.8)	3 (3.5)	0 (0.0)	8 (3.9)	0.64 (<0.001)
Ruptured uterus with previous c/s	2 (1.9)	3 (3.5)	0 (0.0)	5 (2.4)	
HELLP	0 (0.0)	4 (4.8)	0 (0.0)	4 (2.0)	
Eclampsia	3 (2.9)	0 (0.0)	0 (0.0)	3 (1.5)	
Endocrine disease	2 (1.9)	1 (1.2)	0 (0.0)	3 (1.5)	
Other non-pregnancy-related infections	0 (0.0)	2 (2.4)	0 (0.0)	2 (1.0)	
Pregnancy induced hypertension without proteinuria	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
Motor vehicle accident	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
Respiratory disease	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
Complications of antiretroviral therapy	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
Chorioamnionitis with ruptured membranes	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
Chorioamnionitis with intact membranes	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	

6.3.2 Stillbirth characteristics

Birth weight

The birth weights of 197 stillbirths were recorded with the median birth weight being 1 785g (900-2 660g). A total of 64 stillbirths (32.5%) were in the 500-999g category, 59 stillbirths (30.0%) weighed >2 500g, 44 stillbirths (22.3%) were in the 1 000-1 999g category and 30

stillbirths (15.2%) were in the 2 000-2 499g weight group. There were more stillbirth deliveries in the 500-599g weight group among non-South African citizens (39.8%) compared to South African citizens (28.9%). Stillbirth deliveries in the 2 000-2 499g weight category occurred more in South African citizens (18.6%) than in non-South African citizens (12.1%).

Gestational age

Of the 206 files reviewed, a total of 192 had the gestational age recorded. The median gestational age being 33 weeks (26-37 weeks). 138 of stillbirths, (71.9%), were grouped as late foetal deaths (LFD) with a gestational age of greater than 28 weeks, and 54 of the stillbirths (28.1%) were grouped as early foetal deaths (EFD) at less than 28 weeks. The EFD's occurred more among non-South African citizens (32.9%) than among South citizens (28.5%). LFD's occurred more among South African citizens (74.5%) than among non-South African citizens (67.1%). However, there were no significant differences in gestational ages of stillbirth amongst South African and non-South African citizens (p16).The gestational age of 189 stillbirths was estimated. Ninety five (50.3%) based on dates, 84 (44.4%) based on ultrasounds and 10 (5.3%) based on clinical examination. There was certainty of gestational age estimation in 147 (77.8%) and uncertainty in 42 (22.2%).

Foetal condition

The foetal condition at delivery was recorded as Macerated Stillbirth (MSB) in 118 cases (57.3%) and Fresh Stillbirth (FSB) in 34 cases (16.5%). Some of the remaining stillbirths were alive on admission (n31, 15.9%) i.e. there was evidence of the presence of foetal heart activity either by auscultation, cardiotocography tracing or ultrasound, indicating that on admission there foetus was alive in utero. The admission status of the remaining stillbirths was uncertain (n23, 11.2%) i.e. it had not been determined if the foetus was alive in utero prior to delivery. These were recorded as 'stillborn' in the records because they were born with no signs of life. Macerated stillbirths occurred more among non-South African citizens (63.5%) than among South African citizens (50.5%) although this was not statistically significant (p0.39)

Weight categories

The stillbirth weight range for those categorised as 'stillbirth alive on admission' (n31) was 500-3 900g with a median weight of 775g. The gestational age range for these stillbirths was 22-42 weeks with a median gestation of 25 weeks. 58% of these were EFD's and 38.7% were LFD's. Nine (30%) of the deliveries in this group were cases of medical terminations for

severe preeclampsia and congenital abnormalities. All of the EFD's were preterm deliveries in the weight category 500-999g. There were 4 unexplained stillbirths with 3 weighing >2 500g and one in the 2 000-2 499g weight group. Three cases were identified as cases of foetal distress with 2 in the 2 000-2 499g weight group and one >2 500g. Uterine rupture was found in 2 cases, both weighing >2 500g. However, there were no significant differences amongst South African and non-South African citizens with regards to birth weight (p0.31)
Table 6.4 below summarises the foetal characteristics of the stillbirth deliveries, it further annotates the stillbirth characteristics between South African and non-South African citizens

Table 6.4 A summary of foetal characteristics

Characteristics	**South African n=105 (51.0%)**	**non-South African n=85 (41.2%)**	**Not indicated n=16 (7.8%)**	**Total N=206**	**p values (overall)**
Birth weight (grams) ● Median ● Inter-quartile range	 1 940 935 – 2 740	 1 400 770 – 2 590	 2 108 1 290 – 2 895	 1 785 900 – 2 660	0.31 (0.002)
Birth weight (grams) ● 500 – 999 ● 1 000 – 1 999 ● 2 000 – 2 499 ● ≥2 500	(n=97) 28 (28.9) 21 (21.7) 18 (18.6) 30 (30.9)	(n=83) 33 (39.8) 17 (20.5) 10 (12.1) 23 (27.7)	(n=16) 2 (12.5) 6 (37.5) 2 (12.5) 6 (37.5)	(n=197) 63 (32.1) 44 (22.4) 30 (15.3) 59 (30.1)	
Gestational age (weeks) ● Median ● Inter-quartile range	 33 27 – 37	 33 26 – 37	 33 33 – 38	 33 26 – 37	0.16 (<0.001)
Gestational age (weeks) ● Less than 28 weeks ● 28 or more weeks	(n=98) 25 (25.5) 73 (74.5)	(n=79) 26 (32.9) 53 (67.1)	(n=15) 3 (20.0) 12 (80.0)	(n=192) 54 (28.1) 138 (71.9)	
Gestational age accuracy ● Certain ● Uncertain	(n=96) 71 (74.0) 25 (26.0)	(n=79) 64 (81.0) 15 (29.0)	(n=13) 11 (84.6) 2 (15.4)	(n=189) 147 (77.8) 42 (22.2)	
Gestational age based on ● Dates ● Ultrasound ● Clinical exam	(n=96) 47 (49.0) 43 (44.8) 6 (6.8)	(n=79) 40 (50.7) 36 (45.6) 3 (3.8)	(n=13) 8 (61.5) 4 (30.8) 1 (7.7)	(n=189) 95 (50.3) 84 (44.4) 10 (5.3)	
Number of foetuses ● Single ● Multiple	(n=105) 100 (95.2) 5 (4.8)	(n=85) 83 (97.6) 2 (2.4)	(n=16) 16 (100.0) 0 (0.0)	(n=206) 199 (96.6) 7 (3.4)	
Condition at birth	(n=105)	(n=85)	(n=16)	(n=206)	

• Stillborn, alive on admission	17 (16.2)	13 (15.3)	1 (6.3)	31 (15.0)	
• Fresh stillborn, dead on admission	19 (18.1)	12 (14.1)	3 (18.8)	34 (16.5)	0.39
• Stillborn, admission status unknown	16 (15.2)	6 (7.1)	1 (6.3)	23 (11.2)	
• Macerated stillborn	53 (50.5)	54 (63.5)	11 (68.8)	118 (57.3)	
Mode of delivery	(n= 105)	(n=85)	(n=16)	(n=206)	
• Normal vaginal delivery	88 (83.8)	69 (81.2)	13 (81.3)	170 (82.5)	
• Caesarean section	17 (16.2)	16 (18.8)	3 (18.8)	36 (17.5)	
Manner of delivery	(n=88)	(n=69)	(n=13)	(n=170)	
• Spontaneous delivery	58 (65.9)	44 (63.8)	10 (76.9)	111 (65.2)	
• Induced delivery	28 (31.8)	25 (36.2)	3 (23.1)	56 (32.9)	
• Assisted delivery	2 (2.3)	0 (0.0)	0 (0.0)	2 (1.2)	
Indication for caesarean section	(n=17)	(n=16)	(n=3)	(n=36)	
• Foetal distress	3 (17.7)	2 (12.5)	0 (0.0)	5 (13.9)	
• Antepartum haemorrhage (APH) / abruptio placentae	6 (35.3)	2 (12.5)	2 (66.7)	10 (27.8)	
• Poor progress	1 (5.88)	1 (6.3)	0 (0.0)	2 (5.6)	
• Severe pre-eclampsia	1 (5.88)	1 (6.3)	0 (0.0)	2 (5.6)	
• Previous caesarean section	6 (35.3)	4 (25.0)	1 (33.3)	11 (30.6)	
• Other	0 (0.0)	6 (37.5)	0 (0.0)	6 (16.7)	

6.3.3 Cause of death

6.3.3.1 Primary obstetric cause of death

The most common primary obstetric cause of death is unexplained intrauterine death-macerated in 73 (35.4%) of the cases. There were no significant differences in the two citizen groups regarding this finding (p0.57). Of the 18 cases (8.7%) that fall into the category of 'other cause not described in the classification', there were 10 cases of Medical Termination Of Pregnancy (MTOP) for severe pre-eclampsia and 6 cases of foeticide for severe/multiple congenital abnormalities with poor prognoses.

There were 15 cases (7.3%) with abruption with hypertension and another 15 cases (7.3%) with proteinuric hypertension. There was double the occurrence of abruption placentae with hypertension among SA citizens (8.6%) compared to non-SA citizens (4.7%) however, this was not statistically significant (p0.43). Additionally, there was double the occurrence of abruption without hypertension among SA citizens (4.8%) compared to non-SA citizens (2.4%). This was also not statistically significant (p0.19). There was nearly double the

occurrence of proteinuric hypertension amongst non-SA citizens (8.2%) compared to SA citizens (4.8%) although it was not statistically significant (p0.12).
These statistics are reflected in table 6.5 and illustrated in figure 6.2.

Table 6.5 Primary obstetric causes of death

Characteristics	South African n=105 (51.0%)	non-South African n=85 (41.2%)	Not indicated n=16 (7.8%)	Total n=206	p value (overall)
Unexplained intrauterine death – macerated	35 (33.3)	33 (38.5)	5 (31.2)	73 (35.4)	0.57 (<0.001)
Other cause of death not described in this classification	12 (11.4)	6 (7.1)	0 (0.0)	18 (8.7)	0.25 (<0.001)
Proteinuric hypertension	5 (4.8)	7 (8.2)	3 (18.8)	15 (7.3)	0.12 (0.05)
Abruptio placentae with hypertension	9 (8.6)	4 (4.7)	2 (12.5)	15 (7.3)	0.43 ((,0.001)
Unexplained intrauterine death	6 (5.7)	7 (8.2)	1 (6.3)	14 (6.8)	0.61 (0.001)
Unexplained IUD due to lack of notes	6 (5.7)	3 (3.5)	1 (6.3)	10 (4.9)	
Spontaneous pre-term labour	5 (4.8)	4 (4.7)	1 (6.3)	10 (4.9)	
Abruptio placentae without hypertension	5 (4.8)	2 (2.4)	2 (12.5)	9 (4.4)	0.19 (<0.001)
Idiopathic pre-term labour	4 (3.8)	3 (3.5)	0 (0.0)	7 (3.4)	
Intrauterine death	4 (3.8)	0 (0.0)	0 (0.0)	4 (1.9)	
Pre-term premature rupture of membranes	2 (1.9)	1 (1.2)	0 (0.0)	3 (1.5)	
Ruptured uterus	1 (1.0)	2 (2.4)	0 (0.0)	3 (1.5)	
Intrapartum asphyxia	2 (1.9)	1 (1.2)	0 (0.0)	3 (1.5)	
Pregnancy induced hypertension without proteinuria	1 (1.0)	1 (1.2)	0 (0.0)	2 (1.0)	
Labour related intrapartum asphyxia	1 (1.0)	1 (1.2)	0 (0.0)	2 (1.0)	
Traumatic breech deliver	1 (1.0)	1 (1.2)	0 (0.0)	2 (1.0)	
Cord prolapse	2 (1.9)	0 (0.0)	0 (0.0)	2 (1.0)	
Syphilis	0 (0.0)	2 (2.4)	0 (0.0)	2 (1.0)	0.24 (0.68)
Post-maturity	0 (0.0)	2 (2.4)	0 (0.0)	2 (1.0)	

