

An illustration of a woman with dark hair tied back, wearing a purple top and a gold hoop earring, holding a baby. The woman is looking down at the baby with a gentle expression. The baby is looking up at the woman. The background is a soft, yellowish light.

Saving Mothers 2011-2013: Fifth report on the Confidential Enquiries into Maternal Deaths in South Africa

Comprehensive Report

Compiled by the National Committee for Confidential Enquiry into Maternal
Deaths



Saving Mothers 2011-2013

Sixth Comprehensive Report on Confidential Enquiries into Maternal Deaths in South Africa

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List of abbreviations

Abbreviation	Meaning
AA	Anaesthetic related death
AC	Acute collapse
AIDS	Acquired Immune Deficiency Syndrome
AF	Avoidable Factors
APH	Antepartum haemorrhage
ARV	Antiretroviral drugs
BDACS	Bleeding during or after caesarean section
CEMD	Confidential enquiries into maternal deaths
CFR	Case Fatality Rate
CHC	Community Health Centre
CS	Caesarean Section
Decl.	Declined
DIC	Disseminated Intravascular Coagulation
DH	District Hospital
EC	Eastern Cape
Ec	Ectopic pregnancy
Em	Embolism
EOST	Emergency Obstetric Simulation Training
ESMOE	Essential Steps in Managing Obstetric emergencies
FS	Free State
Gau	Gauteng
HAART	Highly active antiretroviral therapy
HCP	Health Care Professional
HG	Hyperemesis Gravidarum
HT	Hypertension
iMMR	Institutional Maternal Mortality Ratio
KZN	KwaZulu-Natal
Lim	Limpopo
MD	Pre-existing maternal disorders
Misc.	Miscarriage
Mpu	Mpumalanga
MMR	Maternal Mortality Ratio
NC	Northern Cape
NCCEMD	National Committee for the Confidential Enquiries into Maternal Deaths
Neg.	Negative
NPRI	Non-pregnancy related infections
NNDR	Neonatal death rate
NW	North West Province
Obs. Hge	Obstetric Haemorrhage
PCP	Pneumocystis carinii pneumonia
Pos.	Positive
PPH	Postpartum haemorrhage
PRS	Pregnancy related sepsis
PNMR	Perinatal Mortality Rate
RH	Regional Hospital
TH	Tertiary Hospital
TB	Tuberculosis
Unk.	Unknown
WC	Western Cape

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6. All the members of hospital management and the maternity care service providers for their compliance with the notification process and the commitment to learning from the process to improve the service they provide.

Foreword

There is still much to be done! The current Short Report of Saving Mothers 2011-2013 shows that there is a decreasing trend of maternal deaths. This is due mainly, to a decrease in deaths from non-pregnancy related infections, and there are indications that there will be a further decrease in deaths related to HIV as the underlying cause. The decrease in these HIV-related deaths is mainly due to increasing numbers of women accepting the offer of HIV testing and the raising of the CD₄ count to 350 cells/ μ ml.

On the other hand, there are worrying trends of increasing numbers of deaths due to bleeding associated with caesarean sections and deaths due to medical and surgical conditions. Much more effort is required to overcome these challenges. We need to place more emphasis on our 3 key building blocks, viz.

1. Knowledgeable and skilled health care professionals
2. Appropriately resourced health facilities
3. Rapid and emergency transport services.

We need to get these foundation pillars working in concert over the next decade to achieve our aim of the quote *"the right to health is a human right and the health of a nation is determined by the health of its women, newborns and children"*.

Lastly, the NCCEMD process have evolved and matured since its first report. The data is now very reliable and we are able to respond rapidly to trends or issues that arise.



J MOODLEY

Chair

National Committee on the Confidential Enquiries into Maternal Deaths

Aims of the Enquiry and Definitions of Maternal Mortality

Aims and objectives of the Enquiry

In recognition of the need to reduce maternal mortality in South Africa, deaths during pregnancy, childbirth and the puerperium were made notifiable events on 1 October 1997, in terms of the National Policy Health Act, Number 116 of 1990. The Minister of Health appointed a National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD). The NCCEMD is responsible for the confidential enquiry into maternal mortality in South Africa and in so doing has developed a reporting system for maternal deaths.

Confidential enquiries into maternal deaths (CEMD) can be defined as: a systematic multidisciplinary anonymous investigation of all or a representative sample of maternal deaths occurring at an area, region (state) or national level which identifies the numbers, causes and avoidable or remediable factors associated with them. Through the lessons learnt from each woman's death, and through aggregating the data, confidential enquiries provide evidence of where the main problems in overcoming maternal mortality lie and an analysis of what can be done in practical terms, and highlight the key areas requiring recommendations for health sector and community action as well as guidelines for improving clinical outcomes.

The task of the NCCEMD is

“To make recommendations, based on the confidential study of maternal deaths to the Minister of the Department of Health such that the implementation of the recommendations will result in a decrease in the maternal mortality”

The terms of reference of the NCCEMD are:

- Make **recommendations** based on analysis of the maternal deaths that were reported such that **the implementation of the recommendations would result in a reduction in the maternal mortality**
- Recommendations must be phrased in such a manner that their **implementation can be measured**
- To play **an advisory role** to the department of health on the implementation of recommendations and monitoring of progress
- Reports **will document progress** on implementation of the recommendations
- Recommendations should be **within the health care resources** of the country
- Recommendations are **made to the National Minister of Health**

Definitions of maternal mortality

The International Classification of Diseases, Injuries and Causes of Death – 10th Revision defines a maternal death as “the death of a woman while pregnant or within 42 days of termination of pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes”.

Definitions of maternal deaths

Maternal deaths	Deaths of women while pregnant or within 42 days of termination of pregnancy from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes
Direct	Deaths resulting from obstetric complications of the pregnancy state (pregnancy, labour and puerperium), from interventions, omissions, incorrect treatment or from a chain of events resulting from any of the above.
Indirect	Deaths resulting from previous existing disease, or disease that developed during pregnancy and which were not due to direct obstetric causes, but which were aggravated by the physiological effects of pregnancy.
Coincidental	Deaths from unrelated causes which happen to occur in pregnancy or the puerperium.
Unknown	Deaths during pregnancy or the puerperium where an underlying cause was not identified.

The maternal death notification process requires that all deaths that occur in pregnancy, labour and within 42 days of delivery be reported. These deaths are then subdivided into *direct*, *indirect* and *coincidental* deaths. The NCCEMD does not report on *late* deaths, that are deaths occurring between 42 days and one year after abortion or delivery that are due to direct or indirect maternal causes. Only *direct* and *indirect* deaths are counted for statistical purposes.

Coincidental (formerly *fortuitous*) deaths are included in the recording of maternal deaths in South Africa, to identify the magnitude of the problem of violence against women and to identify the number of suicides in pregnancy.

Methodology

After each maternal death in a facility, a defined process is followed. First, the facility completes a Maternal Death Notification Form (MDNF) which is sent to the provincial office within 7 days of the maternal death. The provincial MCWH coordinator informs the secretariat of the NCCEMD that a death has occurred. The NCCEMD issues a unique file number for the case. The Province forwards all documentation to a Provincial Assessor. The Provincial Assessor team comprising of a doctor and midwife is responsible for completion of the assessor's form. The assessor's must provide information on the primary, final and contributory causes of death and must also establish whether there were avoidable factors, missed opportunities or any other aspects of substandard care present in the maternal death. The assessor must complete and return all documentation to the Province within 30 days. All documentation is then forwarded to the NCCEMD for collations and analysis. The NCCEMD uses this data to compile reports on maternal deaths in South Africa. Once the report is accepted, all data is destroyed, and work begins on the next report. Detailed reports come out every three years.

The data provided in this report represents all maternal cases reported to the National Office through the Confidential Enquiry into Maternal Deaths process described above during the period from 1st January 2008 to 31st December 2010.

Denominator data used for calculating mortality rates

The number of deliveries is uncertain for the whole of South Africa. The Maternal Mortality Ratio (MMR) used in this report is based on the number of reported maternal deaths and deliveries. The District Health Information System (DHIS) records the births in all institutions in South Africa. This information was used as the denominator to calculate the *Institutional* MMR.

Key findings

- There were 4452 maternal deaths entered on the database for 2011-2013 by 15th May 2014
- The Institutional Maternal Mortality Ratio (iMMR) has decreased from 176.22 per 100000 live births in 2008-2010 to an iMMR of 154.06 per 100000 live births in 2011-2013 (a 12.6% decrease). There was a decrease in iMMR at district hospitals and tertiary hospitals, but a slight increase in regional hospitals.
- Non-pregnancy related infections (mainly deaths in HIV infected pregnant women complicated by tuberculosis and pneumonia) accounted for 34.7% of maternal deaths, a considerable decrease from 40.5% in 2008-2010. The iMMR for 2008-2010 was 71.29 per 100000 live births compared with 53.47 per 100000 live births in 2011-2013 (a 25% reduction in deaths).
- Maternal deaths due to obstetric haemorrhage and hypertension accounted for 30.4% of deaths (15.8% and 14.8% respectively). There has been a steady decline in maternal deaths due to complications of hypertension which have dropped 18% from 2002-2004 (from an iMMR of 27.72 to 22.75 per 100000 live births) but the deaths due obstetric haemorrhage have increased 24.7% from an iMMR of 19.51 per 100000 live births in 2002-2004 to an iMMR of 24.32 per 100000 live births in 2011-2013. In 2011-2013 a third of the maternal deaths due to obstetric haemorrhage were due to bleeding at or after caesarean section.
- There has been a significant reduction in deaths due to complications of antiretroviral therapy
- The top three causes of maternal death (non-pregnancy related infections, obstetric haemorrhage and hypertension) accounted for just more than two thirds of all maternal deaths.
- There has been a doubling of maternal deaths due to pre-existing medical and surgical conditions from 2002-2004 to 2011-2013. They now account for 11.4% of maternal deaths.
- Obesity conveys a significant risk of pulmonary embolism especially after caesarean section
- The iMMR causally related to mode of delivery was three times higher for operative delivery; 66.6 per 100000 live births for vaginal birth and 185.8 per 100000 live births for caesarean section.
- Deaths in private hospitals follow the same pattern as public hospitals, and the recommendations are as applicable to private institutions as public ones.
- Maternal deaths due to obstetric haemorrhage and hypertension were thought to be possibly and probably preventable in 89% and 67% of cases respectively.
- Maternal deaths due to non-pregnancy related infections, obstetric haemorrhage and hypertension were the three biggest contributors to preventable maternal deaths, accounting for 65% of avoidable deaths
- Poor clinical assessment, delays in referral, not following standard protocols and not responding to abnormalities in monitoring of patients were the most common health care provider avoidable factors.
- Lack of appropriately trained doctors and nurses was thought to be a significant contributory factor in 15.6% and 8.8% of assessable maternal deaths, up from 9.3% and 4.5% in 2008-2010 respectively. Lack of appropriately trained doctors and nurses was combined in 2002-2004 and was 8.9%. Lack of appropriately trained doctors was recorded as a significant factor in 47%, 27% 24% and 19% of maternal deaths due to anaesthesia, obstetric haemorrhage, pregnancy related sepsis and complications of hypertension respectively.

Summary and recommendations

Aim

This report summarises the findings on confidential enquiries into maternal deaths in South Africa for 2011-2013 and presents new data on the HIV and TB epidemic in pregnant women, maternal deaths associated with caesarean sections and maternal deaths in private hospitals.

Method

The report covers the maternal deaths that were reported to the NCCEMD secretariat by 15th May 2014, and that occurred in 2011-2013. The same definitions used in previous Saving Mothers reports were used in this report.

Results

Data was entered on 4452 deaths in pregnancy and the puerperium for the period 2011-2013. The institutional maternal mortality ratio (iMMR) has decreased from 176.22/100000 live births in 2008-2010 to 154.06/100000 live births in 2011-2013. The iMMR decreased in district and tertiary hospitals but there was a slight increase in regional hospitals.

In 2011-2013, the “big 5” causes of maternal deaths were **non-pregnancy related infections (NPRI)** (34.7%, mainly deaths due to HIV infection complicated by Tuberculosis (TB), PCP and pneumonia), **obstetric haemorrhage** (15.8%), complications of **hypertension in pregnancy** (14.8%), **medical and surgical disorders** (11.4%) and **pregnancy related sepsis** (9.5%, includes septic miscarriage and puerperal sepsis). These five account for 86.2% of maternal deaths. Bleeding at or after caesarean section was responsible for a third of obstetric haemorrhage deaths. TB was the most common cause of deaths due non-pregnancy related infections and was probably underdiagnosed in a number of other women.

The HIV status was known for 87% of women who died; 65% of were HIV positive, a small decrease from 70% in 2008-2010. Almost 90% of women who died from NPRI were HIV positive. Of these, 55% were on HAART, compared to 36% in 2008-2010. It is not known how many women were not virologically suppressed on HAART. This may be due to recent initiation of HAART, adherence problems, or virological failure. TB remains the single most common cause of mortality amongst HIV positive women, and the most common respiratory cause. There has been a significant reduction in deaths due to complications of antiretroviral therapy. This has followed the change in ART guidelines that nevirapine should not be routinely prescribed for women of reproductive age, including pregnant women, and efavirenz used instead.

The iMMR of deaths due to complications of hypertension in pregnancy have declined 18% from 2002-2004 till 2011-2013, but deaths due to obstetric haemorrhage have increased 25% from 2002-2004 till 2011-2013. The iMMR causally related to mode of delivery was three times higher for operative delivery; 66.6 per 100000 live births for vaginal birth and 185.8 per 100000 live births for caesarean section.

Poor clinical assessment, delays in referral, not following standard protocols and not responding to abnormalities in monitoring of patients were the most common health care provider avoidable factors. Lack of appropriately trained doctors and nurses has emerged as a significant contributory factor in maternal deaths being recorded in 15.6% and 8.8% for doctors and nurses respectively.

Conclusions

There has been a significant reduction in maternal deaths in the 2011-2013 triennium and this reduction is mostly due to a decrease in deaths due to NPRI; however to maintain this fall and obtain an exponential fall much more still needs to be done. Assessors classified 60% of maternal deaths to be possibly or probably preventable indicating mostly poor quality of care during the antenatal, intrapartum and postnatal periods.

Three conditions have been identified that contribute to the two-thirds of preventable maternal deaths, namely non-pregnancy related infections, obstetric haemorrhage and complications of hypertension in pregnancy. These are the same conditions that were listed in the fifth Saving Mothers report (2008-2010). Recommendations were made in that report to deal with these issues. Most were acted upon in the past three years; however the same recommendations still remain valid in 2014. The challenge remains one of implementation of the known effective interventions.

Recommendations

To **Save Mothers Lives** three key aspects of a health system are essential

- Knowledgeable and skilled health care providers
- Appropriately resourced and accessible health care facilities (including equipment and human resources)
- Rapid inter-facility emergency transport system

These three basic building blocks of the health system must be available to all pregnant women; especially the less informed and most disadvantaged people. When all these aspects are in place, rapid declines in the iMMR can be expected, as demonstrated in Free State from 2011 to 2012¹.

As the targeted date for millennium goals draw to a close, it is clear that the millennium goals will not easily be achieved unless extraordinary steps are taken. These steps would not only be important for attempting to achieve the goals, but to improve on maternal mortality beyond the millennium goals. The Priority Cost Effective Lessons for Systems Strengthening (PRICELESS SA) study of the MRC and Wits Rural Public Health and Health Transitions Unit, Wits School of Public Health produced a report in 2014 called "Results of the LiST modelling for maternal and child lives that can be saved by scaling up interventions in 2014 and 2015 in South Africa". This estimated that by implementing 8 interventions at a 95% coverage a further 1919 maternal deaths could be prevented every year. These 8 interventions would also save an estimated 1380 lives of neonates. Fortunately these 8 interventions had been already incorporated in the life saving services (signal functions) that facilities should provide to pregnant women² and were included in the **5 H's** recommendations of the fifth Saving Mothers report of 2008-2011. (PRICELESS SA also listed a further 5 interventions which would decrease the lives lost of neonates by 5983 lives per year at a 95% coverage. Two of these last interventions occur in the antenatal period and most occur in the labour ward, illustrating the integrated nature of maternal and neonatal care.)

After reviewing the **5 Hs** recommendations made in the last Saving Mothers report, the NCEMD decided to continue with the **5 Hs** recommendations. However, the NCEMD decided to further strengthen these recommendations by adding the **5 Cs**, which are aimed more specifically at improving implementation and targeting specific interventions.

The 5 Hs are summarised as follows:

The 5 Hs

- **HIV**
- **Haemorrhage**
- **Hypertension**

¹ M G Schoon. Impact of inter-facility transport on maternal mortality in the Free State Province. *S Afr Med J* 2013;103(8):534-537

² UNICEF, WHO, UNFPA. Guidelines for monitoring the availability and use of obstetric services. New York, United Nations Children Fund, 1997 and "Monitoring emergency obstetric care: a handbook". World Health Organization 2009

- Health professional training and
- Health system strengthening

The last two (Health worker training and Health system strengthening) are part of the three Basic Building Blocks of a health system as described above. They are essential to achieving the first three Hs (HIV, Haemorrhage, and Hypertension). The **5 Cs** give implementation strategies to move from the 2Hs (Basic Building Blocks of the health system) to achieve the 3Hs (reduction in maternal deaths due the HIV and TB, Haemorrhage and Hypertension).

The **5 Cs** are summarised as:

- Care: Commitment to Quality
- Coverage
- Caesarean section safety
- Contraception
- Community involvement

The **5Cs** are shown in the table below.

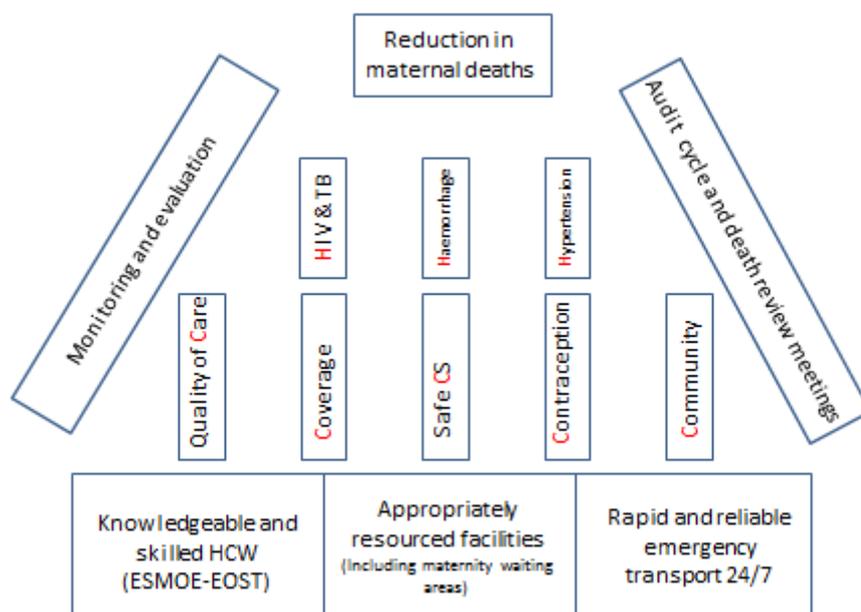
How	Who
Care: Commitment to quality	<ul style="list-style-type: none"> • DCSTs and clinical heads of department to improve clinical governance, clinical supervision, response to local audit findings, and leadership functions • HCPs to make themselves available for training, to participate in drills and to behave in professional manner • Managers to ensure emergency drills performed regularly • Managers need to evaluate and accredit HCWs to ensure they have appropriate skills
Coverage	<ul style="list-style-type: none"> • District managers to ensure all effective interventions are implemented in maternity services, especially for the poorest section of the population • EMS to ensure transport from home to institution and between institutions • CEOs to include maternity waiting areas where appropriate • Use MomConnect to communicate with the community
Caesarean section safety	<ul style="list-style-type: none"> • CEOs and district managers rationalise resources to ensure skills and facilities available 24/7 • HCW have skills to perform safe CS, including safe anaesthesia • DCSTs specific training package to be implemented
Contraception	<ul style="list-style-type: none"> • All HCW to motivate people to prevent unwanted pregnancies • Managers to ensure various modalities are always available • WBOTs to identify women requiring contraception, and refer • Use MomConnect to communicate with the community
Community involvement	<ul style="list-style-type: none"> • Health facility management to engage with community health committees • WBOTs convey the essential maternity and baby care messages to all pregnant and postnatal women • Use MomConnect to communicate with the community

HCP- Health Care Professional; DCSTs – District Clinical Specialist Teams; CEOs – Chief Executive Officers; WBOTs – Ward Based Outreach Teams; CS - Caesarean Section

The “what” consists of the **5Hs** as shown below:

What	Priority activities to be implemented.
- Three foundation stones for the Health system	
Improve Health worker training	<ul style="list-style-type: none"> - Train all HCPs involved in maternity care in the ESMOE-EOST programme and obstetric anaesthetic module, - Train all HCPs in HIV screening and treatment protocols
Strengthen Health system	<ul style="list-style-type: none"> - Ensure 24 hour access to functioning emergency obstetric care (both basic and comprehensive) - Promote where appropriate maternity waiting areas - Accessible and appropriate contraceptive services for all women
- Targeted activities	
Reduce deaths due to HIV and TB	<ul style="list-style-type: none"> - Promote preventive measures - Health care workers(HCP) actively screen for HIV co-infections and treat especially TB
Reduce deaths due to Haemorrhage	<ul style="list-style-type: none"> - Promote preventive interventions: - HCP involved in EOST exercises on haemorrhage
Reduce deaths due to Hypertension	<ul style="list-style-type: none"> - Promote preventative measures: e.g. calcium supplementation, - HCP involved in EOST exercises on hypertension

HCP: health care professional; ESMOE : essential steps in management of obstetric emergencies; EOST: emergency obstetric simulation training.



The above figure illustrates the recommendations.

The actions that follow from the recommendations are detailed for each category of health care workers, from the policy makers and managers to the clinicians and teachers and professional bodies and communities. This is shown in Appendix 2.

Monitoring and evaluation

The effect of implementation of these recommendations can be **monitored and evaluated** by assessing the emergency obstetric care signal functions. This can be linked with the neonatal

emergency care signal functions as some of the major neonatal emergency care signal functions occur in the antenatal period. This will promote the integration of maternal and neonatal services. Table 1 shows the obstetric and neonatal signal functions.

Table 1. Obstetric and neonatal signal functions.¹

Dimensions of Facility Care	Obstetric	Neonatal
General requirements for health facility		
	Service availability 24/7	
	Skilled providers in sufficient numbers	
	Referral service to higher-level care, communication tools	
	Reliable electricity and water supply, heating in cold climates, clean toilets	
A. Routine care (for all mothers and babies)		
	Monitoring and management of labour using partograph	Thermal protection
	Infection prevention measures (hand-washing, gloves)	Immediate and exclusive breastfeeding
	Active management of third stage of labour (AMTSL)	Infection prevention including hygienic cord care
	HIV and TB Screening and treatment	PMTCT if HIV-positive mother
B. Basic emergency care (for mothers and babies with complications)		
	Parenteral magnesium sulphate for (pre-) eclampsia	Antibiotics for preterm or prolonged PROM to prevent infection
	Assisted vaginal delivery	Corticosteroids in preterm labour
	Parenteral antibiotics for maternal infection	Resuscitation with bag and mask of non-breathing baby
	Parenteral oxytocic drugs for haemorrhage	KMC for premature/very small babies
	Manual removal of placenta for retained placenta	Alternative feeding if baby unable to breastfeed
	Removal of retained products of conception	Injectable antibiotics for neonatal sepsis
	ARVs for mother	
C. Comprehensive emergency care (functions in addition to Basic)		
	Surgery (e.g., C-section) including anaesthesia	Intravenous fluids
	Blood transfusion	Safe administration of oxygen

The signal functions are measures of life saving services, thus giving Magnesium Sulphate is a measure of being able to manage severe hypertension and eclampsia; ability to give oxytocin is a measure of being able to manage obstetric haemorrhage etc.

The National Committee appreciates all the efforts that were made to reduce maternal deaths and the positive impact of implementing the recommendations of the committee is evident in this report. However, much more need to be done to get our country on the right tract. Your assistance in implementing the new recommendations and to maintain what have been done previously is critically important to assist in prevention of mothers dying whilst giving life.

¹Adapted from Gabrysch S, Civitelli G, Edmond KM, Mathai M, Ali M, et al. (2012) New Signal Functions to Measure the Ability of Health Facilities to Provide Routine and Emergency Newborn Care. PLoS Med 9(11): e1001340.doi:10.1371/journal.pmed.1001340

Chapter 1: Overview and key recommendations

1. Introduction

The Confidential Enquiries system of recording and analysing maternal deaths has been in operation since 1 October 1997. The first comprehensive report into maternal deaths in South Africa was published in October 1999, and dealt in detail with maternal deaths occurring during 1998. The second to fifth comprehensive reports covered the trienniums 1999-2001, 2002-2004, 2005-2007 and 2008-2010. These reports all described the magnitude of the problem of maternal deaths, the pattern of disease causing maternal deaths, the avoidable factors, missed opportunities and substandard care related to these deaths and made recommendations concerning ways of decreasing the number of maternal deaths.

This report describes the pattern of disease causing maternal deaths and the health system failures related to these deaths during 2011-2013. Information on Institutional Maternal Mortality Ratio (MMR), Perinatal Mortality Rate (PNMR), Stillbirth rate (SBR) and Early Neonatal Death Rate (ENNDR) per district are given at the end of the report.

The definitions of underlying causes used in this report are the same as those used in the 2008-2010 “Saving Mothers” report.

Data used in this report consist of the maternal deaths that occurred and were reported to the National Committee for Confidential Enquiries into Maternal Deaths (NCCEMD) secretariat and were entered on the MaMMAS database before 15th May 2014. This cut-off date was selected to try and ensure most deaths were reported and entered into the MaMMAS Database but still allow for a fairly rapid analysis of the data.

Reporting of maternal deaths and Maternal Death Surveillance and Response (MDSR)

Reporting of maternal deaths is becoming more and more efficient and reliable. The NCCEMD has been able to produce an interim report before the end of the following year in the preceding three years. This includes a breakdown of deaths per district and the underlying causes of those deaths. The data from the 2012 year was presented to the National Department of Health (NDOH) before mid-year and the data for 2013 and the triennial report was available before the 31st May 2014. This has been achieved by the regular and timely review of maternal deaths by the assessors and their entry into the MaMMAS database. This rapid reporting enabling the NCCEMD to identify a trend of increase maternal deaths due to complications of antiretroviral therapy and for the NDOH to be notified and for corrective action to be taken. Similarly the increase in maternal deaths due to bleeding at or after caesarean section has been identified.

Table 1.1 Comparison between reporting of maternal deaths to the NCCEMD and DHIS

	NCCEMD MD				DHIS MD				Difference			
	2011	2012	2013	Total	2011	2012	2013	Total	2011	2012	2013	Total
Eastern Cape	210	183	200	593	112	121	163	396	98	62	37	197
Free State	124	72	85	281	77	64	70	211	47	8	15	70
Gauteng	270	339	240	849	170	265	218	653	100	74	22	196
KwaZulu-Natal	360	326	278	964	275	315	278	868	85	11	0	96
Limpopo	249	245	256	750	174	222	209	605	75	23	47	145
Mpumalanga	148	136	115	399	72	136	116	324	76	0	-1	75
North West	99	96	97	292	75	109	103	287	24	-13	-6	5
Northern Cape	40	36	34	110	27	31	27	85	13	5	7	25
Western Cape	60	75	79	214	41	65	70	176	19	10	9	38
South Africa	1560	1508	1384	4452	1023	1328	1254	3605	537	180	130	847

Table 1.1 gives a comparison of the reporting of maternal deaths to the NCCEMD and District Health Information System (DHIS). There has been a gratifying improvement in reporting of maternal deaths in the DHIS since 2012 and both systems now can be employed into an effective maternal Death Surveillance and Response system.

Distribution of deaths

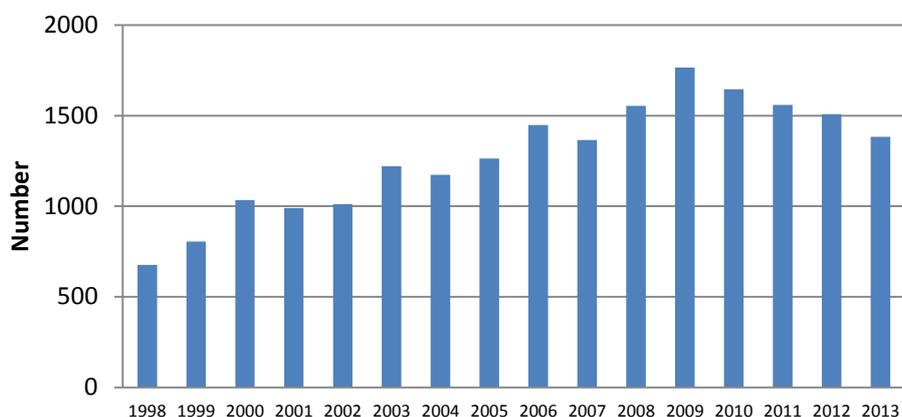
Table 1.2 give the deaths entered on the database since the start of the CEMD.

Table 1.2 Deaths during pregnancy, childbirth and puerperium reported per province in 1998- 2013

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
EC	56	95	120	103	113	112	145	149	154	160	215	263	232	210	183	200
FS	94	79	96	119	100	171	161	150	170	164	139	171	120	124	72	85
Gau	131	138	171	184	213	205	251	222	257	190	268	319	293	270	339	240
KZN	188	252	238	245	238	275	209	268	354	339	366	378	385	360	326	278
Lim	27	63	88	71	72	108	101	181	199	211	222	196	198	249	245	256
Mpu	66	72	128	97	98	120	75	74	108	87	128	115	150	148	136	115
NW	58	54	115	106	80	135	111	105	100	84	97	161	134	99	96	97
NC	22	18	29	23	38	28	40	53	53	58	59	53	52	40	36	34
WC	34	34	50	42	60	67	80	61	53	73	60	110	82	60	75	79
Tot.	676	805	1035	990	1012	1221	1173	1263	1448	1366	1554	1766	1646	1560	1508	1384

Note: includes coincidental deaths; subsequent tables exclude coincidental deaths

Figure 1.1 Illustration of deaths during pregnancy, childbirth and puerperium reported to the NCCEMD between 1998- 2013



The term *institutional* Maternal Mortality Ratio (iMMR) is used in this report instead of the MMR because the deaths during pregnancy, childbirth and puerperium reported to the NCCEMD predominantly occur in institutions or are reported to the institutions and the few home deaths noted are reported in a non-systematic unstructured way. These are included in the numerator. Since 2009 there has been a steady decline in the number of maternal deaths reported (figure 1.1) and the iMMR has also shown a similar decline since 2009 (Figure 1.2). A 12.6% reduction has been observed from 2008-2010 to 2011-2013.

The MMR reported by the Health Data Advisory and Co-ordination Committee (HDACC) in the Rapid Mortality Survey of 2012³ is higher than the iMMR as their report is based on deaths certificates and home deaths are being recorded by their process. This reduction in deaths is in line with the decreasing maternal deaths reported by Dorrington *et al*³.

Further HDACC has recently changed its methodology for calculating the MMR which involved a change in the estimate of the number of births. It is now estimated that the MMR rose from 280 per 100000 live births in 2008 to peak at 304 per 100000 live births in 2009 before dropping to 269 per 100000 live births in 2010. These new MMRs are much more in keeping with the findings of the NCCEMD, understanding that the NCCEMD misses most of the maternal deaths occurring outside of health care facilities.

Figure 1.2 iMMR from 2005 to 2013

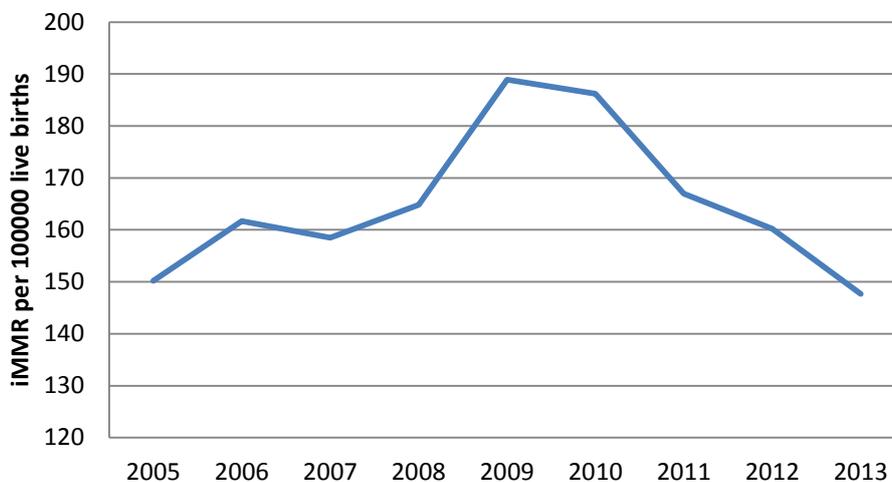


Figure 1.3 illustrated the provincial distribution of reported maternal deaths for 2011-2013. The most populous provinces have the most deaths, with the exception of the Western Cape where it reported the second lowest number of deaths, but is the third most populous province.

³ Dorrington RE, Bradshaw D, Laubscher R (2014). Rapid Mortality surveillance report 2012. CapeTown: South African Medical Research Council. ISBN: 978---1---920618---19---3

Figure 1.3 Distribution maternal deaths per province 2011-2013

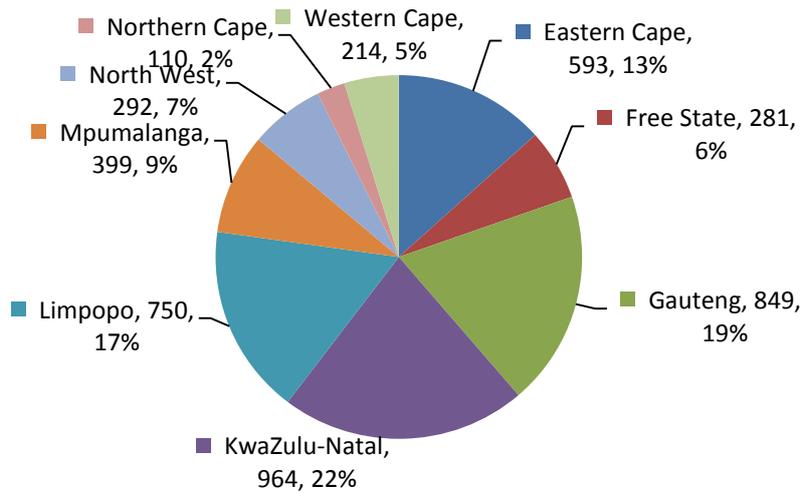


Figure 1.4 illustrates the trends in iMMR per province since 2005. The Free State and Northern Cape provinces have shown the biggest declines in mortality. All provinces except Limpopo province have shown a decline in recent years.

Figure 1.4 Trends in iMMR per province since 2005

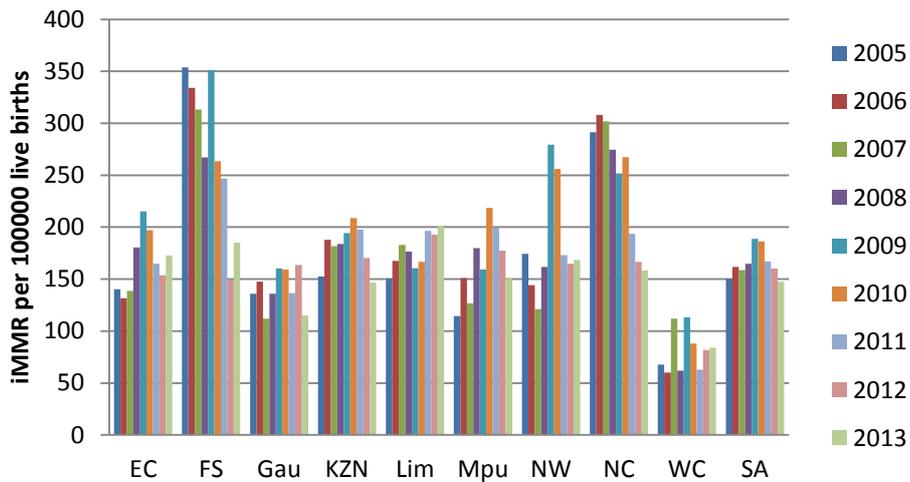


Table 1.4 give the maternal deaths, facility live births and iMMR per province for 2011-2013.

Table 1.4 Deaths during pregnancy, childbirth and the puerperium, live births and iMMR per province 2011-2013

Province 2011-2013	Maternal deaths	live births	iMMR
Eastern Cape	593	362313	163.67
Free State	281	144373	194.63
Gauteng	849	613725	138.34
KwaZulu-Natal	964	563446	171.09
Limpopo	750	381034	196.83
Mpumalanga	399	227304	175.54
North West	292	173037	168.75
Northern Cape	110	63752	172.54
Western Cape	214	281602	75.99
South Africa	4452	2812597	158.29

Underlying obstetric causes of maternal death

Table 1.5 gives a comparison of the numbers and distribution of the underlying obstetric causes of all deaths for the trienniums 2002-2004, 2005-2007, 2008-2010 and for 2011-2013.