Pre-term premature rupture of membranes with chorioamnionitis	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
Antepartum haemorrhage	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	0.62 (0.17)
Intrauterine growth restriction	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	0.49 (0.86)
Eclampsia	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
Neural tubal defects	0 (0.0)	0 (0.0)	1 (6.3)	1 (0.5)	
Cardiovascular system abnormality	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
Non-immune hydrops foetal abnormality	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
Motor vehicle accident	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	

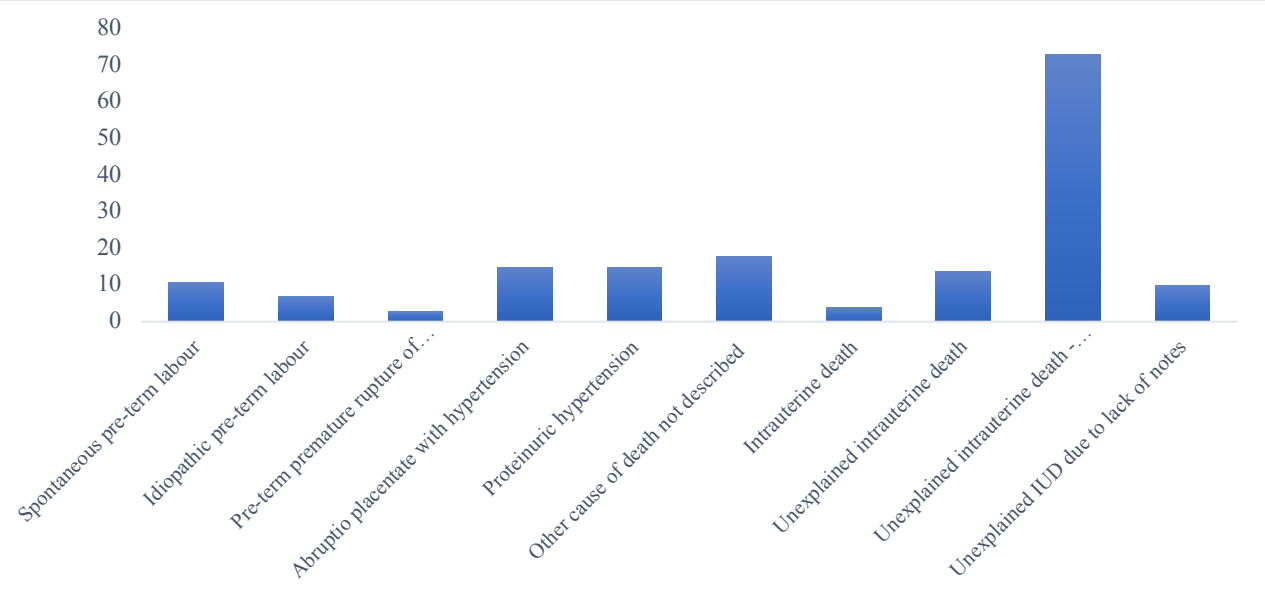


Figure 6.2 Primary obstetric causes of death

6.3.3.2 Other conditions present

These conditions that were found to be present in addition to the primary obstetric cause of death may have contributed significantly to the pathophysiological process that led to stillbirths.

"IUGR with histologic features of ischaemic placental disease" was the most common other obstetric condition present in 21 cases (19.0%), followed by proteinuric hypertension in 15 cases (13.6%) and IUGR in 14 of the cases (12.7%). There was a 2.7 times higher occurrence

of IUGR with features of placental ischaemic disease in non-SA citizens (25.5%) compared to SA citizens (9.3%) and this was a significant difference (p 0.04). The rate of hypertensive disease is comparable between the two groups. Maternal diabetes mellitus occurred 1.5 times more in SA citizens than non-SA citizens. The rate of occurrence of congenital abnormalities (neural tube defects, cardiovascular and renal abnormalities) was higher in SA citizens compared to non-SA citizens but not statistically significant (p0.23). Table 6.6 and Figure 6.3 depict these findings.

Table 6.6 Other conditions present

Characteristics	**South African n=54 (49.1%)**	**non-South African n=47 (42.7%)**	**Not indicated n=9 (8.2%)**	**Total N=110**	**p value (overall)**
IUGR with histologic features of ischaemic placental disease	5 (9.3)	12 (25.5)	4 (44.4)	21 (19.0)	0.04 (0.06)
Proteinuric hypertension	8 (14.8)	6 (12.8)	1 (11.1)	15 (13.6)	0.73 (0.02)
Intrauterine growth restriction	7 (13.0)	7 (14.9)	1 (11.1)	15 (13.6)	0.89 (0.22)
Foetal congenital abnormalities	(n=8)	(n=1)	(n=0)	(n=9)	
● Foetal abnormality non specific	2 (3.2)	0(0.0)	0 (0.0)	2 (1.8)	
● Neural tube defects	1 (1.9)	0 (0.0)	0 (0.0)	1 (0.9)	0.23
● Cardiovascular system abnormality	3 (5.6)	0 (0.0)	0 (0.0)	3 (2.7)	(0.50)
● Renal system abnormality	2 (3.7)	1 (2.1)	0 (0.0)	3 (2.7)	
Maternal diabetes mellitus	4 (7.4)	2 (4.3)	1 (11.1)	7 (6.4)	0.70 (0.38)
Syphilis	2 (3.7)	2 (4.3)	0 (0.0)	4 (3.6)	
Chronic hypertension	2 (3.7)	1 (2.1)	0 (0.0)	3 (2.7)	0.23 (0.09)
Other cause of death not described in this classification	3 (5.6)	0 (0.0)	0 (0.0)	3 (2.7)	0.23 (0.45)
Hypertensive disorders	2 (3.7)	0 (0.0)	0 (0.0)	2 (1.8)	
Spontaneous pre-term labour	0 (0.0)	1 (2.1)	1 (11.1)	2 (1.8)	
Unexplained IUD due to lack of notes	1 (1.9)	0 (0.0)	1 (11.1)	2 (1.8)	
Pre-term premature rupture of membranes	1 (1.9)	1 (2.1)	0 (0.0)	2 (1.8)	
Other maternal disease	1 (1.9)	1 (2.1)	0 (0.0)	2 (1.8)	

Cervical incompetence	0 (0.0)	2 (4.3)	0 (0.0)	2 (1.8)	
Other maternal disease	1 (1.9)	1 (2.1)	0 (0.0)	2 (1.8)	
Meconium aspiration	1 (1.9)	1 (2.1)	0 (0.0)	2 (1.8)	
Intrapartum asphyxia	0 (0.0)	2 (4.3)	0 (0.0)	2 (1.8)	
Other infections	0 (0.0)	1 (2.1)	0 (0.0)	1 (0.9)	
Antepartum haemorrhage	1 (1.9)	0 (0.0)	0 (0.0)	1 (0.9)	
Post-maturity	0 (0.0)	1 (2.1)	0 (0.0)	1 (0.9)	
Abnormality of multiple systems	0 (0.0)	1 (2.1)	0 (0.0)	1 (0.9)	
Non-specific foetal abnormality	0 (0.0)	1 (2.1)	0 (0.0)	1 (0.9)	
Labour related intrapartum asphyxia	1 (1.9)	0 (0.0)	0 (0.0)	1 (0.9)	
Cord prolapse	1 (1.9)	0 (0.0)	0(0.0)	1 (0.9)	
Traumatic breech delivery	1 (1.9)	0 (0.0)	0 (0.0)	1 (0.9)	
Ruptured uterus	0 (0.0)	1 (2.1)	0 (0.0)	1 (0.9)	
Unexplained intrauterine death - fresh	1 (1.9)	0 (0.0)	0 (0.0)	1 (0.9)	

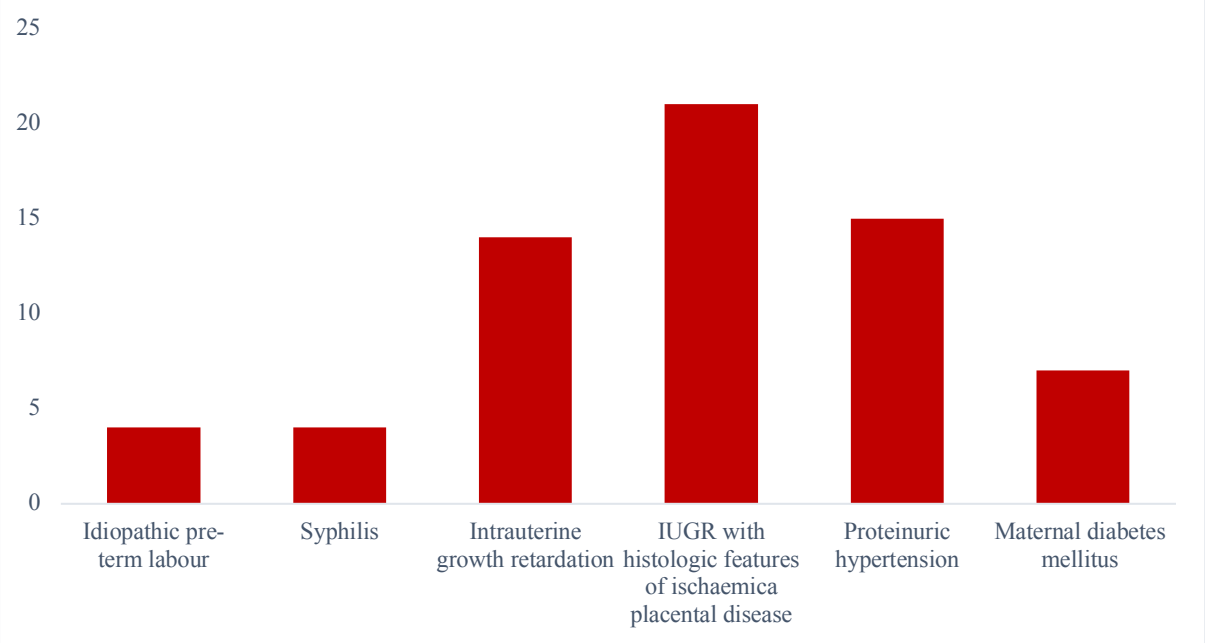


Figure 6.3 Incidence of other obstetric conditions present

6.4 AVOIDABLE FACTORS

Factors if avoided, could have prevented the stillbirth.

6.4.1 Patient associated avoidable factors

Table 6.7 depicts the patient related avoidable factors comparing the incidence of probabilities and possibilities amongst SA citizens and non-SA citizens. Consideration is given for the fact that more than one factor is applicable to each patient in terms of possibility and probability.

As seen in Table 6.7, the main patient associated avoidable factors were:

1. A delay in seeking medical attention during labour. This was probably the factor in 74 cases (35.9%) and possibly in 51 cases (24.7%).
2. Declining admission was probable in 47 cases (22.8%) and possible in 38 (18.4%).
3. Booking late in pregnancy was probable in 10 cases (4.9%) and possible in 30 (14.6%).
4. Never initiating antenatal care was probable in 3 cases (1.5%) and possible in 28 (13.5%).

The occurrence of delaying seeking medical attention during labour were comparable (p 0.55) amongst SA citizens and non-SA citizens; for the SA citizens it was possible in 34 cases (32.4%) and probable in 25 (23.8%), for non-SA citizens it was possible in 32 cases (37.6%) and probable in 21 (24.7%).