Table 1.5. A comparison of underlying obstetric causes of death between triennia 2002-2004, 2005-2007 2008-2010 and 2011-2013

Underlying Obstetric Cause	2002-2004		2005-2007		2008-2010		2011-2013	
	N	%	N	%	N	%	n	%
Direct	1767	53.6	1819	45.9	2252	46.3	2155	49.73
Hypertension	628	19.1	622	15.7	679	14	640	14.77
Obstetric haemorrhage	442	13.4	491	12.4	688	14.1	684	15.79
Ectopic pregnancy	47	1.4	55	1.4	75	1.5	102	2.35
Miscarriage	114	3.5	136	3.4	186	3.8	185	4.27
Pregnancy Related Sepsis	274	8.3	223	5.6	258	5.3	226	5.22
Anaesthetic related	91	2.8	107	2.7	121	2.5	105	2.42
Embolism	64	1.9	57	1.4	93	1.9	102	2.35
Acute collapse	107	3.2	128	3.2	148	3	106	2.45
Hyperemesis gravidarum					4	0.1	5	0.12
Indirect	1430	43.4	1966	49.7	2399	49.3	1997	46.09
Non pregnancy related Infections	1246	37.8	1729	43.7	1969	40.5	1504	34.71
Medical and Surgical conditions	184	5.6	237	6	430	8.8	493	11.38
Unknown	99	3	174	4.4	216	4.4	181	4.18
Total	3296	100	3959	100	4867		4333	100.00
Coincidental	110		118		99		119	

Non-pregnancy related infections remains the largest category of maternal death, but this has decreased significantly both in numbers and distribution. Table 1.6 compares the triennia with respect to the iMMR. There has been a highly significant drop in the iMMR for non-pregnancy related infections, dropping by 25.0% from 2008-2010. There also has been a drop in the maternal deaths due to complications of hypertension and pregnancy related sepsis when the trend is examined from 2002-2004. There has been an increase in deaths due to obstetric haemorrhage and early pregnancy losses (ectopic pregnancies and miscarriage). Maternal deaths due to medical and surgical conditions have more than doubled since 2002-2004.

Table 1.6 Comparison of iMMR per underlying cause from 2002-2012

Disease category	2002-2004	2005-2007	2008-2010	2011-2013
Institutional MMR /100000 live births				
Direct	77.99	69.73	81.39	76.62
Hypertension	27.72	23.85	24.58	22.75
Obstetric haemorrhage	19.51	18.82	24.91	24.32
Ectopic pregnancy	2.07	2.11	2.72	3.63
Miscarriage	5.03	5.21	6.73	6.58
Pregnancy-related sepsis	12.09	8.55	9.34	8.04
Anaesthetic complications	4.02	4.1	4.38	3.73
Embolism	2.82	2.19	3.37	3.63
Acute collapse - cause unknown	4.72	4.91	5.36	3.77
Hyperemesis gravidarum,	0	0	0	0.18
Indirect	63.12	75.37	86.86	71.00
Non-pregnancy-related infections	55	66.28	71.29	53.47
Medical and surgical disorders	8.12	9.09	15.57	17.53
Unknown	4.37	6.67	7.82	6.44
iMMR South Africa	145.48	151.77	176.22	154.06

Coincidental deaths are excluded

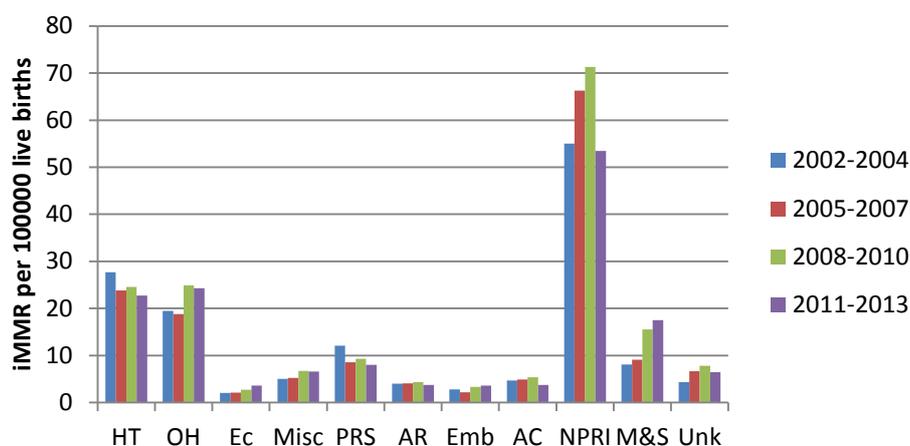
Table 1.7 and Figure 1.5 illustrate the trends of iMMR per disease category for the years 2011, 2012 and 2013. The declining trend is seen clearly for non-pregnancy related infections and overall.

Table 1.7 iMMR of underlying causes of maternal death 2011-2013

iMMR	2011-13	2011	2012	2013
Direct	76.62	79.74	78.41	71.71
Hypertension	22.75	22.90	23.48	21.88
Obstetric haemorrhage	24.32	24.94	25.71	22.30
Ectopic pregnancy	3.63	4.07	2.34	4.48
Miscarriage	6.58	7.06	6.91	5.76
Pregnancy-related sepsis	8.04	8.99	7.22	7.90
Anaesthetic complications	3.73	4.39	4.36	2.45
Embolism	3.63	3.10	4.46	3.31
Acute collapse - cause unknown	3.77	4.07	3.82	3.41
Hyperemesis gravidarum	0.18	0.21	0.11	0.21
Indirect	71.00	76.53	69.91	66.59
Non-pregnancy-related infections	53.47	58.87	54.08	47.49
Medical and surgical disorders	17.53	17.66	15.83	19.10
Unknown	6.44	6.85	6.91	5.55
Total	154.06	163.11	155.23	143.85

Coincidental deaths are excluded

Figure 1.5. Comparison of iMMR per disease category for four triennia



Indirect maternal deaths

Table 1.8 gives the sub-categories of maternal deaths due to non-pregnancy related infections. Tuberculosis (TB) contributes most to NPRI, 62% of all deaths were due one or other respiratory infection. Meningitis was the other major cause contributing 12.3% of cases. There has been a marked reduction in deaths due to complications of antiretroviral treatment with only 16 being recorded in 2013 compared with 42 in 2010. This probably reflects the result of the removal of nevirapine in 2011 as a result of the sudden massive increase in deaths in this category in 2010.

Table 1.8 Distribution of the sub-categories of Non-pregnancy related infections

Underlying causes sub-categories	2011	2012	2013	Total	Distribution (%)
- PCP pneumonia	72	77	77	226	15.0
- Other pneumonia	127	92	91	310	20.6
- TB	139	119	138	396	26.3
- Endocarditis	2	1	1	4	0.3
- UTI	3		3	6	0.4
- Malaria	2	6	4	12	0.8
- Cryptococcal meningitis	18	22	16	56	3.7
- Other meningitis	37	58	34	129	8.6
- Kaposi's sarcoma	10	8	8	26	1.7
- Hepatitis	5	6	9	20	1.3
- Gastroenteritis	17	23	23	63	4.2
- Wasting syndrome	23	26	8	57	3.8
- Complications of antiretroviral therapy	64	49	17	130	8.6
- Other	31	22	16	69	4.6
Non-pregnancy-related infections	550	509	445	1504	100.0

Table 1.9 gives the distribution of the HIV status in the NPRI group. In only 3.6% of cases the HIV status was not known, in 6.6% of cases it was negative, leaving 90% of cases in the NPRI group being HIV infected. 40.6% of cases were not on ARVs. The new protocol of giving all HIV ARVs only came into being in 2011. However, there is still much room for improvement.

Table 1.9 HIV status and NPRI

	Neg	Pos	- AIDS not on HAART	- AIDS on HAART	Declined testing	Unknown	Total
- PCP pneumonia	1	21	89	113		2	226
- Other pneumonia	36	42	96	111	1	24	310
- TB	29	35	118	201	3	10	396
- Endocarditis	1		1	2			4
- UTI	1		2	2		1	6
- Malaria		5	4	2		1	12
- Cryptococcal meningitis		2	23	30		1	56
- Other meningitis	15	6	40	62		6	129
- Kaposi's sarcoma			8	18			26
- Hepatitis	3	4	5	8			20
- Gastroenteritis	4	6	17	36			63
- Wasting syndrome	1	3	32	21			57
- Complications of antiretroviral therapy		13	8	109			130
- Other	9	12	19	24		5	69
Non-pregnancy-related infections	100	149	462	739	4	50	1504
Distribution of HIV status (%)	6.6	9.9	30.7	49.1	0.3	3.3	100.0

The distribution of medical and surgical conditions (previously pre-existing medical diseases) is shown in Table 1.10. Cardiovascular disease remains the largest contributor, but respiratory infections are becoming increasingly more important.

Table 1.10 Sub-categories of medical and surgical conditions 2011-2013

	n	Sub-category %
- Cardiac disease	169	34.3
- Endocrine	20	4.1
- GIT	35	7.1
- CNS	50	10.1
- Respiratory	71	14.4
- Haematological	24	4.9
- Genito-urinary	9	1.8
- Auto-immune	3	0.6
- Skeletal	1	0.2
- Psychiatric	11	2.2
- Neoplasm	32	6.5
- Other	68	13.8
Total Medical and surgical disorders	493	100.0

Direct maternal deaths

Table 1.11 gives the sub-categories of the direct causes of death. Complications of caesarean section play a significant role in maternal deaths with 231 cases having complication due to haemorrhage or bowel injury.

Table 1.11 Direct underlying causes of deaths 2011-2013

Underlying cause	Number	Sub-category %
Ectopic pregnancy	102	
- Less than 20 weeks	94	92.2
- More than 20 weeks	8	7.8
Miscarriage	185	
- Septic miscarriage	114	61.6
- Haemorrhage (non-traumatic)	48	25.9
- Uterine trauma	6	3.2
- GTD	8	4.3
- Following legal TOP	9	4.9
Hyperemesis gravidarum	5	
Pregnancy-related sepsis	226	
- Chorioamnionitis with ruptured membranes	8	3.5
- Chorioamnionitis without ruptured membranes	2	0.9
- Puerperal sepsis after NVD	117	51.8
- Puerperal sepsis after Caesarean section	88	38.9
- Bowel trauma at Caesarean section	11	4.9
Obstetric haemorrhage	684	
- Abruption with hypertension	56	8.2
- Abruption without hypertension	54	7.9
- Placenta praevia	16	2.3
- Other APH not specified	8	1.2
- Ruptured uterus with previous c/s	52	7.6
- Ruptured uterus without previous c/s	51	7.5
- Retained placenta	45	6.6
- Morbidly adherent placenta	17	2.5
- Uterine atony	50	7.3
- Vaginal trauma	4	0.6
- Cervical trauma	21	3.1
- Inverted uterus	5	0.7
- Bleeding during Caesarean section	42	6.1
- Bleeding after Caesarean section	179	26.2
- Other PPH not specified	84	12.3
Hypertension	640	
- Chronic hypertension	28	4.4
- Proteinuric hypertension	169	26.4
- Eclampsia	347	54.2
- HELLP	85	13.3
- Liver rupture	6	0.9
- Acute fatty liver	5	0.8
Anaesthetic complications	105	
- General anaesthetic	30	28.6
- Spinal anaesthetic	75	71.4
Embolism	102	
- Pulmonary embolism	83	81.4
- Amniotic fluid embolism	19	18.6
Acute collapse - cause unknown	106	

Maternal age and underlying cause of death

Table 1.12 demonstrates the age categories associated with the underlying cause of death. Teenagers are at increased risk of dying due to complications of anaesthesia. and women over 34 years of age are generally at increased risk of dying due to most conditions. Non-pregnancy related infections were highest between 25-40 years of age, showing the increasing maturity of the HIV epidemic. Figure 1.6 gives an estimate of the iMMR per age category. It demonstrates clearly how

the mortality increases with the increasing age. The graph is “J” shaped with teenagers having more or less the same estimated iMMR compared with the 20-24 year olds.

Table 1.12 Distribution of the underlying cause of death and age category of maternal death

Primary obstetric problem	< 20	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45+
Medical and surgical disorders	9.5	20.5	29.2	19.7	13.8	5.9	1.4
Non-pregnancy-related infections	4.9	19.4	30.1	26.8	14.0	3.4	1.4
Ectopic pregnancy	4.9	9.8	35.3	30.4	13.7	4.9	1.0
Miscarriage	7.0	18.9	33.0	23.2	10.8	4.9	2.2
Pregnancy-related sepsis	13.3	21.2	25.7	15.9	14.2	6.2	3.5
Obstetric haemorrhage	7.2	14.0	23.1	24.0	19.0	9.4	3.2
Hypertension	12.3	20.9	24.8	18.9	14.4	5.8	2.8
Anaesthetic complications	16.2	25.7	17.1	19.0	16.2	3.8	1.0
Embolism	6.9	13.7	20.6	25.5	18.6	9.8	3.9
Acute collapse - cause unknown	4.7	21.7	27.4	17.9	16.0	10.4	1.9
Total	8.0	19.0	27.3	23.2	14.8	5.5	2.1
General pop.	12.2	27.4	26.4	19.3	11.0	3.5	0.3
>15%	14.0	31.5	30.3	22.2	12.6	4.0	0.4
<15%	10.3	23.3	22.4	16.4	9.3	2.9	0.3

xxxxx 15% above general pregnant population
xxxxx Between 15% above and below general pregnant population
xxxxx 15% below national general pregnant population

General pop. – General pregnant population from: Stats SA Recorded Live Births 2012, November 2013 P0305

Figure 1.6 Comparisons maternal age groups and iMMR: 2011-2013

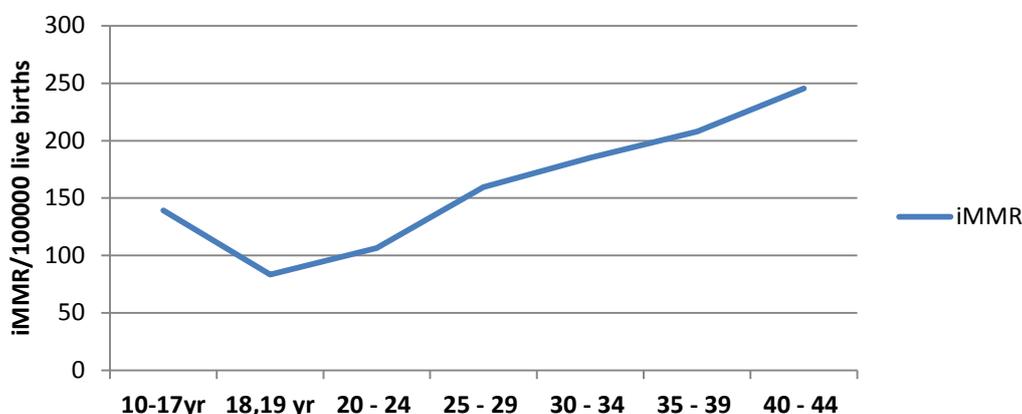


Table 1.13 demonstrates the priority conditions with respect to age. Hypertension in teenagers, non-pregnancy related infections in women between 20-39 years and obstetric haemorrhage in women 40 years and over were the top ranked conditions in their respect age groups.

Table 1.13. Distribution of diseases within age category

Underlying cause of death	< 20 %	20 - 24 %	25 - 29 %	30 - 34 %	35 - 39 %	40 - 44 %	45+ %
Medical and surgical disorders	13.6	12.3	12.2	9.7	10.6	12.1	7.7
Non-pregnancy-related infections	21.1	35.5	38.2	40.1	32.7	21.3	23.1
Ectopic pregnancy	1.4	1.2	3.0	3.1	2.2	2.1	1.1
Miscarriage	3.8	4.3	5.2	4.3	3.1	3.8	4.4
Hyperemesis gravidarum	0.0	0.2	0.3	0.0	0.0	0.0	0.0
Pregnancy-related sepsis	8.7	5.8	4.9	3.6	5.0	5.9	8.8
Obstetric haemorrhage	14.2	11.7	13.4	16.3	20.2	26.8	24.2
Hypertension	22.8	16.3	13.4	12.0	14.3	15.5	19.8
Anaesthetic complications	4.9	3.3	1.5	2.0	2.6	1.7	1.1
Embolism	2.0	1.7	1.8	2.6	3.0	4.2	4.4
Acute collapse - cause unknown	1.4	2.8	2.5	1.9	2.6	4.6	2.2
Unknown	6.1	4.9	3.7	4.5	3.6	2.1	3.3
Total	100.0						

XXXXX	Top priority
XXXXX	Second priority
XXXXX	Third priority

Parity and underlying cause of death

Tables 1.14 and 1.15 demonstrate the relationship between parity and maternal death.

Table 1.14. Distribution of underlying causes of maternal death diseases and parity

%	P0	P1	P2	P3	P4	P5	P6+	Unknown	Total
Medical and surgical disorders	14.8	10.3	10.4	7.6	11.6	10.6	8.2	7.7	11.4
Non-pregnancy-related infections	29.8	40.3	38.8	35.7	26.1	19.2	21.3	35.4	34.7
Ectopic pregnancy	2.4	2.3	1.4	2.6	1.9	1.0	0.0	11.5	2.4
Miscarriage	3.4	3.8	4.6	5.0	1.4	6.7	4.9	13.8	4.3
Hyperemesis gravidarum	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.8	0.1
Pregnancy-related sepsis	6.0	5.2	4.4	5.0	3.9	3.8	9.8	4.6	5.2
Obstetric haemorrhage	10.9	13.4	18.0	22.4	26.1	35.6	32.8	7.7	15.8
Hypertension	19.5	13.6	12.3	12.4	13.5	12.5	14.8	6.9	14.8
Anaesthetic complications	3.6	2.3	2.1	1.5	1.4	1.0	1.6	0.8	2.4
Embolism	2.3	2.4	1.8	2.4	3.4	1.9	3.3	4.6	2.4
Acute collapse - cause unknown	2.3	2.5	1.4	2.4	6.3	5.8	0.0	3.1	2.4
Unknown	5.0	3.6	4.8	2.8	4.3	1.9	3.3	3.1	4.2

Table 1.15. Distribution of parity within underlying cause of death category

Primary obstetric problem	P0	P1	P2	P3	P4	P5	P6+	Unknown	Total %
Medical and surgical disorders	39.6	24.1	19.1	7.1	4.9	2.2	1.0	2.0	100.0
Non-pregnancy-related infections	26.1	30.9	23.3	10.9	3.6	1.3	0.9	3.1	100.0
Ectopic pregnancy	30.4	25.5	12.7	11.8	3.9	1.0	0.0	14.7	100.0
Miscarriage	24.3	23.8	22.7	12.4	1.6	3.8	1.6	9.7	100.0
Hyperemesis gravidarum	40.0	40.0	0.0	0.0	0.0	0.0	0.0	20.0	100.0
Pregnancy-related sepsis	35.0	26.5	17.7	10.2	3.5	1.8	2.7	2.7	100.0
Obstetric haemorrhage	20.9	22.5	23.8	15.1	7.9	5.4	2.9	1.5	100.0
Hypertension	40.0	24.5	17.3	8.9	4.4	2.0	1.4	1.4	100.0
Anaesthetic complications	44.8	24.8	18.1	6.7	2.9	1.0	1.0	1.0	100.0
Embolism	29.4	27.5	15.7	10.8	6.9	2.0	2.0	5.9	100.0
Acute collapse - cause unknown	28.3	27.4	12.3	10.4	12.3	5.7	0.0	3.8	100.0
Unknown	36.5	23.2	23.8	7.2	5.0	1.1	1.1	2.2	100.0
Total	30.4	26.6	20.9	10.6	4.8	2.4	1.4	3.0	100.0

Underlying Cause of Death and Levels of Care

Figure 1.7 and table 1.16 illustrates the place of death and an estimated Institutional MMR per level of care. The denominator used was the number of facility live births recorded by the DHIS for 2011-2013 as of 2nd July 2014. The DHIS data was used as it collects births from all the public institutions and does not collect home births or births in private hospitals. Twenty percent of facility live births occurred in CHCs, 40% in district hospitals, 25% in regional hospitals and 15% in tertiary hospitals. Sixty percent of the facility live births occur in the primary level of care. In numbers (excluding home deaths and deaths in private hospitals) 1498 (35.4%) of maternal deaths occurred at the primary care level, 1705 (40.3%) in the regional hospitals and only 1031 (24.4%) in the tertiary hospitals. The tertiary hospitals comprise both the provincial tertiary hospitals and the national central hospitals. The iMMR for the levels of care for 2011-2013 is compared with 2008-2010 and 2005-2007. There has been decrease in the iMMR in the district hospitals and tertiary hospitals, and a slight increase in the regional hospitals. It would be expected that most deaths should occur at the tertiary level, but from the numbers and distribution of maternal deaths far too many deaths are occurring at the primary level of care, and the regional hospitals may be overburdened with workload.

Figure 1.7 Comparison of iMMR and level of care for the three triennia

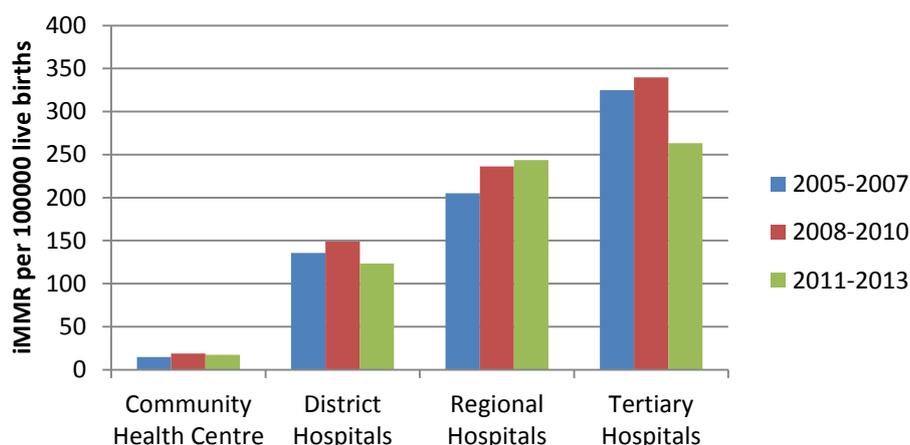


Table 1.16 Comparison of the iMMR per level of care for the three triennia

Level of care	2005-2007	2008-2010	2011-2013
Community Health Centre	14.8	18.91	17.43
District Hospitals	135.8	149.03	123.31
Regional Hospitals	205.1	236.33	243.62
Tertiary Hospitals	324.8	339.72	263.49
Private Hospitals		33.30	

Table 1.17 shows the distribution of the cause of death within each level of care, and Table 1.18 shows the distribution of causes of deaths across the levels of care for each condition.

Table 1.17 Distribution (in percentage) of causes of death within each level of care

Primary obstetric problem	Home	CHC	District hospital	Regional hospitals	Tertiary hospitals	Private hospitals
Medical and surgical disorders	5.3	10.4	8.5	9.5	18.6	14.4
Non-pregnancy-related infections	13.2	13.5	36.4	37.6	32.4	25.4
Ectopic pregnancy	0.0	0.0	3.1	2.9	1.2	0.0
Miscarriage	1.3	2.1	4.1	5.8	2.6	2.5
Hyperemesis gravidarum	0.0	0.0	0.2	0.1	0.0	0.0
Pregnancy-related sepsis	1.3	1.0	5.0	5.8	5.6	3.4
Obstetric haemorrhage	6.6	14.6	18.3	16.2	12.0	19.5
Hypertension	13.2	21.9	10.5	14.0	21.2	15.3
Anaesthetic complications	0.0	0.0	4.3	2.2	0.8	0.8
Embolism	2.6	6.3	2.3	1.4	2.4	11.9
Acute collapse - cause unknown	13.2	8.3	2.1	2.2	1.6	5.1
Unknown	43.4	21.9	5.2	2.2	1.7	1.7
Total maternal deaths	100.0	100.0	100.0	100.0	100.0	100.0

Table 1.18 Distribution of causes of death across the levels of care

Primary obstetric problem	Home	CHC	District hospital	Regional hospitals	Tertiary hospitals	Private hospitals	Total
Medical and surgical disorders	0.8	2.0	23.7	32.0	37.9	3.4	100.0
Non-pregnancy-related infections	0.7	0.9	33.2	41.6	21.7	2.0	100.0
Ectopic pregnancy	0.0	0.0	41.2	47.1	11.8	0.0	100.0
Miscarriage	0.5	1.1	30.3	52.4	14.1	1.6	100.0
Hyperemesis gravidarum	0.0	0.0	60.0	40.0	0.0	0.0	100.0
Pregnancy-related sepsis	0.4	0.4	30.1	42.5	24.8	1.8	100.0
Obstetric haemorrhage	0.7	2.0	36.7	39.5	17.7	3.4	100.0
Hypertension	1.6	3.3	22.5	36.6	33.3	2.8	100.0
Anaesthetic complications	0.0	0.0	56.2	35.2	7.6	1.0	100.0
Embolism	2.0	5.9	31.4	23.5	23.5	13.7	100.0
Acute collapse - cause unknown	9.4	7.5	27.4	34.9	15.1	5.7	100.0
Unknown	18.2	11.6	39.2	20.4	9.4	1.1	100.0
Total maternal deaths	1.8	2.2	31.6	38.4	23.2	2.7	100.0

Distribution of underlying causes of death within Provinces

The distribution of the underlying causes of maternal death per province is shown in tables 1.19. Non-pregnancy related infection was the most cause of maternal death in all provinces, with obstetric haemorrhage and hypertension either second or third, except in the Western Cape and KwaZulu-Natal where medical and surgical conditions were second and third respectively.

Table 1.20 gives the institutional MMR per disease category per province and indicates the distribution of the iMMR per disease category above or below 15% of the institutional MMR for South Africa. The denominator used is the number of facility live births obtained from the DHIS on 2nd June 2014. The Western Cape consistently had Institutional MMRs per disease category 15% below that of the national average, Gauteng followed. Caution must be used in interpreting the Gauteng data as it is known that there has been significant under-reporting of maternal deaths in 2013. The Free State, and Limpopo provinces have iMMRs more than 15% above that of South Africa.

Table 1.21 compares the Institutional MMRs of 2011-2013 with 2008-2010 per province. In all most provinces except Limpopo province there has been a reduction in iMMR. The biggest drops in iMMR

were in the NPRI category. This indicates the scale-up of the ARV programme is having a significant positive effect on reducing maternal deaths in HIV infected women.

Table 1.19 Distribution of primary causes of maternal death within Provinces

Percent	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Limpopo	Mpumalanga	North West	Northern Cape	Western Cape	South Africa
Medical and surgical disorders	13.1	14.9	12.0	12.0	9.1	5.1	8.3	14.4	19.5	11.4
Non-pregnancy-related infections	34.4	31.6	33.3	42.5	31.3	32.1	29.9	34.0	33.5	34.7
Ectopic pregnancy	1.0	2.6	2.9	2.2	3.3	3.3	1.7	1.0	0.5	2.4
Miscarriage	1.6	3.3	6.3	5.6	4.4	3.8	3.1	1.0	2.5	4.3
Pregnancy-related sepsis	4.8	3.3	3.6	5.3	5.4	7.4	6.9	5.2	8.0	5.2
Obstetric haemorrhage	15.2	12.6	17.8	12.8	17.6	19.1	21.5	13.4	7.0	15.8
Hypertension	18.3	17.8	14.0	8.3	16.3	17.8	18.1	14.4	18.0	14.8
Anaesthetic complications	2.6	1.5	1.1	2.2	4.7	4.6	1.0	0.0	0.5	2.4
Embolism	2.1	4.5	2.8	1.2	1.1	2.5	2.4	9.3	5.0	2.4
Acute collapse - cause unknown	2.4	2.6	4.5	1.9	1.5	0.8	2.8	1.0	3.5	2.4
Unknown	4.3	4.5	1.8	5.8	5.2	3.6	4.2	6.2	2.0	4.2
Provincial iMMR	159.53	186.32	135.24	168.61	191.06	172.90	166.44	152.15	71.02	154.06

xxxxx Top priority
xxxxx Second priority
xxxxx Third priority

Table 1.20 iMMR per disease category per province

iMMR	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Limpopo	Mpumalanga	North West	Northern Cape	Western Cape	South Africa
Medical and surgical disorders	20.98	27.71	16.29	20.23	17.32	8.80	13.87	21.96	13.85	17.53
Non-pregnancy-related infections	54.92	58.88	44.97	71.70	59.84	55.43	49.70	51.76	23.79	53.47
Ectopic pregnancy	1.66	4.85	3.91	3.73	6.30	5.72	2.89	1.57	0.36	3.63
Miscarriage	2.48	6.23	8.47	9.41	8.40	6.60	5.20	1.57	1.78	6.58
Pregnancy-related sepsis	7.73	6.23	4.89	8.87	10.24	12.76	11.56	7.84	5.68	8.04
Obstetric haemorrhage	24.29	23.55	24.12	21.65	33.59	33.00	35.83	20.39	4.97	24.32
Hypertension	29.26	33.25	18.90	14.02	31.23	30.80	30.05	21.96	12.78	22.75
Anaesthetic complications	4.14	2.77	1.47	3.73	8.92	7.92	1.73	0.00	0.36	3.73
Embolism	3.31	8.31	3.75	1.95	2.10	4.40	4.05	14.12	3.55	3.63
Acute collapse - cause unknown	3.86	4.85	6.03	3.19	2.89	1.32	4.62	1.57	2.49	3.77
Unknown	6.90	8.31	2.44	9.76	9.97	6.16	6.93	9.41	1.42	6.44
Provincial iMMR	159.53	186.32	135.24	168.61	191.06	172.90	166.44	152.15	71.02	154.06

xxxxx 15% above national average
xxxxx Between 15% above and below national average
xxxxx 15% below nation average

Table 1.21 Comparison between 2011-2013 and 2008-2010 of the iMMR per province

Institutional MMR /100000 live births Disease category	Eastern Cape		Free State		Gauteng*		KwaZulu-Natal		Limpopo	
	2011-2013	2008-2010	2011-2013	2008-2010	2011-2013	2008-2010	2011-2013	2008-2010	2011-2013	2008-2010
Direct	76.73	88.55	90.04	142.14	71.53	78.08	66.55	68.66	103.67	83.19
Hypertension	29.26	30.07	33.25	56.72	18.90	22.75	14.02	18.85	31.23	22.91
Obs Hge	24.29	28.4	23.55	41.69	24.12	22.41	21.65	17.12	33.59	29.18
Ectopic pregnancy	1.66	1.39	4.85	2.05	3.91	3.45	3.73	2.42	6.30	2.73
Miscarriage	2.48	2.78	6.23	8.88	8.47	7.41	9.41	11.41	8.40	6.55
Preg. Related Sepsis	7.73	11.14	6.23	14.35	4.89	10.69	8.87	8.47	10.24	6
Anaesthetic related	4.14	3.62	2.77	2.05	1.47	2.41	3.73	4.84	8.92	9.55
Embolism	3.31	4.73	8.31	4.1	3.75	2.59	1.95	0.52	2.10	3.55
Acute collapse	3.86	6.4	4.85	12.3	6.03	6.38	3.19	5.02	2.89	2.73
Indirect	75.90	100.53	86.58	124.37	61.27	66.18	91.93	108.95	77.16	77.73
Non preg. Rel. infect.	54.92	77.97	58.88	107.29	44.97	53.43	71.70	94.08	59.84	59.73
Pre-exist Med Dis	20.98	22.56	27.71	17.08	16.29	12.75	20.23	14.87	17.32	18
Unknown	6.90	4.18	8.31	21.87	2.44	3.27	9.76	14.35	9.97	3.82
iMMR per province	159.53	193.26	186.32	289.07	135.24	147.54	168.61	192.31	191.06	164.74

* - There has been considerable under-reporting of maternal deaths in Gauteng

Institutional MMR /100000 live births Disease category	Mpumalanga		North West		Northern Cape		Western Cape		South Africa	
	2011-2013	2008-2010	2011-2013	2008-2010	2011-2013	2008-2010	2011-2013	2008-2010	2011-2013	2008-2010
Direct	102.51	95.29	95.93	109.45	69.02	99.99	31.96	40.7	76.44	81.39
Hypertension	30.80	23.59	30.05	31.78	21.96	29.03	12.78	14.26	22.75	24.58
Obs Hge	33.00	36.32	35.83	45.9	20.39	20.97	4.97	7.3	24.32	24.91
Ectopic pregnancy	5.72	2.83	2.89	4.12	1.57	9.68	0.36	1.39	3.63	2.72
Miscarriage	6.60	5.66	5.20	5.3	1.57	6.45	1.78	1.74	6.58	6.73
Preg. Related Sepsis	12.76	10.85	11.56	13.53	7.84	6.45	5.68	4.87	8.04	9.34
Anaesthetic related	7.92	7.08	1.73	4.71	0.00	3.23	0.36	1.04	3.73	4.38
Embolism	4.40	6.6	4.05	1.18	14.12	14.51	3.55	4.87	3.63	3.37
Acute collapse	1.32	2.36	4.62	2.94	1.57	9.68	2.49	5.22	3.77	5.36
Indirect	64.23	79.72	63.57	109.45	73.72	130.63	37.64	42.09	71.00	86.86
Non preg. Rel. infect.	55.43	74.06	49.70	90.03	51.76	93.54	23.79	31.65	53.47	71.29
Pre-exist Med Dis	8.80	5.66	13.87	19.42	21.96	37.09	13.85	10.43	17.53	15.57
Unknown	6.16	8.49	6.93	10	9.41	19.35	1.42	2.09	6.44	7.82
MMR per province	172.90	183.51	166.44	229.5	152.15	249.98	71.02	84.87	154.06	176.22

Contributory conditions and maternal deaths 2011-2013

HIV infection and maternal deaths in 2011-2013

HIV testing of maternal deaths has improved significantly with 87% of maternal deaths being tested for HIV infection (Table 1.22).

Table 1.22 HIV testing 2008-2010 and 2011-2013

HIV Status	2008-2010			2011-2013		
	n	%	% tested	n	%	% Tested
Negative	1166	24	29.6	1351	30.3	34.9
Positive not require HAART	949	19.5	24.1	629	14.1	16.3
AIDS not on HAART	938	19.3	23.8	647	14.5	16.7
AIDS on HAART	882	18.1	22.4	1240	27.9	32.1
Declined	39	0.8		6	0.1	
Unknown	992	20.4		579	13.0	

HIV infection was the most common underlying condition associated with maternal death. 87% of women who died in pregnancy, childbirth or the puerperium were tested for HIV infection throughout South Africa, and of those tested 65.3% were HIV infected. This however is a drop from 2008-2010.

Tables 1.23 and 1.24 gives a list of the underlying causes of maternal death. The HIV negative women had a standard distribution of maternal deaths as seen in other low and middle income, with obstetric haemorrhage and hypertension being the most common causes of death.

Table 1.23 Distribution of underlying causes of maternal deaths within each category of HIV status. (Percent)

Underlying cause	Neg	Pos	- AIDS not on HAART	- AIDS on HAART	Declined testing	Unknown
Medical and surgical disorders	16.2	12.6	5.0	9.1	0.0	11.2
Non-pregnancy-related infections	7.5	24.3	71.6	59.9	66.7	9.8
Ectopic pregnancy	1.0	2.6	0.6	1.0	16.7	11.0
Miscarriage	1.6	4.9	3.4	3.0	0.0	14.7
Hyperemesis gravidarum	0.2	0.0	0.2	0.1	0.0	0.0
Pregnancy-related sepsis	5.4	6.5	4.7	5.4	0.0	3.5
Obstetric haemorrhage	25.8	18.1	6.2	10.1	0.0	13.1
Hypertension	24.2	15.8	4.3	6.7	0.0	21.9
Anaesthetic complications	4.5	2.6	1.4	0.8	0.0	2.0
Embolism	4.3	2.8	0.6	0.8	0.0	2.7
Acute collapse - cause unknown	4.0	3.4	0.8	0.6	0.0	3.7
Unknown	5.3	6.4	1.2	2.4	16.7	6.5
Total Maternal deaths	100.0	100.0	100.0	100.0	100.0	100.0

In the HIV infected group, NPRI was by far the most common cause of death. It must be remembered that at the start of this triennium ARVs were only given to HIV positive pregnant women with a CD4 count less than 200 cells/mm³, thus there were still a large number of women who would have been given ARVs if they had been pregnant later in the triennium.

Table 1.24 HIV status categories for each underlying cause of death (Percent)

Underlying cause	Neg	Pos	- AIDS not on HAART	- AIDS on HAART	Declined testing	Unknown
Medical and surgical disorders	43.6	15.6	6.5	22.7	0.0	11.6
Non-pregnancy-related infections	6.6	9.9	30.7	49.1	0.3	3.3
Ectopic pregnancy	12.7	15.7	3.9	11.8	1.0	54.9
Miscarriage	11.4	16.2	11.9	20.0	0.0	40.5
Hyperemesis gravidarum	60.0	0.0	20.0	20.0	0.0	0.0
Pregnancy-related sepsis	31.4	17.7	13.3	29.6	0.0	8.0
Obstetric haemorrhage	50.0	16.2	5.8	18.1	0.0	9.8
Hypertension	50.0	15.2	4.4	13.0	0.0	17.5
Anaesthetic complications	57.1	15.2	8.6	9.5	0.0	9.5
Embolism	55.9	16.7	3.9	9.8	0.0	13.7
Acute collapse - cause unknown	50.0	19.8	4.7	7.5	0.0	17.9
Unknown	38.7	21.5	4.4	16.6	0.6	18.2
Total Maternal deaths	30.6	14.1	14.9	28.5	0.1	11.8

Table 1.25 gives the final causes of maternal death in relation to their HIV status at the time of death.