The occurrence of a patient declining admission was comparable (p 0.08) between the two groups; for the SA citizens it was possible in 18 cases (17.1%) and probable in 26 (24.8%), for non-SA citizens it was possible in 18 cases (21.2%) and probable in 17 (20.0%).

It was possible that there was an inappropriate response to antepartum haemorrhaging in 4.7% of the non-SA citizens and 1.9% of the SA citizens. It was probable that there was an inappropriate response to antepartum haemorrhaging in 2.4% of the non-SA citizens and 6.7% of the SA citizens. However there were no significant differences p=0.84
There was a comparable (p 0.92) probability and possibility of booking late in pregnancy, among SA citizens and non-SA citizens. The possibility of not booking was found to be 1.3 times more likely in SA citizens (16.2%) compared to non-SA citizens (12.9%).

Table 6.7 Patient related avoidable factors

Characteristics	**South African n=105 (51.0%)**	**non-South African n=85 (41.2%)**	**Not indicated n=16 (7.8%)**	**Total n=206**	**p values (overall)**
Delay in seeking medical attention during labour					
● Possible	34 (32.4)	32 (37.6)	8 (50.0)	74 (35.9%)	0.55
● Probable	25 (23.8)	21 (24.7)	5 (31.5)	51 (24.7%)	(0.10)

Declines admission / treatment for personal or social reasons					0.08 (0.58)
● Possible	18 (17.1)	18 (21.2)	2 (12.5)	38 (18.4%)	
● Probable	26 (24.8)	17 (20.0)	4 (25.0)	47 (22.8%)	
Booked late pregnancy					0.92 (0.002)
● Possible	13 (12.6)	13 (12.6)	4 (25)	30 (14.6%)	
● Probable	5 (4.8)	4 (4.7)	1 (6.3)	10 (4.9%)	
Never initiated antenatal care					
● Possible	17 (16.2)	11 (12.9)	0 (0.0)	28 (13.5)	0.18 (0.35)
● Probable	3 (2.9)	0 (0.0)	0 (0.0)	3 (1.5)	
Other patient associated factors					
● Possible	5 (4.8)	5 (6.3)	1 (6.3)	11 (5.3)	
● Probable	12 (11.1)	9 (10.6)	1 (6.3)	22 (10.7)	
Infrequent visit to antenatal clinic					
● Possible	2 (1.9)	2 (2.4)	0 (0.0)	4 (1.9)	
● Probable	4 (3.8)	4 (4.7)	0 (0.0)	8 (3.9)	
Failed to return on the prescribed date					
● Possible	2 (1.9)	4 (4.7)	1 (6.3)	7 (3.4)	
● Probable	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
Inappropriate response to antepartum haemorrhage					0.84 (0.54)
● Possible	2 (1.9)	4 (4.7)	0 (0.0)	6 (2.9)	
● Probable	7 (6.7)	2 (2.4)	0 (0.0)	9 (4.4)	
Inappropriate response to poor foetal movements					0.94 (0.02)
● Possible	3 (2.9)	2 (2.4)	1 (6.3)	6 (2.9)	
● Probable	5 (4.8)	5 (5.9)	1 (6.3)	11 (5.3)	
Partner or family declines admission / treatment					
● Possible	1 (1.0)	3 (3.5)	0 (0.0)	4 (1.9)	
● Probable	0 (0.0)	0 (0.0)	1 (6.3)	1 (0.5)	
Alcohol abuse					
● Possible	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
● Probable	2 (1.9)	0 (0.0)	0 (0.0)	2 (1.0)	
Smoking					
● Possible	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
● Probable	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Illegal drug use					

• Possible • Probable	1 (1.0) 0 (0.0)	0 (0.0) 0 (0.0)	0 (0.0) 0 (0.0)	1 (0.5) 0 (0.0)	
Attempted termination of pregnancy • Possible • Probable	1 (1.0) 4 (3.8)	0 (0.0) 0 (0.0)	0 (0.0) 0 (0.0)	1 (0.5) 4 (1.9)	

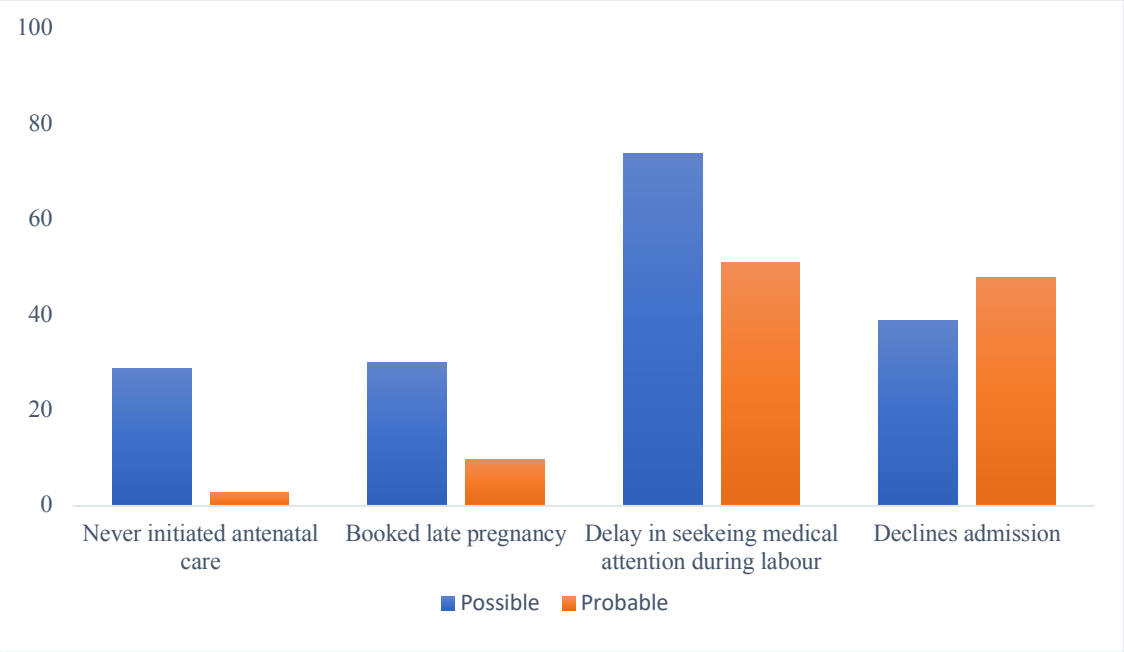


Figure 6.4 Avoidable factors: Most common, possible and probable patient-related conditions

6.4.2 Administrative related avoidable factors

The main administrative related issue was a lack of transport from home to health care institutions and between institutions. This was probable in 128 (62.1%) of all patients and possible in 21 (10.2%) of all patients. This is demonstrated in Table 6.8. There were no significant differences between the two citizen groups. For "lack of transport from home to institution" p=0.78 and for "lack of transport from institution to institution" p=0.70

Table 6.8 Administrative related avoidable factors

Characteristics	**South African n=105 (51.0%)**	**non-South African n=85 (41.2%)**	**Not indicated n=16 (7.8%)**	**Total n=206**	**p values (overall)**
Lack of transport – home to institution • Possible	12 (11.4) 65 (61.9)	8 (9.4) 52 (61.2)	1 (6.3) 11 (68.8)	21 (10.2) 128 (62.1)	0.78 (0.10)

• Probable					
Lack of transport – institution to institution • Possible • Probable	3 (2.9) 7 (6.7)	2 (2.4) 3 (3.5)	0 (0.0) 0 (0.0)	5 (2.4) 10 (4.9)	0.70 (0.68)
Other administrative problems • Possible • Probable	3 (2.9) 1 (1.0)	1 (1.2) 1 (1.2)	0 (0.0) 0 (0.0)	4 (1.9) 2 (1.0)	
No syphilis screening performed at hospital/clinic • Possible • Probable	0 (0.0) 1 (1.0)	0 (0.0) 1 (1.2)	0 (0.0) 0 (0.0)	0 (0.0) 2 (1.0)	
Result of syphilis screening not returned to hospital/clinic • Possible • Probable	0 (.0) 3 (2.9)	0 (0.0) 2 (2.4)	0 (0.0) 1 (6.3)	0 (0.0) 6 (2.9)	
No dedicated high risk clinic at referral hospital • Possible • Probable	1 (1.0) 1 (1.0)	0 (0.0) 0 (0.0)	0 (0.0) 0 (0.0)	1 (0.5) 1 (0.5)	
Insufficient nurses on duty to manage the patient adequately • Possible • Probable	3 (2.9) 7 (6.7)	2 (2.4) 3 (3.5)	0 (0.0) 0 (0.0)	1 (0.5) 2 (1.0)	
Insufficient doctors available to manage the patient • Possible • Probable	2 (1.9) 3 (2.9)	0 (0.0) 0 (0.0)	0 (0.0) 0 (0.0)	2 (1.0) 3 (1.5)	
Personnel not sufficiently trained to manage the patient • Possible • Probable	1 (1.0) 1 (1.0)	1 (1.2) 0 (0.0)	0 (0.0) 1 (6.3)	2 (1.0) 2 (1.0)	
Personnel to junior to manage the patient • Possible • Probable	2 (1.9) 1 (1.0)	0 (0.0) 1 (1.2)	0 (0.0) 1 (6.3)	2 (1.0) 3 (1.5)	
Theatre delay: all theatres occupied • Possible • Probable	1 (1.0) 1 (1.0)	0 (0.0) 0 (0.0)	0 (0.0) 0 (0.0)	1 (0.5) 1 (0.5)	

Congenital abnormality not diagnosed: no ultrasound service available ● Possible ● Probable	0 (0.0) 1 (1.0)	0 (0.0) 0 (0.0)	0 (0.0) 0 (0.0)	0 (0.0) 1 (0.5)	

6.4.3 Medical personnel related avoidable factors

Table 6.9 shows that the main medical personnel related factors are a delay in referring to secondary or tertiary care. This is a possibility in 12 (11.4%) cases and probable in 7 (6.7%). Incorrect management of hypertensive disease is possible in 8 (3.9%) cases and probable in 3 (1.5%). No response to poor fundal growth was possible in 5 (2.4%) cases and probable in 16 (7.8%). There were no significant differences between the two citizen groups, for "no response to poor fundal growth" p=0.23, for "delay in referring patient to secondary/tertiary care" p= 0.21 and for "no response to a history of stillbirth" p=0.67.

Table 6.9 Medical personnel related avoidable factors

Characteristics	**South African n=105 (51.0%)**	**non-South African n=85 (41.2%)**	**Not indicated n=16 (7.8%)**	**Total n=206**	**p values (overall)**
No response to poor uterine fundal growth ● Possible ● Probable	1 (1.0) 7 (6.7)	4 (4.7) 6 (7.1)	0 (0.0) 3 (18.8)	5 (2.4) 16 (7.8)	0.23 (0.57)
Delay in referring patient for secondary/tertiary care ● Possible ● Probable	7 (6.7) 2 (1.9)	5 (5.9) 5 (5.9)	0 (0.0) 0 (0.0)	12 (11.4) 7 (6.7)	0.21 (0.71)
No response to history of stillbirths, abruption, etc. ● Possible ● Probable	1 (1.0) 1 (1.0)	2 (2.4) 4 (4.7)	0 (0.0) 0 (0.0)	3 (1.5) 5 (2.4)	0.67 (0.41)
Other medical personnel related factors ● Possible ● Probable	1 (1.0) 3 (2.9)	2 (2.4) 3 (3.5)	2 (12.5) 0 (0.0)	5 (2.4) 6 (2.9)	
Inadequate/no advice given to mother	2 (1.9)	3 (3.5)		5 (2.4)	

• Possible	1 (1.0)	3 (3.5)	0 (0.0)	4 (1.9)	
• Probable			0 (0.0)		
Foetal distress not detected intrapartum; foetus monitored					
• Possible	3 (2.9)	1 (1.2)	0 (0.0)	4 (1.9)	
• Probable	1 (1.0)	2 (2.4)	0 (0.0)	3 (1.5)	
No response to maternal hypertension	2 (1.9)	2 (2.4)	0 (0.0)	4 (1.9)	
• Possible	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
• Probable					
Foetal distress not detected antepartum; foetus monitored					
• Possible	1 (1.0)	1 (1.2)	0 (0.0)	2 (1.0)	
• Probable	3 (2.9)	2 (2.4)	0 (0.0)	5 (2.4)	
No response to positive maternal syphilis serology test					
• Possible	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
• Probable	2 (1.9)	1 (1.2)	0 (0.0)	3 (1.5)	
No response to apparent post-term pregnancy					
• Possible	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
• Probable	2 (1.9)	0 (0.0)	0 (0.0)	2 (1.0)	
No response to history of poor foetal movements					
• Possible	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
• Probable	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	
Multiple pregnancy not diagnosed antenatally					
• Possible	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
• Probable	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Physical examination of the patient at clinic incomplete					
• Possible	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
• Probable	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Medical personnel overestimated foetal size					
• Possible	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
• Probable	3 (2.9)	0 (0.0)	0 (0.0)	3 (1.5)	
No response to maternal glycosuria	1 (1.0)	2 (2.4)	0 (0.0)	1 (0.5)	
• Possible	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	

● Probable					
Poor progress in labour but partogram not used					
● Possible	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
● Probable	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Poor progress in labour but partogram not used correctly					
● Possible	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
● Probable	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Breech presentation not diagnosed until late in labour					
● Possible	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
● Probable	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
Incorrect management of antepartum haemorrhage					
● Possible	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
● Probable	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Incorrect management of premature labour					
● Possible	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
● Probable	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
Incorrect management of cord prolapse	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
● Possible	0 (0.0)	2 (2.4)	0 (0.0)	2 (1.0)	
● Probable					
Delay in doctor responding to call					
● Possible	1 (1.0)	1 (1.2)	0 (0.0)	2 (1.0)	
● Probable	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.5)	
Delay in medical personnel calling for expert assistance					
● Possible	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
● Probable	2 (1.9)	0 (0.0)	0 (0.0)	2 (1.0)	
Congenital abnormality not diagnosed; U/S examination not performed	0 (0.0)	3 (3.5)	0 (0.0)	3 (1.5)	
● Possible	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
● Probable					
Congenital abnormality not diagnosed; U/S examination was performed	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
● Possible	1 (1.0)	1 (1.2)	0 (0.0)	2 (1.0)	

● Probable					

6.5 PLACENTAL HISTOLOGICAL FINDINGS

Placental histological analysis was done in 190 cases (Table 6.10). The features of placental vascular flow compromise (hypoperfusion, malperfusion, underperfusion, infarction, hypoxic vasculopathy or uteroplacental insufficiency) were seen in 75 (39.5%) cases while chorioamnionitis was detected in 26 (13.7%) cases. Both hypoperfusion and chorioamnionitis was detected in 12 (6.3%) cases and 6 (3.2%) cases had other pathologies such as abruptio placentae while 71 (37.4%) cases showed nonspecific changes. Figure 6.5 depicts these findings. A test of association showed a significant relation between abnormal placental histologic findings and stillbirth, $p<0.001$.

Table 6.10 Placental histology results

Characteristics	**Total n=190 (%)**	**p value (over all)**
Placental histology results		
● No specific changes	71 (37.4)	
● Chorioamnionitis	26 (13.6)	0.30
● Infarction, malperfusion, hypoperfusion, ischaemic, hypoxic, vasculopathy or uteroplacental insufficiency	75 (39.5)	(<0.001)
● Both	12 (6.3)	
● Other	6 (3.2)	

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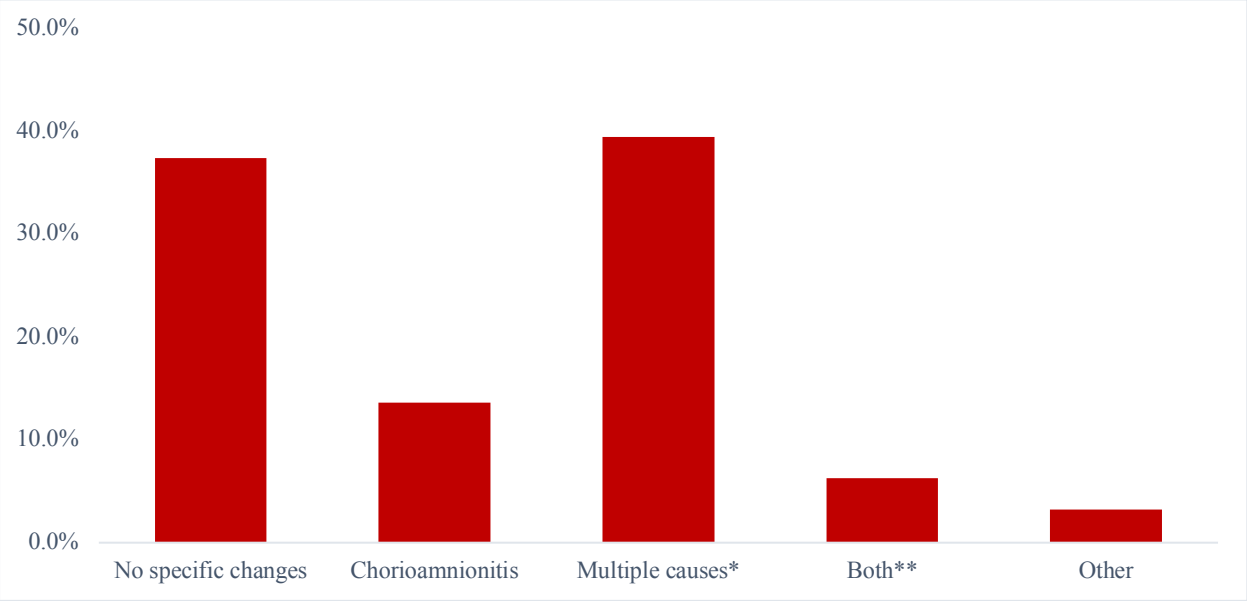


Figure 6.5: Placental histology results

** Infarction, malperfusion, hypoperfusion, ischaemic, hypoxic, vasculopathy or uteroplacental insufficiency*

***Both chorioamnionitis and "multiple causes"*

7. DISCUSSION

7.1 THE STILLBIRTH RATE AT RMMCH

The stillbirth rate of any institution or region reflects quality of antenatal coverage and intrapartum care. This study shows that the stillbirth rate at RMMCH between August 2016 and July 2017 was between half and two thirds less than the overall SBR in LMIC's of 30-40/1 000 (44). The stillbirth rate at RMMCH appears to be better than the rate of Southern Africa (21/1 000) and of South Africa (18/1 000) (8). It still falls short of the WHO's global stillbirth rate target of 12/1 000 by the year 2030 (43).

The stillbirth rate in the LFD group was two and a half times more than the EFD group. This indicates that most stillbirths occurring at RMMCH happen after the foetus has reached viability. The stillbirth rate for LFD's at RMMCH falls within the range for LMIC's of 8/1 000-22/1 000, occurring in foetuses of more than 1 000g (43).

7.2 OBSTETRICAL FACTORS

7.2.1 Maternal factors

7.2.1.1 Maternal demographics

A vast majority of patients who delivered stillbirths at the institution attended and/or received antenatal care (booked). This is comparable to the percentage of women attending and receiving antenatal care across LMIC's where 93.5% of women attended at least one antenatal care visit during their pregnancy (44). Mothers at RMMCH had attended antenatal care at least twice, at their initial visit for risk assessments and investigations and then at an appointed follow up visit to receive the outcomes of certain investigations and for review. At the initial visit, each patient's personal demographics are recorded, their vital signs, weights and heights are recorded; then investigations for syphilis, HIV, Rhesus blood group and urinalysis are done. Scheduling of subsequent visits is then made according to the Maternity Guidelines and BANC protocol (10,45). This study did not indicate the gestation at first antenatal encounter.

Very few patients who delivered stillbirths were women of advanced maternal age, more than 35 years and fewer were teenagers aged less than 18 years. This is not in keeping with the general notion that extremes of maternal age i.e. less than 18yrs and more than 35yrs are risk factors for stillbirth (3,46). However, the average maternal age of 28.6 years (p 0.12) found in

this study correlates with the age range of 26-30 years, found to be the age group with the highest SBR in patients in a teaching hospital in South Eastern Nigeria (47).

The results on parity correlates with findings in a Limpopo hospital that found nulliparity to be associated with more stillbirths (48). In LMIC's in general, nulliparity is associated with stillbirths (3). Only two patients in this study were grande multiparae (a parity of more than five), which in LMIC's, is found to have a risk of 1.2% for stillbirths (3).

The HIV status of 94.6% of patients was known. Of those who tested positive, 91.2% were on antiretroviral therapy. This is in agreement with the UNAIDS 90 90 90 treatment target to help end the AIDS epidemic. This program states that by the year 2020 90% of people should know their HIV status, 90% of people testing positive for HIV should be on antiretroviral therapy and 90% of people on antiretroviral therapy should have HIV viral loads that are undetectable within three months of starting therapy (49). This study did not include an assessment of HIV viral load. The incidence of HIV positive mothers of 24yrs is slightly higher than the institutional HIV incidence of 18-20yrs.

Syphilis is a major cause of maternal and perinatal morbidity and mortality. It is easily tested for with rapid tests, and treatment can achieve a recovery in both mother and baby (10,45). Just under a quater of those that tested positive for syphilis received treatment but not a complete course. The remainder either did not receive treatment at all or the records did not indicate whether treatment was given or not. This unfortunately implies that of those that tested positive for syphilis, none had completed the recommended treatment course of weekly dosing with Benzathine penicillin (Bicillin) over three weeks (11), attributable to ongoing stockouts. According to the WHO, Benzathine penicillin has been in short supply globally for several years. The consequence is that pregnant women with syphilis receive ineffective or no treatment at all (50). However, when benzathine penicillin cannot used for example in allergic patients, or when it is unavailable, recommended alternative treatments include Erythromycin 500mg four times daily orally for 14 days or Ceftriaxone 1g daily intramuscular injections for 10 to 14 days or Azithromycin 2g as a stat dos orally. These alternative treatments do not cross the placenta completely and thus do not treat the foetus. It is therefore recommended that the neonate be treated for syphilis after delivery (51).

The recommendation of the Maternity Guidelines is that the haemoglobin count be tested at first antenatal encounter and then repeated at 28, 32 and 38 weeks gestation (45). The vast

majority of patients were not anaemic with their average haemoglobin count being 11.5g/dL. Approximately one out of five patients fit the description of having anaemia as recognised when the haemoglobin count is less than 10g/dL. Affecting up to one out of five pregnant women in South Africa, it is a sign of poor nutrition and poverty and is commonly caused by a nutritional deficiency of the iron microelement, chronic illness and/or folic acid deficiency. It is associated with an eight fold increased risk of stillbirth. Treatment and prevention of anaemia is achieved with elemental iron supplementation (10,45,52).

The BMI findings in this study correlates with one study in sub-Saharan Africa where it was found that a BMI of more than 26kg/m^2 was associated with stillbirths (46).

The place of delivery for a vast majority of stillbirths occurred in RMMCH. In developing countries, the site of delivery varies widely from 100% of deliveries occurring in a health institution in Argentina to 99.9% deliveries occurring in homes in Guatemala (53).

7.2.1.2 Maternal conditions

The 6th Report on Confidential Enquiries identified the five points below for improvement in maternal health care (45,54).