Table 1.25 HIV status categories for the final causes of maternal death (Percent)

%	neg	pos	AIDS not on HAART	AIDS on HAART	Unk or decl.	Total
Circulatory system	41.3	37.7	25.8	28.9	46.7	35.8
- Hypovolaemic shock	29.5	23.1	10.2	14.4	31.6	21.8
- Septic shock	11.8	14.6	15.6	14.5	15.0	13.9
Respiratory failure	24.3	31.8	57.5	44.8	19.3	35.2
Cardiac failure	34.7	27.8	13.0	17.4	20.2	23.9
- Pulmonary oedema	15.0	10.5	4.2	6.3	5.6	9.1
- Cardiac arrest	19.7	17.3	8.8	11.1	14.5	14.7
Acute collapse due to embolism	4.6	3.5	2.5	1.7	2.9	3.1
Renal failure	11.4	9.9	10.0	11.0	9.6	10.6
Liver failure	7.6	7.8	7.0	12.5	4.4	8.5
Cerebral complications	20.5	19.4	18.1	18.3	20.7	19.4
- Intracranial haemorrhage	7.0	5.4	1.4	2.1	7.7	4.7
- Cerebral oedema resulting in coning	2.4	1.7	0.3	1.0	1.9	1.5
- Meningitis	1.6	2.2	10.0	8.3	1.7	4.8
- Cerebral emboli	0.3	0.5	0.5	0.2	0.3	0.3
- Brain death following hypoxic event	4.8	3.2	0.8	1.5	2.9	2.8
- Unspecified	4.4	6.4	5.1	5.2	6.2	5.3
Metabolic	7.0	12.9	10.8	15.2	7.4	10.7
- Maternal ketoacidosis	1.0	2.2	0.8	1.0	0.5	1.1
- Electrolyte imbalance	3.1	6.0	8.2	8.1	4.3	5.8
- Thyroid crisis	0.4	0.2	0.0	0.0	0.0	0.1
- Lactic acidosis	1.6	2.9	1.7	4.6	2.1	2.7
- Other	0.9	1.6	0.2	1.4	0.5	1.0
Haematological	25.8	27.3	24.7	25.5	20.3	25.0
- DIC	14.7	12.1	6.5	10.3	10.4	11.4
- Severe anaemia	11.0	15.3	18.2	15.2	9.9	13.7
Immune system	1.1	28.6	68.2	56.4	1.5	30.2

Non-pregnancy related infections are by far the most common underlying cause of death in HIV infected pregnant women. Respiratory failure was the most final cause of death in HIV infected pregnant women.

Prolonged labour and maternal deaths

Table 1.26 illustrates the role of prolonged labour in maternal deaths where the women were in labour. Prolonged labour plays a significant part in deaths of women due to puerperal sepsis, obstetric haemorrhage, anaesthetic complications and embolism. Of the women that died and were in labour 12% had prolonged labour. The majority of maternal deaths in cases with prolonged labour were classified as obstetric haemorrhage (44%), pregnancy related sepsis (12%) and anaesthetic related deaths 12%. A quarter of the deaths due to obstetric haemorrhage with prolonged labour were due to bleeding at or after caesarean section.

Table 1.26 Relationship of prolonged labour and maternal death

Primary obstetric problems	No prolonged labour	Prolonged labour present	Total in labour	% prolonged labour
Medical and surgical disorders	231	11	242	4.5
Non-pregnancy-related infections	704	26	730	3.6
Pregnancy-related sepsis	98	33	131	25.2
- Chorioamnionitis with ruptured membranes	3	2	5	40.0
- Chorioamnionitis without ruptured membranes	1	5	6	83.3
- Puerperal sepsis after NVD	48	25	73	34.2
- Puerperal sepsis after Caesarean section	42	1	43	2.3
- Bowel trauma at Caesarean section	4		4	0.0
Obstetric haemorrhage	369	125	494	25.3
- Abruptio with hypertension	38	4	42	9.5
- Abruptio without hypertension	35	3	38	7.9
- Placenta praevia	9		9	0.0
- Other APH not specified	5		5	0.0
- Ruptured uterus with previous c/s	22	10	32	31.3
- Ruptured uterus without previous c/s	25	11	36	30.6
- Retained placenta	23	4	27	14.8
- Morbidly adherent placenta	11		11	0.0
- Uterine atony	30	11	41	26.8
- Vaginal trauma	3	1	4	25.0
- Cervical trauma	12	4	16	25.0
- Inverted uterus	2		2	0.0
- Bleeding during Caesarean section	23	17	40	42.5
- Bleeding after Caesarean section	90	54	144	37.5
- Other PPH not specified	41	6	47	12.8
Hypertension	360	19	379	5.0
Anaesthetic complications	56	35	91	38.5
- General anaesthetic	17	4	21	19.0
- Spinal anaesthetic	39	31	70	44.3
Embolism	54	10	64	15.6
- Pulmonary embolism	42	8	50	16.0
- Amniotic fluid embolism	12	2	14	14.3
Acute collapse - cause unknown	42	12	54	22.2
Total:	2071	282	2353	12.0

Anaemia and maternal deaths

The level of haemoglobin in the women who died was known in 72.2% of patients. Table 1.27 gives the distribution of anaemia within the categories of maternal death. The definition of anaemia used was a haemoglobin < 10gms/dl (SA Maternity Care Guidelines) and referred to the most recent recording prior to labour or delivery. Anaemia was present in 42.7% of maternal deaths and was highest in early pregnancy losses (ectopic pregnancy and miscarriage) followed by NPRI. It was also present in 39.4% of women who died from pregnancy related sepsis and a 30.3% of women who died of obstetric haemorrhage. The importance of anaemia as a contributory cause of maternal death has been under estimated.

Table 1.27 Distribution of anaemia in maternal deaths

Primary obstetric problems	All	Not anaemic	Anaemia present	Unknown	Total tested	% anaemic
Medical and surgical disorders	493	205	161	127	366	44.0
Non-pregnancy-related infections	1504	464	645	395	1109	58.2
Ectopic pregnancy	102	15	35	52	50	70.0
Miscarriage	185	31	61	93	92	66.3
Hyperemesis gravidarum	5	3	1	1	4	25.0
Pregnancy-related sepsis	226	86	56	84	142	39.4
Obstetric haemorrhage	684	371	161	152	532	30.3
Hypertension	640	357	115	168	472	24.4
Anaesthetic complications	105	68	20	17	88	22.7
Embolism	102	53	25	24	78	32.1
Acute collapse - cause unknown	106	53	24	29	77	31.2
Unknown	181	86	31	64	117	26.5
Maternal deaths	4333	1792	1335	1206	3127	42.7

Final/immediate and contributory causes of maternal death

The final and contributory causes of death are shown in Table 1.28. The patterns are as expected. Pulmonary oedema and intracranial haemorrhage were the most common final causes of death in women with hypertension. This may indicate the control of fluid given to these women might be poor and insufficient urgency in reducing the blood pressure.

The high rate of respiratory failure in various cause of death, especially NPRI, should alert practitioners to be more vigilant in monitoring and acting upon abnormal respiratory signs.

Table 1.28 Final and contributory causes of maternal death 20011-2013

Cause of death	All	M&S	NPRI	Ec	Misc	HG	PRS	OH	HT	AR	Emb	AC	Unk
- Hypovolaemic shock	21.8	7.5	2.7	84.3	37.3	20.0	4.9	89.9	9.1	13.3	3.9	4.7	3.9
- Septic shock	13.9	9.1	11.7	7.8	62.7	20.0	88.5	4.4	3.9	2.9	1.0	3.8	2.2
- Respiratory failure	35.2	33.3	64.4	10.8	22.2	0.0	23.0	6.3	23.6	35.2	24.5	24.5	16.0
- Pulmonary oedema	9.1	23.1	2.6	5.9	3.8	0.0	8.4	5.7	24.2	6.7	8.8	4.7	3.3
- Cardiac arrest	14.7	28.8	7.4	12.7	4.9	0.0	4.9	17.3	19.1	55.2	17.6	23.6	7.2
- Acute collapse due to embolism	3.1	3.2	1.0	1.0	1.1	20.0	0.9	1.6	1.3	0.0	66.7	10.4	1.1
- Renal failure	10.6	11.2	10.2	3.9	14.6	0.0	25.7	7.2	15.5	1.0	6.9	2.8	5.0
- Liver failure	8.5	10.8	11.0	1.0	8.1	0.0	8.8	3.2	12.0	1.0	1.0	0.9	5.0
- Intracranial haemorrhage	4.7	3.9	0.3	0.0	0.5	0.0	0.0	1.5	25.2	1.0	0.0	0.0	0.6
- Cerebral oedema resulting in coning	1.5	1.2	0.4	0.0	0.5	0.0	0.9	0.0	8.1	0.0	0.0	0.0	0.0
- Meningitis	4.8	0.8	13.2	1.0	0.5	0.0	0.4	0.0	0.6	1.0	1.0	0.9	0.6
- Cerebral emboli	0.3	0.6	0.5	0.0	1.1	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
- Brain death following hypoxic event	2.8	2.0	0.6	0.0	0.5	0.0	1.3	2.8	9.4	16.2	0.0	0.9	0.0
- Unspecified CNS complication	5.3	7.5	3.9	2.9	1.6	0.0	2.2	1.0	14.7	1.9	0.0	3.8	7.2
- Maternal ketoacidosis	1.1	2.2	0.7	0.0	2.7	0.0	2.7	0.9	0.6	1.0	0.0	1.9	4.4
- Electrolyte imbalance	5.8	6.7	9.0	1.0	11.9	60.0	8.0	0.7	3.4	0.0	2.9	1.9	0.0
- Thyroid crisis	0.1	0.6	0.0	0.0	1.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
- Lactic acidosis	2.7	3.7	3.5	1.0	4.9	0.0	5.8	1.5	1.7	1.0	0.0	0.0	1.1
- Other metabolic causes	1.0	3.0	0.7	0.0	1.1	20.0	2.7	0.6	0.5	0.0	0.0	0.0	0.6
- DIC	11.4	3.9	4.9	7.8	18.9	0.0	12.8	34.5	12.8	2.9	2.9	3.8	3.3
- Severe anaemia	13.7	14.2	14.4	22.5	25.4	0.0	13.7	21.3	7.0	3.8	3.9	8.5	3.3
- Immune system failure	30.2	18.5	64.0	7.8	25.4	20.0	29.6	7.7	8.8	4.8	6.9	12.3	13.8

There may be more than one cause and the percentages do not add up to 100%

Avoidable factors, missed opportunities and substandard care

Tables 1.29 to 1.33 summarise the avoidable factors, missed opportunities and substandard care for 2011-2013. The patterns remain the same as in previous reports. Lack of appropriately trained doctors and nurses was thought to be a significant contributory factor in 15.6% and 8.8% of assessable maternal deaths, up from 9.3% and 4.5% in 2008-2010 respectively. Lack of appropriately trained doctors and nurses was combined in 2002-2004 and was 8.9%. Lack of appropriately trained doctors was recorded as a significant factor in 47%, 27% 24% and 19% of maternal deaths due to anaesthesia, obstetric haemorrhage, pregnancy related sepsis and complications of hypertension respectively.

Table 1.29 Avoidable factors, missed opportunities and substandard care for all cases

Category	Number of avoidable factors in assessable* cases
	2011-2013
Patient orientated	1954
Administrative factors	1693
Health worker related emergency management problems	
Primary level [#]	1585
Secondary level [#]	1003
Tertiary level [#]	369
Resuscitation	1890

Not all cases could be assessed

[#] Some women first attended primary or secondary levels or care before being referred to higher levels. The care of the woman at each level of care was assessed. For example: of the women that died and were seen at any time at the primary level of care and care could be assessed at the primary level, 37.5% had avoidable factors related to the health care professionals.

Table 1.30 Avoidable factors, missed opportunities and substandard care with respect to patient orientated problems for all cases

Description	All
Lack of information	495
No avoidable factor	2002
Assessable cases	3875
% cases with no patient orientated avoidable factor	51.7
% Avoidable patient orientated factors	
No antenatal care	17.6
Infrequent antenatal care	6.5
Delay in accessing medical help	29.0
Declined medication/surgery/advice	5.0
Family problem	0.7
Community problem	0.2
Unsafe miscarriage*	18.7
Other	4.3

[#] - Denominator is women who died due to miscarriages (n=182), not all maternal deaths

Table 1.31 Avoidable factors, missed opportunities and substandard care with respect to administrative problems for all cases

Description	All
Lack of information	325
No avoidable factor	2409
Assessable cases	4045
% cases with no administrative avoidable factor	59.6
% Avoidable Administration factors	
Transport problem: Home to institution	1.5
Transport problem: Institution to institution [*]	9.8
Lack of accessibility: Barriers to entry	0.9
Lack of accessibility: Other	0.6
Delay initiating critical care (Overburdened service)	6.2
Lack of health care facilities: ICU ^{**}	25.1
Lack of health care facilities: Blood/blood products ^{***}	15.4
Lack of health care facilities: Other	3.0
Lack of appropriately trained staff: Doctors	15.6
Lack of appropriately trained staff: Nurses	8.8
Communication problems: Technical	1.5
Communication problems: Interpersonal	2.7
Other	6.6

[#] - Denominator is the number of cases that were referred between institutions (n=2031).

^{##} - Denominator was the number of patients at tertiary hospitals (n=997)

^{###} - Denominator was the number of cases that required urgent blood transfusions namely ectopic pregnancies, abortions due to trauma, obstetric haemorrhage (n=826).

Table 1.32 Health Care Professional orientated problems per level of care

Medical management problems	Primary Level Number	Distribution of AF Primary	Regional Hospital Number	Distribution of AF regional	Tertiary Hospital Level Number	Distribution of AF tertiary
Lack of information	262		257		155	
No avoidable factor	2565		3149		3854	
Initial assessment	389	25.2	190	19.7	46	12.7
Problem with recognition / diagnosis	658	42.6	395	41.0	128	35.5
Delay in referring the patient	492	31.9	93	9.6	10	2.8
Managed at inappropriate level	372	24.1	67	7.0	0	0.0
Incorrect management (Incorrect diagnosis)	220	14.3	124	12.9	40	11.1
Sub-standard management (Correct diagnosis)	649	42.1	559	58.0	194	53.7
Not monitored / Infrequently monitored	176	11.4	115	11.9	43	11.9
Prolonged abnormal monitoring with no action taken	225	14.6	149	15.5	77	21.3
Patients with avoidable factors	1543		964		361	

Table 1.33 Problems in resuscitation

Resuscitation problems	Number	Percentage of total
Lack of information	380	
Assessable cases	3990	
No avoidable factor	2112	
Resuscitation not attempted	1052	
Assessable cases where resuscitation attempted	2938	
No avoidable factors where resuscitation attempted	1060	36.1
Distribution of avoidable factors		
Airway problems	102	10.1
Breathing problems	226	22.4
Circulation problems	443	44.0
Drug problems	63	6.3
Investigation problems	65	6.5
Monitoring problems	108	10.7
Total avoidable factors	1007	100.0
Assessable cases	3990	
Cases resuscitated (No avoidable factor)	1060	36.1
Assessable case where resuscitation attempted	2938	

Table 1.34 shows the impact of suboptimal care on maternal deaths.

Table 1.34. Impact of suboptimal care on maternal deaths

	n	%
No suboptimal care	1259	29.1
Suboptimal care, different management would have made no difference to the outcome	470	10.8
Suboptimal care, different management might have made a difference to the outcome	1424	32.9
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	1180	27.2

Figure 1.8 Distribution of possibly and probably avoidable deaths per disease category

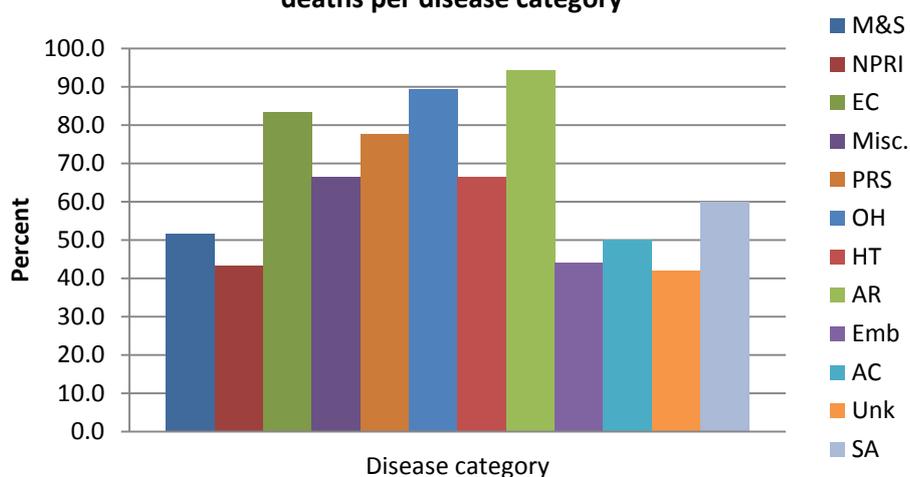
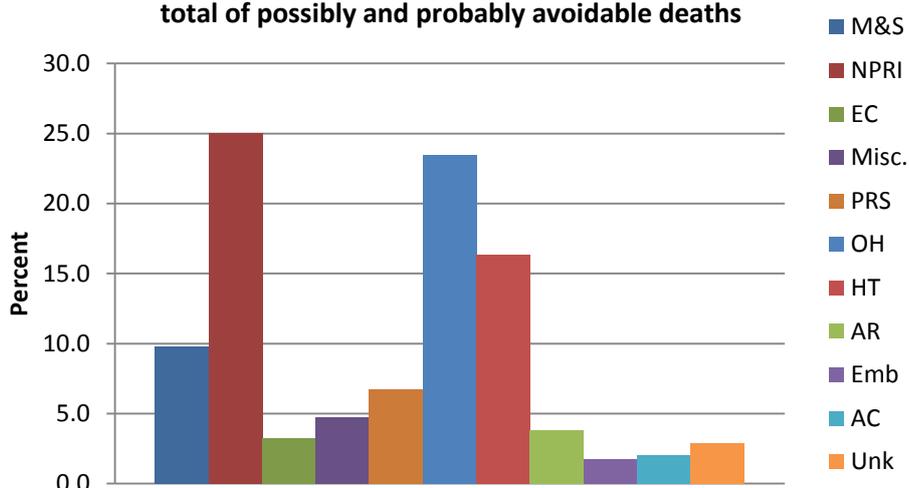


Figure 1.9 Distribution of the disease categories within the total of possibly and probably avoidable deaths



In 26.7% of cases the death was thought to have been probably avoidable and in a further 32.8% the death was considered possibly avoidable. Figure 1.8 illustrates the distribution of the possibly and probably avoidable deaths per disease category. The major contributors are anaesthetic related deaths (94.2%), obstetric haemorrhage (89.4%), sepsis (miscarriage – 67% and puerperal – 78.1%) and hypertension (66.7%). In all 60.4% of all maternal deaths were thought to be possibly or probably avoidable. This indicates a poor quality of care, but also by improving the quality of care there is the possibility of reducing maternal deaths. Figure 1.9 illustrates the proportion each of the categories of disease play in the possibly and probably avoidable deaths. Three conditions stand out, they are obstetric haemorrhage, NPRI and hypertension. Even though the proportion of NPRI deaths that are thought to be preventable is relatively small, the large number of these deaths means that it is a major contributor to preventable maternal deaths.

Conclusions and recommendations

Conclusions

There has been a significant reduction in maternal deaths in the 2011-2013 triennium and this reduction is mostly due to a decrease in deaths due to NPRI; however to maintain this fall and obtain an exponential fall much more still needs to be done. Assessors classified 60% of maternal deaths to be possibly or probably preventable indicating mostly poor quality of care during the antenatal, intrapartum and postnatal periods. Three conditions have been identified that contribute to the two-thirds of preventable maternal deaths, namely non-pregnancy related infections, obstetric haemorrhage and complications of hypertension in pregnancy. These are the same conditions that were listed in the fifth Saving Mothers report (2008-2010). Recommendations were made in that report to deal with these issues. Most were acted upon in the past three years; however the same recommendations still remain valid in 2014. The challenge remains one of implementation of the effective interventions.

The second triennial Saving Mothers report of 1998-2001 concluded with the paragraph “Every woman who becomes pregnant and continues with her pregnancy does so in the expectation of delivering a healthy child and the joy and satisfaction of watching the child grow. Surely, it is the duty of society and the health care

profession to do the utmost to fulfil this expectation? To this end, the deficiencies identified in this report must be urgently addressed. The committee are anxious to see clear signs of progress by the next triennial report". This sixth triennial Saving Mothers report has good news to tell; there has been a clear reduction in maternal deaths and the new triennium starts with a better array of tools to improve the quality, coverage and implementation of care. This includes primary health care re-engineering including the District Clinical Specialist teams (DCSTs), the Ward Based Outreach Teams (WBOTs), and the numerous guidelines, monographs and programmes produced by the NCEMD to guide practice. The NCEMD expects further significant reductions in maternal deaths in the next triennium.

Recommendations

To **Save Mothers Lives** three key aspects of a health system are essential

- Knowledgeable and skilled health care providers
- Appropriately resourced and accessible health care facilities (including equipment and human resources)
- Rapid inter-facility emergency transport system

These three pillars of the health system must be available to all pregnant women; especially the less informed and most disadvantaged people. When all these aspects are in place, rapid declines in the iMMR can be expected, as demonstrated in Free State from 2011 to 2012⁴.

As the targeted date for millennium goals draw to a close, it is clear that the millennium goals will not easily be achieved unless extraordinary steps are taken. These steps would not only be important for attempting to achieve the goals, but to improve on maternal mortality beyond the millennium goals. The Priority Cost Effective Lessons for Systems Strengthening (PRICELESS SA) study of the MRC and Wits Rural Public Health and Health Transitions Unit, Wits School of Public Health produced a report in 2014 called "Results of the LiST modelling for maternal and child lives that can be saved by scaling up interventions in 2014 and 2015 in South Africa". This estimated that by implementing 8 interventions at a 95% coverage a further 1919 maternal deaths could be prevented every year. These 8 interventions would also save an estimated 1380 lives of neonates. Fortunately these 8 interventions had been already incorporated in the life saving services (signal functions) that facilities should provide to pregnant women⁵ and were included in the **5 H's** recommendations of the fifth Saving Mothers report of 2008-2011. (PRICELESS SA also listed a further 5 interventions which would decrease the lives lost of neonates by 5983 lives per year at a 95% coverage. Two of these last interventions occur in the antenatal period and most occur in the labour ward, illustrating the integrated nature of maternal and neonatal care.)

After reviewing the **5 Hs** recommendations made in the last Saving Mothers report, the NCEMD decided to continue with the **5 Hs** recommendations. However, the NCEMD decided to further strengthen these recommendations by adding the **5 Cs**, which are aimed more specifically at improving implementation and targeting specific interventions.

The 5 Hs are summarised as follows:

The 5 Hs

- HIV

⁴ M G Schoon. Impact of inter-facility transport on maternal mortality in the Free State Province. *S Afr Med J* 2013;103(8):534-537

⁵ UNICEF, WHO, UNFPA. Guidelines for monitoring the availability and use of obstetric services. New York, United Nations Children Fund, 1997 and "Monitoring emergency obstetric care: a handbook". World Health Organization 2009

- Haemorrhage
- Hypertension
- Health worker training and
- Health system strengthening

The last two (Health worker training and Health system strengthening) are part of the three Basic Building Blocks of a health system as described above. They are essential to achieving the first three H's (HIV, Haemorrhage, and Hypertension). The 5 C's give implementation strategies to move from the 2H's (Basic Building Blocks of the health system) to achieve the 3H's (reduction in maternal deaths due the HIV and TB, Haemorrhage and Hypertension).

The 5 Cs are summarised as:

- Care: Commitment to Quality
- Coverage
- Caesarean section safety
- Contraception
- Community involvement

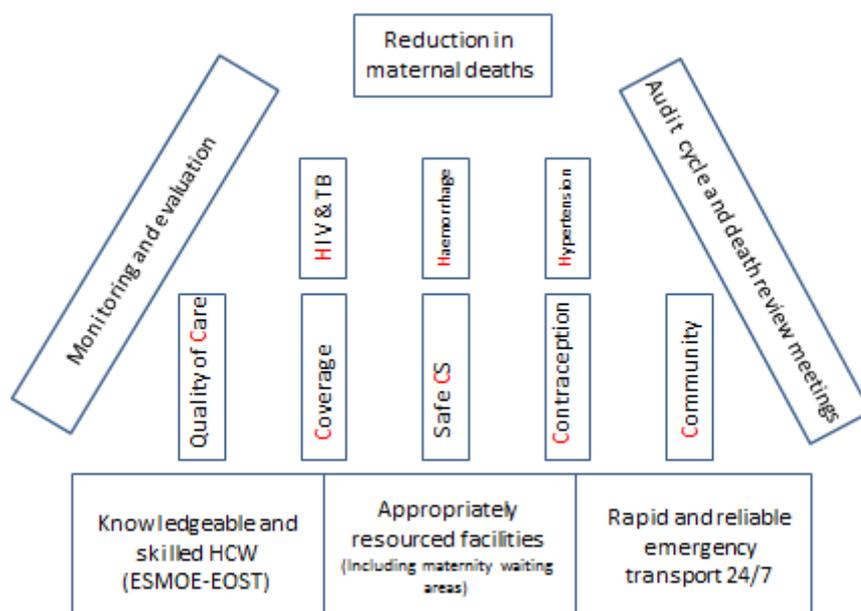
The 5Cs are shown in the table below.

How	Who
Care: Commitment to quality	<ul style="list-style-type: none"> • DCSTs and clinical heads of department to improve clinical governance, clinical supervision, response to local audit findings, and leadership functions • HCPs to make themselves available for training, to participate in drills and to behave in a professional manner • Managers to ensure emergency drills performed regularly • Managers need to evaluate and accredit HCWs to ensure they have appropriate skills
Coverage	<ul style="list-style-type: none"> • District managers to ensure all effective interventions are implemented in maternity services, especially for the poorest section of the population • EMS to ensure transport from home to institution and between institutions • CEOs to include maternity waiting areas where appropriate • Use MomConnect to communicate with the community
Caesarean section safety	<ul style="list-style-type: none"> • CEOs and district managers rationalise resources to ensure skills and facilities available 24/7 • HCW have skills to perform safe CS, including safe anaesthesia • DCSTs specific training package to be implemented
Contraception	<ul style="list-style-type: none"> • All HCP to motivate people to prevent unwanted pregnancies • Managers to ensure various modalities are always available • WBOTs to identify women requiring contraception, and refer • Use MomConnect to communicate with the community
Community involvement	<ul style="list-style-type: none"> • Health facility management to engage with community health committees • WBOTs convey the essential maternity and baby care messages to all pregnant and postnatal women • Use MomConnect to communicate with the community

HCP – Health care professional; DCSTs – District Clinical Specialist Teams; CEOs – Chief Executive Officers; WBOTs – Ward Based Outreach Teams; CS - Caesarean Section

The **what** consists of the 5H's as shown below:

What	Priority activities to be implemented.
- Three foundation stones for the Health system	
Improve Health worker training	<ul style="list-style-type: none"> - Train all HCPs involved in maternity care in the ESMOE-EOST programme and obstetric anaesthetic module, - Train all HCPs in HIV screening and treatment protocols
Strengthen Health system	<ul style="list-style-type: none"> - Ensure 24 hour access to functioning emergency obstetric care (both basic and comprehensive) - Promote where appropriate maternity waiting areas - Accessible and appropriate contraceptive services for all women
- Targeted activities	
Reduce deaths due to HIV and TB	<ul style="list-style-type: none"> - Promote preventive measures - Health care workers(HCP) actively screen for HIV co-infections and treat especially TB
Reduce deaths due to Haemorrhage	<ul style="list-style-type: none"> - Promote preventive interventions: - HCP involved in EOST exercises on haemorrhage
Reduce deaths due to Hypertension	<ul style="list-style-type: none"> - Promote preventative measures: e.g. calcium supplementation, - HCP involved in EOST exercises on hypertension



The above figure illustrates the recommendations.

The actions that follow from the recommendations are detailed for each category of health care workers, from the policy makers and managers to the clinicians and teachers and professional bodies and communities. This is shown in Appendix 2.

Quality of care

- DCSTs to improve clinical governance, clinical supervision and leadership functions
- Improve professionalism and accountability of all Health Care Professionals
- Improve knowledge and skills of Health Care Professionals regarding Basic Antenatal Care, Intrapartum, Postnatal care and especially emergency obstetric and neonatal care specifically;

- Continue regular ESMOE-EOST training at all levels of care, especially at district level, but also introduce as core competency to undergraduate medical and nursing training.
- Ensuring that all health facilities have regular emergency obstetric training (EOST) exercises (fire-drills)
- Improve screening for TB and detection/management of pregnant women with respiratory illness
- Ensure staffing norms and resources appropriate for facility are available
- Ensure safe delivery sites including caesarean section: this might involve a realignment of resources, to ensure a critical mass of staff and resources to provide safe delivery. This requires strategies that both improve functioning of District hospitals but seek to reduce overburdening regional maternity hospitals.
- Ensure good communication links between the different levels of care in respect of advice and patient management and transfer

Coverage

- Ensure all effective interventions are implemented **everywhere**, especially the lowest quintile of the population
- Ensure rapid and reliable emergency transport
- Promote maternity waiting areas in appropriate places
- Ensure the Ward Based Outreach Teams reach all antenatal and postnatal women in their area and can provide basic care and information regarding antenatal, postnatal and contraceptive care.
- Ensure the whole population has access to safe delivery sites including access to safe caesarean sections. This requires access to facilities with adequate resources and skills as access to areas without the resources and skills translates into no access. Improving access to safe delivery and caesarean section sites will entail the use of maternity waiting areas, dedicated inter-facility transport and implementing the basic and comprehensive signal functions required for obstetric and neonatal care.
- Encourage use of MomConnect. MomConnect is a SMS service for all pregnant women and they receive messages appropriate to their gestational age. This is a very effective way of communicating with the community.

Safe caesarean section

- Implement safe CS protocol as described in the short report and in CS monograph
- Implement on-site training, supervision and monitoring of CS morbidity and mortality at all sites performing CS
- Safe caesarean sections require adequate staff to provide a 24-hour access to emergency surgery. A critical mass of staff and workload is required for maintaining surgical and anaesthetic skills among professionals
- Safe caesarean section also implies safe blood transfusions and access to safe and cross-matched blood.

Contraception

- Prevent unwanted pregnancies by encouraging the concept of planning your pregnancy
- Ensure that contraception advice is made available in all disciplines of medicine especially gynaecological wards and internal medicine
- Prevent pregnancies in unstable medical conditions that could adversely impact on maternal outcome
- Delay first pregnancy especially in teenagers and prevent pregnancies later in life
- Promotion of Family Planning Services in the population at large (women, their partners, families and communities).
- Encourage all pregnant women to register with MomConnect so they can receive the appropriate pregnancy messages.

Community involvement

- Engage with district health forums to elicit community views on access to and quality of maternity care

- Ensure the WBOTs convey the essential maternity and baby care messages to all pregnant and postnatal women
 - Early antenatal care
 - Contraception
 - Use health care facilities
 - Maternity waiting areas
- Advise communities to make travel arrangements when in labour. If this is challenging to make alternative arrangements such as maternity waiting areas
- Engage on activities to involve communities in lifestyle adjustments and advice on nutrition and the impact after delivery on the infant and rest of the family
- Encourage all pregnant women to register with MomConnect so they can receive the appropriate pregnancy messages.

The implementation of the **5Cs** will help achieve the **5Hs**

HIV and TB

- Promote the “Know your status” and “plan your pregnancy” messages in communities and in the health sector; and ensure non-judgemental approaches.
- Ensure every maternity facility is able to screen for HIV infection and perform early initiation of HAART therapy; and to recognise and treat co-infections, especially Tuberculosis and respiratory infections.

Haemorrhage

- Promote preventive interventions: community education, prevent prolonged labour, prevent anaemia; use of safe methods for induction of labour and practice active management of the third stage of labour (AMSTL).
- Severe obstetric haemorrhage must have the status of a ‘major alert’ requiring a team approach; with immediate attention to diagnosis of the cause of haemorrhage, resuscitation and stepwise approach to arresting the haemorrhage.

Hypertension

- All maternity facilities must provide calcium supplementation to all women throughout their antenatal care and ensure the detection, early referral and **timely delivery of women with hypertension in pregnancy. The aetiology of pre-eclampsia is not known, therefore treatment is empirical and delivery of the baby and placenta is the only cure for this disorder of pregnancy**
- Severe hypertension, imminent eclampsia, eclampsia and HELLP syndrome must be recognised as life threatening conditions (Major Alerts) requiring urgent attention and delivery. All maternity facilities must be able to administer magnesium sulphate to prevent convulsions, administer rapid acting agents to lower severely raised blood pressure, provide close monitoring prior to and following delivery and manage fluid balance safely.

Health worker training

- Train all health care workers involved in maternity care in the ESMOE-EOST programme and obstetric anaesthetic module,
- Train all health care workers who deal with pregnant women in HIV advice, counselling, testing and support (ACTS), initiation of HAART, monitoring of HAART and the recognition, assessment, diagnosis and treatment of severe respiratory infections.
- Basic skills for every doctor embodied in ESMOE style training
 - More advanced skills for selected doctors at every district hospital embodied in DA, DCH and Dip Obstetrics type training.
 - The DA program is designed around safe anaesthesia at the district hospital and we would like to make that a training goal for the managers to implement – ensuring that they have a couple of DA trained medical officers at every facility that provides anaesthesia.

Health system strengthening

- Ensure 24 hour access to functioning emergency obstetric care (both basic and comprehensive)

- Ensure accessible and appropriate contraceptive services for all women which are integrated into all levels of health care and which must be available on site for women post-miscarriage and postpartum women.

The effect of implementation of these recommendations can be **monitored and evaluated** by assessing the emergency obstetric signal functions. This can be linked with the neonatal emergency care signal functions as some of the major neonatal emergency care signal functions occur in the antenatal period. This will promote the integration of maternal and neonatal services. Table 1 shows the obstetric and neonatal signal functions.

Table 1. Obstetric and newborn signal functions.⁶

Dimensions of Facility Care	Obstetric	Newborn
General requirements for health facility		
	Service availability 24/7	
	Skilled providers in sufficient numbers	
	Referral service to higher-level care, communication tools	
	Reliable electricity and water supply, heating in cold climates, clean toilets	
A. Routine care (for all mothers and babies)		
	Monitoring and management of labour using partograph	Thermal protection
	Infection prevention measures (hand-washing, gloves)	Immediate and exclusive breastfeeding
	Active management of third stage of labour (AMTSL)	Infection prevention including hygienic cord care
	HIV and TB Screening and treatment	
B. Basic emergency care (for mothers and babies with complications)		
	Parenteral magnesium sulphate for (pre-) eclampsia	Antibiotics for preterm or prolonged PROM to prevent infection
	Assisted vaginal delivery	Corticosteroids in preterm labour
	Parenteral antibiotics for maternal infection	Resuscitation with bag and mask of non-breathing baby
	Parenteral oxytocic drugs for haemorrhage	KMC for premature/very small babies
	Manual removal of placenta for retained placenta	Alternative feeding if baby unable to breastfeed
	Removal of retained products of conception	Injectable antibiotics for neonatal sepsis
	ARVs for mother	PMTCT if HIV-positive mother
C. Comprehensive emergency care (functions in addition to Basic)		
	Surgery (e.g., C-section) including anaesthesia	Intravenous fluids
	Blood transfusion	Safe administration of oxygen

Adapted from: Gabrysch S, Civitelli G, Edmond KM, Mathai M, Ali M, et al. (2012) New Signal Functions to Measure the Ability of Health Facilities to Provide Routine and Emergency Newborn Care. PLoS Med 9(11): e1001340.doi:10.1371/journal.pmed.1001340

The signal functions are measures of life saving services, thus giving Magnesium Sulphate is a measure to be able to manage of severe hypertension and eclampsia; ability to give oxytocin is a measure of managing obstetric haemorrhage etc.

The National Committee appreciates all the efforts that were made to reduce maternal deaths and the positive impact of implementing the recommendations of the committee is evident in this report. However, much more need to be done to get our country on the right tract. Your assistance in implementing the new recommendations and to maintain what have been done previously is critically important to assist in prevention of mothers dying whilst giving life.

⁶ Gabrysch S, Civitelli G, Edmond KM, Mathai M, Ali M, et al. (2012) New Signal Functions to Measure the Ability of Health Facilities to Provide Routine and Emergency Newborn Care. PLoS Med 9(11): e1001340.doi:10.1371/journal.pmed.1001340

Chapter 2: Special topics

Accelerating the reduction of HIV and TB maternal mortality

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HIV Infection

The decrease in maternal mortality in this triennium is largely due to a decrease in HIV related deaths, and particularly deaths from HIV- associated TB. This has occurred at a time of increased eligibility for HAART in pregnant women.

The CD4 threshold for initiating HAART in pregnant women increased from 200 to 350/mm³ in early 2010, and for all adults in August 2011. The current report covers the time period when all pregnant women were able to benefit from this change. On World AIDS day 2012, all pregnant women and breastfeeding women became eligible to initiate HAART irrespective of CD4 count. This was rolled out in most provinces in mid-2013. Its impact on maternal health will therefore only be reflected in the next triennial report.

HIV testing

More of the women who died had been tested for HIV than in the previous triennium; there was a fall in the overall percentage of HIV positive women, and more women were on HAART.