1. HIV: promoting the 'know your status campaign', screening for HIV and early initiation of antiretroviral therapy at all health facilities.
2. Haemorrhage: prevention of anaemia by giving elemental iron supplementation, avoiding prolonged labour and postpartum haemorrhaging.
3. Hypertensive disorders in pregnancy: early detection and treatment, referral and timeous delivery. Recognition of features of severity and complications such as imminent eclampsia, HELLP syndrome and eclampsia.
4. Health worker training with ESMOE-ESOT: HIV testing and counselling and initiation of therapy, recognition of serious morbidities.
5. Health systems strengthening: 24hr services and emergency obstetric care.

The majority of mothers in this study were healthy and had no obstetric condition. They would be otherwise grouped as low risk patients during the antenatal period and receive routine antenatal care at the local clinic. The main obstetric conditions seen were hypertensive disorders; these are identified in point 3 above as an area of focus for improvement of maternal health care and a condition linked to perinatal mortality (15). Approximately one quarter of all patients had proteinuric hypertension and others had chronic hypertension. The

other maternal condition associated with stillbirth found in this study is abruption (a form of haemorrhage, identified in point 2 above).

7.2.2 Stillbirth characteristics

The median birth weight of stillbirths at RMMCH is 1 785g. This indicates that most stillbirths are occurring after viability of the foetus has been reached. Approximately one third of all the stillbirths in this study were found in babies weighing more than 2 500g however in LMIC's 47.9% of stillbirths are found to occur in this weight group (44). Birth weight measurements are less prone to error and tend to vary within and between populations. However, stillbirths due to intrauterine growth restriction might be missed (55).

Gestational age has a better prognostic value in perinatal morbidity and mortality evaluation but estimations are more prone to error especially when based on LNMP (which relies on a patient's memory) and ultrasound dating estimations (which can be operator dependent) (55). A majority of stillbirths in this study were found to be occurring as LFD's, more than 28 weeks gestation or more than 1 000g birth weight. Half of the gestational age estimates were based on dates and LNMP, some were based on ultrasound dating and few were based on clinical examination, palpation and symphysiofundal height (SFH) measurements. However, ultrasound based gestational age dating has been shown to be better than dating based on LNMP and clinical SFH measurements, even in late clinic attenders (56). LNMP estimation is subject to a patient's memory and level of education while SFH measures are operator dependent (56).

Most stillbirths were found to be macerated (MSB) with signs of skin changes and few were documented as fresh stillbirths (FSB) with intact skin. The file review revealed that these were confirmed as intrauterine foetal deaths before delivery. The remainder were only documented as stillbirths, fitting the definition of being born with no signs of life. it was unsure if the foetus was alive in utero prior to delivery. The duration from admission to delivery varied from immediate to a few hours to a few days. In LMIC's 76.4% of stillbirths are FSB but a study in South Eastern Nigeria showed that 75% of stillbirths were MSB (44,47). Owing to inaccurate recording of stillbirth condition at birth, the figures on MSB versus FSB in this study are skewed but it is evident that a majority are MSB.

7.2.3 Cause of death and other conditions present

In developing countries, infections are responsible for up to 50% of stillbirths. These include maternal infections, placental infections and foetal infections. Congenital abnormalities account for 5% of stillbirths. Hypertensive disease is responsible for approximately 24% of stillbirths and cord accidents (associated with asphyxia and hypoxia) accounting for 25% (57). Another study found that in low socioeconomic settings 11% of stillbirths are unexplained, antepartum haemorrhage (placental abruption and placenta praevia) accounts for 30% and hypertensive disease accounts for 28% (58).

One study found that maternal disease was responsible for 5-25% of stillbirths, congenital abnormality was responsible for 5-10%, intrauterine infection was responsible for 5-15% and 50% were unexplained stillbirths (59).

The Saving Babies Report 2012-2013 lists unexplained stillbirth as the number one cause of death in stillbirths. Antepartum haemorrhage came second, followed by complications of hypertension and other causes such as preterm labour, intrapartum asphyxia and birth trauma as other causes of death among stillbirths (11,18).

In this study the most common cause of death among stillbirths occurring at RMMCH during August 2016 to July 2017 was ‘unexplained cause of intrauterine death- macerated’. Other causes of death were ‘abruption with hypertension’ causing and ‘hypertension with proteinuria’. In this study were instances of ‘other cause not described in the PPIP classification’. These included cases of medical terminations of pregnancy (MTOP) for severe preeclampsia and cases of foeticide for severe or multiple congenital abnormalities that were incompatible with life. There were also cases of preterm labour found as the cause of death.

Conditions that contributed to the cause of stillbirth were intrauterine growth restriction (IUGR) as defined by a failure of a foetus to reach its growth potential, where the foetal weight is smaller than expected for the gestational age during the antenatal period. Clinically IUGR presents with serial SFH measurements that do not grow with advancing gestation, i.e. SFH remaining the same at three consecutive antenatal visits (11). The detection rate of SFH measurements in detecting small-for-gestation foetuses or growth restricted foetuses is between 56-86%. It is operator dependent but is useful as a screening tool for IUGR (60). The most common ‘other medical condition present’ found in this study was ‘IUGR’ and ‘ IUGR with histologic features of ischaemic placental disease’. These were found in conjunction with

cases of hypertensive disease. IUGR is known to be associated with preeclampsia (proteinuric hypertension) and unexplained stillbirths (51,62). Maternal diabetes was found in seven cases of unexplained stillbirths,. Syphilis and preterm labour were also noted as 'other obstetric conditions present'. This is in keeping with commonly reported causes of stillbirths in LMIC's (3,15).

7.2.4 Contribution of obstetric factors associated with stillbirths in this study

The main obstetric factor contribution to stillbirths at RMMCH between August 2016 and July 2017 were maternal factors. This study found a statistically significant association with no attendance to antenatal care (p 0.001) and stillbirths. Antepartum haemorrhage in the form of abruption with or without hypertension had a statistically significant association with stillbirths during this time period.

7.3 AVOIDABLE FACTORS

7.3.1 Patient related avoidable factors

It was deduced from the file reviews that the main patient related avoidable factor was a delay in seeking medical care. This delay is evident by the fact that patient's records show that there was a time lapse from the time a patient experienced danger signs to their arrival for medical care. Danger signs include reduced or absent foetal movements, per vaginal bleeding, rupturing of membranes, lower abdominal pains, headaches, visual disturbance and dizziness (45). A study conducted in a teaching hospital in Ethiopia found that only 3 % of patients had delayed in seeking skilled care (63).

The results show that booking late (presenting after the first trimester for initial antenatal visit (10)) for antenatal care attendance was a major avoidable factor and never initiating antenatal care, which had a statistically significant relation to stillbirths. Various studies have shown that absent or inadequate antenatal care during pregnancy is a risk factor for stillbirths (3,43,45–47). The previously mentioned Ethiopian study found that absent or inadequate antenatal care was an avoidable factor in 2-5% of cases (63).

Declining hospital admission was one of the patient related avoidable factor noted. This was evident from historical entries into patient's records stating: 'signed a refusal of hospital treatment (RHT)' and 'patient wants to go home and discuss with family'. The historical entries show that awareness was raised via extensive counselling about the foetal condition.

The pregnancy posed a risk and there was a need for timeous delivery or intervention to avert a stillbirth or other complications and adverse outcomes. They also demonstrated by means of time lines that patients then returned after a period of time with an intrauterine foetal death and subsequently delivered a stillborn foetus.
In this study, each patient had more than one patient related avoidable factor.

7.3.2 Administration related avoidable factors

The main administrative related avoidable factor was a lack of transport from a patient's location or home to the health institution as was deduced from historical entries that eluded to the fact that a patient did not have transport to come to the health facility or that they had contacted emergency obstetric services that arrived to their location/home to bring them to the health institution. Studies have demonstrated that a patient's remote access to health care is a risk factor for stillbirths (3,44). This is attributable to the overburdened emergency medical services system. The Ethiopian study found that transport difficulties from home to hospital accounted for 3% of administrative related avoidable factors (63). A lack of transport between referring and referral institutions was found to be another main administrative related avoidable factor. This was a possibility in 10 cases and a probability in 5 cases. Time lines could be tracked from entries in patient's records stating time of contacting the emergency medical services transport to time of arrival at the referring institution and time of departure from the referring institution to time of arrival to the referral institution.

7.3.3 Health worker related avoidable factors

No response to poor fundal growth by a health worker during antenatal reviews where serial plotting of fundal growth on the antenatal card showed a plateauing growth or a drop in growth on more than 2 or more antenatal visits. Hypertension was diagnosed with a blood pressure of more than 140/90mmHg in some cases but there was no indication on the records of historical entries that treatment was prescribed or that referral was made to a higher institution for further management. It was found that there was a delay in referring such patient for specialised care, file reviews showed that a condition was detected but the timing of referral was not in accordance to relevant guidelines. The basic antenatal care hand book recommends that such patients should be referred immediately to a higher institution (10).

A prospective study conducted in a teaching hospital in Ethiopia found that a delay in referring to a higher level hospital was the main health worker related avoidable factor in 10% of cases (63). There were cases where the mother was given inadequate advice; historical

accounts indicate that where referral was necessary, a patient was advised to return to a lower level of care. In terms of 'Other medical personnel related factors', files were reviewed and historical entries indicated that there were staffing constraints, it is noted that the doctor was busy operating and was unable to attend the case. This indicates that there were not enough sufficiently trained staff to attend the case.

7.4 PLACENTAL HISTOLOGY RESULTS

Investigation of stillbirths requires a complete history, placental histologic evaluation, laboratory tests, genetic evaluation and foetal autopsy in order to detect the cause of death of the stillbirth (29).

The placenta plays an essential role in maintaining a healthy pregnancy. Evaluation of the placenta together with a complete clinical history can detect up to 65% of the causes of death of stillbirths (64). Placental abnormalities have been found to be causal or contributory in more than 60% of cases of stillbirths (60). Placental dysfunction is involved in the pathophysiology of stillbirths, especially in cases of IUGR. Examination of placentae reduces the proportion of unexplained stillbirths and gives useful information in classification of stillbirths (65).

A great majority of patients who delivered stillbirths had placentae submitted for histological analysis, with most placentae showing pathological changes. Of the placentae with pathological changes, the major findings were features of placental vascular flow compromise as indicated on laboratory reports with diagnoses such as 'ischaemia', 'infarction', 'malperfusion', 'hypoxic vasculopathy' and 'uteroplacental insufficiency. Chorioamnionitis was present in few placentae and even fewer had both chorioamnionitis and features of placental vascular flow compromise. There were no specific changes found on the remainder of placentae. In this study it is found that there was a statistically significant relationship between abnormal placental pathology and stillbirths ($p < 0.001$). A systematic review of placental pathology in association with stillbirths found a significant correlation ranging from $p < 0.0003$ to $p < 0.001$, for pathologies ranging from chorioamnionitis to chord abnormalities and placental vasculopathies (61).

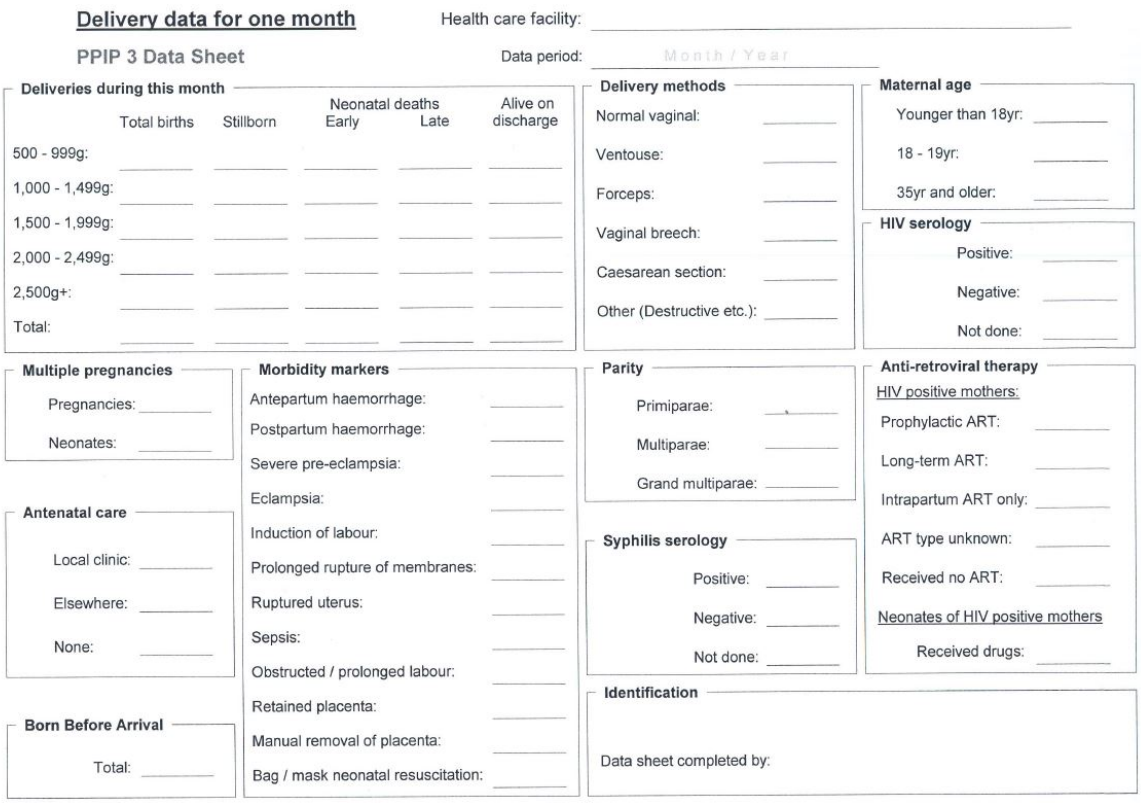
This study aimed to describe the common histological diagnoses on placental evaluation only and has not used placental histological finding to reclassify stillbirths.

8. CONCLUSION

The occurrence of stillbirths at any institution reflects the quality of antenatal and intrapartum care service that is rendered to a mother during pregnancy. The stillbirth rate has risen from 12.0/1 000 births in 2015 to 15.6/1 000 births in 2016/2017 at RMMCH. The stillbirth rates were comparable between South African citizens at 13.7/1 000 and non-South African citizens at 14.8/1 000.

The majority of stillbirths were LFD's at the rate of 10.4/1 000. Infections and placental blood flow compromise were the main pathologies found on placental histological analysis with statistical significance. This suggests that screening is very important for infections and conditions known to compromise placental blood, during the antenatal period. The main patient related avoidable factor was found to be a delay in seeking medical attention while a lack of transport was the main administration related factor and no response to poor fundal growth was the main health care worker related avoidable factor. This calls for creating, implementing and strengthening educational campaigns that seek to inform the understanding of patients around issues of pregnancy and stillbirth. It is an opportunity to intensify healthcare worker training and knowledge enrichment in identifying at risk pregnancies and implementing definitive care to avert stillbirths.

APPENDIX A



Delivery data for one month

Health care facility: _____

PPIP 3 Data Sheet

Data period: Month / Year

Deliveries during this month

	Total births	Stillborn	Neonatal deaths Early	Neonatal deaths Late	Alive on discharge
500 - 999g:					
1,000 - 1,499g:					
1,500 - 1,999g:					
2,000 - 2,499g:					
2,500g+:					
Total:					

Delivery methods

Normal vaginal: _____
Ventouse: _____
Forceps: _____
Vaginal breech: _____
Caesarean section: _____
Other (Destructive etc.): _____

Maternal age

Younger than 18yr: _____
18 - 19yr: _____
35yr and older: _____

HIV serology

Positive: _____
Negative: _____
Not done: _____

Multiple pregnancies

Pregnancies: _____
Neonates: _____

Antenatal care

Local clinic: _____
Elsewhere: _____
None: _____

Born Before Arrival

Total: _____

Morbidity markers

Antepartum haemorrhage: _____
Postpartum haemorrhage: _____
Severe pre-eclampsia: _____
Eclampsia: _____
Induction of labour: _____
Prolonged rupture of membranes: _____
Ruptured uterus: _____
Sepsis: _____
Obstructed / prolonged labour: _____
Retained placenta: _____
Manual removal of placenta: _____
Bag / mask neonatal resuscitation: _____

Parity

Primiparae: _____
Multiparae: _____
Grand multiparae: _____

Syphilis serology

Positive: _____
Negative: _____
Not done: _____

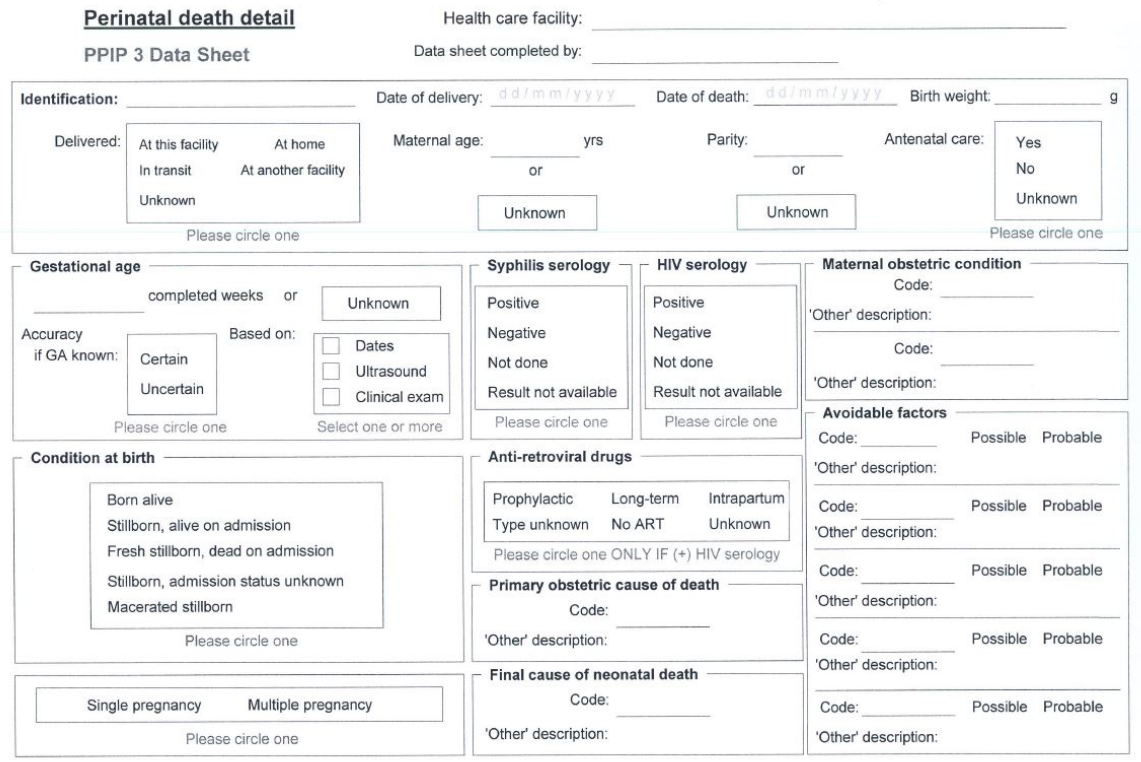
Anti-retroviral therapy

HIV positive mothers:
Prophylactic ART: _____
Long-term ART: _____
Intrapartum ART only: _____
ART type unknown: _____
Received no ART: _____

Neonates of HIV positive mothers
Received drugs: _____

Identification

Data sheet completed by:



Perinatal death detail

Health care facility: _____

PPIP 3 Data Sheet

Data sheet completed by: _____

Identification: _____ Date of delivery: dd/mm/yyyy Date of death: dd/mm/yyyy Birth weight: _____ g

Delivered: At this facility / At home / In transit / At another facility / Unknown — Please circle one

Maternal age: _____ yrs or Unknown

Parity: _____ or Unknown

Antenatal care: Yes / No / Unknown — Please circle one

Gestational age

_____ completed weeks or Unknown

Accuracy if GA known: Certain / Uncertain — Please circle one

Based on: ☐ Dates ☐ Ultrasound ☐ Clinical exam — Select one or more

Syphilis serology

Positive / Negative / Not done / Result not available — Please circle one

HIV serology

Positive / Negative / Not done / Result not available — Please circle one

Maternal obstetric condition

Code: _____
'Other' description: _____
Code: _____
'Other' description: _____

Avoidable factors

Code: _____ Possible Probable
'Other' description: _____
Code: _____ Possible Probable
'Other' description: _____
Code: _____ Possible Probable
'Other' description: _____
Code: _____ Possible Probable
'Other' description: _____
Code: _____ Possible Probable
'Other' description: _____

Condition at birth

Born alive
Stillborn, alive on admission
Fresh stillborn, dead on admission
Stillborn, admission status unknown
Macerated stillborn

Please circle one

Anti-retroviral drugs

Prophylactic / Long-term / Intrapartum / Type unknown / No ART / Unknown

Please circle one ONLY IF (+) HIV serology

Primary obstetric cause of death

Code: _____
'Other' description: _____

Final cause of neonatal death

Code: _____
'Other' description: _____

Single pregnancy / Multiple pregnancy — Please circle one

APPENDIX B

modified PPIPv3.0

Record ID	_____
Study Number	_____
RSA Citizen	◯ Yes ◯ No ◯ Not indicated
Maternal Age	_____
Gravidity	_____
Parity	_____
Antenatal care	◯ yes ◯ no ◯ unknown
Syphilis Serology	◯ Positive ◯ Negative ◯ Not done ◯ Results not available

	Completed	Not completed	Not received	Unkown
Treatment recieved If positive syphilis serology	◯	◯	◯	◯

HIV serology	◯ Positive ◯ Negative ◯ Not done ◯ Results not available

	Yes	No	Unknown
Treatment recieved If positive HIV serology	◯	◯	◯

Haemoglobin	_____
Rhesus Factor	◯ Positive ◯ Negative
If Rhesus Factor negative, antibodies present?	◯ Yes ◯ No
Height	_____

Weight	_____		
Body Mass Index	_____		
Social Habits	☐ Alcohol ☐ Drugs ☐ Smoking		
Place of delivery	◯ In Hospital ◯ In transit ◯ At Home ◯ Unknown		
Birth Weight	_____		
Gestational Age in weeks	_____		
Gestational age	unknown ◯		
Accuracy	Certain ◯		Uncertain ◯
GA Based on	Dates ◯	Ultrasound ◯	Clinical Exam ◯
Number of Foetuses	◯ Single ◯ Multiple		
Condition at Birth	◯ Stillborn, alive on admission ◯ Fresh Stillborn, dead on admission ◯ Stillborn, admission status unknown ◯ Macerated stillborn		