In total, 87% of women who died of all causes had an HIV test; of the 13% of unknown status, only 6 women declined HIV testing. Compared to the previous triennium, more women were of known HIV status, when 78.8% of women had tested, and of the 22.2% of unknown status 39 women declined testing. At provincial level, there was a wide variation in the percentage of women of unknown status, ranging from 7.4% in KwaZulu Natal to 20.6% in Gauteng. In terms of underlying cause of death, the highest proportion of women of unknown status were amongst deaths from ectopic pregnancy (55%) and miscarriage (68%). Only 3.6% of women who died from non-pregnancy related infections were of unknown status. The reasons why HIV status was not known need to be elucidated. Many may have presented when critically ill and died shortly thereafter. However, there may have been missed opportunities to test at previous contacts with health services, and any testing gaps need to be addressed.

Of women who tested, 65% were HIV positive, and 35% HIV negative. This compares to the last triennium, when 70.3% of those tested were HIV positive and 29.7% HIV negative. There was again a wide regional variation: the W Cape had the lowest percentage of HIV positive women amongst those who tested, and KwaZulu Natal the highest (47.3% and 74%, respectively). In total, 89% of women dying from NPRI were HIV positive. Amongst direct deaths, 60.6% of women dying from pregnancy related infections were HIV positive, and 48.1% of women dying from miscarriage. This compares to around 30% of women with obstetric haemorrhage and hypertension, which is equivalent to the antenatal HIV prevalence amongst pregnant women in general.

HIV positive women on HAART

In 2011 -2013, 49% of HIV positive mothers who died were on HAART, an increase from 32% in the previous triennium. There were no major differences between provinces, with the percentage on HAART ranging from 45.4% in the North West Province to 54.4% in Limpopo.

Data collected during this triennium conformed to the classification in previous reports, with women categorised as 'HIV positive', 'AIDS on HAART' or 'AIDS not on HAART'. Prior to this triennium, women with CD4 counts < 200 cells/mm³ or WHO Stage IV defining conditions were eligible for HAART, hence these categories enabled assessment of the number of women who were eligible for HAART but were not on treatment. It is difficult in the current report to assess how many women were eligible and not on treatment, with the changes in CD4 threshold for HAART.

Additionally, CD4 counts were often not recorded in patients' notes. This may be because CD4 counts were not requested, or because results were not obtained, or not available due to lack of access to computerised results systems. The CD4 count is no longer needed to start HAART. However the CD4 count is important to assess the degree of risk for opportunistic infections, and the specific infections that need to be considered; for example, *Pneumocystis jirovecii* pneumonia and Cryptococcal meningitis generally occur at CD4 counts < 200 cells /mm³. It remains important that CD4 counts are known, and recorded in antenatal and hospital notes, and that there is easy access to results from other institutions.

For women on treatment, information concerning duration of HAART, the regimen used and viral load results was frequently not documented. This is important information for assessment of HIV positive women presenting with acute illness. Complications of antiretroviral therapy cannot be assessed if the regimen is not known. Women who have recently started HAART are at risk of unmasking new opportunistic infections during the first few months of treatment. TB is the most common 'unmasking' disease.

Those who have started treatment for opportunistic infections and subsequently initiate HAART are at risk of paradoxical IRIS. TB is the most common form of paradoxical IRIS.

In terms of viral load testing, there was little evidence that viral load tests were requested for women established on HAART. Viral load monitoring is essential for both maternal and infant. Women who are not virologically suppressed are at increased risk for opportunistic infections; there is also a high risk of vertical transmission.

HIV positive pregnant women with acute medical problems

HIV positive women presenting with acute medical problems were frequently poorly assessed, and sub-optimally managed. Lack of problem recognition and substandard care contributed to avoidable maternal deaths.

Lack of problem recognition included cases where medical staff failed to recognise the mother was seriously unwell when admitted with second trimester miscarriage or preterm delivery. The focus of

care was solely on obstetric issues. It was not recognised that the precipitating cause for early delivery was maternal febrile illness, and women died without being investigated or treated. Many of these deaths were correctly attributed to non-pregnancy related infection. However the increased HIV prevalence amongst maternal deaths from miscarriage compared to other obstetric causes, as noted above, suggests that deaths attributed to complications of miscarriage may in fact have been HIV related.

In other cases, there was failure to recognise that the mother had a treatable condition; symptoms and signs that should have prompted investigation were instead attributed to 'terminal AIDS'. Many deaths classified as due to wasting syndrome did not fit the accepted definition of HIV wasting syndrome, and instead were deaths from acute illness where a diagnosis had not been established.

Differential diagnosis and investigation in patients who are acutely or chronically ill with low CD4 counts is often challenging. Multisystem problems are common, and the cause may be multifactorial. These patients are more susceptible to bacterial infections, may have more than one co-existing opportunistic infections, and are more likely to experience adverse drug reactions. For pregnant women, obstetric complications, medical problems and HIV related opportunistic infections may present with similar symptoms and signs. For example, seizures may result from eclampsia, cerebral malaria or TB meningitis. The joint involvement of obstetricians and physicians, infectious diseases specialists and other doctors are experienced in HIV and TB management may be necessary, and referral to a higher level of care.

Maternal mortality due to Tuberculosis

TB is the single most common cause of death from NPRI. There were 384 deaths attributed to TB during this triennium; which is 26% of all non-pregnancy related infections. The number of maternal deaths classified as TB has fallen from 529 since the last triennium; a decrease of 24.6%. The scale up of HAART, TB screening at antenatal visits, and increased use of Isoniazid Prophylaxis for TB (IPT) are factors which have likely contributed to this fall.

Overall, 92% of women who died from TB were HIV positive; and 55.2% of these were on HAART. Many women were diagnosed with TB during the index admission, others were already on treatment. For the latter group, there was generally little information about how long the patient had been on TB treatment, whether the diagnosis was proven, drug sensitivity, and adherence to treatment.

Problem recognition was the major avoidable factor in terms preventing deaths from TB. Deaths attributed to other causes include deaths that were likely due to underlying TB, which had not been considered or investigated. This includes deaths attributed to other pneumonia, pneumocystis pneumonia, wasting syndrome, and meningitis. Deaths classified as 'other meningitis' included deaths due to TB meningitis, which had been coded as such because only cryptococcal meningitis is a specific category for assessment of maternal deaths. There were other cases where CSF abnormalities were considered to support a diagnosis of bacterial meningitis, without recognising that predominantly lymphocytic CSF with a high protein strongly suggests TB meningitis.

The contribution of TB to maternal mortality is therefore likely to be significantly underestimated.

TB presents differently in HIV positive patients with low CD4 counts, and can be difficult to diagnose. Extra-pulmonary TB is more common, chest x-ray may be atypical or normal, sputum microscopy is more often negative, and TB progresses more rapidly. TB may present as a respiratory illness, or with non-specific febrile illness and wasting. TB may co-exist with other respiratory illnesses such as bacterial pneumonia or *Pneumocystis jirovecii* pneumonia, which have precipitated acute deterioration and the need for hospital admission. Diagnosis of TB is more difficult in HIV positive patients: empiric TB treatment may be indicated when there is a strong suspicion of TB.

Anaemia of chronic disease is common in HIV patients with severe immunocompromise. TB can further suppress the bone marrow. Overall, 58% of women with non-pregnancy related infections were anaemic. Treatment of anaemia in these patients involves investigation and management of the underlying cause. Blood transfusion may be necessary if delivery is imminent, there is active bleeding, or respiratory distress. However blood transfusion does not 'cure' anaemia of chronic disease, and is not a substitute for investigation and treatment of the underlying cause.

Complications of antiretroviral therapy

There was a significant increase in deaths due to complications of antiretroviral therapy (ART). Deaths in this category increased from 3.7% to 8.8% of all NPRI deaths. In absolute terms, this was an increase from 74 to 130 deaths. The number of deaths increased each year from 2008 to a peak of 64 in 2011; thereafter deaths have decreased, reaching a nadir of 17 in 2013. The majority of deaths were due to nevirapine, causing either severe Stevens-Johnson's syndrome, fulminant liver failure or both.

All provinces showed an increase this triennium; however there was a wide range in term of the percentage of deaths from non-pregnancy related infection. This ranged from 15.3% (13 deaths) in the Free State, to 4.5% in the Eastern Cape (9 deaths). Kwa-Zulu Natal had 47 deaths (11.6% of NPRI deaths in the province), which accounted for 36.2% of deaths from complications of ART.

The increase in deaths correlates with increased use of nevirapine containing HAART regimens in pregnant women, due to increased eligibility for HAART. There were no deaths resulting from single dose nevirapine use. Nevirapine was included in first line HAART for pregnant women until mid-2012, when the risks of nevirapine were highlighted by the NCCEMD following a significant increase in deaths in the previous triennium. Guidelines then changed, with nevirapine no longer used routinely for pregnant women and women of reproductive age, and efavirenz used instead.

There is an increased risk of severe hypersensitivity reactions to nevirapine with CD4 counts > 250 cells/mm³. When the CD4 threshold for HAART for pregnant women was raised to 350cells/mm³, nevirapine based regimens continued to be prescribed. However it should be noted that the risk of hypersensitivity is still present, albeit lower, with CD4 counts below 250 cells/mm³. In the current report, when CD4 counts were available, almost two thirds of women who died due to the adverse effects of nevirapine had CD4 counts < 250 cells/mm³. The dramatic decrease in deaths due to

complications of antiretroviral therapy in 2013 has shown that translation of findings from the Saving Mothers audit can rapidly be implemented to reduce maternal deaths.

Resources:

Maartens G, Cotton M, Wilson D, Venter F et al. Handbook of HIV Medicine. 3rd ed. Cape Town: Oxford University Press Southern Africa, 2012.

Medicins Sans Frontieres. MSF HIV/TB Clinical Guide. 8th ed. Available free online from www.samumsf.org

Safe Caesarean section

Dr S Gebhardt and Prof S Fawcus for the NCCEMD

Introduction

Of the 2 831 066 deliveries in South Africa during the last triennium, 655 686 women were delivered with a Caesarean sections (CS); with a national CS rate of 23.1%. There were 1243 maternal deaths where a Caesarean section was the mode of delivery and 1471 deaths after vaginal delivery. The CS Rate for mothers that died (during or after the procedure) was higher than the national average, at 33%. The most serious issue identified in this report is bleeding during or after CS; of all the mothers who died during or after a CS, one third was due to hypovolaemic shock (as a final cause).

There are limitations of estimating fatality rates from Caesarean section, as it is difficult to separate the risk associated with the disorder for which the surgery is done (such as eclampsia or placenta praevia), from the risk associated with the procedure itself (surgical, anaesthesia or postoperative care). Nevertheless, if the risk of death from vaginal delivery is 1, the overall relative risk of death from a Caesarean section was 2.8.

Table 2.1. Case fatality rate for CS deliveries compared with vaginal delivery rate

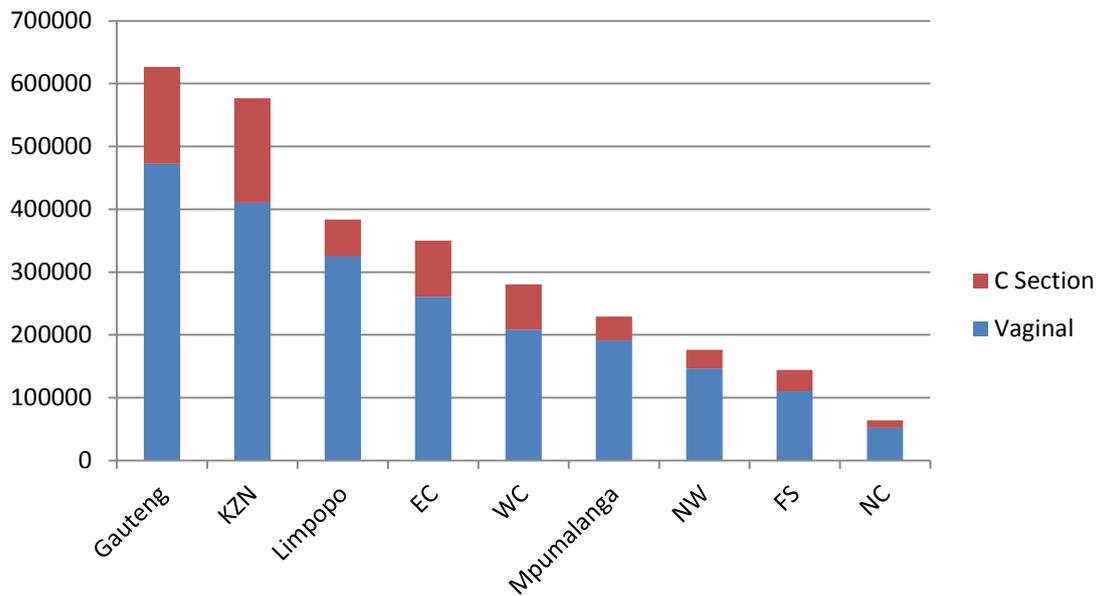
Type of delivery	Total number	Total number of deaths	Case Fatality Rate (per 10 000)	Relative risk	95% confidence interval
Vaginal delivery	2 175 380	1471	6,7	1	
Caesarean section	655 686	1243	18.9	2.8	2.5-3

Expressing the data as Case Fatality Rates (CFR); the CFR causally related to mode of delivery was 2.8 times higher for operative delivery- 6.7 per 10 000 vaginal births and 18.9 per 10 000 for Caesarean delivery. Of the 1243 mothers who died during or after a Caesarean section, 42 (3.38% of all CS deaths) died due to bleeding problems during the procedure, and 174 (14% of all CS deaths; and 0.025% of all CS done) died from haemorrhage following the procedure. Including all cases of death from obstetric haemorrhage where a CS was done (n=363), the haemorrhage CFR equates to 5.5 deaths from haemorrhage for every 10 000 CS performed.

Most CS were indicated in an attempt to save the mother or the baby's life after life-threatening pathology had already set in. During 2011-2013, of all the CS performed in public sector facilities, 35% took place at district hospitals, 40% at regional hospitals and 25% at tertiary or central hospitals, which is not much different from previous years.

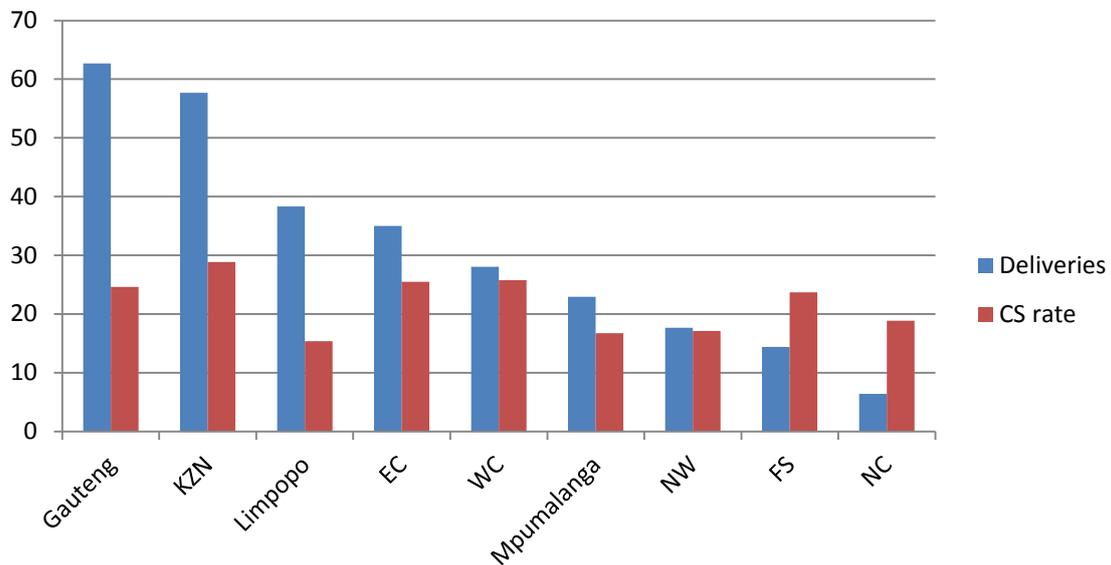
This chart shows the number of deliveries in each province, including the number of CS in decreasing order of delivery number; with most deliveries taking place in Gauteng, and most CS (in terms of actual numbers) done in KZN.

Figure 2.1. Total numbers of deliveries and CS per province, 2011-2013



There is a difference in CS rate between the different provinces, not related to the number of deliveries; with the highest CS rate in KZN and the lowest rate (15.4%) in Limpopo. This is shown schematically in the following chart:

Figure 2.2. Caesarean rates per province 2011-2013*



*CS rate per province, in percentage; with the number of deliveries (deliveries/10 000 for scale)

Table 2.2: The number of deliveries and Caesarean sections per province, as well as the number of CS deaths and the CS rate for each province:

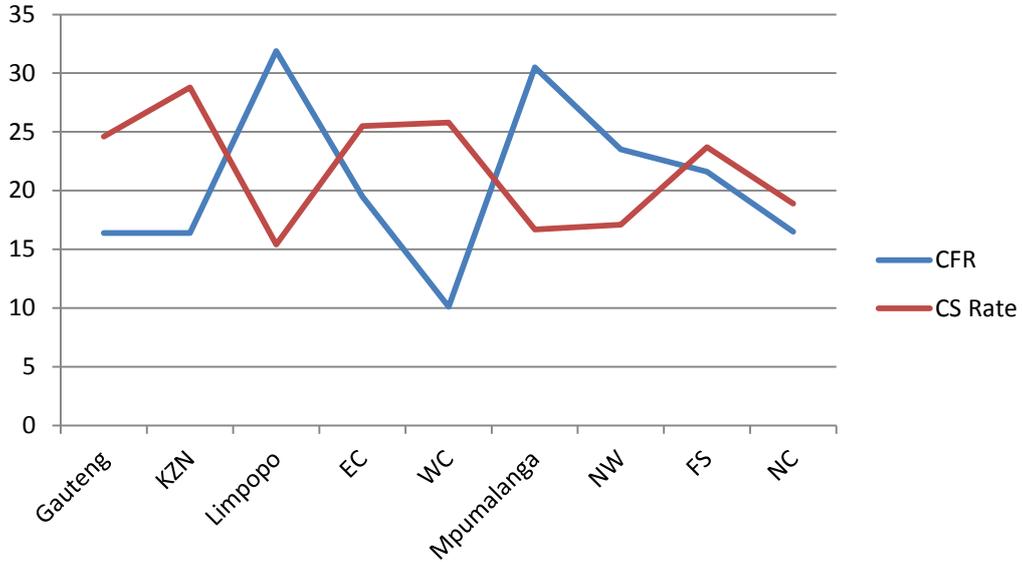
		Numbers of deliveries and Caesarean sections				Caesarean section rate (%)				CS deaths
		2011	2012	2013	Total	2011	2012	2013	Total	
Eastern Cape	CS	28851	30097	30188	89136	24,8	25,4	26,2	25,5	174
	Deliveries	116414	118414	115095	349923					
Free State	CS	10495	11817	11798	34110	21,8	24,1	25,1	23,7	74
	Deliveries	48052	48964	47056	144072					
Gauteng	CS	48611	51659	54083	154353	23,7	24,6	25,5	24,6	253
	Deliveries	204745	209831	212167	626743					
KwaZulu Natal	CS	53905	55018	57413	166336	28,0	28,5	30,0	28,8	273
	Deliveries	192284	192941	191591	576816					
Limpopo	CS	18850	19338	20709	58897	14,8	15,1	16,2	15,4	188
	Deliveries	127554	128034	127889	383477					
Mpumalanga	CS	12215	12749	13357	38321	16,3	16,5	17,4	16,7	117
	Deliveries	74765	77420	76981	229166					
Northern Cape	CS	3951	4024	4089	12064	18,7	19,3	18,6	18,9	20
	Deliveries	21138	20871	21974	63983					
North West	CS	9594	9841	10777	30212	16,4	16,6	18,3	17,1	71
	Deliveries	58448	59127	58836	176411					
Western Cape	CS	22588	23328	26341	72257	24,1	25,1	28,1	25,8	73
	Deliveries	93886	92777	93812	280475					
South Africa	CS	209060	217871	228755	655686	22,3	23,0	24,2	23,2	1243
	Deliveries	937286	948379	945401	2831066					

Table 2.3. Comparison of CS deaths per province; proportion of deaths and case fatality rates

Province	Number of deaths during or after CS	% of total deaths for the province	CFR (number of deaths from CS per total procedures performed x 10 000)
Western Cape	73	34,1	10.1
Gauteng	253	29,8	16.4
KwaZulu-Natal	273	28,3	16.4
Northern Cape	20	18,2	16.5
South Africa	1243	27,9	18.9
Eastern Cape	174	29,3	19.5
Free State	74	26,3	21.6
North West	71	24,3	23.5
Mpumalanga	117	29,3	30.5
Limpopo	188	25,1	31.9

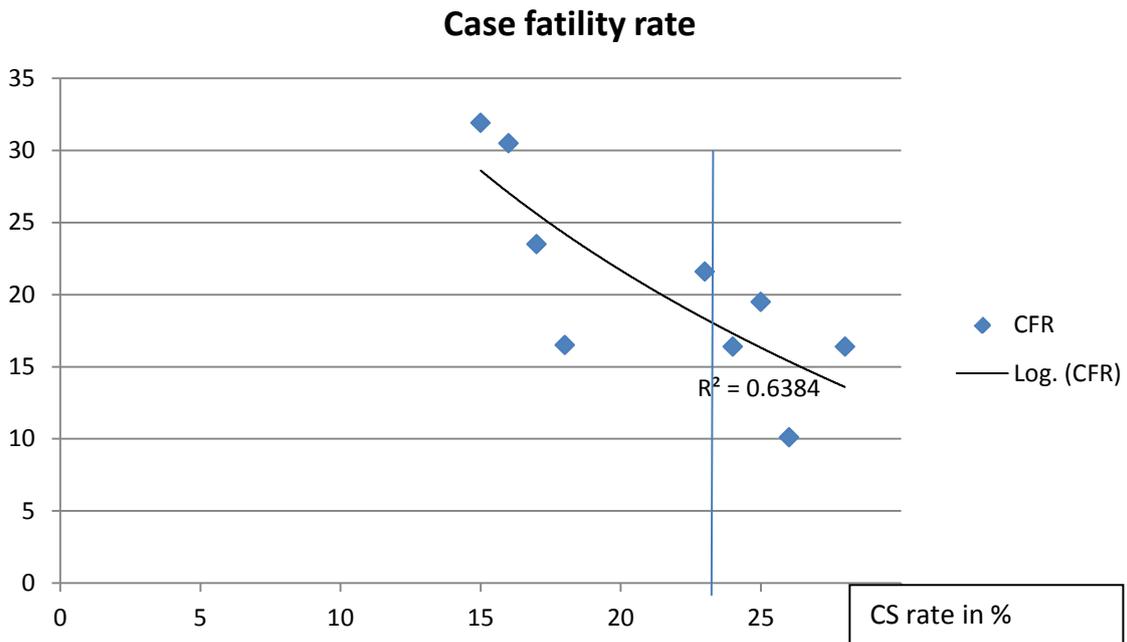
When the CS rate for each province is compared to its CFR from CS, it is quite striking that more mothers die from CS in the provinces where there is a low overall CS rate. The provinces with a CS rate >23% all had a CS CFR below 20; and those with a CS rate of <17% had the worst CFR.

Figure 2.3. Comparison of Caesarean section rate and CFR from CS per province, 2011-2013



This could be due to a variety of reasons; including lack of easy access to safe CS, long waiting times to get to theatre and retention of skills when a reasonable CS rate is maintained. What it does argue is that doing more CSs does not necessarily lead to more surgically-related deaths, but that a reasonably safe, population-based CS rate for a province is around 24%. This is also in keeping with international studies for low-income countries, where a CS rate is inversely related to maternal as well as neonatal mortality. Even at this level, the number of women dying after CS is still double the number of women dying after vaginal delivery.

Figure 2.4. Graphic presentation of negative correlation between Caesarean section rates and Case fatality rates in provinces, 2011-2013.



The following table shows the main primary obstetric problems associated with a maternal death and the route of delivery; including those patients undelivered at time of death. It includes the delivery-type specific CFR, and separates the patients identified as bleeding during or after CS (BDACS) from the overall haemorrhage group; to show its rank in terms of the other deaths (sorted in descending order). It also shows the relative risk of dying by type of delivery.

Table 2.4a. Relationship between primary obstetric cause of death and route of delivery

Primary obstetric problems	Vaginal delivery	CFR for vaginal delivery only	CS	CFR for CS delivery only	RR (for CS delivery; if RR for vaginal delivery=1)	Total (includes undelivered)
SA Total del.						2831066
SA Total Vag. Del						2175380
SA Total CS						655686
Total Deaths during pregnancy	1471	6.7	1243	19	2.8	4452
Non-pregnancy-related infections	646	2.9	166	2.5		1504
Hypertension	154	0.7	272	4.1	5.9	640
-Pre-eclampsia	39	0.18	68	1	5.8	
-Eclampsia	78	0.36	146	2.2	6.2	
-HELLP	27	0.4	44	0.67	1.6	
Medical and surgical disorders	165	0.76	125	1.9	2.5	493
Obstetric haemorrhage (-BDACS)	250	1.1	147	2.2	1.9	468
Pregnancy-related sepsis	112	0.5	100	1.5	2.96	226
Bleeding -Caesarean section (BDACS)			174+42	3.3		216
Miscarriage	6	0.027	1	0.01		185
Unknown	72	0.3	41	0.6		181
Coincidental cause	14	0.06	20	0.03		119
Anaesthetic complications	5	0.02	79	1.2		105
Embolism	23	0.1	44	0.6	6.3	102
Acute collapse - cause unknown	24	0.1	27	0.4	3.7	106
% of total:	33,1		27,9			

Table 2.4b. Relationship between final cause of death and route of delivery

Final cause of death	Vaginal del.	CS	RR	CI	P	% vag del.	% CS
Circulatory system	486	567				33,6	46,6
- Hypovolaemic shock	279	407	4.8	4.1-5	0.00	19,3	33,4
- Septic shock	207	160				14,3	13,1
Respiratory failure	595	282			ns	41,1	23,2
Cardiac failure	298	363				20,6	29,8
- Pulmonary oedema	113	133				7,8	10,9
- Cardiac arrest	185	230				12,8	18,9
Embolism	38	52				2,6	4,3
- Acute collapse due to embolism	38	52	4.5	2.9-7	0.00	2,6	4,3

As a final cause of death, hypovolaemic shock was associated with one third of all CS deaths; this risk was almost 5 times higher than for vaginal delivery. Likewise, the risk of dying of acute collapse due to embolism (as a final cause of death) was 4.5 times increased after CS.

From the data in these two tables, maternal deaths in patients with CS as route of delivery is a specific problem in the following categories:

1. Bleeding during or after CS
2. Pre-eclampsia and eclampsia (6 times increased risk of dying)
3. Anaesthetic deaths
4. Pregnancy-related sepsis (3 times increased risk)
5. Acute collapse and embolism (combined, a 5 times increased risk)

Even though the indication for the CS may have been an attempt to save a life, this is an area of concern and a concentrated effort should be done to make these CS safer.

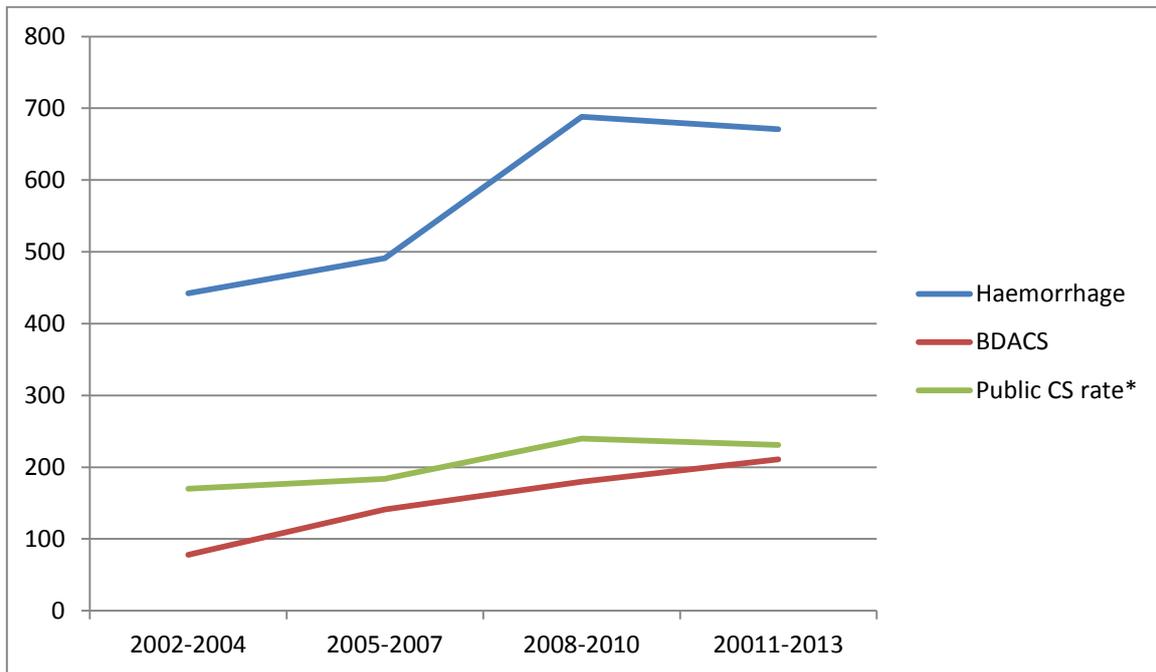
➤ **Bleeding during and after CS**

The rate of haemorrhage during and after caesarean section (BDACS) continues to increase; with 216 cases reported in the last triennium. This group accounted for 78 deaths in 2002-2004; 141 deaths in the 2005-2007, and 180 in 2008-2010.

Since the 2008-2010 report, the category 'other uterine trauma' (which was used in previous years, and was a composite of bleeding with CS as well as vaginal/cervical trauma) was changed so that bleeding during and after CS is measured separately; thus the actual number of deaths from bleeding during or after CS only for 2002-2004 and 2005-2007 may be lower. These numbers now exclude deaths attributed to other pathology (placenta praevia, abruptio, cervical tears, bowel perforation during CS etc.), although most were delivered by CS; to focus on a group where the possible preventable problem can be focused on bleeding at or after the procedure itself. This group (BDACS) is (in terms of numbers) as an important cause of death as pregnancy-related sepsis.

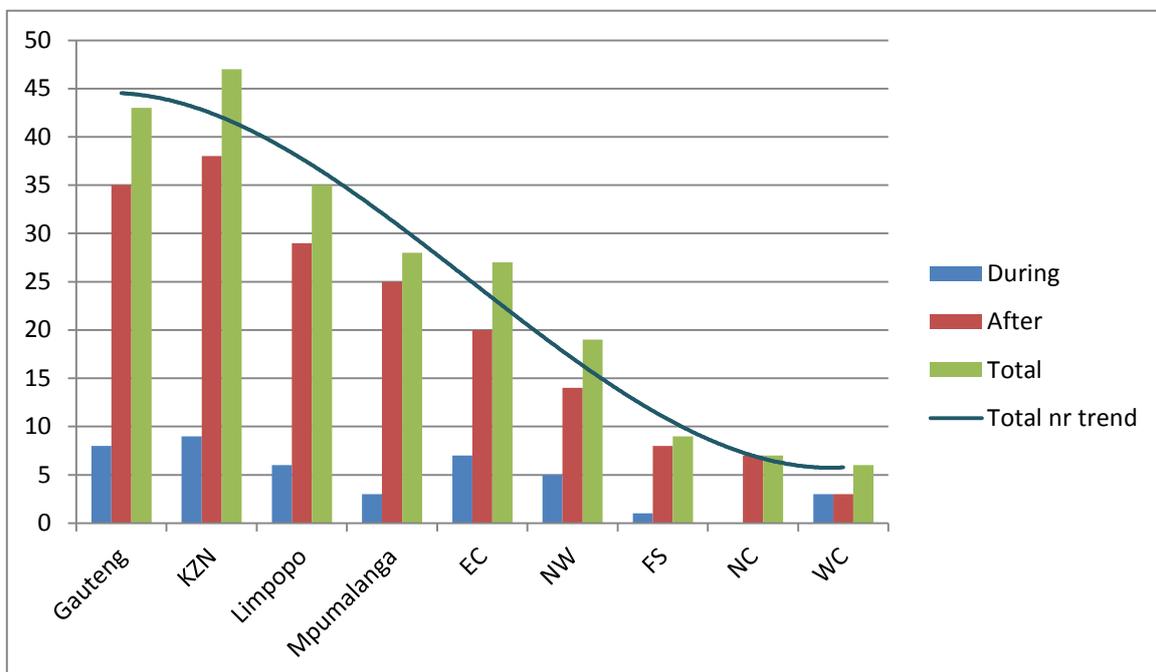
It is of great concern that in the majority of cases, no attempt was made to go back to theatre to stop the bleeding, or the decision was taken too late. It was either not part of the plan, or no assistant was available, or the patient was referred but died waiting for an ambulance or en route to the next level of care. When a laparotomy was done, the management was mostly ineffective and did not follow the PPH monograph protocols.

Figure 2.5. Deaths due to bleeding during or after CS (BDACS), and total deaths due to bleeding from all causes over the last 4 triennia.



*CS Rate is expressed as cases/1000 and not percentage, for comparison purposes

Figure 2.6. The actual number of deaths from bleeding during and after a CS in each province



There were 363 deaths associated with haemorrhage and CS; of which 216 was directly associated with the procedure; a further 54 CS-related deaths in the haemorrhage group were attributed to abruptio placentae and 26 deaths to complications arising from placenta praevia or placenta accreta. A mother's risk of dying from bleeding during or after CS (directly related to the procedure) in South

Africa was 1 in 3053. There were 110 deaths attributed to abruptio placentae and the risk of dying from abruptio placentae was relatively low (1 in 25 736 deliveries); but that risk was more than 8 times increased when abruptio placentae was managed with a CS (Relative Risk 8.8; 95% Confidence Interval 5.5-13; $p < 0.0001$).

Further analysis of BDACS deaths revealed the following:

- Of the maternal deaths following BDACS, 38% took place at district level (also 38% in 2005-2007), 43% at regional level and 16% at tertiary or central hospital level.
- There was a previous CS present in 36% of patients who died from BDACS and 33% of those women ($n=185$) tested were anaemic before the CS.
- Deaths were assessed as clearly avoidable in 70% of cases of bleeding during CS and in 72% of cases of bleeding after CS; only 1.8% of deaths were assessed as no suboptimal care.

Table 2.5. Avoidable factors at each level of care

Medical management problems	Bleeding during CS	Bleeding after CS	Bleeding during CS	Bleeding after CS	Bleeding during CS	Bleeding after CS
	District Level Number		Regional Level Number		Tertiary Level Number	
Lack of information	0	6	2	6	1	2
No avoidable factor	20	71	26	115	34	159
Initial assessment	3	15	1	4	0	3
Problem with recognition / diagnosis	11	42	5	24	3	5
Delay in referring the patient	8	29	2	2	0	0
Managed at inappropriate level	4	15	1	3	0	0
Incorrect management (Incorrect diagnosis)	2	7	2	3	0	3
Sub-standard management (Correct diagnosis)	14	63	9	42	4	8
Not monitored / Infrequently monitored	1	15	0	11	0	1
Prolonged abnormal monitoring with no action taken	5	27	1	16	1	5

There are some common themes that arise from the folder assessments:

- Many women died in ambulance before during or after referral. This reflected reluctance to perform necessary surgery at the district hospitals (due to lack of sufficient blood products) and lack of surgical competence), but also ambulance delays
- Better monitoring by nurses was observed compared to previous years but there was poor response to signs of deteriorating vital signs by nurses and doctors, the latter frequently gave telephonic advice rather than assessing the patient. Colour coded Early warning Charts were not found in the folders.
- Poor use of uterotonics especially ergometrine to prevent and treat uterine atony at CS.
- Poor surgical skills at initial CS.
- Referral for post CS bleeding arranged rather than a re - look laparotomy
- Internal bleeding common in post CS bleeding deaths but delay in recognition.
- Poor use of uterine compression sutures, balloon tamponade and uterine tourniquets

Recommendations to reduce deaths from bleeding during or after CS:

1. Prevent anaemia, prolonged labour and second stage Caesarean section (CS)
2. Hospital managers to ensure a continuous stock of emergency blood and freeze dried plasma to be available at district hospitals.
3. Implementation of standard protocols for use of uterotonics for prevention/management of PPH at CS.
4. Training to focus on problem recognition and skills training of doctors performing CS, and anaesthetics for obstetric patients at district hospitals.
5. Women with abnormal vital signs after CS should not leave the recovery area and should not be transferred unstable to a postnatal ward.
6. All women with blood loss after CS need to be immediately resuscitated, and a doctor called to assess, with immediate return to theatre if poor response to uterotonics.
7. Direct Telephonic links for 24 hour specialist support to district hospital doctors.
8. Emergency transport to be onsite for transfers from district hospitals.
9. Essential skill competencies to include: District hospitals –safe caesarean section, safe anaesthesia, balloon tamponade, uterine compression sutures and uterine tourniquet; and at Regional/Tertiary hospitals – all of the above plus hysterectomy.

➤ Findings and recommendations from anaesthetic deaths

See Anaesthetic chapter

➤ CS for hypertension, eclampsia and HELLP syndrome

It is becoming apparent that there are a number of specific issues related to the multi-disciplinary management of eclampsia:

1. All women with eclampsia, irrespective of type, must be managed at regional / tertiary levels of care. Aim for a vaginal delivery as far as possible.
2. Eclamptic women with a Glasgow Coma Scale (GCS) of 15/15 generally do well and if a caesarean section is required, regional anaesthesia can be considered as long as this is:
 - Carried out by an experienced anaesthetist or supervised by such a person.
 - The high blood pressure is stabilised.
 - There is no coagulation problem, platelet counts are $>100 \times 10^9/l$, and there is no evidence (clinically or biochemically) of HELLP syndrome.
 - Preventative measures are taken against PPH and the patient is observed after the procedure in a high care bed or one dedicated for this purpose for at least 24 hours after the initiation of $MgSO_4$.
3. Eclamptic women with a GCS of 10-14 – if a C/S is required, this should be done under general anaesthesia by an experienced anaesthetist or under his/her supervision.

Special attention must be given to:

- The *Edematous Eclamptic* who may have a swollen airway. In addition, if such patients have an elevated serum urate level, they may be in danger of pulmonary oedema. Careful attention must be given to fluid balance management.
- The *Restless Eclamptic* – these patients may be hypoxic and/or have cerebral oedema.

Strong consideration must be given to ventilate such patients (edematous and restless eclamptics), for at least 24 hours following delivery.

Other indicators that a patient may be placed in this more serious category could be biochemical evidence of more than one end organ damage such as HELLP, renal failure and abruptio placentae.

Management of cerebral oedema: the use of dexamethazone is controversial. Some patients may respond to doses of up to 32mg/day. Use of dexamethazone in such circumstances should be discussed with an expert and not regarded as a routine procedure.

4. Glasgow Coma Scale ≤ 9 should be ventilated for 24 hours after the procedure.
5. The pressor response to intubation can be exacerbated in pre-eclamptic patients. High blood pressure should be controlled, even in the operating theatre before intubation. An expert familiar with the use of agents (such as magnesium and alfentanil) to the pressure response to intubation should be contacted.
6. Post-delivery care is mandatory in all pre-eclamptics and a step-wise decrease in the dosage of antihypertensives may prevent readmission due to hypertensive complications.
7. All caesarean sections should be performed by experienced persons and steps taken to minimise bleeding.

➤ **CS and thrombo-embolism**

Recommendations

1. Measure the Body Mass Index (BMI) at booking. Women with a booking BMI of 40 kg/m^2 or more should preferably be managed at a specialist/regional hospital level due to the increased risk of thrombosis, diabetes, macrosomic babies, difficult CS (both anaesthesia and surgery), and risk of post-partum haemorrhage. Women with a booking BMI of 50 kg/m^2 or more should preferably deliver at a tertiary hospital due to the increased anaesthetic risks, including difficult airway and post-operative difficulty in breathing.
2. Identify women at risk for thrombo-embolism, and provide effective thrombo-prophylaxis until 7 days after delivery (see Table 6).

Table 2.6. Risk factors for embolism and suggested prophylaxis

Risk factor	Indication	Suggested prophylaxis Start 6-12 hours after delivery.
HIGH RISK Emergency Caesarean section BMI > 40 kg/m ² Prolonged hospital admission MEDICAL COMORBIDITIES, e.g. heart or lung disease, SLE, cancer, inflammatory conditions, nephrotic syndrome, sickle cell disease Intravenous drug user	Any one of these high risk risk factors	<u>Unfractionated heparin:</u> 5000 Units 2-3 times daily, subcutaneously <u>Low molecular weight heparin:</u> Enoxaparin <50kg: 20 mg daily subcutaneously 50-90kg 40mg daily subcutaneously >90kg 60mg daily subcutaneously Daltaparin <50kg: 2500U daily subcutaneously 50-90kg 5000U daily subcutaneously >90kg 7500U daily subcutaneously PLUS TED stockings (knee length)
INTERMEDIATE RISK Elective Caesarean section Age > 35 years Obesity (BMI > 30kg/m ²) Parity ≥ 3 Smoker Any surgical procedure in the puerperium (e.g. sterilisation) Gross varicose veins Current systemic infection Immobility, e.g. paraplegia Pre-eclampsia Prolonged labour (> 24 hours) PPH > 1 litre Blood transfusion	Any 2 or more of these risk factors	PLUS TED stockings (knee length)
If only one INTERMEDIATE risk factor		Prevent dehydration, early mobilisation

➤ **Post- CS sepsis**

Recommendations

- Adhere to the accepted anti-sepsis strategies during surgery
- Use the WHO surgical safety checklist (maternity version)
- Administer prophylactic antibiotics (e.g. 2g cephazolin) to EVERY CS, whether elective or emergency. Administer 30-60 minutes before surgery (e.g. as pre-med).
- Provide additional therapeutic antibiotics for 5 days in all cases of
 - HIV positive patients
 - Blood transfusion during surgery
 - Blood loss >1000ml during surgery
 - Second stage emergency CS
 - Prolonged (>12 hours) rupture of membranes
 - >5 vaginal examinations during labour
 - When someone had to push up the head vaginally during difficult delivery of the head
 - BMI >40kg/m²
- Anticipate difficult surgery (two or more previous CS, BMI >40kg/m², previous CS with septic wound, second stage CS) and request most experienced surgeon to operate. Do a longitudinal abdominal incision for CS with previous two or more

Pfannenstiel incisions, especially for an emergency CS, to prevent accidental bowel or bladder injury.

Further reading

S Fawcus, J Moodley, for the National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD)- Haemorrhage associated with caesarean section in South Africa – be aware. May 2011, Vol. 101, No. 5 SAMJ p306

National Committee on Confidential Enquiries into Maternal Deaths. Saving Mothers. Essential Steps in the Management of Common Conditions Associated with Maternal Mortality. Pretoria: Department of Health, 2007.

National Committee on Confidential Enquiries into Maternal Deaths. Monograph on the Management of Postpartum Haemorrhage. Pretoria: Department of Health, 2010.

National Committee on Confidential Enquiries into Maternal Deaths. Caesarean section monograph. Pretoria: Department of Health, 2013.

Maternal deaths in private hospitals

Dr T Frankish for the NCCEMD

Abstract

The pattern of causes of maternal deaths in private institutions is similar to that of public institutions, with the exceptions of pulmonary embolus being identified more frequently, and anaesthetic complications and pregnancy-related sepsis less frequently, as the cause. The impact of HIV on maternal deaths is also similar. It should be noted that actual numbers are relatively small and caution should be exercised in drawing definitive conclusions. The reporting of maternal deaths to the NCCEMD still needs to be improved to collect all the cases occurring in private hospitals. The iMMR for this sector of the health service is approximately 45 per 100,000 live births.

Key findings

1. The pattern of disease resulting in maternal deaths in private hospitals is similar to that in public hospitals
2. The lessons learnt in the analysis of the deaths in the public sector also apply to the private sector
3. Notification of maternal deaths private hospitals needs to be improved

Source of data

This chapter deals with maternal deaths in "the private sector", comprised of the three large private hospital groups, some independent private hospitals, the NGO sector and not-for-profit health establishments across all nine provinces.

The number of deaths reported by the private sector to NCCEMD has increased steadily from 37 in the triennium 1999-2001 to 118 in the triennium reviewed in this report. The denominator number of live births for this triennium 2011-2013 was obtained through a survey of private health establishments by the National Department of Health. Information from this survey of the hospital groups showed that there were 344,611 live births.

The 118 maternal deaths reported to the NCCEMD gives an iMMR of 34.2 per 100,000 live births. However, in the survey, private health establishments reported that they had 156 maternal deaths, giving an iMMR of 45.3, which is probably a more realistic calculation. This discrepancy in the number of maternal deaths indicates that approximately a quarter of maternal deaths in the private sector are not reported to the NCCEMD and therefore not subject to analysis of trends. The findings reported in this chapter are based only on those deaths reported to the NCCEMD.

Analysis of causes of death

Table 2.7 below shows the number of deaths (n=118) reported by category.

The underlying causes of maternal deaths are similar to those reported from the public sector with non-pregnancy related infections (NPRIs), obstetric haemorrhage and hypertension accounting for nearly two thirds (25.4%, 19.5% and 15.3% respectively).

Table 2.7. Underlying causes of maternal deaths in private hospitals

Underlying cause of maternal death	n	
Non-pregnancy-related infection	30	(25%)
Obstetric haemorrhage	23	(19%)
Hypertension	18	(15%)
Medical and surgical disorders	17	(14%)
Embolism	14	(12%)
Acute collapse including emb.	6	(5%)
Pregnancy-related sepsis	4	(3%)
Miscarriage	3	(3%)
Unknown	2	(2%)
Anaesthetic complications	1	(1%)
Ectopic pregnancy	0	(0%)
Total	118	

Haemorrhage associated with caesarean section occurred in 17% of cases of obstetric haemorrhage, in comparison to the one third of cases in the public sector reports – given the high rate of caesarean section in the private sector (approximately 67% of deliveries are by caesarean section) this was a surprisingly low proportion. Uterine atony, at 17%, appeared as a similar proportion of cases. 35% of deaths due to haemorrhage resulted from placental abruption while 9% were caused by a ruptured uterus. These four categories were responsible for nearly 80% of the deaths due to obstetric haemorrhage, as illustrated in Figure 2.7 below:

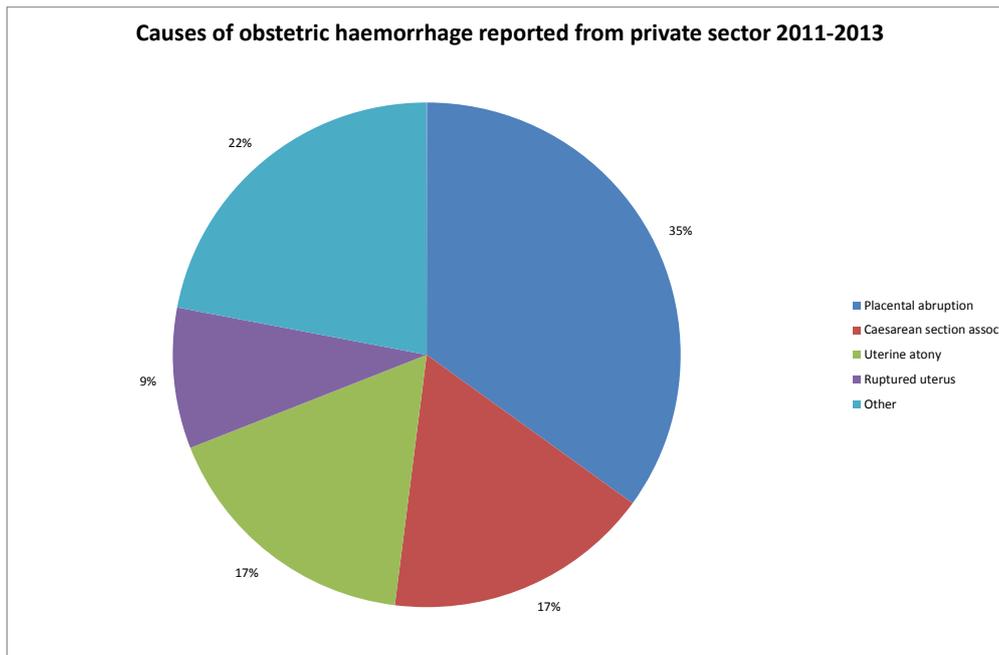


Figure 2.7

Medical and surgical disorders at 14.4% are similar in frequency to those in the public sector while acute collapse and pulmonary embolism, at 5.1% and 11% respectively, were diagnosed more frequently as the cause of death. Pregnancy-related sepsis (3.4%) and anaesthetic complications (0.8%) were less common – public sector figures for the period were 5.2% and 2.4% respectively.

Non-pregnancy related infections accounted for a quarter of the deaths in this triennium. The trend of causes of maternal deaths over 5 triennia is illustrated in Figure 2.8 below. While denominator data is not available for all the triennia before 2011-2013, the relative proportion of causes of death is instructive. In 2005-2007, the percentage of deaths caused by non-pregnancy related infections more than doubled (37%) from the periods 1999-2001 and 2002-2004 (16%). In 2011-2013 more than two thirds of deaths from NPRIs were attributed to pneumonia and TB, indicators of underlying HIV infection - similar underlying causes are assumed to have been the causes in prior periods. (In a review of the triennium 2008-2010 by Pattinson (personal communication, unpublished data), nearly 60% of deaths from NPRIs were HIV positive, in comparison to less than 10% in those mothers who died from causes other than NPRIs.) This suggests that no section of the country's population was spared the effects of HIV.

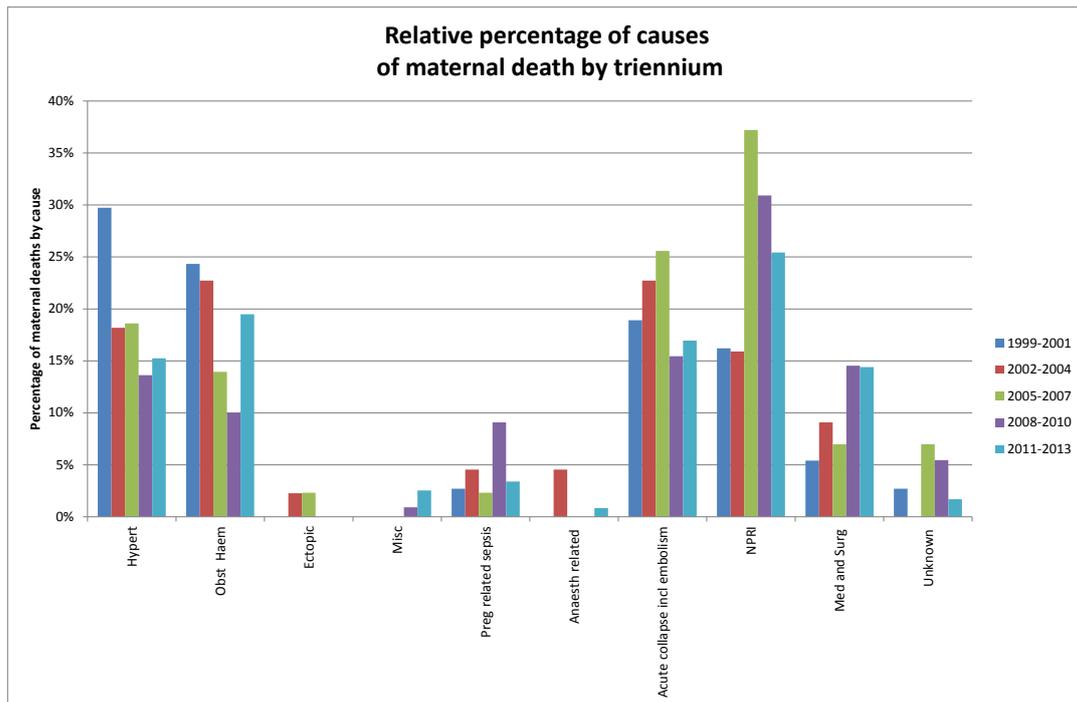


Figure 2.8

Comments

Reporting and clinical governance remain challenges with the relative independence of both hospitals and clinicians. The new 2014 maternal death report does however make it clear what is expected in the event of a maternal death and this should enhance learning and accountability.

The increasing costs of litigation in respect of claims for alleged negligent or sub-standard care in labour and of the newborn has become problematic in the country (Howarth,2014). Apart from the effect on finances of the state, the effect on private obstetricians is that the costs of personal professional indemnity has resulted in private obstetricians/gynaecologists withdrawing from practising obstetrics, a trend which is likely to continue, reducing further the doctor resources for pregnant women.

Recommendations for the private sector:

1. The 5 H's and the 5 C's are as relevant to the private sector as they are to the public sector and attention needs to be paid to them. ESMOE training should also be emphasised to optimally manage the "near misses" which may not end up as maternal deaths.
2. The private sector, from primary care level to advanced hospital level, needs to be included in national campaigns such as "Every Newborn".
3. The private sector needs to be encouraged to report all maternal deaths to the NCCEMD. It is suggested that the Minister of Health communicate with the heads of the private health care organisations (large and small) to request their cooperation in this regard, not only as a

legal requirement but also to ensure proper understanding of the underlying causes in order to guide appropriate interventions.

4. Collaboration with the professional indemnity insurers should be considered as a means to assist in managing risk and ensuring compliance with recommended protocols in private health establishments, as well as reducing the costs to the country from litigation.
5. Centralised reporting of all live births to ensure up to date denominator data should be institutionalised, either by way of good practice or legislation. Cooperation with the Department of Home Affairs may facilitate this.

Further Reading

Howarth, "The rising cost of litigation: a threat to private obstetric care?", "Medical negligence claims threaten NHI", HPCSA e-bulletin 30 April 2014, <https://www.aon.co.za/index.php/en/news-articles/302-soaring-medical-malpractice-claims-demand-statutory-intervention>).

Chapter 3. Hypertensive disorders of pregnancy

Abstract

There were 640 deaths associated with hypertensive disorders of pregnancy in South Africa for the triennium 2011 to 2013, accounting for 14% of deaths. This compares with 679 (14%) deaths in the 2008-2010 report.

Eclampsia remained the major cause of death and accounted for 347 or 54.7% of the hypertensive deaths for the period 2011-2013. There were 169 (24.2%) deaths due to pre-eclampsia; 28(4.4%) associated with chronic hypertension; 85 (13.3%) due to the HELLP syndrome and 5 (0.8%) related to liver rupture.

Cerebral complications were the final cause of death in 357(58.2%) of the cases, while pulmonary oedema was the cause of death in 155(25%) of cases.

A sizeable proportion of women died at home and some were assessed as avoidable factors such as poor quality of antenatal care , delay in referral and lack of transport both from home to a health facility and issues with inter facility transport'. Sixty-six % of the deaths were assessed as possibly or probably avoidable.

Deaths from hypertensive disorders of pregnancy were reported from all 9 provinces except for KwaZulu-Natal which had a decreased number of deaths due to hypertensive disorders of pregnancy. Avoidable factors viz. patient related, administrative and health professional, were identified. The problems identified in the previous reports (2008-2010) have not changed.

A review of a sample of patients' folders indicates that health care professional avoidable factors still play an important role. It was found that in many cases, clinical features of hypertensive disorders such as persistent proteinuria, haematuria, increased weight gain and third trimester oedema were recorded without any action being taken. In addition, pre-eclampsics requiring 2 or more anti-hypertensive agents were being managed as out-patients without an action plan and being managed by inexperienced health professionals.

In addition, patients with severe early onset pre-eclampsia were being managed with extreme conservatism despite clear indications for delivery in regional and tertiary hospitals. This was not a feature of the previous reports. Attention must be given to indicators suggesting poor maternal outcomes rather than attempting to achieve fetal viability to the detriment of maternal morbidity and mortality.

Thus improvement in the quality of antenatal care, failure to reduce severe high blood pressure, fluid balance management and instituting delivery timeously are major factors requiring attention.

Recommendations for reducing maternal deaths together with appropriate vignettes demonstrating lessons to learn and clinical management algorithms are presented.

Key Recommendations

Severe Acute Hypertension is a MAJOR ALERT.

1. Aggressive lowering of acute severe high blood pressure (BP \geq 160/110mmHg must be instituted (using clinical protocols outlined in the Maternity Care Guidelines) in a high care setting high care bed or dedicated high care.
2. Ensure continued measuring of BP, pulse rate, respiratory rates and urine output at frequent and appropriate intervals after “stabilization of high blood pressure” on admission, in the antenatal, intra-partum periods and up to 48 hour following delivery.
3. More attention must be paid to “Fluid Management” in all women with severe hypertension and eclampsia. Such patients should not be fluid loaded and all health professionals must examine the chest at regular intervals; “Be Aware of the Oedematous Patient” and those with renal dysfunction.
4. Females \leq 18 years and those \geq 35 years are in age groups at risk of pre-eclampsia and its complications. Reproductive health services in particular, contraceptive services, must be promoted in schools, the workplace, amongst families, and the community through the electronic and print media.
5. Improving the quality of antenatal care to ensure women at risk of high blood pressure are identified and that early signs of pre-eclampsia are detected so that timeous and appropriate interventions are instituted.
6. Establish district or regional centres of excellence for care of hypertensive patients and provision of advice on management of hypertensive disorders. Advice may be issued through call centres at a regional hospital.
7. Women with severe hypertension, eclampsia and the HELLP syndrome should NOT be managed at a district hospital. However, such patients must be identified appropriately, high blood pressure lowered, a magnesium sulphate regimen initiated and both the base hospital and emergency medical services informed of the urgency. Also phone the base hospital and use the SBAR from the transfer.
8. Strong consideration must be given to delivery of women with severe early onset pre-eclampsia in maternal interests.
9. Women with chronic hypertension and a history of a previous hypertensive disorder must be referred to the regional hospital for appropriate specialist antenatal care.
10. Attention to Emergency Obstetric Simulation Training (EOST-“Fire Drills”) on emergency hypertensive crises and indications for early delivery in women with early onset of pre-eclampsia must be provided.

Introduction

Hypertensive disorders of pregnancy (HDP) remain a major cause of maternal mortality globally. Since the first reports of NCCEMD in 1988, HDP have remained a major direct cause of maternal deaths in South Africa. This is because the exact cause of the disorder remains elusive and treatment is empiric. Clinical management is therefore dependent on the identification of the early signs of the disease and timeous delivery of the baby. Clinical management however is subjective and dependent on the experience of health professionals.

Table 3.1 shows the numbers, rates and trends of deaths due to HDP over previous reports. The number of deaths from HDP have declined slowly. This slow reduction in the number of deaths is an obvious concern. Guidelines for clinical management of HDP have been disseminated broadly throughout South Africa and rapid acting antihypertensive agents are widely available. It is possible that rapid turnover of staff indicates the need for continuing training on guidelines and the need for fire drills.

Table 3.1 Numbers, rates and trends of deaths from HDP

Time (years)	Number of Hypertensive deaths	%
2002 – 2004	628	19%
2005 – 2007	622	16%
2008 – 2010	679	14%
2011 – 2013	640	14%

Causes of Deaths

The primary cause of death in the sub-categories of HDP in table 3.2. The numbers of deaths for eclampsia since the last reports has remained the same .In fact the number of deaths in all subcategories of HDP has remained the same except for a slight decrease in the number of deaths from liver rupture; 9 (2008-2010) to 6 (2011 to 2013).

Table 3.2 Distribution of sub categories of hypertensive disorders of pregnancy

Sub-categories	2011-2013		2008-2010		2005-2007		2002-2004	
	N	%	N	%	N	%	N	%
Chronic hypertension	28	4.4	34	5.0	38	6.1	37	5.9
Proteinuric hypertension	169	26.4	299	29.3	173	27.8	171	27.2
Eclampsia	347	54.2	347	51.1	344	55.3	347	55.3
HELLP syndrome	85	13.3	86	12.7	54	8.7	70	11.1
Rupture of the liver	6	0.9	9	1.3	10	1.6	3	0.5
Acute fatty liver	5	0.9	4	0.6	3	0.5	0	0.0
TOTAL	640		779		622		628	

Note that all 3 rapid-acting antihypertensive agents can be associated with adverse events. Intravenous hydralazine may increase the risk of hypotension and maternal tachycardia; labetalol may cause neonatal bradycardia and should be avoided in women with asthma, heart disease or congestive cardiac failure; nifedipine has been associated with an increased risk of “overshoot” hypotension and tachycardia.

The concern that the combined use of magnesium sulphate and nifedipine has not been substantiated in a retrospective study, but careful monitoring is advisable.

The breakdown of the primary causes in subcategories for the triennium 2011 – 2013 are shown in table 3.3. It would appear that we may be beginning to see a decrease in deaths in certain categories of HDP over this triennium. There is a decrease in numbers of deaths from chronic hypertension and HELLP syndrome. The iMMR for HDP was 22.75 for the current triennium.

Table 3.3 – No. of deaths for the triennium 2011 – 2013

	Total	2011	2012	2013
All hypertensive	640	214	221	205
- Chronic hypertension	28	10	12	6
- Proteinuric hypertension	169	52	61	56
- Eclampsia	347	119	116	112
- HELLP	85	32	29	24
- Liver rupture	6	-	2	1
- Acute fatty liver	5	1	1	3

Table 3.4 shows the commonest final causes of death

Table 3. 4 Commonest final causes of hypertensive deaths

	2008 – 2010	2011 – 2013
Intracranial haemorrhage	157 (23%)	158 (24.7%)
Pulmonary oedema	188 (27%)	38 (5.9%)
Renal failure	95 (14%)	48 (7.5%)

There has certainly been a considerable fall in deaths assessed to be due to pulmonary oedema and renal failure. This is probably due to the emphasis placed on the fluid overload in the last report (2008 – 2010). However, deaths from the intracranial haemorrhage remain and is of extreme concern. Although a number of the patients with eclampsia did arrive in hospitals with low Glasgow Coma Scales with probable cerebral complications. In addition to intracranial haemorrhage, another 52 had cerebral oedema with evidence of coning.

Table 3.5 shows the final and contributory causes of maternal deaths from hypertension

Table 3.5 Final and contributory causes of maternal deaths from hypertension

	%
Circulatory system	13.2
- hypovolaemic shock	9.2
- septic shock	4.0
Respiratory failure	23.8
Cardiac failure	43.7
- Pulmonary oedema	24.6
Cardiac arrest	19.2
Pulmonary embolism	1.3
Renal failure	15.5
Liver failure	12.2
Cerebral complications	58.2
- Haemorrhage	25.0
- Cerebral oedema	8.2
- Meningitis	0.6
- Cerebral emboli	0.5
- Brain death following hypoxia	9.4
Unspecified	14.0
Haematological	20.3
- Severe Anaemia	7.0
Home deaths	3.0

It is difficult to distinguish what is being reported when patients are being reported to die from cardiac, renal or respiratory failure. Cardiac failure may lead to hypotension and pulmonary oedema, or both; renal failure might lead to pulmonary oedema. Certainly, we can state that cerebral complications are a major final cause of death.

The underlying causes of hypertensive deaths per province for 2011-2013 (expressed as iMMR) is shown in Table 3.6.

Table 3.6 Hypertensive deaths per province (expressed as iMMR)

	Hypertension (iMMR)	Total Provincial iMMR
Northern Cape	40.9	152.15
Western Cape	14.9	71.0
Eastern Cape	29.26	159.53
Free State	25.04	186.32
Gauteng	18.9	135.24
KwaZulu-Natal	14.2	168.61
Limpopo	31.23	191.0
Mpumalanga	30.8	172.0
North West	30.5	166.44

It would seem that WC and KZN had relatively low iMMR to hypertensive deaths. KwaZulu-Natal in particular, has had a remarkable fall in iMMR for hypertensive deaths. However, it's more rural districts e.g. Uthungulu and Umkanyakude have iMMRs similar to other rural districts in Limpopo and Mpumalanga. This may be due to poor inter-facility transport.

Table 3.7 Maternal age (years) and hypertension

	< 20	20 – 24	25 – 29	30 – 34	35 – 39	40 – 44
Hypertension	77	133	158	117	91	37
- Chronic	0	2	8	8	3	7
- Proteinuric hypertension	19	35	49	27	28	3
- Eclampsia	49	77	78	59	48	24
- HELLP	9	16	21	20	10	2
- Liver rupture	0	0	2	1	2	0
Acute fatty liver	0	3	0	2	0	0

From a pure numbers point of view, chronic hypertension is a disease of women 25 years and greater; this is expected, however the sub-categories of proteinuric hypertension, eclampsia and HELLP occur in all age groups.

Table 3.8 Parity and hypertension

	Parity 0	Parity 1	Parity 2	Parity 3	Parity 4	Parity 5
Hypertension	252	154	109	57	28	13
- Chronic	5	2	6	5	4	2
- Proteinuric hypertension	73	43	28	15	6	1
- Eclampsia	136	85	56	28	15	9
- HELLP	33	22	18	8	2	1
- Liver rupture	2	0	1	1	1	0
- Acute fatty liver	3	2	0	0	0	0

Eclampsia occurs most frequently in primigravidae; of the 252 deaths in primigravidae with hypertension, 136 died from eclampsia.

Although there are decreasing numbers of hypertensive deaths at district hospitals, there is still a need for improvement. Chart reviews indicate barriers to referral and issues with inter-facility transport. Surprisingly, there are increasing numbers of deaths in regional hospitals. This may be due

to increasing numbers of referrals from lower levels of health care or a lack of experienced staff at regional hospitals. The lack of staff is difficult to ascertain from patient folders.

Table 3.9 Hypertensive deaths at different levels of care

Level of Care	No. of hypertensive deaths
Home	10
Community Health Centre	21
District Hospital	141
Regional Hospital	232
Tertiary Hospital	209
Private Hospital	18

Table 3.10. Distribution of avoidable factors in hypertensive disorders

Avoidable Factors	All	HT
No suboptimal care	1299	158
Suboptimal care, different management would	471	52
Suboptimal care, different management might	1433	211
Suboptimal care, different management would	1167	210
The following filters have been applied:		
%	All	HT
No suboptimal care	29.7	25.0
Suboptimal care, different management would	10.8	8.2
Suboptimal care, different management might	32.8	33.4
Suboptimal care, different management would	26.7	33.3
	SA	HT
Possibly or probably avoidable deaths	2600	421
% of possibly or probably avoidable deaths per disease category	59.5	66.7
% of disease categories which contribute to possibly or probably avoidable		16.4

The percentage of possibly or probably avoidable factors was 66.7% and the percentage of deaths in which a different management would have led to a better outcome was 16.4%, and where different management might have led to a different outcome was 33.4%. These figures suggest that in most cases, guidelines for clinical management were not being followed during the antenatal, intrapartum and postpartum periods.

Table 3.11 Patient related avoidable factors

Description	All	HT
Lack of information	495	66
No Avoidable factor	2002	311
No antenatal care	682	105
Infrequent antenatal care	250	43
Delay in accessing medical help	1123	130
Declined medication / surgery / advice	194	28
Family problem	27	5
Community problem	6	1
Unsafe abortion	34	1
Other	168	19
Total cases	4370	4370
Filtered cases	4370	631
% of total cases	100	14.4

There were no avoidable factors in 311 patients. This was almost half of the 640 deaths due to HDP. A further 105 of the 640 (16%) had no antenatal care. This is a continuing concern and community

education is important to overcome this problem of booking and booking early in pregnancy for antenatal care.

Table 3.12 Administrative issues

	Total	HDP
Transport problem: institution to institution	200	46
Lack of accessibility: barriers to entry	36	8
Lack of accessibility: other	25	5
Delay initiating critical care (overburdened service)	249	43
Lack of health care facilities: ICU	250	47
Lack of health care facilities: blood/blood products	127	7
Lack of health care facilities: other	123	18
Lack of appropriately trained staff: Doctors	633	113
Lack of appropriately trained staff: Nurses	357	72
Communication problems: technical	61	8
Communication problems: interpersonal	111	15
Other	265	44
Assessable cases	4045	592
TOTAL	4370	4370

Inter-facility transport, delay in initiating critical care and lack of trained doctors & nurses were identified as avoidable factors. The lack of trained doctors and nurses may be a debatable issue, but may be related to delay in initiation of critical resuscitative care.

The health professional avoidable factors across different levels of care is shown in Table 2.13.

Table 3.13 Avoidable health professional factors

	1 ^o Level		2 ^o Level		3 ^o Level	
	N	%	N	%	N	%
Lack of information	28		38		22	
No avoidable factor	365		450		537	
Initial assessment	53	22.34	27	18.9	5	6.0
Problem with recognition / diagnosis	95	39.9	47	32.9	18	25.0
Delay in referring the patient	104	43.7	18	12.6	4	5.6
Managed at inappropriate level	67	28.2	15	10.5	0	0.0
Incorrect management (incorrect diagnosis)	37	15.5	17	11.9	11	15.3
Sub-standard management (correct diagnosis)	100	42.0	89	62.2	41	56.9
Not or infrequently monitored	21	8.8	15	10.5	10	13.0
Prolonged abnormal monitoring with no action	24	10.1	23	16.1	16	22.2
Assessable cases with AF	238		143		72	
Assessable cases	603		593		609	

Delay in referring patients (43.7%) was a major factor at 1^o level of care (clinics and district hospitals), as was problem recognition (39.9%) and substandard care. It would be that correct diagnosis was made, but sub-standard care offered. This is also supported by the fact that infrequent monitoring and prolonged monitoring without taking action also pointed to substandard care. It is difficult to ascertain whether this is due to poorly trained staff, lack of professionalism, or staff shortage.

Table 3.14 shows similar avoidable factors as indicated in previous reports and the lack of skills in dealing with airway, breathing and circulation problems. The ESMOE training modules are popular

and have been shown to improve skills and knowledge, which needs to be maintained by simulation training (fire drills) on a frequent basis.

Table 3.14 Resuscitative problems

	No.	%
Airway problems	25	15.06
Breathing problems	50	30.12
Circulatory problems	49	29.52
Drug problems	14	8.43
Investigation problems	9	5.42
Monitoring problems	19	11.45
TOTAL	166	

VIGNETTE 1

Beware the “Wet Chest” in pre-eclampsia

A 34 year old, P2 G3 at 36 weeks gestation

4 antenatal visits which were described as uneventful

Admitted to a district hospital, clinical findings – BP 160/120mmHg, proteinuria +++, oedema. Chest revealed coarse crepitations. A diagnosis of pneumonia was made and antibiotics prescribed. Patient referred to the next level of health care.

NOTE: high blood pressure was not lowered / and no X-ray done.

On arrival at the next hospital, she was dyspnoeic, had a cardiac arrest and resuscitation was unsuccessful

Lessons to learn:

If coarse crepitations are detected in women with pre-eclampsia, think pulmonary oedema, even if there might be clinical reasons for considering pneumonia (in this case, the patient was HIV positive with a CD₄ count of 140). At least an emergency X-ray should be done to confirm one or other diagnosis or treat as pulmonary oedema initially.

High blood pressure must be lowered using rapid-acting agents such as labetalol (IV), nifedepine or nepresol-dihydralazine. Labetalol should be the first line rapid-acting antihypertensive agent.

See Boxes for Labetalol Dosages

VIGNETTE 2

Poor quality of antenatal care at a regional hospital

35 year old G4 P3, previous C/S x 2, booked at a community health clinic x 3 visits. First booking at 26 weeks; booking bloods normal

1Feb12 – referred to a regional hospital for previous C/S x 2 at 28 weeks gestation. Seen by doctor, TCA 13Feb12 for scan.

13Feb12 – seen at regional hospital ANC, BP 140/90, urine NAD. Fetal movements felt by mom. Seen by doctor who requested BP to be repeated and if normal, patient to be discharged and return in 1 week for follow-up. BP review not recorded.

28Feb12 – seen at regional hospital ANC. BP 151/91mmHg, urine protein 2+ with oedema of lower limbs. FMF by mom. Seen by doctor, diagnosed as GPH. Bloods for maternal panel taken. Started on aldomet 250mg tds. Plan was if results normal, to discharge t. TCA 5Mar12.

12Mar12 – patient only came now for follow-up; seen and given TCA 26Mar12.

19Mar12 – seen at regional ANC c/o oedema of lower limbs, FMF by mom. BP 150/90, no record or urine, blood for maternal panel repeated; TCA in 2 weeks for blood results

3Apr12 – came for review, BP 185/119, 2+ proteinuria. Adalat 10mg p/o given. BP rechecked after 30minutes = 173/114. Seen by medical officer. Diagnosed as GPH with uncontrolled BP. Plan was to admit and repeat maternal panel and book for elective C/S. Admitted in m3w and booked for elective C/S on 5Apr12 but not done due to emergencies in theatre. Patient rebooked for 10Apr12. Kept in m3w.

9Apr12 – seen on ward rounds and valvular heart disease queried. CTG reactive and not in labour. Booked for ECHO on 10Apr12 and then for elective C/S. Patient c/o difficulty in breathing and vomited pinkish frothy vomitus, oxygen saturation 45%. MO notified, patient t/f to labour ward high care unit. Seen by MO and diagnosed as pulmonary oedema. Lasix 120mg given IV stat. BP 141/100, oxygen saturation 65%. Patient fully conscious. Fetal distress noted and patient counselled for emergency C/S, which was done under general anaesthesia. At 13h45 a live male infant was delivered, Apgars 3/10, 5/10, 7/10, seen by paediatrician and t/f to M3N. Mother had cardiac arrest in theatre and was resuscitated successfully. There were no beds available in ICU at regional hospital. Arrangements made through hospital superintendent – patient for transfer to a tertiary hospital ICU. No paramedics available, patient transported by an ordinary ambulance escorted by an intern doctor and midwife at 15h30 who were bagging and suctioning the patient though suctioning was difficult due to a manual machine. Patient arrested again en route to tertiary hospital. Resuscitated but failed due to inadequate resuscitative equipment. Equipment available was oxygen cylinder, Ambubag and manual suction apparatus. Patient was certified dead on arrival at tertiary hospital ICU at 16h20.

Missed Opportunities

Patient should have been admitted to hospital earlier during antenatal care for pre-eclampsia.

She should have been given an earlier return date for blood pressure check-up instead of a month

If thorough physical examination is done to each and every patient, cardiac problems can be identified earlier and therefore early interventions instituted.

Patient with uncontrolled blood pressure was supposed to have been admitted in a high care area for close monitoring instead of being admitted to an antenatal ward

Because of the high volume of emergency C/S, patient's elective C/S due on 5 Apr12 was cancelled

Anaesthetic MO could have called anaesthetic consultant to assist with administration of anaesthesia.

Chapter Head's Comments

The above comments were made by the PPIP co-ordinator at the regional hospital. In my view, this case illustrates more than sub-standard care. It is poor, poor antenatal care and illustrates the following:

The term GPH should not be used because it doesn't convey the seriousness of the condition. Patients must be classified into mild to moderate pre-eclampsia and severe pre-eclampsia. The diagnosis should be pre-eclampsia (BP \geq 140/90 and proteinuria). It is better to classify the sub-categories of HDP into:

Gestational hypertension, i.e. new onset hypertension (\geq 140/90mmHg, no proteinuria) – these patients may be managed as outpatients depending on severity of the blood pressure. If 2 antihypertensive agents have to be used, manage as an inpatient or seek advice. Usually delivered before 40 weeks gestation, all being well. Decision to be made by specialist or his/her advice obtained.