Maternal Obstetric Condition	☐ 0100 NO OBSTETRIC CONDTION ☐ 0101 Healthy mother ☐ 0200 COINCIDENTAL CONDITIONS ☐ 0201 Motor vehicle accident ☐ 0202 Other accidents ☐ 0203 Assault ☐ 0204 Rape ☐ 0205 Herbal Medicine ☐ 0299 Other conditions ☐ 0300 MEDICAL AND SURGICAL DISORDERS ☐ 0301 Cardiac disease ☐ 0302 Endocrine disease ☐ 0303 GIT disease ☐ 0304 CNS disease ☐ 0305 Respiratory disease ☐ 0306 Haematological disease ☐ 0307 Genito-urinary disease ☐ 0308 Auto-immune disease ☐ 0309 Skeletal disease ☐ 0310 Psychiatric disease ☐ 0311 Neoplastic disease ☐ 0399 Other medical and surgical disorders ☐ 0400 NON-PREGNANCY-RELATED INFECTIONS ☐ 0401 PCP pneumonia ☐ 0402 Other Pneumonia ☐ 0403 Tuberculosis ☐ 0404 Endocarditis ☐ 0405 Urinary tract infection ☐ 0406 Appendicitis ☐ 0407 Malaria ☐ 0408 Cryptococcal meningitis ☐ 0410 Kaposi's sarcoma ☐ 0411 Toxoplasmosis ☐ 0412 Cholera ☐ 0413 Hepatitis ☐ 0414 Gastroenteritis ☐ 0415 Wasting Syndrome ☐ 0416 Complications of antiretroviral therapy ☐ 0499 Other non-pregnancy-related infections ☐ 0500 EXTRAUTERINE PREGNANCY ☐ 0501 Extrauterine pregnancy ☐ 0600 PREGNANCY RELATED SEPSIS ☐ 0601 Chorioamnionitis with ruptured membranes ☐ 0602 Chorioamnionitis with intact membranes ☐ 0700 OBSTETRIC HAEMORRHAGE ☐ 0701 Abruption with hypertension ☐ 0702 Abruption without hypertension ☐ 0703 Placenta praevia ☐ 0704 Other APH not specified ☐ 0705 Ruptured uterus with previous c/s ☐ 0706 Ruptured uterus without previous c/s ☐ 0800 HYPERTENSION ☐ 0801 Chronic Hypertension ☐ 0802 Proteinuric Hypertension ☐ 0803 Eclampsia ☐ 0804 HELLP ☐ 0805 Liver rupture ☐ 0806 Acute fatty liver ☐ 0807 Pregnancy induced hypertension without proteinuria ☐ 0900 ANAESTHETIC COMPLICATIONS ☐ 0901 Complications of general anaesthesia ☐ 0902 Complications of epidural anaesthesia ☐ 0903 Complications of spinal anaesthesia ☐ 1000 EMBOLISM ☐ 1001 Pulmonary embolism ☐ 1002 Amniotic fluid embolism ☐ 1100 ACUTE COLLAPSE - CAUSE UNKNOWN ☐ 1101 Acute collapse, cause unknown

Primary Obstetric Cause of Death	◯ 0100 SPONTANEOUS PRETERM LABOUR ◯ 0101 Idiopathic preterm labour ◯ 0102 Preterm premature rupture of membranes ◯ 0103 Preterm rupture of membranes with chorioamnionitis ◯ 0104 Preterm labour with chorioamniontis wih intact membranes ◯ 0105 Cervical incompetence ◯ 0106 Iatrogenic preterm delivery for no real reason ◯ 0200 INFECTIONS ◯ 0201 Syphilis ◯ 0202 Amniotic fluid infection ◯ 0203 Beta-haemolytic streptococcal infection ◯ 0204 Malaria ◯ 0298 AIDS/HIV ***NOT USED*** ◯ 0299 Other infections ◯ 0300 ANTEPARTUM HAMORRHAGE ◯ 0301 Abruptio Placentae ◯ 0302 Abruptio Placentae with hypertentsion ◯ 0303 Placenta praevia ◯ 0304 Antepartum haemorrhage of unknown origin ◯ 0400 INTRAUTERINE GROWTH RETARDATION ◯ 0401 Idiopathic intrauterine growth retardation ◯ 0402 IUGR with histologic features of ischaemic placental disease ◯ 0403 Postmaturity ◯ 0500 HYPERTENSIVE DISORDERS ◯ 0501 Chronic Hypertension ◯ 0502 Proteinuric Hypetension ◯ 0503 Eclampsia ◯ 0504 Pregnancy induced hypertension without proteinuria ◯ 0600 FOETAL ABNORMALITY ◯ 0601 Foetal Chromosomal Abnormality ◯ 0602 Neural tube defects ◯ 0603 Cardiovascular system abnormality ◯ 0604 Renal system abnormality ◯ 0605 Hydrocephalus ◯ 0606 Abnormality of multiple systems ◯ 0607 Non- immune hydrops foetalis ◯ 0608 Non-specific foetal abnormality ◯ 0700 TRAUMA ◯ 0701 Motor vehicle accident ◯ 0702 Accidental abdominal trauma ◯ 0703 Domestic violence ◯ 0704 Assault ◯ 0800 INTRAPARTUM ASPHYXIA ◯ 0801 Labour related intrapartum asphyxia ◯ 0802 Meconium aspiration ◯ 0803 Cord prolapse ◯ 0804 Cord around the neck ◯ 0805 Traumatic breech delivery ◯ 0806 Traumatic assisted delivery ◯ 0807 Shoulder dystocia ◯ 0808 Precipitous labour ◯ 0809 Ruptured uterus ◯ 0900 MATERNAL DISEASE ◯ 0901 Maternal diabetes mellitus ◯ 0902 Maternal heart disease ◯ 0903 Maternal disease due to herbal medicine use ◯ 0999 Other maternal disease ◯ 1000 MISCILLANEOUS ◯ 1001 Rhesus isoimmuisation ◯ 1002 Twin-to-twin transfusion ◯ 1003 Extrauterine pregnancy ◯ 1099 Other cause of death not described in this classification. ◯ 1100 INTRAUTERINE DEATH ◯ 1101 Unexplained intrauterine death [IUD]

- ◯ 1102 Unexplained intrauterine death- macerated
- ◯ 1103 Unexplained IUD due to lack of notes
- ◯ 1200 NO OBSTETRIC CAUSE/ NOT APPLICABLE
- ◯ 1201 No obstetric cause/ not applicable

Other obstetric conditions present	◯ 0100i SPONTANEOUS PRETERM LABOUR ◯ 0101i Idiopathic preterm labour ◯ 0102i Preterm premature rupture of membranes ◯ 0103i Preterm rupture of membranes with chorioamnionitis ◯ 0104i Preterm labour with chorioamniontis wih intact membranes ◯ 0105i Cervical incompetence ◯ 0106i Iatrogenic preterm delivery for no real reason ◯ 0200i INFECTIONS ◯ 0201i Syphilis ◯ 0202i Amniotic fluid infection ◯ 0203i Beta-haemolytic streptococcal infection ◯ 0204i Malaria ◯ 0298i AIDS/HIV ***NOT USED*** ◯ 0299i Other infections ◯ 0300i ANTEPARTUM HAMORRHAGE ◯ 0301i Abruptio Placentae ◯ 0302i Abruptio Placentae with hypertentsion ◯ 0303i Placenta praevia ◯ 0304i Antepartum haemorrhage of unknown origin ◯ 0400i INTRAUTERINE GROWTH RETARDATION ◯ 0401i Idiopathic intrauterine growth retardation ◯ 0402i IUGR with histologic features of ischaemic placental disease ◯ 0403i Postmaturity ◯ 0500i HYPERTENSIVE DISORDERS ◯ 0501i Chronic Hypertension ◯ 0502i Proteinuric Hypetension ◯ 0503i Eclampsia ◯ 0504i Pregnancy induced hypertension without proteinuria ◯ 0600i FOETAL ABNORMALITY ◯ 0601i Foetal Chromosomal Abnormality ◯ 0602i Neural tube defects ◯ 0603i Cardiovascular system abnormality ◯ 0604i Renal system abnormality ◯ 0605i Hydrocephalus ◯ 0606i Abnormality of multiple systems ◯ 0607i Non- immune hydrops foetalis ◯ 0608i Non-specific foetal abnormality ◯ 0700i TRAUMA ◯ 0701i Motor vehicle accident ◯ 0702i Accidental abdominal trauma ◯ 0703i Domestic violence ◯ 0704i Assault ◯ 0800i INTRAPARTUM ASPHYXIA ◯ 0801i Labour related intrapartum asphyxia ◯ 0802i Meconium aspiration ◯ 0803i Cord prolapse ◯ 0804i Cord around the neck ◯ 0805i Traumatic breech delivery ◯ 0806i Traumatic assisted delivery ◯ 0807i Shoulder dystocia ◯ 0808i Precipitous labour ◯ 0809i Ruptured uterus ◯ 0900i MATERNAL DISEASE ◯ 0901i Maternal diabetes mellitus ◯ 0902i Maternal heart disease ◯ 0903i Maternal disease due to herbal medicine use ◯ 0999i Other maternal disease ◯ 1000i MISCILLANEOUS ◯ 1001i Rhesus isoimmuisation ◯ 1002i Twin-to-twin transfusion ◯ 1003i Extrauterine pregnancy ◯ 1099i Other cause of death not described in this classification. ◯ 1100i INTRAUTERINE DEATH

- ○ 1101i Unexplained intrauterine death- fresh
- ○ 1102i Unexplained intrauterine death- macerated
- ○ 1103i Unexplained IUD due to lack of notes
- ○ 1200i NO OBSTETRIC CAUSE/ NOT APPLICABLE
- ○ 1201i No obstetric cause/ not applicable

Avoidable factors

	Possible	Probable
0100 PATIENT ASSOCIATED	○	○
0101 Never initiated antenatal care	○	○
0102 Booked late n pregnancy	○	○
0103 Infrequent visit to antenatal clinic	○	○
0104 Failed to return on the prescribed date	○	○
0105 Inappropriate response to rupture of membranes	○	○
0106 Inappropriate response to antepartum haemorrhage	○	○
0107 Inappropriate response to poor foetal movements	○	○
0108 Delay in seeking medical attention during labour	○	○
0110 Declines admission/treatment/for personal/social reasons	○	○
0111Partener/family declines admission/treatment	○	○
0112 Alcohol abuse	○	○
0113 Smoking	○	○
0114 Illegal drug use	○	○
0115 Assault	○	○
0116 Attempted termination of pregnancy	○	○
0199 Other patient associated factor	○	○

	Possible	Probable
0200 ADMINISTRATIVE PROBLEMS	○	○
0201 Lack of transport- Home to institution	○	○
0202 Lack of transport- Institution to institution	○	○
0204 No syphilis screening performed at hospital/clinic	○	○
0205 Result of syphilis screening not returned to hospital/clinic	○	○
0208 No dedicated high risk clinic at referral hospital	○	○
0210 Inadequate theatre facilities	○	○
0212 Inadequate resuscitation equipment	○	○
0213 Insufficient blood/blood products available	○	○
0214 Insufficient nurses on duty to manage the patient adequately	○	○
0215 Insufficient doctors available to manage the patient	○	○
0216 Personel not sufficiently trained to manage the patient	○	○
0217 Personel too junior to manage the patient	○	○
0218 Staff rotation too rapid	○	○
0219 Anaesthetic delay	○	○
0220 Theatre delay: staff not available	○	○
0221 Theatre delay: all theatres occuied	○	○
0222 Congenital abnormality not diagnosed: no ultrasound service available	○	○
0299 Other administrative problems	○	○

	Possible	Probable
0300 MEDICAL PERSONEL ASSOCIATED	○	○
0301 No response to history of stillbirths, abruptio, etc	○	○
0302 No response to maternal glycosuria	○	○
0303 No response to poor uterine fundal growth	○	○
0304 No response to maternal hypertension	○	○
0305 No response to positive maternal syphilis seroloy test	○	○
0306 No response to apparent postterm pregnancy	○	○
0307 No response to history of poor foetal movements	○	○
0308 No antenatal response to abnormal foetal lie	○	○
0309 Multiple pregnancy not diagnosed antenatally	○	○
0310 Physical examination of the patient at clinic incomplete	○	○
0311 GP did not give card/letter about antenatal care	○	○
0312 Medical personel overestimated foetal size	○	○
0313 Medical personel underestimate foetal size	○	○
0314 Foetal distress not detected antepartum; foetus monitored	○	○
0315 Foetal distress not detected antepartum; foetus not minitored	○	○
0316 Antenatal steroids not given	○	○
0317 Poor progress in labour but partogram not used	○	○
0318 Poor progress in labour but partogram not used correctly	○	○
0319 Poor progress in labour but partogram interpreted incorrectly	○	○