This patient was 35 years old with 2 previous C/S; once BP of 140/90 was noted, a detailed history for indications should have been taken; the urine rechecked for protein and a complete physical examination done. The patient should preferably have been admitted for a 24 hour urine of proteinuria and an estimation of serum urates, platelets, and haemoglobin.

Certainly when she returned 2 weeks later and her blood pressure was 151/91mmHg, 2+ proteinuria and had oedema – she should have been admitted with a diagnosis of mild to moderate pre-eclampsia (not given aldomet and sent home). No assessment of the fetus was done. Such patients must be admitted, investigated and examined by a specialist.

The patient had 2 other visits – very poor notes but managed as an outpatient; this was in the patient's case notes.

Pre-eclampsia – high blood pressure and proteinuria. If BP 140-150/90-109mmHg, then label as mild to moderate pre-eclampsia. Such patients must be admitted for FBC including platelets, serum urates, creatinine, urea and liver function tests done, fetal function must be evaluated fully (clinically, sonar, CTG). Can be treated as outpatient after BP stabilised but consider delivery if more than 2 antihypertensive agents required. Deliver in the 37th week of pregnancy. Obtain specialist advice in respect of this and look closely at maternal and fetal markers for delivery. Outpatient management of such high risk patients should involve a specialist or a medical officer experienced in maternity care.

Severe hypertension / pre-eclampsia / imminent eclampsia – BP \geq 160/110mmHg is a **MAJOR ALERT** and should be managed by a team (specialist obstetrician / experienced anaesthetist / critical care specialist / physician. See Boxes 1, 2 and 3 re. management.

She had 3 visits where assessments were non-existent / poor; poor documentation.

She had an antenatal visit in which her BP was 185/119mmHg and 2+ proteinuria. She was given nifedipine 10mgs as an outpatient, presumably by a professional nurse, and only seen 30 minutes or more after by a doctor with a plan to admit and do an elective C/S. THIS WAS POOR MANAGEMENT. No diagnosis was made in this case. Please be aware that severe hypertension is a major alert, warranting a team management and immediate admission to a high care bed or a bed dedicated for this purpose. Once BP is stabilised, the patient requires urgent delivery – not a planned elective C/S. (See boxes 1, 2 and 3 for management of severe hypertensive crises).

It is of extreme concern that doctors at a regional hospital do not understand the management of a hypertensive crisis.

Lessons to learn from this case:

The need to improve the quality of antenatal care at all levels of health care

To ensure that if a diagnosis of pre-eclampsia is made, patients are admitted, appropriate investigations (maternal and fetal) are carried out. The patient seen by a specialist or advice obtained from a maternal health specialist and a PLAN OF MANAGEMENT recorded.

Severe hypertension (\geq BP 160/110mmHg) is a MAJOR ALERT warranting immediate close monitoring and lowering of high blood pressure.

All patients should have proper documentation made following examination.

VIGNETTE 3

Antenatal Care at Community Health Centres : referral Indicators

P2, G3 age 29 had 2 visits to a community health centre for antenatal care:

Her BP was not taken at her first visit. She was not on any chronic medication

At her second visit, BP 170/103 which settled to 160/90. The urine examination was NAD. She was started on methyldopa and advice on nutrition was provided (low salt diet)

A month later she had a BP of 172/101mmHg and the dose of aldomet was increased and she was asked to return in 2 weeks.

She was brought to the clinic 2 days later, unconscious.

Lessons to learn:

Patients who are found to have hypertension in pregnancy at a CHC must be referred to the base hospital. In this case she had a BP of 160/100 but was being treated at the clinic. She should have been referred to the base hospital (a telephone call should have been made to the base hospital, advice obtained about the date of referral).

Referral patterns and referral indicators must be established.

All health professionals must be advised on referral patterns and indicators every 6 months. District health specialist teams must take responsibility for training on referral indicators. In this case, she had 3 antenatal visits and on 2 occasions, there was high blood pressure. Therefore there were 2 missed opportunities to refer.

Guidelines on hypertension must include the fact that either a sustained systolic of > 160mmHg or sustained diastolic > 110mmHg is dangerous. In this case the systolic BP (> 160mm was sustained). There was failure to recognise this.

VIGNETTE 4

Beware Severely Oedematous Patients with Renal Impairment

27 year old P1 G2 at 34 weeks gestation (> 2kg baby)

Booked at local clinic where she had a BP of 197/133mmHg. She was referred to a tertiary hospital but only arrived 3 days later.

Tertiary hospital diagnosed as pre-eclampsia with > 2kg baby. Also had renal dysfunction.

Patient only delivered 5 days later because of deteriorating renal function on tests

On day 2 following C/S, sudden acute respiratory distress – resuscitation unsuccessful.

Lessons to Learn

Transfer from local clinic – patient may have absconded. Appropriate counselling of patients and follow-up is essential.

Delay at tertiary hospital in planning delivery of a severe hypertensive. Plan of action of high risk patients must be made.

Fluid management may have been a problem. She was oedematous, had renal dysfunction and was encouraged to increase intake of fluids

Cause of death may have been pulmonary oedema or pulmonary embolus

Fluid management is a priority in the oedematous pre-eclamptic

HEALTH INFORMATION TO THE COMMUNITY PAMPHLET

HEALTH BULLETIN

INFORMATION FOR WOMEN, THEIR PARTNERS, FAMILIES AND COMMUNITIES

HIGH BLOOD PRESSURE (BP) IN PREGNANCY KILLS

Purpose of this Bulletin

To bring to your attention that high blood pressure is dangerous for women, men and children. It is a particular health hazard in pregnancy.

What should you do?

You may be at risk if you have a family history of high BP or high BP in a previous pregnancy, or in age groups ≤ 18 and ≥ 35 years old.

Therefore

Have your BP checked at your nearest clinic

Plan your pregnancy; the best time is between the ages of 19-34 years old

If you do become pregnant, start attending an antenatal clinic early at 10 weeks.

Why is this information important?

If you have high BP, starting treatment early can prevent complications and even death.

References

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Firoz T, Magee L, McDonald K, et al. Community Level Interventions for Pre-Eclampsia Working Group. Br J Obstet Gynaecol 2013; 120: 657-60.

Reducing deaths due to HDPs via the 5 C's: Care (Quality of Care); Coverage , Contraception; CS (Safe CS) and the Community

Care

Improve quality of antenatal and post natal care

- Detection of high BP, proteinuria, haematuria, excessive weight gain and third trimester oedema. Once detected, ensure you phone your base hospital for advice regarding further management of women with such signs (if at a clinic or district hospital).
- If necessary, refer to your base hospital's next clinic within a week. If BP severe, > 160/110mmHg, ensure to phone base hospital immediately. All patients with severe hypertension are a MAJOR ALERT.
- Ensure proper history taking, refer if chronic hypertension, previous history of pre-eclampsia, abruptio placenta, unexplained stillbirth. Phone base hospital for advice and refer if appropriate to next antenatal clinic of base hospital
- All patients with risk factors should preferably be seen more frequently at antenatal clinic – 2 weekly from 28-36 weeks gestation, then weekly until delivery.
- Establish district / or a number of regional centres for high risk patients

Improve quality of postnatal care

- Ensure women with hypertension have their blood pressures taken frequently following delivery; those with severe hypertension should have blood pressure measured at intervals indicated in Boxes 1, 2, 3, (Management of severe hypertension)
- No patient with hypertension should be discharged within 6 hours of delivery. All patients with HDP must have their BP checked and blood investigations done (platelets, urea and creatinine) and show an improving trend.
- Establish a postnatal clinic to which all HDP can be seen 6 days after discharge to check BP, proteinuria and renal function.

Improve on quality of care for women with hypertensive crises (severe BP; eclampsia; HELLP; Pulmonary Oedema and Abruptio Placentae)

- Major alert
- Team management
- Aggressive lowering of severe hypertension
- High Care bed / or one created for the individual case
- Close monitoring of blood pressure before delivery / before transfer of patients / post-delivery – see Boxes 1, 2, and 3.
- Women with severe early onset pre-eclampsia should be delivered earlier, rather than being managed expectantly. Such patients must be managed by experienced maternal health specialists or an experienced obstetrician.

Safe Caesarean Section (C/S)

- Ensure that anaesthetists are informed of all severe pre-eclamptics because a great majority will require C/S. Abdominal delivery may be associated with findings of abruptio, development of bleeding defects, low platelets and postpartum haemorrhage.
- Patients may also develop HELLP and/or liver rupture. Anaesthetists need to be aware.

- Have clear and strict guidelines for anaesthesia in severe HDP. Platelet counts and peripheral blood smears (in platelet counts < 150,000) should be done. The HELLP syndrome should be excluded if the platelet count is low and in such a situation, liver rupture or haematoma must be considered. C/S for patients with severe hypertension and HELLP should be done by a specialist obstetrician or experienced medical officer. These patients are also prone to PPH/abruption.
- Anaesthetist should be aware that endotracheal intubation may cause further increases in high blood pressure and precautionary measures should be taken. Care must be given when regional anaesthetist is used for patients with hypertensive crises. In such cases a very experienced anaesthetist should be contacted.
- All patients with a hypertensive crisis should have close monitoring in a high care bed post-delivery (see algorithms on management of severe hypertension in pregnancy).

Coverage

- Ensure that all pregnant women are provided with folic acid calcium supplementation from early pregnancy for prevention of HDP.
- Ensure rapid and reliable inter-facility transport
- Ensure that barriers to transfer are overcome by establishing clear, strict referral patterns and referral indicators within a health district.
- Encourage use of *Mom Connect*
- Create 24 hour call centres to provide advice on, and for the management of HDP

Contraception

- Promote PLAN YOUR PREGNANCY
- Promote contraceptive advice and use for young women ≤ 18 years and adult women ≥ 34 years of age. (Delay pregnancies in young women; promote tubal ligation in women who are over 34 years of age and have completed their families).

Community

- Promote the importance of early antenatal care. The first antenatal booking should be at 10 weeks gestation or approximately 2 missed menstrual periods)
- Disseminate information pamphlets on symptoms and signs of pre-eclampsia and the advantages of ante natal care
- Provide information on the need for preparedness for labour, including the arrangements for transport.

Training and Continuing Medical Education

- Ensure that ESMOE/EOST training and proper record-keeping/documentation in clear hand writing is promoted for all health professionals during undergraduate and postgraduate years, and throughout their careers (CPD).
- Ensure Review Meetings are conducted regularly at all levels of health care.
- Ensure Medical Schools and Nursing Colleges place emphasis on professionalism during the undergraduate and post graduate years (including their internship and Community service years).

HEALTH STRENGTHENING AND HYPERTENSION

- Ensure all facilities have working blood pressure machines and equipment for resuscitation

- Ensure that rapid acting agents, nifedipine 10mgm orally (at all levels of health care), and labetalol are available at regional and tertiary district hospitals.
- Ensure that the DCST discuss referral criteria and patterns at all health facilities.
- Ensure overcoming of obstacles to referral and ensuring that doctors are available at all times and that specialists examine patients physically.
- Ensure improvement in ambulance services
- Ensure doctors document all findings each time a patient is examined or transferred.
- The implementation of the 5 C's will reduce deaths from HDP. However, the Basic Building Blocks (3 B's) in relation to hypertension also need to be strengthened.

MANAGEMENT OF ACUTE ONSET SEVERE HYPERTENSION DURING PREGNANCY, LABOUR AND THE IMMEDIATE POSTPARTUM PERIOD

Acute onset, severe hypertension (≥ 160 mmHg systolic; ≥ 110 mmHg diastolic blood pressure sustained systolic or diastolic of those high levels are also included in this diagnosis), can occur during pregnancy or in the immediate postpartum period. This degree of severe hypertension is now known to be associated with cerebral nervous system injury. Almost 50% of deaths due to hypertensive disorders of pregnancy in South Africa are due to cerebral haemorrhage (Saving Mothers 2011-2013).

Acute severe hypertension usually occurs in the second and early third trimesters of pregnancy in women not known to have chronic hypertension. However, it can also occur in 20-30% of pregnant women with chronic hypertension. Such cases require lowering of high systolic and diastolic blood pressure to levels in a range of 140-150/90mmHg in order to prevent repeated prolonged severe systolic hypertension with subsequent loss of cerebral vasculature auto regulation.

Hypertensive emergencies can occur at different settings; in a clinic or a hospital setting, either prior to delivery, or in the immediate postpartum period. Another setting is in the operating theatre where there is the risk of severe hypertension associated with endotracheal intubation. Precautions against this must be taken. Furthermore, women with pre-eclampsia are more prone to post-partum haemorrhage.

Recommendations for the management of acute severe hypertension are shown in the boxes below:

Regard Severe Hypertension in Pregnancy as MAJOR ALERT

- Notify the most experienced doctor in the health facility (experienced medical officer, specialist), and if appropriate contact the base / referral hospital
- Institute fetal heart rate monitoring if fetus is viable and undelivered
- If BP persists after 15 minutes, or if the woman has signs and symptoms of impending eclampsia (persistent headache, epigastric pain, increased peripheral reflexes) use Labetalol as your first line agent
- Administer labetalol (20mgms IV over 2 minutes)
- Repeat BP in 10 minutes and record results
- If either BP threshold (systolic or diastolic) is still exceeded, administer labetalol 40mg IV over 2 minutes. If BP is below threshold, then continue to monitor BP closely.
- If either threshold is still exceeded, administer labetalol (80mg over 2 minutes). If BP is below threshold, continue to monitor BP closely
- Repeat BP in 10 minutes and record results.
- If either BP threshold is still exceeded, discuss with an obstetric medicine expert / critical care specialist / obstetric anaesthetist regarding use of the following:
 - Dihydralazine 10-12.5 mgs IV over 4 minutes
 - Nifedipine 10mgs orally (not chewed or sublingually)
 - Oral labetalol 200mgs / or labetalol infusion
 - Sodium Nitroprusside – rarely used.
- If threshold BPs achieved, continue BP timing per specific order. This should manually be as follows: repeat blood pressure:
 - @ 10 minute intervals for 1 hour
 - then at 15 minute intervals for 1 hour
 - then 30 minutes for 1 hour
 - then every 4 hours.

Note that additional treatment such as magnesium sulphate for the prevention of convulsions (not used as an antihypertensive agent) must be instituted and pulse rate, urine output and respiration rate measured at regular specified intervals.

Note also that delivery of the baby should not occur prior to the high blood pressure being lowered.

Lowering of severe hypertension in pregnancy and the immediate postpartum period with oral nifedipine

- Notify most experienced obstetrician or medical officer
- Institute fetal surveillance if fetus is undelivered and viable
- If severe hypertension persists for 15 minutes or more, administer nifedipine (10mg orally...not sublingually and not chewed)
- Repeat BP in 20 minutes and record results
- If either BP is still exceeded, administer nifedipine 20mgs orally. If BP is below threshold, continue to monitor closely
- Repeat BP in 20 minutes and record results
- If either BP is still exceeded, administer nifedipine 20mgs capsule (orally). If BP is below threshold, continue to monitor closely
- Repeat BP measurement in 20 minutes and record results
- If either BP is still exceeded, administer labetalol 40mgs IV over 2 minutes and obtain emergency consultation with obstetric medicine / critical care / physician / obstetric anaesthetist experts
- Institute additional BP measurement per specific order.

Management of severe hypertension in pregnancy or the immediate postpartum period with dihydralazine (nepresol)

- Notify experienced medical officer and experienced specialist if BP is > 160mmHg systolic and/or diastolic \geq 110mmHg
- Institute fetal surveillance if undelivered and viable
- If BP elevations exist for 15 minutes or more, administer hydralazine 6.25 or 12.5mgs IV over 2-4 minutes
- Repeat BP measurement in 20 minutes and record results
- If either BP threshold is still exceeded, administer hydralazine 12.5mg over 2-4 minutes. If BP is below threshold, continue to monitor closely
- If either BP threshold is exceeded, administer labetalol 20mg over 2 minutes
- Repeat BP levels in 10 minutes. If threshold lowered, continue close BP monitoring
- If BP thresholds elevations persist, administer labetalol 40mg IV over 2 minutes and obtain advice from obstetric medicine / critical care / physician / obstetric anaesthetist experts
- Give additional antihypertensives per specific order
- Once the abovementioned BP thresholds are achieved, i.e. \leq 140 systolic and less than 110 diastolic, repeat BP measurements:
 - every 10 minutes for 1 hour
 - then every 15 minutes for 1 hour
 - then every 30 minutes for 1 hour
 - then 4 hourly.

4. Obstetric Haemorrhage

Abstract

Obstetric haemorrhage was the second most common cause of maternal death in South Africa for the triennium 2011 to 2013, accounting for 684 deaths or 15.8% of the total. This compares with 688 (14.1%) deaths in the 2008-2010 triennium. The haemorrhage related maternal mortality ratio (MMR) was 24.3 deaths per 100,000 live births, which is similar to 24.9 in 2008-2010 but higher than the MMR of 18.8 in 2005-2007. There was considerable provincial variation with the iMMR due to haemorrhage being highest in North West (35.8), Limpopo (33.6) and Mpumalanga (33.0) and lowest in Western Cape (5.0). As in the previous triennium, maternal age over 35 years was a risk factor for deaths from obstetric haemorrhage, with 31.6% of the deaths occurring in women over 35 years of age. The current report shows that prolonged labour and anaemia were common underlying factors occurring in 25.3% and 30.3% respectively. The major causes of death from haemorrhage were similar to the previous triennium: bleeding associated with caesarean section (32.3%), abruptio placentae (16.1%) uterine rupture (15.1%), uterine atony (7.3%) and retained placenta (6.6%). Of concern is the increasing numbers of deaths due to bleeding after caesarean section (CS) and the continuing high numbers due to abruptio placentae and ruptured uterus. The majority of deaths (93.9%) occurred at public hospitals: 36.7% at district hospitals, 39.5% at regional hospitals and 17.7% at tertiary hospitals. This is similar to the proportion of deliveries and CS performed at each level of hospital, suggesting that the women tend to die from haemorrhage at the level where they delivered or had their CS. Assessors judged 89.3% of these deaths to have a possible or probable avoidable factor; and 61.5% were thought to be probably avoidable. Patient related avoidable factors, mostly delay in seeking care, were present for 30.7%. Administrative factors occurred for 61.9%, highlighting major problems in health facility management and training. Administrative factors included lack of blood (13.7%), delays in inter-institution transport (12.2%), delays initiating clinical care due to overburdened services (10.2%), and a worrying 40.6% due to lack of appropriately trained doctors (27%) or nurses (13.6%), especially at district hospitals. Health worker related avoidable factors occurred for 52.3% of assessable deaths at district hospitals, 34.8% at regional hospitals and 11.8% at tertiary hospitals. Analysis of avoidable factors indicates that focus needs to be addressed to district hospitals particularly in the provinces with greatest numbers and rates of haemorrhage deaths.

Review of a sample of folders suggests that there is improved monitoring of obstetric patients postpartum and after CS compared to previous triennia. However there is serious concern about lack of sufficient response to signs of ongoing bleeding and shock. A very frequently cited avoidable factor is "lack appropriately trained doctors" at district hospitals, suggesting that ESMOE/EOST training is not filtering down to doctors at this level. This is illustrated by: poor use of uterotonic drugs at CS and for managing PPH; lack of skills to perform EUA/laparotomy for severe PPH after vaginal delivery; lack of skills to perform relook laparotomy for bleeding after CS where referral of an unstable patient is instead decided upon; infrequent use of uterine compression sutures and tourniquets; poor resuscitation in abruptio placentae and inadequate management of subsequent PPH. Many women died in the ambulance just before, during or immediately after referral from a

district hospital. Recommendations for reducing OH deaths and management algorithms are presented.

Key recommendations

1. Prevent anaemia, prolonged labour and second stage Caesarean section (CS)
2. Hospital managers to ensure a continuous stock of emergency blood and freeze dried plasma to be available at district hospitals
3. Implementation of standard protocols for use of uterotonic agents for (a) Induction of labour and (b) for prevention /management of PPH after vaginal delivery and at CS
4. Where possible, to ensure women with abruptio placentae plus fetal demise are referred to and deliver at regional hospitals
5. Direct Telephonic links for 24 hour specialist support to district hospital doctors.
6. Emergency transport to be onsite for transfers from district hospitals.
7. All women with blood loss in excess of 500 mls and ongoing, need to be immediately resuscitated, bleeding controlled, and a doctor called to assist.
8. Training to focus on problem recognition and skills training of doctors performing CS, other surgical procedures, and anaesthetics for obstetric patients at district hospitals.
9. Essential skill competencies to include: CHCs – Manual Removal of Placenta (MROP); District hospitals – MROP, safe caesarean section, balloon tamponade, uterine compression sutures and uterine tourniquet; and at Regional /Tertiary hospitals – all of the above plus hysterectomy.

Introduction

During the triennium 2011-2013, there were 684 deaths from obstetric haemorrhage (OH). Obstetric haemorrhage was the second third most common cause of death accounting for 15.8 % of total deaths. This proportion has increased from 14.1% during 2008-2010¹. If denominator data for live birth estimates from DHIS data are used, then the Obstetric Haemorrhage related maternal mortality ratio (MMR) for the current triennium (2011-2013) was 24.3 deaths per 100,000 live births compared to 24.9 for the previous one (2008-2010). From the overview chapter it is quite clear that these OH deaths are the most avoidable group, 89.3% were probably or possibly avoidable. An in-depth assessment of these deaths therefore is vitally important to develop more effective interventions to tackle the problem.

Globally obstetric haemorrhage remains a major cause of maternal death accounting for 27.1% of maternal deaths²; and accounts for an even larger proportion in poor resource setting³. It is an obstetric emergency which particularly tests the accessibility and functioning of the health system because it progresses in severity so rapidly, and prompt effective action at the site where the OH occurs is life-saving. Women with OH do not always survive referral to the next level of care.

Obstetric haemorrhage cannot always be prevented, but antenatal and intrapartum assessment which enables women at risk to be transferred from clinic to hospital should allow delivery to take place in a hospital with more opportunities for resuscitation and arresting haemorrhage. Also antenatal detection and treatment of anaemia and chronic illnesses such as HIV can improve maternal health before the onset of labour. In addition active management of the third stage of labour contributes to a reduced risk of PPH. The two pillars of management of severe obstetric haemorrhage are aggressive resuscitation and various treatment modalities to arrest the haemorrhage. There are well known medical and surgical treatments for the different causes of obstetric haemorrhage, which can be implemented at each level of care⁴. These are described in detail in the PPH monograph produced by the NCCEMD in 2010⁵. Support by a regionalised tiered maternity system with available supply of blood products and good transport systems for referrals with severe haemorrhage, are also essential.

The 684 maternal deaths from obstetric haemorrhage during 2011-2013 will now be described in more detail and the data compared with the previous triennium.

Results

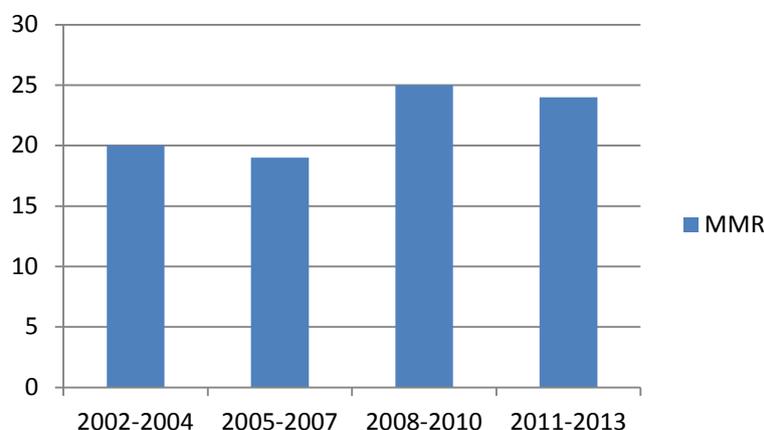
Overall Maternal mortality ratio (MMR).

In the current triennium, the number of maternal deaths from obstetric haemorrhage and the MMR from haemorrhage remains high, similar to the previous triennium, with 684 deaths and an institutional MMR of 24.3 deaths per 100,000 live births. This is similar to the previous triennium but significantly greater than that for the 2002-2004 triennium.

Comparing the three years within the triennium, there were 233 OH deaths in 2011 (MMR 24.9), 242 in 2012 (MMR 25.7), and 209 (MMR 22.3) in 2013. The small reduction in 2013 could be due to closure of the database earlier in 2014 to analyse the deaths, or could represent early signs of a downward trend.

Figure 4.1 displays the trend of OH related MMR over the recent triennia.

Figure 4.1. Institutional MMR due to Obstetric haemorrhage in 2011-2013 compared to previous triennia



Provincial distribution of haemorrhage deaths

Table 4.1 (a) and (b) show the distribution of haemorrhage deaths by province and a comparison with previous triennium. The largest number of haemorrhage deaths occurred in Gauteng, Kwazulu Natal and Limpopo provinces. There was considerable provincial variation in haemorrhage MMR, being highest in North West province (35.8), Limpopo (33.6) and Mpumalanga (33.0); and lowest in Western Cape (5) In terms of trends between triennia, Free State which had one of highest MMR from OH in the 2008-2010 triennium (41.7) has shown a marked decline to 23.6 in 2011-2013. Other provinces showing smaller decreases in MMR were North West, Mpumalanga , E Cape, and W Cape. Small increases in OH MMR were noted in Limpopo, Gauteng and Kwazulu Natal, with minimal change noticed in N.Cape.

Table 4. 1(a) Distribution Obstetric Haemorrhage within the provinces 2011-2013

Obstetric Haemorrhage	N	%	Institutional MMR*
Eastern Cape	88	12.9	24.3
Free State	34	5	23.6
Gauteng	148	21.6	24.1
KwaZulu-Natal	122	17.8	21.7
Limpopo	128	18.7	33.6
Mpumalanga	75	11	33
North West	62	9.1	35.8
Northern Cape	13	1.9	20.4
Western Cape	14	2	5
Total	684	100.0	24.3

MMR=number maternal deaths per 100,000 live births

Table 4.1 (b) Provincial comparisons of haemorrhage related MMR between triennia

Province	MMR 2011-2013	MMR 2008-2010
Eastern Cape	24.3	28.4
Free State	23.6	41.7
Gauteng	24.1	22.4
KwaZulu-Natal	21.7	17.1
Limpopo	33.6	29.2
Mpumalanga	33.0	36.3
North West	35.8	45.9
Northern Cape	20.4	21
Western Cape	5.0	7.3
Total	24.3	24.9

It is notable that there was considerable variation in OH MMR between districts, ranging from 63.6% in the district with the highest OH MMR to zero in a few districts with no OH deaths in the recent triennium. Such district variations reflect socio-economic determinants, distribution of facilities, and referral patterns, as well as quality of care.

Underlying factors for haemorrhage deaths.

Age and Parity: Women who died from haemorrhage were more likely to be 35 years or older compared to the general population, 31.6% versus 14.8% (Table 4.2). There are no comparative figures against which to compare parity. 67.2% of women were parity 0-2, with 8.3% being grand multipara (Table 4.3)

Table 4.2. Relationship of Obstetric Haemorrhage to maternal age

Age category (years)	N	%	General pregnant population* %
< 20	49	7.2	12.2
20 - 24	96	14.0	27.4
25 - 29	158	23.1	26.4
30 - 34	164	24.0	19.3
35 - 39	130	19.0	11.0
40 - 44	64	9.4	3.5
45+	22	3.2	0.3
Unknown	1	0.1	
Total N	684	100.0	

* Data for distribution of general pregnant population is derived from Recorded Live Births 2012, Statistics South Africa; Statistical release P0305

Table 4.3. Relationship of Obstetric Haemorrhage and parity

Parity	N	%
P0	143	20.9
P1	154	22.5
P2	163	23.8
P3	103	15.1
P4	54	7.9
P5	37	5.4
P6+	20	2.9
Unknown	10	1.5
Total	684	100.0

HIV status:

40.2% of all women with maternal deaths from haemorrhage were HIV positive. If only those tested are considered, 45% were HIV positive; this is considerably higher than the national prevalence.

Anaemia:

30.3% of women were anaemic.

Prolonged labour:

25.3% of women had prolonged labour. This increased to 26.8% of deaths due to uterine atony, 30.9% of deaths from ruptured uterus and 38.6% for deaths from bleeding associated with CS.

Timing of emergency event and deaths. (Table 4.4)

The majority of deaths (87.5%) occurred in the postpartum period; in 53.5% the emergency event occurred postpartum but in 44.6% the emergency event was antepartum or intrapartum.

Table 4.4 Timing of emergency and timing of death of Obstetric Haemorrhage

	Timing of emergency		Timing of death	
	N	%	N	%
Antenatal period	116	16.8	36	5.4
Intrapartum period	191	27.8	48	7.1
Postpartum period	368	53.5	587	87.5
Anaesthesia	13	1.9	7	1

Causal sub categories of maternal deaths due to Obstetric Haemorrhage

Table 4.5a shows the causal subcategories of haemorrhage; and compares them with the previous triennium. The major causes of death from haemorrhage were similar to the previous triennium: bleeding associated with caesarean section (32.3%), abruptio placentae (16.1%) uterine rupture (15.1%), uterine atony (7.3%) and retained placenta (6.6%). Of concern is the increasing numbers of death due to bleeding after CS and the continuing high numbers due to ruptured uterus and abruptio placentae. There were 8 deaths classified as 'APH-non specified' and 84 classified as 'PPH-non specified'. The latter group is thought to represent PPH after vaginal delivery in which the cause has not been identified, reflecting insufficient attempts to ascertain the cause. The proportion of deaths due to uterine atony has remained similar and that for retained placenta decreased slightly when compared to the previous triennium. The deaths from uterine atony need to be interrogated further. It could be that some have been misclassified under the 'PPH-non specified group'. This would reflect problems with health workers not identifying the cause of the PPH. Also it is important to note that uterine atony, particularly following prolonged labour, was often the cause of the bleeding associated with CS.

Table 4.5a. Distribution of sub-categories of Obstetric Haemorrhage

Obstetric Haemorrhage	2011-2013	2011-2013	2008-2010	2008-2010
	N=684	%	N=688	%
- Abruptio without hypertension	54	7.9	63	9.2
- Placenta praevia	16	2.3	13	1.9
- Other APH not specified	8	1.2	25	3.6
- Ruptured uterus with previous c/s	52	7.6	47	6.8
- Ruptured uterus without previous c/s	51	7.5	61	8.9
- Retained placenta	45	6.6	62	9.0
- Morbidly adherent placenta	17	2.5	19	2.8
- Uterine atony	50	7.3	44	6.4
- Vaginal trauma	4	0.6	9	1.3
- Cervical trauma	21	3.1	11	1.6
- Bleeding during Caesarean section	42	6.1	30	4.4
- Bleeding after Caesarean section	179	26.2	150	21.8
- Inverted uterus	5	0.7	4	0.6
- other PPH-non specified	84	12.3	103	15

Table 45b shows OH MMRs per causal subcategory, using total live births (N=2,812,597) as the denominator. These OH MMRs are compared with those of the previous triennium.

Table 4.5b Comparison of OH MMRs with previous triennium

	2011-20103		2008-2010	
	No	MMR	No	MMR
Bleeding at/after CS)	221	7.85	180	6.24
Abruptio placenta	110	3.91	110	4.0
Ruptured uterus	103	3.66	108	3.9
“Other PPH”	84	2.98	103	3.7
Retained/adherent placenta	62	2.2	81	2.9
Atonic uterus	50	1.77	44	1.6
Vaginal /cervical trauma	25	0.88	20	0.69
Placenta praevia	16	0.56	13	0.5
“Other APH”	8	0.28	25	0.69
Inverted uterus	5	0.17	4	0.1
TOTAL	684	24.3	688	24.9

The proportion of deaths and MMR due to abruptio placentae and ruptured uterus has not changed and both remain as a major causal subcategory. Of particular concern is the high proportion in this category which is due to uterine rupture without previous CS. Many of these were due to prolonged obstructed labour but it is of concern that some were due to incorrect use of misoprostol for induction of labour in late pregnancy and inappropriate use of oxytocin. The percentage of deaths due to uterine rupture could be even higher since postmortems were infrequently performed and such deaths could have been classified as ‘APH non-specified’ or ‘PPH non-specified’.

The proportion of deaths and MMR due to bleeding associated with CS is alarmingly high accounting for 32.3% of haemorrhage deaths compared to 26.2% in 2008-2010. The precise cause of the bleedings associated with CS was not always specified in the patient folder; ie whether it was due to uterine atony, lower segment tears, or bleeding from the placental site. Most of these women had inadequate medical treatment with uterotonic agents and inadequate surgical haemostasis during the CS. They then bled postoperatively, either as a revealed PPH or intra abdominally. A folder analysis of a sample of the women who died from CS associated bleeding often showed poor documentation of the use of prophylactic oxytocin and poor description of the surgery performed, even when it was complicated. This folder review found that many of the CS were performed for appropriate indications such as cephalopelvic disproportion and two previous caesarean sections. Frequently the CS was done too late when labour had become obstructed and / or where the second stage had proceeded for too long. However there were several CS done where they may have been unnecessary such as for ‘fetal distress’ when only early decelerations were recorded.

Table 4.6 shows that the final cause of death for women who died from haemorrhage was hypovolaemic shock (90%) and disseminated intravascular coagulopathy (34.5%). These women **bled to death**.

Table 4.6. Distribution of final causes of death in Obstetric Haemorrhage*

	N	%
Circulatory system	645	94.3
- Hypovolaemic shock	615	90.0
- Septic shock	30	4.4
Respiratory failure	43	6.3
Cardiac failure	157	23
- Pulmonary oedema	39	5.7
- Cardiac arrest	118	17.3
Acute collapse due to embolism	11	1.6
Renal failure	49	7.2
Liver failure	22	3.2
Cerebral complications	36	5.3
- Intracranial haemorrhage	10	1.5
- Cerebral oedema resulting in coning	0	0.0
- Meningitis	0	0.0
- Cerebral emboli	0	0.0
- Brain death following hypoxic event	19	2.8
- Unspecified	7	1.0
Metabolic	26	3.8
- Maternal ketoacidosis	6	0.9
- Electrolyte imbalance	5	0.73
- Thyroid crisis	1	0.15
- Lactic acidosis	10	1.5
- Other	4	0.6
Haematological	382	55.8
- DIC	236	34.5
- Severe anaemia	146	21.3
Immune system	53	7.7
TOTAL	684	100

*many women had more than one contributory cause

Antenatal care

Table 4.7 shows that 84.6% of women attended for antenatal care. Of note, 88.2% and 92.7% of women who died from uterine rupture without prior CS and bleeding after CS respectively had booked for antenatal care. This indicates either poor quality of antenatal care but more likely that it was an acute intrapartum or postpartum problem that led to the death which could not necessarily have been predicted.

Table 4.7. Antenatal attendance per sub category of Obstetric Haemorrhage

Obstetric Haemorrhage	Attended %	No attendance %	Unknown %
Obstetric haemorrhage	84.6	9.7	5.7
- Abruptio with hypertension	76.8	16.1	7.1
- Abruptio without hypertension	77.8	13	9.2
- Placenta praevia	93.8	6.2	0
- Other APH not specified	75	25	0
- Ruptured uterus with previous c/s	77	19.2	3.8
- Ruptured uterus without previous c/s	88.2	9.8	2
- Retained placenta	71.1	17.8	11.1
- Morbidly adherent placenta	82.4	17.6	0
- Uterine atony	82	14	4
- Vaginal trauma	100	0	0
- Cervical trauma	90.5	0	9.5
- Inverted uterus	60	20	20
- Bleeding during Caesarean section	100	0	0
- Bleeding after Caesarean section	92.7	1.7	5.6

Perinatal outcome

Table 4.8 a. Perinatal outcome in Obstetric Haemorrhage

Perinatal outcome	N	%
Survivors	382	55.9
Stillbirths	214	31.3
NND	16	2.3
Miscarriage and ectopic	14	2.0
Undelivered	58	8.5

Table 4.8 shows the high perinatal mortality associated with maternal deaths from haemorrhage. There was a live neonate in only 55.9% of women, and there were stillbirths in 31.3% of women. The latter were mostly due to abruptio placentae and ruptured uterus, but some may have been related to prolonged labour which resulted in uterine atony and bleeding after CS. The 8.5 % of deaths that were undelivered were mostly deaths due to abruptio placentae and undetected uterine rupture. This means that, in nearly half the OH deaths, the family experienced a double bereavement; that of the mother and the baby.

Level of care

Table 4.9 shows that the majority of haemorrhage deaths (93.9%) occurred at public hospitals; 36.7% at level one (district), 39.5% at level two (regional) and 17.7% at level 3 (tertiary) hospitals. This compares with 20% of all deliveries in SA over the same time period at CHCs, 40.4% at level one hospitals, 24.9% at level 2 hospitals and 13.9% at level 3 hospitals. This shows that most of haemorrhage deaths occur at district and regional hospitals, which is where the majority of deliveries occur.

The deaths associated with haemorrhage at CS occurred as follows: Level one hospital – 84(38%); Level two – 97 (43.9%); Level three – 36 (16.3%). This is similar to the proportions, shown from DHIS statistics, of total CS done at each level of care i.e. Level one - 36%; Level two - 39%; Level three -

25%. This suggests that most women who die from haemorrhage associated with CS die at the same level at which the CS was performed.