0320 Foetal distress not detected intrapartum; foetus monitored	○	○
0321 Foetal distress not detected intrapartum; foetus not monitored	○	○
0322 Breech presentation not diagnosed until late in labour	○	○
0323 Multiple pregnancy not diagnosed intrapartum	○	○
0324 Incorrect management of hypertensive disease	○	○
0325 Incorrect management of antepartum haemorrhage	○	○
0326 Incorrect management of premature labour	○	○
0327 Incorrect manangement of cord prolapse	○	○
0328 Iatrogenic delivery for no real reason	○	○
0329 Management of 2nd stage of labour: prolonged with no intervention	○	○
0330 Management of 2nd stage of labour: inappropriate use of forceps	○	○
0331 Management of 2nd stage of labour: inappropriate use of vacuum	○	○
0337 Delay in doctor responding to call	○	○
0338 Doctor did not respond to call	○	○
0339 Delay in medical personel calling for expert assistance	○	○
0340 Delay in referring patient for secondary/tertiary care	○	○
0342 Inadequate/no advice given to mother	○	○
0343 Congenital abnormality not diagosed; U/S examination not performed	○	○

0344 Congenital abnormality not diagnosed; U/S examination was performed	○	○
0399 Other medical personel related factors	○	○
	Possible	Probable
0400 INSUFFICIENT NOTES TO COMMENT ON AVOIDABLE FACTORS	○	○
0401 Insufficient notes	○	○
0402 File missng	○	○
0403 Antenatal card lost	○	○

Placental Histological diagnosis

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Other Investigations

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APPENDIX C

Maternal obstetric condition at perinatal death

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the obstetric condition.

Code	Description
0100	NO OBSTETRIC CONDITION
0101	Healthy mother
0200	COINCIDENTAL CONDITIONS
0201	Motor vehicle accident
0202	Other accidents
0203	Assault
0204	Rape
0205	Herbal medicine
0299	Other coincidental conditions
0300	MEDICAL AND SURGICAL DISORDERS
0301	Cardiac disease
0302	Endocrine disease
0303	GIT disease
0304	CNS disease
0305	Respiratory disease
0306	Haematological disease
0307	Genito-urinary disease
0308	Auto-immune disease
0309	Skeletal disease
0310	Psychiatric disease
0311	Neoplastic disease
0399	Other medical and surgical disorders
0400	NON-PREGNANCY-RELATED INFECTIONS
0401	PCP pneumonia
0402	Other pneumonia

Maternal obstetric condition at perinatal death

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the obstetric condition.

Code	Description
0403	Tuberculosis
0404	Endocarditis
0405	Urinary tract infection
0406	Appendicitis
0407	Malaria
0408	Cryptococcal meningitis
0409	Other meningitis
0410	Kaposi's sarcoma
0411	Toxoplasmosis
0412	Cholera
0413	Hepatitis
0414	Gastroenteritis
0415	Wasting syndrome
0416	Complications of antiretroviral therapy
0499	Other non-pregnancy-related infections
0500	EXTRA-UTERINE PREGNANCY
0501	Extra-uterine pregnancy
0600	PREGNANCY-RELATED SEPSIS
0601	Chorioamnionitis with ruptured membranes
0602	Chorioamnionitis with intact membranes
0700	OBSTETRIC HAEMORRHAGE
0701	Abruption with hypertension
0702	Abruption without hypertension
0703	Placenta praevia

Maternal obstetric condition at perinatal death

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the obstetric condition.

Code	Description
0704	Other APH not specified
0705	Ruptured uterus with previous c/s
0706	Ruptured uterus without previous c/s
0800	HYPERTENSION
0801	Chronic hypertension
0802	Proteinuric hypertension
0803	Eclampsia
0804	HELLP
0805	Liver rupture
0806	Acute fatty liver
0807	Pregnancy-induced hypertension without proteinuria
0900	ANAESTHETIC COMPLICATIONS
0901	Complications of general anaesthetic
0902	Complications of epidural anaesthetic
0903	Complications of spinal anaesthetic
1000	EMBOLISM
1001	Pulmonary embolism
1002	Amniotic fluid embolism
1100	ACUTE COLLAPSE - CAUSE UNKNOWN
1101	Acute collapse - cause unknown

Obstetric cause of perinatal death

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the cause of death.

Code	Description
0100	SPONTANEOUS PRETERM LABOUR
0101	Ideopathic preterm labour
0102	Preterm premature rupture of membranes
0103	Preterm premature rupture of membranes with chorioamnionitis
0104	Preterm labour with chorioamnionitis with intact membranes
0105	Cervical incompetence
0106	Iatrogenic preterm delivery for no real reason
0200	INFECTIONS
0201	Syphilis
0202	Amniotic fluid infection
0203	Beta-haemolytic streptococcal infection
0204	Malaria
0298	AIDS/HIV related *** NOT USED ***
0299	Other infections
0300	ANTEPARTUM HAEMORRHAGE
0301	Abruptio placentae
0302	Abruptio placentae with hypertension
0303	Placenta praevia
0304	Antepartum haemorrhage of unknown origin
0400	INTRAUTERINE GROWTH RETARDATION
0401	Idiopathic intrauterine growth retardation
0402	IUGR with histological features of ischaemic placental disease
0403	Postmaturity
0500	HYPERTENSIVE DISORDERS

Obstetric cause of perinatal death

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the cause of death.

Code	Description
0501	Chronic hypertension
0502	Proteinuric hypertension
0503	Eclampsia
0504	Pregnancy-induced hypertension without proteinuria
0600	FETAL ABNORMALITY
0601	Fetal chromosomal abnormality
0602	Neural tube defects
0603	Cardiovascular system abnormality
0604	Renal system abnormality
0605	Hydrocephalus
0606	Abnormality of multiple systems
0607	Non-immune hydrops fetalis
0608	Non-specific fetal abnormality - FLK
0700	TRAUMA
0701	Motor vehicle accident
0702	Accidental abdominal trauma
0703	Domestic violence
0704	Assault
0800	INTRAPARTUM ASPHYXIA
0801	Labour related intrapartum asphyxia
0802	Meconium aspiration
0803	Cord prolapse
0804	Cord around the neck
0805	Traumatic breech delivery
0806	Traumatic assisted delivery

Obstetric cause of perinatal death

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the cause of death.

Code	Description
0807	Shoulder dystocia
0808	Precipitous labour
0809	Ruptured uterus
0900	MATERNAL DISEASE
0901	Maternal diabetes mellitus
0902	Maternal heart disease
0903	Maternal disease due to herbal medicine use
0999	Other maternal disease
1000	MISCELLANEOUS
1001	Rhesus isoimmunisation
1002	Twin-to-twin transfusion
1003	Extra-uterine pregnancy
1099	Other cause of death not described in classification
1100	INTRAUTERINE DEATH
1101	Unexplained intrauterine death - fresh
1102	Unexplained intrauterine death - macerated
1103	Unexplained IUD due to lack of notes
1200	NO OBSTETRIC CAUSE / NOT APPLICABLE
1201	No obstetric cause / Not applicable

Avoidable factors

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the avoidable or modifiable factor.

Code	Description
0100	PATIENT ASSOCIATED
0101	Never initiated antenatal care
0102	Booked late in pregnancy
0103	Infrequent visits to antenatal clinic
0104	Failed to return on the prescribed date
0105	Inappropriate response to rupture of membranes
0106	Inappropriate response to antepartum haemorrhage
0107	Inappropriate response to poor fetal movements
0108	Delay in seeking medical attention during labour
0109	Delay in seeking help when baby ill
0110	Declines admission/treatment for personal/social reasons
0111	Partner/Family declines admission/treatment
0112	Alcohol abuse
0113	Smoking
0114	Illegal drug use
0115	Assault
0116	Attempted termination of pregnancy
0117	Infanticide
0118	Abandoned baby
0199	Other patient associated factors
0200	ADMINISTRATIVE PROBLEMS
0201	Lack of transport - Home to institution
0202	Lack of transport - Institution to institution
0203	Lack of adequate neonatal transport
0204	No syphilis screening performed at hospital / clinic
0205	Result of syphilis screening not returned to hospital/clinic

Avoidable factors

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the avoidable or modifiable factor.

Code	Description
0206	No on-site syphilis testing available
0207	No Motherhood card issued
0208	No dedicated high risk clinic at referral hospital
0209	Inadequate facilities/equipment in neonatal unit/nursery
0210	Inadequate theatre facilities
0211	No accessible neonatal ICU bed with ventilator
0212	Inadequate resuscitation equipment
0213	Insufficient blood / blood products available
0214	Insufficient nurses on duty to manage the patient adequately
0215	Insufficient doctors available to manage the patient
0216	Personnel not sufficiently trained to manage the patient
0217	Personnel too junior to manage the patient
0218	Staff rotation too rapid
0219	Anaesthetic delay
0220	Theatre delay: staff not available
0221	Theatre delay: all theatres occupied
0222	Congenital abnormality not diagnosed: No ultrasound service available
0299	Other administrative problems
0300	MEDICAL PERSONNEL ASSOCIATED
0301	No response to history of stillbirths, abruptio etc.
0302	No response to maternal glycosuria
0303	No response to poor uterine fundal growth
0304	No response to maternal hypertension
0305	No response to positive syphilis serology test
0306	No response to apparent postterm pregnancy

Avoidable factors

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the avoidable or modifiable factor.

Code	Description
0307	No response to history of poor fetal movement
0308	No antenatal response to abnormal fetal lie
0309	Multiple pregnancy not diagnosed antenatally
0310	Physical examination of patient at clinic incomplete
0311	GP did not give card/letter about antenatal care
0312	Medical personnel overestimated fetal size
0313	Medical personnel underestimated fetal size
0314	Fetal distress not detected antepartum; fetus monitored
0315	Fetal distress not detected antepartum; fetus not monitored
0316	Antenatal steroids not given
0317	Poor progress in labour, but partogram not used
0318	Poor progress in labour, but partogram not used correctly
0319	Poor progress in labour - partogram interpreted incorrectly
0320	Fetal distress not detected intrapartum; fetus monitored
0321	Fetal distress not detected intrapartum; fetus not monitored
0322	Breech presentation not diagnosed until late in labour
0323	Multiple pregnancy not diagnosed intrapartum
0324	Incorrect management of hypertensive disease
0325	Incorrect management of antepartum haemorrhage
0326	Incorrect management of premature labour
0327	Incorrect management of cord prolapse
0328	Iatrogenic delivery for no real reason
0329	Management of 2nd stage: prolonged with no intervention
0330	Management of 2nd stage: inappropriate use of forceps
0331	Management of 2nd stage: inappropriate use of vacuum
0332	Neonatal resuscitation inadequate

Avoidable factors

Code list version: 3.00

Please note that PPIP does not allow you to enter a group heading. You must select an individual item which describes the avoidable or modifiable factor.

Code	Description
0333	Neonatal care: inadequate monitoring
0334	Neonatal care: management plan inadequate
0335	Baby managed incorrectly at Hospital/Clinic
0336	Baby sent home inappropriately
0337	Delay in doctor responding to call
0338	Doctor did not respond to call
0339	Delay in medical personnel calling for expert assistance
0340	Delay in referring patient for secondary/tertiary treatment
0341	Nosocomial infection
0342	Inadequate / No advice given to mother
0343	Congenital abnormality not diagnosed; U/S examination not performed
0344	Congenital abnormality not diagnosed; U/S examination was performed
0399	Other medical personnel associated factors
0400	INSUFFICIENT NOTES TO COMMENT ON AVOIDABLE FACTORS
0401	Insufficient notes
0402	File missing
0403	Antenatal card lost

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