Table 4.9 . Numbers of maternal deaths in sub-categories at each level of care

Primary obstetric problem	Home	CHC	District hospital	Regional hospital	Tertiary hospital	Private hospital	Total
Obstetric haemorrhage	5	14	251	270	121	23	684
- Abruptio with hypertension	1	1	15	24	12	3	56
- Abruptio without hypertension	0	1	14	22	12	5	54
- Placenta praevia	0	0	4	7	3	2	16
- Other APH not specified	0	0	5	1	2	0	8
- Ruptured uterus with previous c/s	0	0	15	22	14	1	52
- Ruptured uterus without previous c/s	0	1	19	20	10	1	51
- Retained placenta	0	1	22	16	5	1	45
- Morbidly adherent placenta	0	0	7	7	3	0	17
- Uterine atony	0	2	22	20	2	4	50
- Vaginal trauma	0	1	1	1	1	0	4
- Cervical trauma	0	0	7	9	4	1	21
- Inverted uterus	0	2	1	1	1	0	5
- Bleeding during Caesarean section	0	0	15	17	7	3	42
- Bleeding after Caesarean section	0	0	69	80	29	1	179
- Other PPH not specified	4	5	35	23	16	1	84

Considering proportions of deaths from different subcategories within each level of care, it can be seen that for CHCs (n=14), PPH non-specified accounted for 5 (36%) of deaths at this level of care, followed by uterine atony (2 deaths) and there were two deaths from uterine inversion at CHCs. For all levels of hospital and private sector hospitals, bleeding after CS was the most frequent cause of death for that level of care followed by abruptio placentae (all hospitals) and ruptured uterus (public hospitals). Level one and two hospitals had a larger proportion of deaths from retained placenta and PPH - non specified, than level three hospitals.

Avoidable factors

Table 4.10 shows the distribution of avoidable factors in assessable cases. At patient/community level there were 30.7% of assessable cases with avoidable factors, and at administrative level there were 61.9%. For health worker related care there were avoidable factors in 52.3% of assessable cases at level one facilities, 34.8% at level two and 11.8% at level three. In addition there were problems with resuscitation in 57.6% of OH deaths. There has been minimal change in the overall proportions and distribution of avoidable factors compared to previous triennia; with level one / district hospitals having the greatest proportion of health provider related avoidable deaths.

Table 4.10. Distribution of avoidable factors, missed opportunities and sub-standard care in Obstetric Haemorrhage

Category	Assessable cases (n)	N (% of avoidable factors in assessable cases)
Patient orientated	636	195(30.7)
Administrative factors	658	407(61.9)
Health worker related emergency management problems		
Primary level	663	347(52.3)
Secondary level	666	232(34.8)
Tertiary level	667	79(11.8)
Resuscitation	630	363(57.6)

Patient related factors (Table 4.11)

These are factors operating at the level of the patient, her community and the socio – political context in which she lives. There were a few women who delivered at home, had a retained placenta and then had considerable delays in getting to a health facility. Since the Confidential Enquiry is predominantly institutional, these factors are the least investigated or understood. In the absence of detailed community inquiry, it is conjectural to explore reasons for non-booking (8.8%) and delayed presentation (17%), which are the most frequent avoidable factors in this category, but have decreased in comparison to the previous triennium. Poverty, long distances, lack of knowledge, lack of community support structures and income generating responsibilities are all factors suspected as being contributory.

Table 4.11. Distribution of patient orientated avoidable factors, missed opportunities and sub-standard care*

Description	Number	Percentage of assessable deaths
Lack of information	48	7.5
No avoidable factor	441	69.3
No antenatal care	56	8.8
Infrequent antenatal care	41	6.4
Delay in accessing medical help	108	17.0
Declined medication/surgery/advice	16	2.5
Family problem	2	0.3
Community problem	0	
Unsafe abortion	2	0.3
Other	18	2.8

*total number assessable cases =636

Administrative related avoidable factors (Table 4.12)

Administrative related avoidable factors were more frequently documented than patient related factors; the most frequently cited problems were:

- Transport problems between institutions (12.2%); this was documented more than in the previous triennium. It remains an important limiting factor with many district hospitals not having on site emergency transport.
- Lack of blood products (13.6%); this remains a major problem although it has improved from the previous triennium. This may be due to increased awareness about resuscitation but more likely due to the concerted efforts by the SA National Blood Transfusion service (SANBS) to place fridges in district hospitals and ensure a regular supply of emergency blood.
- Lack of appropriately trained doctors (27%) and lack of appropriately trained nurses (13.6%) has increased as an identified avoidable factor. This refers to an ongoing lack of essential staff in public hospitals particularly level one hospitals, but also to a lack of appropriate clinical expertise and skills.

Table 4.12. Distribution of administrative related avoidable factors, missed opportunities and sub-standard care*

Description	Number	Percentage of assessable deaths
Lack of information	26	4.0
No avoidable factor	251	38.1
Transport problem: Home to institution	14	2.1
Transport problem: Institution to institution	80	12.2
Lack of accessibility: Barriers to entry	10	1.5
Lack of accessibility: Other	4	0.6
Delay initiating critical care (Overburdened service)	67	10.2
Lack of health care facilities: ICU	49	7.4
Lack of health care facilities: Blood/blood products	90	13.7
Lack of health care facilities: Other	24	3.6
Lack of appropriately trained staff: Doctors	175	26.6
Lack of appropriately trained staff: Nurses	89	13.5
Communication problems: Technical	19	2.9
Communication problems: Interpersonal	23	3.5
Other	51	7.8

*total number assessable cases =658

Health worker related avoidable factors (Table 4.13)

Health provider Avoidable factors for different levels of care are shown in Table 4.13.

Problem recognition, substandard care and monitoring problems remain the most frequent health provider factors, at all levels of care.

Table 4. 13. Distribution of health worker related avoidable factors, missed opportunities and sub-standard care*

Medical management problems	1° Level Number	Distribution of AF Primary	2° Level Number	Distribution of AF secondary	3° Level Number	Distribution of AF tertiary
Lack of information	21		18		17	
No avoidable factor	316	47.7	434	65.2	588	88.2
Initial assessment	71	20.5	30	12.9	16	20.3
Problem with recognition / diagnosis	126	36.3	83	35.8	25	31.6
Delay in referring the patient	86	24.8	13	5.6	1	1,3
Managed at inappropriate level	72	20.7	8	3,4	0	0,0
Incorrect management (Incorrect diagnosis)	37	10.7	36	15.5	8	10.1
Sub-standard management (Correct diagnosis)	187	53.9	148	63.8	32	40.5
Not monitored / Infrequently monitored	46	13.3	22	9.5	10	12.7
Prolonged abnormal monitoring with no action taken	68	19.6	33	14.2	16	20.3
Assessable cases with avoidable factors	347	52.3	232	34.8	79	11.8
Assessable cases	663		666		667	

*total number assessable cases =663 (L1hosp); 656 (L2hosp); 667(L3 hosp)

The combined problems of '**lack of appropriately trained doctors and nurses**' and '**substandard care**' were explored in more detail by in-depth folder review. The following themes emerged:

- Many women died in ambulance before during or after referral. This reflected reluctance to perform necessary surgery at the district hospitals (due to lack of sufficient blood products and lack of surgical competence) but also ambulance delays
- Better monitoring by nurses was observed compared to previous triennia but there was often poor response to signs of deteriorating vital signs by nurses and doctors, the latter frequently giving telephonic advice rather than assessing the patient. Colour coded Early warning charts were not found in the folders, despite this being a recommendation on the previous Saving Mothers report.
- Poor use of uterotonics especially oxytocin and ergometrine / syntometrine to treat uterine atony after vaginal delivery; and to prevent and treat uterine atony at CS
- Poor surgical skills at initial CS
- Referral for post CS bleeding arranged rather than a re - look laparotomy
- Internal bleeding common in post CS bleeding deaths but delay in recognition
- Delays/ fear of laparotomy for PPH after vaginal delivery.
- Poor utilisation of uterine compression sutures and tourniquets
- Poor resuscitation in abruptio placentae and inadequate management of subsequent PPH

The following vignettes illustrate some of these problems.

Vignettes

1. Bleeding after CS. District hospital

Emergency CS in para 1 for CPD. No documentation of prophylactic oxytocin. PPH in recovery, sent to postnatal ward (PNW) despite low BP and tachycardia. PPH in PNW. Low BP and tachycardia >120 bts/min continued. Well monitored but no response to shock. After 2 hours, a doctor was called, gave telephonic advice for oxytocin 20 IU iv bolus and 30 IU infusion. Doctor called again when no improvement, and came to see patient. Decided to refer rather than do re-laparotomy. Died in the lift on way to ambulance.

Comment

- *Oxytocin prophylaxis should always be given at CS. The patient should not have been allowed to leave the recovery area with signs of hypovolaemic shock. Despite good monitoring there was a delayed response by the nurse in calling the doctor. The doctor did not assess the patient and telephonically prescribed an incorrect dose of oxytocin. On subsequent assessment, the doctor decided to refer the patient without performing any definitive treatment.*
- *Immediate use of further uterotonics and re-look laparotomy should have been performed before the patient left the recovery area*

2. Abruptio placentae

- Admitted to District hospital (DH) with signs of shock due to abruptio placentae with IUD.
- Induced with artificial rupture of membranes and oxytocin.
- Given 1 unit emergency blood. Delay in transfusing cross-matched blood because of shift changeover of blood bank technicians.
- No FFP/FDP
- Delivered after long induction of labour (12hours); massive PPH
- 20 IU Oxytocin infusion
- Died after one hour.

Comment

It would have been preferable to have resuscitated the patient and transferred her for delivery to the regional hospital. Resuscitation was inadequate because of delays with blood and the DH did not have freeze dried plasma in stock. Inadequate management of PPH.

3. Ruptured uterus

- 38yrs P5, G6 with normal first stage labour at regional hospital
- Prolonged second stage of labour of 2½ hours
- Delay calling doctor
- Decision for CS
- Collapsed and died after spinal anaesthetic
- Postmortem diagnosis: ruptured uterus

Comment

Second stage of labour in grand multipara should not be allowed to last more than 30 mins without critical assessment and intervention. Obstructed labour and ruptured uterus was not recognised prior to death. Anaesthetic substandard care occurred in addition to obstetric management problems

4. Retained placenta

- 30yrs P2, AIDS recently commenced on HAART
- Admitted with preterm delivery to district hospital; Hb =7.4)
- NVD, Retained placenta plus PPH
- iv oxytocin infusion, no repeat cord traction
- No monitoring of BP and Pulse post delivery
- Dr called after one hour due to retained placenta; did not come
- Patient died after 3 hours; placenta still in utero.
- No blood was given.

Comment

Blood should have been transfused during labour and continued after with retained placenta. There was no response to retained placenta; no monitoring of vital signs and not attempt to repeat cord traction to deliver the placenta. The nurse appeared to lack necessary skills. There was delay in calling the doctor, who when called, did not come to assist. A retained placenta should be seen as an emergency and both nurses and doctors trained to manage it urgently

5. Uterine atony (DH)

- 21yrs P0. Prolonged second stage. Delivered with fundal pressure and two episiotomies.
- Fresh SB, vaginal tears/ episiotomy suture
- PPH with abnormal vital signs
- Delay calling doctor (+/- one hour)
- Doctor ,on arrival, ordered fluids and organised referral
- Died on arrival to regional hospital

Comment

Assisted delivery would have been preferable to fundal pressure. There was appropriate monitoring by nurse but delayed response by nurse to PPH and signs of shock. Insufficient response by Dr; fluids only, no uterotonics, no exploration for vaginal trauma, no blood, no EUA. Referral without any definitive treatment or resuscitation

The problem of “Too Little Too Late” was illustrated by many cases in which additional surgical measures such as uterine balloon tamponade, uterine compression sutures and uterine artery ligation were not performed. Hysterectomy is the last resort measure for saving lives due to obstetric haemorrhage. It was performed in 170 (24.9%) of these women; often done too late. Earlier recourse to hysterectomy may have saved many of these women’s lives. Junior doctors faced with severe bleeding associated with C section who are not confident to do a hysterectomy and in whom other modalities have failed, can try applying a uterine tourniquet such as a rubber foleys catheter tied around the lower part of the body of the uterus (as is done at myomectomy); this can reduce bleeding during subsequent transfer to higher level of care. More utilization of this procedure as a temporizing measure would be beneficial. There are case series on its use which have been reported in South Africa and demonstrate success in averting maternal deaths (see Discussion).

The above vignettes, together with Table 4.13, indicate that much work still needs to be done in improving the quality of care and effectiveness of care provided by health workers across the levels of care but particularly in level one and two facilities.

Table 4.14 indicates that there were avoidable factors related to the resuscitation in more than half (57.6%) of assessable cases. In 74.1% of this group the problem was with the circulation, ie inadequate fluid and/or blood resuscitation. It is concerning that for 80 women (12.7%) resuscitation was not attempted. This suggests arrival at a facility too late for any attempt at resuscitation or, patients being discovered 'dead in their beds' having had a major bleed that was unrecognised due to inadequate monitoring.

Table 4. 14. Distribution of problems with resuscitation in Obstetric Haemorrhage*

Resuscitation problems	Number	% where resuscitation attempted	Distribution of problems in resuscitation
Lack of information	54		
No avoidable factor	267	51.5	
Airway problems	11		3.6
Breathing problems	15		4.9
Circulation problems	229		74.1
Drug problems	15		4.9
Investigation problems	10		3.2
Monitoring problems	29		9.4
Resuscitation not attempted	80		

*total number assessable cases =630

Table 4.15 shows the overall avoidability of deaths from haemorrhage when administrative and health worker related factors are combined; i.e. only health system factors are considered. There was suboptimal care in 89.3% of deaths; 27.8% were possibly avoidable and a large number of 61.5% were probably avoidable (i.e. different care would reasonably have been expected to make a difference to the outcome). These proportions have not decreased from the previous triennium. Thus haemorrhage deaths remain, the deaths most frequently assessed to be avoidable by assessors. This means that addressing health system failures which contribute to deaths from haemorrhage must be an absolute priority for policy makers, health managers and health workers. OH deaths account for 23.5% of the total avoidable deaths in SA in the recent triennium

Table 4. 15. Distribution of avoidability in Obstetric Haemorrhage

Percent per disease category	N	%
No suboptimal care	58	8.5
Suboptimal care, different management would have made no difference to the outcome	15	2.2
Suboptimal care, different management might have made a difference to the outcome	190	27.8
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	421	61.5

Discussion

It is very disappointing that deaths from obstetric haemorrhage have not decreased and now rank second as cause of maternal mortality, especially since the NCCEMD has focussed on this as a

problem by developing several interventions. These include the pocket- book (manual) on management of PPH, posters on PPH, training DVD on PPH, and PPH training / drills via ESMOE/EOST. The NCCEMD has also drawn attention to the problem in various publications, memoranda and national/provincial forums. It would seem that these interventions have not been fully implemented and have not filtered down to the level where they are most needed, notably the district hospitals

Recent International literature and research stress the need to go beyond single essential interventions to implement whole packages of care to prevent maternal deaths^{6,7}. This is particularly pertinent for obstetric haemorrhage where reduction in mortality requires a package of interventions, including preventive measures at community level, effective antenatal and intrapartum care, and a functioning health system to deal with an emergency problem; in addition to use of uterotonic agents. The Quarite study conducted in Senegal and Mali shows that major improvements in the quality of service provided can be produced and sustained by regular outreach by trained facilitators and on-site training.⁸

The current report identifies priority provinces with the highest or increasing MMRs from haemorrhage for targeting implementation activities. These are North West, Free State, Mpumalanga and Limpopo.

Priority attention needs to be given to addressing the large number of deaths due to bleeding associated with CS, abruptio placenta and ruptured uterus. An in depth review of the maternity case records of these cases has identified serious problems in both prevention and management of obstetric haemorrhage.

There are clear health system failures exemplified by non-functioning and non-availability of theatres for emergency obstetric surgery, delays in replenishing emergency blood, lack of onsite transport particularly from district hospitals, and inadequate use of local audit to address modifiable factors at facility level. CEOs in hospitals and district clinical specialist teams collectively must work towards rectifying these administrative problems. The availability of onsite emergency transport for inter- institution transfer was a key factor in the reduction of OH deaths observed in the Free State and this model should be extended to other provinces. Lack of appropriately trained staff is highlighted as a major problem especially in district hospitals. Despite protocols and posters on haemorrhage being available and disseminated, there were numerous instances where the protocols were not followed by health providers indicating poor implementation. Poor problem recognition (severity and correct diagnosis), substandard care and also incorrect practices remained major problems in the current report. The large number of women dying due to bleeding after CS is due to a combination of poor attempts to secure haemostasis at the CS; poor use of uterine compression sutures, and postoperatively failure to act on deteriorating vital signs. There appeared to be a reluctance of doctors when phoned to actually come and assess such patients and a reluctance to take them back to theatre. It is not possible from the folders to ascertain whether non availability of doctors was due to short staffing or lack of professionalism.

The large number of deaths due to abruptio placentae were associated with inadequate resuscitation and failure to refer to regional or tertiary level prior to delivery. Some in this group who died undelivered may in fact have been uterine rupture deaths for which the diagnosis was missed. The continuing high numbers of uterine rupture deaths were mostly related to poor

management of labour with delayed response to arrested progress in multipara. There were a few that were due to incorrect dosage schedules with misoprostol for induction of labour. This was highlighted in the previous report, and the use of intracervical bulb catheters for cervical ripening suggested as a safer alternative to misoprostol⁹.

Extending ESMOE-EOST training to the districts by the saturation training should assist but needs to be sustained. Regular PPH drills and repeated onsite training in practical and surgical skills for PPH, in particular manual removal of placenta, balloon tamponade, uterine compression sutures, is essential given the high turnover of staff at district hospitals⁵. A priority focus is needed on surgical safety for CS and the ability to manage intraoperative and post-surgical bleeding¹⁰. In addition adequate and appropriate doses of uterotonic agents for both prevention and treatment of haemorrhage at CS needs to be provided which is both effective and safe¹¹. Agreement between anaesthetists and obstetricians is required for this. Where transfer is need to a regional hospital for hysterectomy, a temporizing treatment must be provided such as balloon tamponade¹² or the uterine tourniquet. There are case reports in SA of success with this latter intervention in several hospitals in Kwazulu Natal¹³. The Non –pneumatic Anti-shock Garment (NASG) has shown effects in reducing morbidity for women transferred with PPH from primary care clinics to hospital in Zimbabwe and Zambia but the results were not significant due to insufficient sample size¹⁴. It would be useful to pilot this this in a rural district in South Africa.

Tranexamic acid is a medication which has proven value for reduction in haemorrhage in major trauma cases and has shown promise for treatment of PPH. It is currently being investigated in a randomized control trial, the WOMAN trial¹⁵; the final results are keenly awaited. It is being used in several facilities in SA, especially for traumatic PPH, and has been included in the updated PPH algorithms for medical management of haemorrhage associated with CS after initial treatment measures have been unsuccessful (see appendices).

Interventions required at different levels to reduce deaths from haemorrhage.

In addition to a focus on priority provinces and priority conditions, the assessment of avoidable factors leads to the following recommendations for actions by different role players.

Patient level/ community. Community health workers need to be trained to provide education to pregnant women on: nutrition; prevention of anaemia; dangers of self-use of misoprotol or oxytocics; complication preparedness and home based life-saving skills. They also need to promote antenatal care and facility delivery, coordinate women’s groups, and facilitate transport plans for women in labour.

Provincial and District health managers. It is their responsibility to provide Maternity waiting lodges attached to district hospitals where women who live far from the hospital can stay in the weeks before labour. Emergency ambulance transport must be on site for all facilities that refer women with prolonged labour and haemorrhage to minimise delays at this level. District health planning must ensure that BEOC and CEOC facilities (Basic and comprehensive emergency obstetric care) are accessible and available for all women within the district. For CEOC, facilities must provide 24 hour access to emergency surgery for labour complications with proper staffing of these areas

Health facility managers. At facility level the manager is responsible for maintaining emergency transport, blood supplies, medications and functioning facilities including 24 hour theatres. In addition they are responsible for providing immediate attention to avoidable factors identified at time of death; facility audit must lead to remedial action at institutional level and district/provincial level without delay. Facility managers should also ensure that arrangements are in place for Rapid team response (cf cardiac arrest call) for severe haemorrhage (over 1000mls); which should be practiced by drills

District maternal and child health teams. Provincial and district maternal and child health teams which ideally include an obstetrician, advanced midwife, family physician and primary care nurse should actively engage in outreach and participate in audit meetings. They must provide ESMOE training and scenario training ('drills') for haemorrhage, particularly at CHCs, MOUs and district hospitals. Ongoing skills training in resuscitation, CS and procedures to arrest haemorrhage must be provided to all doctors to ensure competence.

Medical and Nursing Training schools. ESMOE training to be integrated into undergraduate training. Resuscitation skills and Emergency management of obstetric haemorrhage all need to be seen as core competencies for the student to achieve before qualification. The new proposed scope of practice for midwives, which is being developed with the South African Nursing Council, prescribes manual removal of placenta and adult resuscitation as a core competency, this needs further discussion for practicality, feasibility and implementation.

Relevant research by academic centres into newer solutions such as: use of uterine tourniquet as a temporising method, use of uterotonic agents at CS and tranexamic acid for ongoing bleeding at CS, would inform policy and protocols.

Health workers. The PPH monograph and algorithms for PPH after vaginal delivery, and after CS must be available for all maternity workers and be displayed in work areas. Compulsory attendance for regular scenario training on haemorrhage in labour wards and theatres must occur. Partogram and proper management of labour needs to be audited with aim of reducing obstructed labour, and promoting active management of the third stage of labour.

The use of early warning monitoring charts for early detection of haemorrhage after CS introduced in the last triennium should be continued and audited. At ward level, there should be ongoing monitoring of haemorrhage; eg Labour wards should monitor numbers of women monthly with PPH after vaginal delivery and display on graphs in the ward office; and theatre can monitor statistics for bleeding >1000mls after CS and display by graphs. These initiatives are aimed at emphasizing the importance of ward level collection of haemorrhage data and displaying it, in order for trends to be seen immediately by the staff who works there; observed deterioration can lead to remedial action and progress can be an incentive to further improvement.

Guidelines and Algorithms

Guidelines for management of obstetric haemorrhage can be found in the ESMOE booklet and more comprehensively in the PPH monograph produced by the NCCEMD in 2010. Both can be found on the department of health website.

Updated Algorithms from the PPH monograph on the management of PPH (A) following vaginal delivery, (B) during CS and (C) after CS; can be found at the end of this chapter.

Appendix D gives a combined anaesthetic /obstetric guideline for the use of uterotonic agents at caesarean section.

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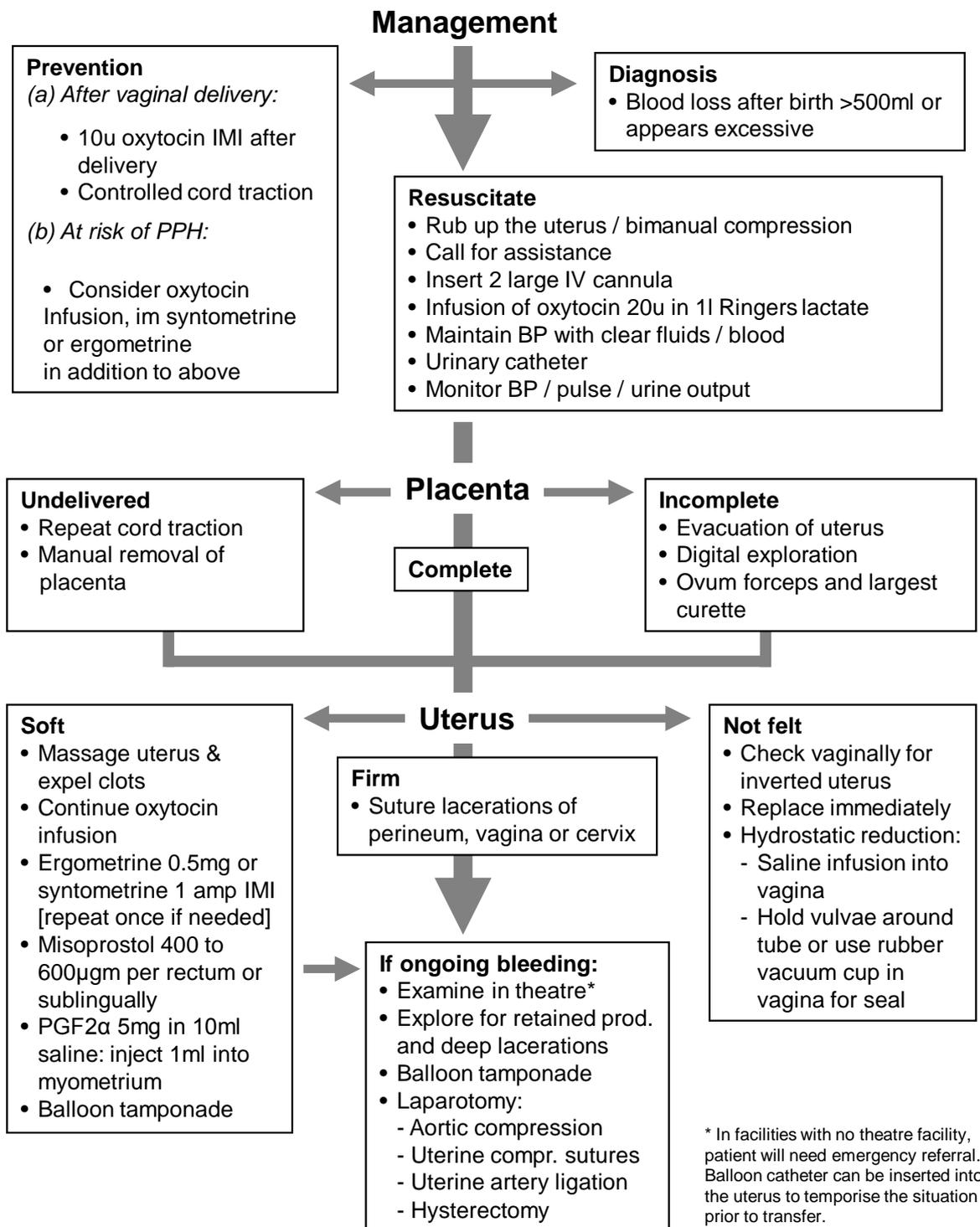
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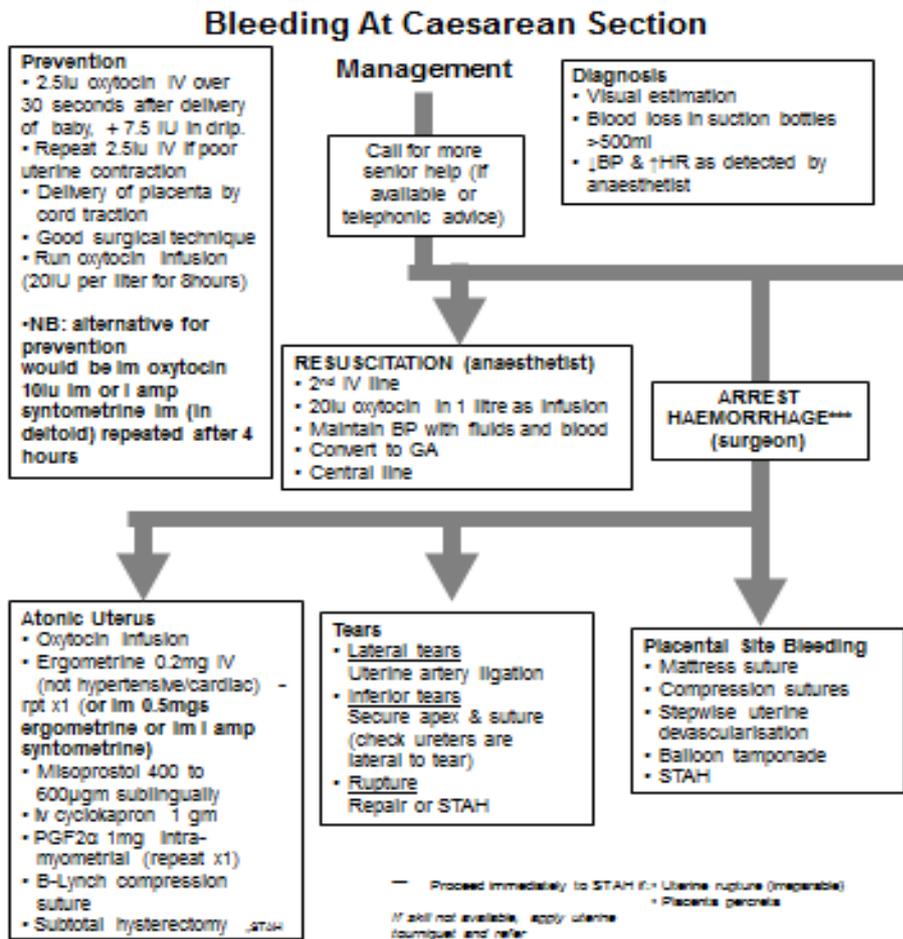
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Appendix A. Algorithm for management of PPH after vaginal delivery

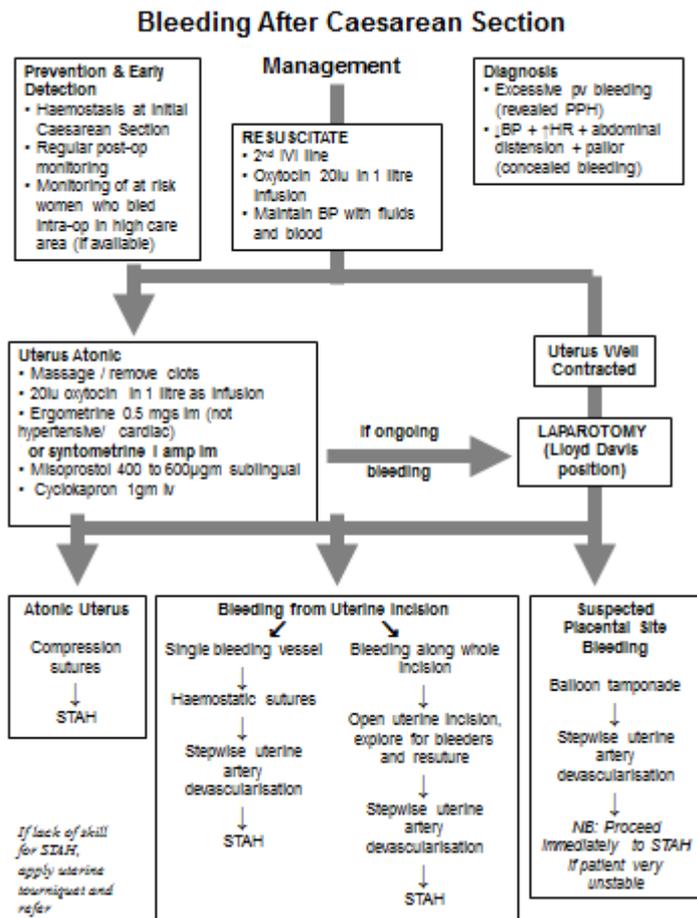
Postpartum Haemorrhage (PPH)



Appendix B. Algorithm for management of bleeding during Caesarean section



Appendix C. Algorithm for bleeding after caesarean section



Appendix D. Use of uterotonics at caesarean section; consensus anaesthetic -obstetric guideline

Stage	Option 1 <i>(Suitable for units equipped with volumetric pumps, syringe drivers and trained anaesthetists)</i>	Option 2 <i>(Suitable for resource constrained units)</i>
Step 1: <i>All Cases</i>	1. Oxytocin 2.5iu ivi slow bolus (over 30 secs) 2. Oxytocin 7.5 iu in remaining ivi fluid running in 3. Oxytocin infusion 20iu/1000mls@125mls/hr for 8 hours <i>(125mls/hr is equivalent to 42 drops per min from a "20 dropper" administration set)</i>	1. Syntometrine® 1 amp in left deltoid after delivery baby (be aware of contraindications) <i>If contraindicated</i> Syntocinon 10 iu in left deltoid after delivery baby (repeat at 4 hours in ward) 2. Oxytocin infusion 20iu/1000mls@125mls/hr
Step 2: <i>Ongoing uterine atony at 3 minutes</i>	1. Repeat oxytocin 2.5iu ivi slow bolus (over 30 secs) 2. Oxytocin infusion 20iu/1000mls@125mls/hr	Oxytocin infusion 20iu/1000mls@125mls/hr
Step 3: <i>Actively Bleeding cases</i>	1. Ergometrine 0.2mg ivi slow bolus repeated up to 0.6 mg Or Syntometrine® 0.1mg/1iu ivi slow bolus (over 30 secs) repeated up to 0.5 mg/5iu Or Misoprostol 400-600 mcg sublingual or rectal (if C/I to ergometrine) 2. Oxytocin infusion 40iu/1000mls@125mls/hr 3. Cyclokapron 1g ivi (may be considered)	1. Syntometrine® or ergometrine in deltoid (if not already administered) Or Misoprostol 400-600 mcg sublingual or rectal (if C/I to ergometrine) 2. Continue oxytocin infusion 3. Cyclokapron 1g ivi (may be considered if available)
Step 4: <i>Resistant Bleeding Cases</i>	1. Consider intramyometrial Prostaglandin F2 alpha (dilute 5mgms in 10 mls and give 1ml intramyometrially, can be repeated x1)	
<p><i>NB. This table focusses on the use of uterotonic agents for medical management of uterine atony at and after CS. It does not describe the concurrent resuscitative measures required for women with excessive bleeding, nor does it cover surgical measures which must be performed following failed medical management of uterine atony associated with CS.</i></p>		

5. Early pregnancy loss

Abstract

There were 287 early pregnancy deaths in 2011-2013, a 10% increase compared to 2008-2010. One hundred and two deaths were caused by ectopic pregnancy (36% increase), and 185 by complications of miscarriage, which was about the same number as in 2008-2010 (186). Sixty-five percent of ectopic pregnancy deaths and 35% of miscarriage deaths were thought to be clearly avoidable within the health system.

Ectopic pregnancy

Deaths from ectopic pregnancy occurred most frequently at regional hospitals (47%), followed by district (41%) and tertiary (12%) hospitals. Eight (8%) were classified as extrauterine pregnancy beyond 20 weeks' gestation. Although the majority of women who died from ectopic pregnancy had unknown HIV status (56%), of those who were tested, 71% were HIV infected. The final cause of death was hypovolaemic shock in 76%. The most frequent patient behaviour-related avoidable factors were lack of antenatal care and delay in accessing medical help. The most frequent administrative avoidable factor was lack of appropriately trained doctors. The most frequent health care provider-related avoidable factors were failure to make the diagnosis, and therefore incorrect management, substandard care despite making the right diagnosis, and substandard resuscitation of hypovolaemic shock.

Miscarriage

Deaths from miscarriage occurred most frequently at regional hospitals (52%), followed by district (30%) and tertiary (14%) hospitals. Of the subcategories of miscarriage, 62% were classified as septic miscarriage, 26% as deaths from haemorrhage (non-traumatic), 5% as deaths following legal termination of pregnancy (TOP), 4% were classified as gestational trophoblastic disease, and 3% as miscarriage deaths related to uterine trauma. Although 41% of women who died from miscarriage had unknown HIV status, of those who were tested, 81% were HIV infected. The final cause of death was septic shock in 55% and hypovolaemic shock in 30%. The most frequent patient behaviour-related avoidable factors were delay in accessing medical help, no antenatal care, and unsafe miscarriage (illegal TOP). The most frequent administrative avoidable factors were lack of appropriately trained doctors and delay in initiating critical care due to an overburdened service. The most frequent health care provider-related avoidable factors were substandard care despite making the right diagnosis, failure to make the diagnosis or recognise the severity of the condition, and substandard resuscitation of circulatory shock, whether due to sepsis or hypovolaemia.

Key recommendations

1. Contraception and family planning services must be promoted in all communities and must be made more accessible in order to reach all those who would benefit from them.
2. Fighting the HIV/AIDS epidemic must remain a priority, with multiple strategies including integration of HIV/AIDS screening and care into maternal and women's care.

3. Communities must be educated about “booking early for antenatal care”, recognising and acting on danger signs in early pregnancy, and how to access safe TOP.
4. There must be regular training of doctors and nurses in the recognition and emergency resuscitative management of circulatory shock in the context of early pregnancy. This should include regular “fire drills” on the management of shock.
5. Casualty departments must have clear policies ensuring that shocked gynaecological patients are given equal priority and attention by casualty staff compared to any other category of shocked patients.
6. Facility managers must ensure that all doctors and nurses are aware of their professional and ethical responsibilities when on-duty, and must hold them accountable when these responsibilities are neglected.
7. There must be regular training of doctors and nurses on the recognition of ectopic pregnancy and its management, particularly regarding the need for immediate surgery if the patient is shocked. District hospital managers must ensure that their doctors have the anaesthetic and surgical skills to perform laparotomy for such cases.
8. All hospitals must be able to provide medical termination of pregnancy to ensure that all women have access to safe TOP. Medical TOP must be available at but not restricted to dedicated TOP clinics.
9. There must be regular training of doctors and nurses on the recognition and management of different types of miscarriage, including indications and technique for evacuation of the uterus, and criteria for referral to specialist level
10. All hospitals which manage early pregnancy complications must have a facility separate from the main theatre complex for performing evacuation of the uterus by manual vacuum aspiration (MVA) without general anaesthesia

Introduction

This chapter describes and discusses maternal deaths resulting from ‘early pregnancy loss’. These deaths are divided into two broad categories: deaths from miscarriage and deaths from ectopic pregnancy. Miscarriage deaths were classified by the assessors into the following five sub-categories: septic miscarriage, deaths from haemorrhage (non-traumatic), uterine trauma, gestational trophoblastic disease, and deaths following legal TOP. Each death had to be assigned to one of these categories, and not more than one. The ectopic pregnancy deaths were classified according to gestational age at the time of death: either less than 20 weeks, or more than 20 weeks. Miscarriages and ectopic pregnancies are, for the most part, analysed separately in this chapter. The term ‘miscarriage’ should be understood to be synonymous with the term ‘abortion’ which was more often used in the early Saving Mothers reports.

Numbers of deaths and Provincial distribution

There were 287 early pregnancy deaths in 2011-2013, a 10% increase over the 261 reported in 2008-2010. This increase is due to a 36% increase in ectopic pregnancy deaths (102 compared to 75 in 2008-10). The number of miscarriage deaths (185) remained almost identical to the number reported in 2008-11(186).

The institutional maternal mortality ratios (iMMR) per province are shown in Table 5.1a for deaths from ectopic pregnancy, and in Table 5.1b for deaths from miscarriage. The iMMR in 2011-13 is compared to that in 2008-10. The iMMR is calculated using the District Health Information System (DHIS) data for the Province to provide the number of live births in the institutions (the denominator), while the numerator is the number of maternal deaths from the specific cause occurring at the institutions, as reported through this confidential enquiry.

Table 5.1a. Institutional maternal mortality ratio (iMMR) for ectopic pregnancy deaths per province

	iMMR 2008-10	iMMR 2011-13
Eastern Cape	1.39	1.66
Free State	2.05	4.85
Gauteng	3.45	3.91
KwaZulu-Natal	2.42	3.73
Limpopo	2.73	6.30
Mpumalanga	2.83	5.72
North West	4.12	2.89
Northern Cape	9.68	1.57
Western Cape	1.39	0.36
Total	2.72	3.63

Table 5.1b. Institutional maternal mortality ratio (iMMR) for miscarriage deaths per province

	iMMR 2008-10	iMMR 2011-13
Eastern Cape	2.78	2.48
Free State	8.88	6.23
Gauteng	7.41	8.47
KwaZulu-Natal	11.41	9.41
Limpopo	6.55	8.40
Mpumalanga	5.66	6.60
North West	5.30	5.20
Northern Cape	6.45	1.57
Western Cape	1.74	1.78
Total	6.73	6.58

Overall the iMMR for deaths from ectopic pregnancy was 3.63 per 100,000 live births. The iMMR for ectopic pregnancy deaths more than doubled in Free State, Limpopo and Mpumalanga compared to 2008-10.

The national iMMR for deaths from miscarriage was 6.58 per 100,000 live births. The iMMR in KZN (9.41), although reduced since 2008-10, remained higher than in any other Province. KZN was the only Province where miscarriage featured in the top five causes of maternal death overall and in the top three causes of direct maternal death (see KZN Provincial chapter). While the reason for this is not clear, it may partly be explained by the fact that KZN is the Province with the highest underlying

prevalence of HIV infection in pregnant women. There does appear to be a strong association between HIV infection and deaths from miscarriage (see section on HIV in this chapter, below).

Northern Cape had the biggest decrease in iMMR for both ectopic and miscarriage deaths.

Age and parity

Ectopic pregnancy.

The relationship between deaths from ectopic pregnancy and maternal age is shown in Table 5.2a. The proportion of deaths in each age category is compared to the proportion of all pregnant women in South Africa who fall within that same age category. What this demonstrates is that a pregnancy at age 25-35 carries an increased risk for death from ectopic pregnancy, and that pregnant women under 25 are at a lower risk.

Table 5.2a. Relationship of ectopic pregnancy deaths to maternal age 2011-13

Age category (years)	N	%	General pregnant population* %
< 20	5	4.9	12.2
20 - 24	10	9.8	27.4
25 - 29	36	35.3	26.4
30 - 34	31	30.4	19.3
35 - 39	14	13.7	11.0
40 - 44	5	4.9	3.5
45+	1	1.0	0.3
Total N	102	100	100

* - Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2012, November 2013 P0305

The relationship between deaths from ectopic pregnancy and parity is shown in Table 5.2b. Deaths from ectopic pregnancy were most common in nulliparous women, and rarely occurred in women with a parity of more than 3.

Table 5.2b. Relationship of ectopic pregnancy deaths and parity 2011-13

Parity	n	%
P0	31	30.4
P1	26	25.5
P2	13	12.7
P3	12	11.8
P4	4	3.9
P5	1	1.0
P6+	0	0.0
Unknown	15	14.7
Total	102	

Miscarriage

The relationship between miscarriage deaths and maternal age is shown in Table 5.3a.

Table 5.3a. Relationship of miscarriage deaths to maternal age 2011-13

Age category (years)	N	%	General pregnant population* %
< 20	13	7.0	12.2
20 - 24	35	18.9	27.4
25 - 29	61	33.0	26.4
30 - 34	43	23.2	19.3
35 - 39	20	10.8	11.0
40 - 44	9	4.9	3.5
45+	4	2.2	0.3
Total N	185	100.0	100.0

* - Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2012, November 2013 P0305

Although the deaths are spread over all age ranges, it is interesting to note that teenagers appear to have a relatively low risk of death from miscarriage.

The relationship between deaths from miscarriage and parity is shown in Table 5.3b.

Table 5.3b. Relationship of miscarriage deaths and parity 2011-13

Parity	n	%
P0	45	24.3
P1	44	23.8
P2	42	22.7
P3	23	12.4
P4	3	1.6
P5	7	3.8
P6+	3	1.6
Unknown	18	9.7
Total	185	

Sub-Categories of deaths from ectopic pregnancy and miscarriage

Tables 5.4a and 5.4b show the distribution of deaths according to the sub-categories of ectopic pregnancy and miscarriage respectively. These sub-categories classify the deaths under a more specific disease entity or primary cause of death.

Table 5.4a. Distribution of sub-categories of ectopic pregnancy deaths 2011-13

Ectopic	n	%
- Less than 20 weeks	94	92.2
- More than 20 weeks	8	7.8

There were eight deaths assessed as being due to ectopic pregnancy at more than 20 weeks' gestation (advanced extra-uterine pregnancy), two fewer than in 2008-10. This means that the 36% increase in ectopic pregnancy deaths in 2011-13, compared to 2008-10, is entirely due to an increase in ectopic pregnancy below 20 weeks. There were several cases of death related to advanced extra-uterine pregnancy where the diagnosis was never considered until a caesarean section was attempted. Difficulties at surgery and excessive bleeding then led to the death. While there are clinical lessons to be learnt here about diagnosing advanced extra-uterine pregnancies, the rarity of

the condition means that it is not a major contributor to maternal deaths in South Africa and the condition will not be further discussed in this chapter.

Table 5.4b. Distribution of sub-categories of miscarriage deaths 2011-13

Miscarriage	n	%
- Septic miscarriage	114	61.6
- Haemorrhage (non-traumatic)	48	25.9
- Uterine trauma	6	3.2
- GTD	8	4.3
- Following legal TOP	9	4.9

The majority of deaths due to miscarriage were classified as septic miscarriage (61.6%). The second most common sub-category was miscarriage death due to haemorrhage (non-traumatic) (25.9%). The predominance of the sub-category “septic miscarriage” is somewhat misleading, as a review of the case files suggests that many of these cases were not typical “septic miscarriages”. The term septic miscarriage should refer to a miscarriage where there is an infective focus in the uterus, which is causing signs of systemic sepsis. It is often associated with unsafe or illegal termination of pregnancy, performed in an unsterile way. A proportion of the “septic miscarriages” in this report were in fact miscarriages which occurred in women who were already critically ill with underlying infective conditions, such as pneumonia, TB, or meningitis (see vignette 4). The septic focus may not have been in the uterus. In such cases it was often unclear to what extent the miscarriage itself contributed to the death. In some of these cases it would have been more appropriate to classify the death as a death due to non-pregnancy-related infection. Thus the number of deaths resulting from unsafe, or illegal termination of pregnancy cannot be simply equated to the number of deaths classified as “septic miscarriage”.

In some other cases of death classified as “septic miscarriage” the main clinical feature was shock, rather than localised signs of sepsis. In these cases, patients often died without being adequately assessed or resuscitated. It was not clear whether these patients were shocked because of sepsis or just because of blood loss and hypovolaemia. These deaths could alternatively have been classified under the sub-category of haemorrhage (non-traumatic), rather than septic miscarriage. For these cases, the key issue was lack of resuscitation, irrespective of whether the shock was due to sepsis or just severe blood loss.

The cases classified as uterine trauma are mainly cases where the uterus sustained trauma (perforation) during an evacuation procedure, either in a health facility or during an illegal termination of pregnancy (TOP). The patients died either due to haemorrhage or due to bowel injury or a combination of both.

Nine cases were classified as miscarriage deaths which followed legal TOP. However, on review of the cases notes, at least two of these cases followed TOP procedures performed by private general practitioners (GP) which resulted in incomplete miscarriage. The GP did not follow these cases up or refer them to a hospital. Such a procedure is in fact an illegal TOP, as the doctor is not complying with the requirements of the Choice on TOP Act, and is no doubt not accredited to perform TOPs. Thus these cases were misclassified.

There were eight cases of death assessed as being due to gestational trophoblastic disease (GTD). Maternal deaths due to GTD are deaths related to molar pregnancies and their immediate

complications. The main message that emerges from these cases is that they present a high risk of catastrophic bleeding, particularly when taken to theatre for evacuation of the uterus. All cases should be referred for management to a specialist centre.

Levels of care where deaths occurred

Table 5.5a shows what proportion of women who died from ectopic pregnancy died at each level of care. The most common site for death from ectopic pregnancy was at the regional hospitals, followed closely by the district hospitals.

Table 5.5a. Distribution of ectopic deaths across levels of care 2011-13

	Home %	Health Care Centre %	District hospital %	Regional hospital %	Tertiary hospital %	Private hospital %	Total %
Ectopic pregnancy	4.0	0.0	41.2	47.1	11.8	0.0	100.0
- Less than 20 weeks	4.6	0.0	43.6	46.8	9.6	0.0	100.0
- More than 20 weeks	0.0	0.0	12.5	50.0	37.5	0.0	100.0

Table 5.5b shows what proportion of women who died from miscarriage died at each level of care. The most common site for death from miscarriage was at the regional hospitals, followed by the district hospitals.

Table 5.5b. Distribution of miscarriage deaths across levels of care 2011-13

	Home %	Health Care Centre %	District hospital %	Regional hospital %	Tertiary hospital %	Private hospital %	Total %
Miscarriage	0.5	1.1	30.3	52.4	14.1	1.6	100.0
- Septic miscarriage	0.0	0.0	28.9	54.4	15.8	0.9	100.0
- Haemorrhage (non-traumatic)	2.1	4.2	39.6	45.8	4.2	4.2	100.0
- Uterine trauma	0.0	0.0	16.7	33.3	50.0	0.0	100.0
- GTD	0.0	0.0	0.0	75.0	25.0	0.0	100.0
- Following legal TOP	0.0	0.0	33.3	55.6	11.1	0.0	100.0

HIV status of deaths

Tables 5.6a and 5.6b show the HIV status and HAART use of women who died from ectopic pregnancy and from miscarriage, in terms of numbers and percentages respectively. The HIV status at the time of death was unknown in 55.9% of ectopic cases and in 40.5% of miscarriage cases. This does not necessarily imply suboptimal care by the health workers involved, in not testing for HIV, nor does it reflect refusal by patients to test for HIV. Most women who died from these causes presented early during pregnancy and were not booked for antenatal care. Therefore, for those whose HIV status was not already known, there may not have been an opportunity for the health workers to offer an HIV test, particularly as many of these women presented in a critical condition and died within a short time of presenting to the health facility. If only those cases where an HIV test result was available are considered, the HIV test was positive in 32 out of 45 cases (71.1%) of maternal death from ectopic pregnancy, and in 89 out of 110 cases (80.9%) of maternal death from miscarriage. Given that the underlying antenatal HIV prevalence in South Africa during the period of this report was about 29.5%¹, this does suggest a strong association between HIV infection and

maternal deaths from both ectopic pregnancy and miscarriage. While the link between HIV–infection and miscarriage-related deaths seems logical, as HIV infection would make the woman more susceptible to septic complications of miscarriage, the reason for a link between HIV and ectopic pregnancy deaths is not obvious.

Table 5.6a. Distribution of ectopic pregnancy and miscarriage deaths with respect to HIV status (numbers) 2011-13

	Negative	Positive, does not qualify for HAART	Positive, qualifies for, but not on HAART	Positive on HAART	Declined	Unknown	Total
Ectopic pregnancy	13	16	4	12	1	56	102
Miscarriage	21	30	22	37	0	75	185

Table 5.6b. Distribution of ectopic pregnancy and miscarriage deaths with respect to HIV status (percent) 2011-13

	Negative	Positive, does not qualify for HAART	Positive, qualifies for, but not on HAART	AIDS on HAART	Declined	Unknown	Total (%)
Ectopic pregnancy	12.7	15.7	3.9	11.8	1.0	54.9	100.0
Miscarriage	11.4	16.2	11.9	20.0	0.0	40.5	100.0

Final cause of death and other complications

Table 5.7a lists the final cause of death and table 5.7b lists the other complications in cases of maternal death due to ectopic pregnancy and miscarriage respectively. For each death a single final cause of death is assigned, which describes the critical organ failure which most directly led to the patient’s death. In addition if the death was associated with other organ system failures these were documented as other complications (can be more than one per death). For both ectopic pregnancy deaths and miscarriage deaths, the great majority of patients died due to circulatory shock. Whereas the shock was almost exclusively hypovolaemic shock in cases of ectopic pregnancy, both hypovolaemic shock and septic shock were common in cases of miscarriage death, and it was often difficult to assess which of the two types of shock was the predominant problem. Immune system failure was a more common contributor to death for miscarriage deaths than for ectopic pregnancy deaths.

Table 5.7a. Distribution of final cause of death and other complications in ectopic pregnancy deaths 2011-13

	Final Cause		Other complications	
	n	%	n	%
Hypovolaemic shock	78	76.5	8	7.8
Septic shock	4	3.9	4	3.9
Respiratory failure	3	2.9	8	7.8
Pulmonary oedema	5	4.9	1	1.0
Cardiac arrest	6	5.9	7	6.9
Acute collapse due to embolism	1	1.0	0	0.0
Renal failure	2	2.0	2	2.0
Liver failure	1	1.0	0	8.1
Meningitis	1	1.0	1	0.5
Brain death following hypoxic event	0	0.0	1	0.5
Electrolyte imbalance	1	1.0	22	11.9
Lactic acidosis	0	0.0	1	1.0
DIC	0	0.0	8	7.8
Severe anaemia	1	1.0	22	21.6
Immune system failure	0	0.0	8	7.8
Unknown	2	2.0	1	1.0
Other	0	0.0	2	2.0
Total deaths	102		102	

Table 5.7b. Distribution of final cause of death and other complications in miscarriage deaths 2011-13

	Final cause		Other Causes	
	n	%	n	%
Hypovolaemic shock	56	30.3	13	7.0
Septic shock	101	54.6	15	8.1
Respiratory failure	13	7.0	28	15.1
Pulmonary oedema	4	2.2	3	1.6
Cardiac arrest	2	1.1	7	3.8
Acute collapse due to embolism	1	0.5	1	0.5
Renal failure	1	0.5	26	14.0
Liver failure	3	1.6	12	6.5
Intracranial haemorrhage	0	0.0	1	0.5
Cerebral oedema resulting in coning	0	0.0	1	0.5
Meningitis	0	1.0	1	0.5
Cerebral emboli	1	0.5	1	0.5
Brain death following hypoxic event	0	0.0	1	0.5
Unspecified CNS complication	0	2.9	3	1.6
Maternal ketoacidosis	0	0.0	5	2.7
Electrolyte imbalance	2	1.1	20	10.8
Thyroid crisis	0	0.0	2	1.1
Lactic acidosis	0	1.0	9	4.9
Other metabolic	0	0.0	2	1.1
DIC	6	3.2	29	15.7
Severe anaemia	4	2.2	43	23.2
Immune system failure	1	0.5	46	24.9
Unknown	4	2.2	1	0.5
Other	2	1.1	1	0.5
Total deaths	185		185	

Number of hysterectomies performed

Table 5.8 documents how many hysterectomies were done according to the various sub-categories of death due to ectopic pregnancy and miscarriage. Hysterectomy can be a life-saving intervention in some cases of miscarriage, particularly cases of septic miscarriage with septic shock. Only 15

hysterectomies were performed in the 114 cases classified as deaths due to septic miscarriage (13.2%). This suggests that in some cases an opportunity was missed to save the patient’s life by doing a hysterectomy. However, it is difficult to quantify this problem as it is likely that in some cases of “septic shock” the source of the sepsis was not of uterine origin, while in others the patient died before any initial resuscitation was attempted (see above section on sub-categories of death).

Table 5.8. Number of hysterectomies performed per sub-category of early pregnancy death 2011-13

Ectopic pregnancy	2
- Less than 20 weeks	1
- More than 20 weeks	1
Miscarriage	22
- Septic miscarriage	15
- Haemorrhage (non-traumatic)	3
- Uterine trauma	3
- Gestational trophoblastic disease	1
- Following legal TOP	1

Avoidable factors, missed opportunities and substandard care

Each maternal death is assessed to see whether there were avoidable factors or missed opportunities which contributed to the death, and whether substandard care was rendered by the health system. The avoidable factors are classified separately according to whether they are patient behaviour-related, administrative or health worker-related. With regard to the health-worker related avoidable factors, they are sub-classified according to the level of institution at which the avoidable factor took place. Problems with resuscitation during the acute emergency which directly led to the death are assessed separately. If inadequate information is available from the case notes to make an assessment about avoidable factors / substandard care, then it is documented that there is lack of information. The remainder of the cases are referred to as assessable cases. Tables 5.9a and 5.9b present the numbers of assessable cases in each category of avoidable factor for ectopic pregnancy and miscarriage deaths respectively. In addition, the percentage of assessable cases with one or more avoidable factors is presented for each type of avoidable factor. In some cases, the assessment of the resuscitation is documented as “resuscitation not attempted”. When there is a death from ectopic pregnancy and miscarriage in a health facility, there can no justification for not having attempted to resuscitate the patient. Therefore “resuscitation not attempted” was included as an avoidable factor.

Table 5.9a. Distribution of avoidable factors, missed opportunities and sub-standard care in ectopic deaths 2011-13

Category	Assessable cases (n)	% of assessable cases with avoidable factors
Patient orientated	91	36.3
Administrative factors	93	54.8
Health worker related emergency management problems		
Primary level#	100	50.0
Secondary level#	100	30.0
Tertiary level#	100	6.0
Resuscitation	90	60.0

Note: not all assessable cases were managed at secondary or tertiary level

Table 5.9b. Distribution of avoidable factors, missed opportunities and sub-standard care in miscarriage deaths 2011-13

Category	Assessable cases (n)	% of assessable cases with avoidable factors
Patient orientated	164	72.6
Administrative factors	166	44.6
Health worker related emergency management problems		
Primary level#	173	36.4
Secondary level#	175	34.3
Tertiary level#	182	6.0
Resuscitation	171	50.3

Note: not all assessable cases were managed at secondary or tertiary level

The following tables (5.10-5.13) provide more detail on the different categories of avoidable factor.

Table 5.10. Number and percentage of assessable deaths with patient behaviour-related avoidable factors and missed opportunities: ectopic pregnancy and miscarriage deaths 2011-13

Description of avoidable factor	Ectopic		Miscarriage	
	Number	Percentage of assessable deaths	Number	Percentage of assessable deaths
No avoidable factor	58	63.7	45	27.4
No antenatal care	19	20.9	51	31.1
Infrequent antenatal care	1	1.1	2	1.2
Delay in accessing medical help	19	20.9	87	53.0
Declined medication/surgery/advice	2	2.2	7	4.3
Family problem	0	0.0	2	1.2
Community problem	0	0.0	0	0.0
Unsafe abortion	0	0.0	29	17.7
Other	0	0.0	2	1.2

Note: 1. there can be more than one avoidable factor per death 2. "Unsafe abortion" refers to cases where there was documented confirmation that the woman had had an illegal TOP

Table 5.11. Number and percentage of assessable deaths with administrative avoidable factors: ectopic pregnancy and miscarriage deaths 2011-13

Description of avoidable factor	Ectopic		Miscarriage	
	Number	Percentage of assessable deaths	Number	Percentage of assessable deaths
No avoidable factor	42	45.2	92	55.4
Transport problem: Home to institution	1	1.1	1	0.6
Transport problem: Institution to institution	5	5.4	5	3.0
Lack of accessibility: Barriers to entry	2	2.2	0	0.0
Lack of accessibility: Other	1	1.1	2	1.2
Delay initiating critical care (Overburdened service)	8	8.6	20	12.0
Lack of health care facilities: ICU	2	2.2	15	9.0
Lack of health care facilities: Blood/blood products	5	5.4	10	6.0
Lack of health care facilities: Other	5	5.4	10	6.0
Lack of appropriately trained staff: Doctors	27	29	24	14.5
Lack of appropriately trained staff: Nurses	8	8.6	7	4.2
Communication problems: Technical	2	2.2	2	1.2
Communication problems: Interpersonal	3	3.2	6	3.6
Other	14	15.1	12	7.2

Note: there can be more than one avoidable factor per death

Table 5.12a. Number and percentage of assessable deaths with health worker related avoidable factors, missed opportunities and sub-standard care: Ectopic pregnancy deaths 2011-13

Medical management problems	CHC & District Hospitals		Regional Hospitals		Tertiary Hospitals	
	N	%	N	%	N	%
Initial assessment	15	15	6	6	1	1
Problem with recognition / diagnosis	32	32	16	16	3	3
Delay in referring the patient	6	6	0	0	0	0
Managed at inappropriate level	5	5	0	0	0	0
Incorrect management (Incorrect diagnosis)	25	25	9	9	2	2
Sub-standard management (Correct diagnosis)	12	12	17	17	1	1
Not monitored / Infrequently monitored	5	5	4	4	1	1
Prolonged abnormal monitoring with no action taken	9	9	2	2	1	1
Assessable cases	100		100		100	

Note: 1. there can be more than one avoidable factor per death 2. not all assessable cases were managed at secondary or tertiary level

Table 5.12b. Number and percentage of assessable deaths with health worker related avoidable factors, missed opportunities and sub-standard care: Miscarriage deaths 2011-13

Medical management problems	CHC & District Hospitals		Regional Hospitals		Tertiary Hospitals	
	N	%	N	%	N	%
Initial assessment	16	9.2	14	8.0	0	0.0
Problem with recognition / diagnosis	26	15.0	21	12.0	1	0.5
Delay in referring the patient	17	9.8	4	2.3	0	0.0
Managed at inappropriate level	12	6.9	4	2.3	0	0.0
Incorrect management (Incorrect diagnosis)	7	4.0	3	1.7	0	0.0
Sub-standard management (Correct diagnosis)	34	19.7	44	25.1	7	3.8
Not monitored / Infrequently monitored	6	3.5	12	6.9	1	0.5
Prolonged abnormal monitoring with no action taken	9	5.2	11	6.3	2	1.1
Assessable cases	173		175		182	

Note: 1. there can be more than one avoidable factor per death 2. not all assessable cases were managed at secondary or tertiary level

Table 5.13a. Number and percentage of assessable deaths with sub-standard resuscitation: Ectopic pregnancy deaths 2011-13

Resuscitation problems	Number	Percentage of assessable deaths
Lack of information	12	Not assessable
No avoidable factor	36	40.0
Airway problems	4	4.4
Breathing problems	6	6.7
Circulation problems	28	31.1
Drug problems	3	3.3
Investigation problems	1	1.1
Monitoring problems	4	4.4
Resuscitation not attempted	17	18.9

Table 5.13b. Number and percentage of assessable deaths with sub-standard resuscitation: Miscarriage deaths 2011-13

Resuscitation problems	Number	Percentage of assessable deaths
Lack of information	14	Not assessable
No avoidable factor	85	49.7
Airway problems	3	1.8
Breathing problems	11	6.4
Circulation problems	33	19.3
Drug problems	1	0.6
Investigation problems	6	3.5
Monitoring problems	5	2.9
Resuscitation not attempted	32	18.7

Avoidability of deaths

For each case, the assessors must make a judgement about the avoidability of the death by classifying the death according to the options presented in tables 14a and 14b. In this classification, “sub-optimal care” refers only to the care the patient received within the health system (including administrative and health-care worker-related avoidable factors). It is not referring to problems with patient behaviour. Eighty-eight percent (88%) of women who died from ectopic pregnancy had sub-optimal care, while 65% would probably have been saved with better care. Seventy-eight percent (78%) of women who died from miscarriage had sub-optimal care, and 35% would probably have been saved if the care had been better.

Table 5.14a. Distribution of avoidability in deaths due to ectopic pregnancy (102 deaths) 2011-13

Percent per disease category	n	%
No suboptimal care	12	11.8
Suboptimal care, different management would have made no difference to the outcome	5	4.9
Suboptimal care, different management might have made a difference to the outcome	19	18.6
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	66	64.7

Table 5.14b. Distribution of avoidability in deaths due to miscarriage (185 deaths) 2011-13

Percent per disease category	n	%
No suboptimal care	41	22.2
Suboptimal care, different management would have made no difference to the outcome	21	11.4
Suboptimal care, different management might have made a difference to the outcome	59	31.9
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	64	34.6

Summary of Avoidable factors

Ectopic pregnancy

The most common patient behaviour-related avoidable factors were “lack of antenatal care” and “delay in accessing medical help”. Although identified by the assessors, it is questionable whether the lack of antenatal care was really an avoidable factor in most of these cases. Most of the women were unbooked because rupture of ectopic pregnancy typically occurs early in the first trimester of pregnancy. Therefore they should not be blamed for being unbooked. There would also be no guarantee that a routine early first trimester antenatal visit would detect an ectopic pregnancy.

With regard to “delay in accessing medical help”, it is likely that this is partly a problem of lack of transport for the patient to get to the health institution. Lack of transport from home to institution does not, however, feature as an important administrative avoidable factor for ectopic pregnancy deaths. This is probably because the lack of transport is not documented in the case notes and cannot therefore be identified by the assessor.

The most common administrative factor by far was a lack of appropriately trained doctors (29% of ectopic deaths). The proportion of ectopic deaths where this was an avoidable factor almost doubled compared to the 2008-10 report (16% of ectopic deaths), implying that increasingly medical officers working at hospitals, particularly district hospitals, are not adequately trained to be able to perform a laparotomy for ectopic pregnancy, either from the surgical or anaesthetic aspect (see vignette No.2).

In contrast, the proportion of ectopic deaths where lack of blood for transfusion was assessed as being an avoidable factor decreased from 11% in 2008-10 to 5% in the current report.

There were several important health worker-related avoidable factors: failure to make the diagnosis at all levels of care, and therefore incorrect management (see vignette No.1); substandard care despite the right diagnosis having been made, again at all levels of care, but especially at regional and district hospital levels (see vignettes Nos.1 and 2); and substandard resuscitation of hypovolaemic shock (see vignette No.1), including cases where resuscitation was not even attempted. Overall resuscitation was sub-standard in 56% of ectopic deaths

Miscarriage

The majority (72.6%) of women who died from miscarriage had patient behaviour-related factors which contributed to the death. 17.7% had documented evidence of having had an unsafe (illegal) termination of pregnancy (TOP), which was a lower proportion than the 23.6% in the 2008-10 report. While this could well indicate better access to safe (legal) TOP services, it is likely that the figure remains an underestimate of the true contribution of unsafe TOP to the deaths from

miscarriage. Over half (53%) delayed in seeking medical care, which in some cases may have been because they were hiding the fact that they had had an illegal TOP.

The most common administrative avoidable factor was “lack of appropriately trained doctors” which was noted in 14.5% of miscarriage deaths. The equivalent figure in 2008-10 was 6.9%. Scrutiny of the case records suggests that this factor was often recorded by assessors when the doctor mismanaged the patient. It appears that the assessor made the inference that the doctor must be lacking the appropriate training. Thus this avoidable factor in fact reflects sub-standard care by the doctors.

“Delay in initiating critical care due to overburdened services” was noted in 12% of miscarriage deaths. This mainly refers to delays in performing an appropriate surgical procedure (e.g. evacuation of the uterus), due to lack of theatre availability. There is no doubt that lack of access to a Department of Health TOP service was an important administrative factor for some of the miscarriage deaths. However, the assessor does not usually have information about this when reviewing the cases notes, and thus it does not get recorded as a specific avoidable factor. The documented cases of unsafe TOP are evidence enough of a lack of access to safe TOP.

The most common health worker-related avoidable factor at all levels of care was substandard care despite the diagnosis having been made (see vignettes Nos. 3 and 4). Failure to make the diagnosis or to recognise the severity of the condition was also a major problem at the primary and secondary levels of care (see vignette No.3). Resuscitation was substandard in 50.3% of miscarriage deaths, 18.7% dying without being resuscitated at all (see vignettes Nos.3 and 4).

Vignettes

No.1

A 27 year old para 1 was brought by ambulance to the casualty department of a regional hospital with problems of lower abdominal pain and a “swollen abdomen”. She had collapsed while at church. Her BP was 102/61 and her pulse rate was 100/min. The abdomen was distended with tenderness and guarding. A diagnosis of acute gastritis or peptic ulcer was made and she was discharged from casualty on oral cimetidine. Four days later, she was referred back to the same casualty department by a general practitioner with problems of severe anaemia and abdominal pain. She was seen by a doctor about an hour after arrival. She was dizzy, with a BP of 101/39 and a pulse rate of 140/min. She was very pale, with a tender, distended abdomen. She had had two months of amenorrhoea and the pregnancy test was positive. A ruptured ectopic was suspected. A plan was made to call the gynaecology doctor. Meanwhile, an intravenous infusion of one litre of Normal.Saline was put up, and blood tests were taken. Over four hours later, the gynaecologist reviewed the patient in casualty and confirmed the diagnosis of a ruptured ectopic pregnancy. The BP was 92/55, with a pulse rate of 134/min. Blood for transfusion was ordered and a laparotomy was planned. Despite there being two gynaecological doctors on duty and two operating theatres, it was decided to wait for emergency caesarean sections to be finished, before she was taken to the operating theatre three hours later. She arrested before the laparotomy could be started and resuscitation efforts failed.

Points

- The Health System failed this patient as she presented early enough to be saved
- A diagnosis of ectopic pregnancy must always be considered when a woman of reproductive age presents with lower abdominal pain. Pallor, dizziness, syncope and tachycardia are additional features consistent with a ruptured ectopic pregnancy.

- The case emphasises that a patient with ruptured ectopic pregnancy who presents with signs of shock must be managed with intensive resuscitation and must be taken to theatre for laparotomy without delay.
- There was failure to act with appropriate urgency once the diagnosis of likely ruptured ectopic pregnancy was made by the casualty officer.
- This case illustrates how casualty staff sometimes fail to prioritise shocked gynaecological patients, compared to other cases such as trauma cases.
- It seems that neither the casualty team nor the gynae team took responsibility for the prompt intervention when it was critically needed, leaving it to each other.
- Once the case was taken over by the gynaecology team, there seemed to be a lack of insight about the implication of the hypovolaemic shock and the need to perform a laparotomy without delay in order to save the patient's life
- This case highlights the need for doctors and nurses working in general out-patient or casualty departments, and those with responsibility for gynaecological patients to be trained in the recognition and management of ectopic pregnancy

No.2

A 15 year-old G1P0 presented in the evening to a district hospital with problems of dizziness, lower abdominal pain, vomiting and diarrhoea. Her last menstrual period was unknown. She was found to be very pale, with a BP of 96/37 and a tachycardia. A pregnancy test done on arrival was positive. The cervix was closed and there was no per vaginal bleeding. The medical officer (MO) on-call made a diagnosis of symptomatic anaemia in pregnancy, with a differential diagnosis of ectopic pregnancy. He made a plan to transfuse two units of emergency blood, and to review the patient the next morning. Over the next three hours, the patient was transfused, but remained restless with BPs ranging between 85/32 and 75/34. The MO was called to review the patient. This time he noted abdominal distension and guarding, and diagnosed ruptured ectopic pregnancy. He arranged transfer of the patient to the regional hospital. She arrived at the regional hospital three hours later in a critical condition. She arrested on arrival and resuscitation failed.

Points

- It is shocking for a 15 year-old to lose her life in this way. The case illustrates the importance of teenagers having access to education on reproductive health matters as well as access to contraception.
- The initial missed diagnosis, which was a clear avoidable factor leading to this patient's death, indicates clinical incompetence and a need for in-service education on this topic for all doctors who have on-call duties at district hospitals, as well as those working in out-patient or casualty departments.
- Eventually, the diagnosis of ruptured ectopic pregnancy was correctly made at the district hospital on clinical grounds. The laparotomy should then have been done without delay at the district hospital. This should be within the scope of district hospital medical officers as it is a life-saving procedure. It was not documented in this case exactly why the decision was made to transfer rather than operate on the patient
- Once a patient with ruptured ectopic pregnancy displays signs of hypovolaemic shock, there must be no delay in taking her to theatre for laparotomy. If the patient is at a district hospital, the laparotomy must be done on-site. It is unacceptable and unethical for doctors to allow a patient to bleed to death without taking action to stop the bleeding.
- Blood transfusion for a shocked patient with a ruptured ectopic pregnancy is unlikely to successfully resuscitate the patient unless, simultaneously, steps are taken to arrest the haemorrhage. The only way to arrest the haemorrhage is to do a laparotomy.

No.3

A 17 year old primigravida was brought by her mother to a district hospital. They reported that she had been four months' pregnant and had had a termination of pregnancy a few days before, conducted by a GP. She had

continued to bleed since. On arrival, she was too weak to walk, and looked pale. Her BP was 100/64 with a pulse rate of 98/min. The medical officer (MO) assessed the patient as being “stable”, and noted that the abdomen was tender, with a bulky uterus. On digital vaginal examination, the cervix was found to be open, and products of conception were felt through the cervix. Without further investigation the MO made a diagnosis of “septic incomplete abortion”, and made a plan for evacuation of the uterus. She had an evacuation done soon after admission under pethidine and diazepam. The cervix was noted to be ragged and possibly necrotic, and a large quantity of foul-smelling products was evacuated from the uterus. She was sent to the general ward on oral antibiotics, with instructions for a ward HB to be done. Overnight she received two units of colloid fluid due to hypotension, but was only reviewed by a doctor late the following morning. The doctor noted that the ward HB was 4,7g/dl, and that the patient was tachycardic and very pale, and had foul-smelling blood on vaginal examination. A blood transfusion was ordered, but the patient died 12 hours later without further resuscitation and without the blood transfusion having been started.

Points

- The case highlights the importance of improving education in schools and in the community about safe sex and contraception, and also highlights the need for better access for teenagers to contraception services and safe TOP services.
- The GP initiated an unsafe termination of pregnancy (TOP), as he did not follow-up on the case or arrange a referral to the hospital. This led to a neglected septic abortion, with the patient eventually presenting very late in a critical condition. It is illegal for GPs to provide TOPs in this way. While it is appropriate for GPs to involve themselves in providing TOP services as it will increase access to the procedure, this case illustrates the need for formal public-private partnerships with a TOP accreditation process for the GP, to ensure safe TOPs.
- Although the admitting doctor at the district hospital made a correct diagnosis of “septic, incomplete abortion”, he failed to recognize the implications of this diagnosis. This patient should have been assessed more thoroughly, resuscitated, stabilized and referred for more intensive and expert management to the regional hospital.
- The doctors and nurses at this hospital would clearly benefit from ESMOE training on the recognition and management of sepsis and shock in the context of miscarriage.

No.4

A 29 year-old gravida 2 para 1 booked early for antenatal care at 10 weeks’ gestation. She was a known HIV positive woman who had started on highly active antiretroviral therapy the year before when her CD4 count had been 188. She attended antenatal care on three occasions. There was no screening for TB done, and no new CD4 count check. At 20 weeks’ gestation she presented with shortness of breath to the casualty at a district hospital. Her BP was 96/52, her pulse rate 126 and her temperature 37,6°C. The medical officer (MO) on duty made a diagnosis of respiratory tract infection and admitted the patient to the medical ward on antibiotics, without evaluating the pregnancy. In the ward the nurses heard from the patient that she had ruptured her membranes while in casualty. She started bleeding per vagina. Her condition was noted to be “very weak and dull”. This was reported by the nurses to the on-call doctor in the evening. He did not come to see the patient, but advised telephonically as follows: “Let her abort. I will review her tomorrow”. She died undelivered the same night without further resuscitation, or recording of vital signs. The doctor came to certify the death.

Points

- This case was assessed as a miscarriage death, but it was not clear to what extent the miscarriage was responsible for the death as opposed to an underlying respiratory illness
- There were missed opportunities during antenatal care to evaluate the patient’s HIV clinical stage and CD4 count, and to screen for TB. Taking these opportunities might have led to earlier detection of the respiratory problem, and a better outcome.

- The care by the doctor(s) at the hospital goes beyond being incompetent. It was unprofessional and negligent, and clearly showed a lack of commitment to saving the woman's life.
- This highlights the need for a prompt meeting at the institutional level to investigate each maternal death. Such meetings should be attended by the relevant managers so that appropriate corrective action can be taken in response to the findings.
- Although disciplinary action is necessary in response to unprofessional conduct, this cannot be the primary solution to improving the commitment to quality care amongst the health care workers in an institution. What is required is for strong clinical leadership to set the example of what is expected.

Discussion

The statistics presented above, together with a review of the case files of women who died from ectopic pregnancies and miscarriage, have highlighted issues which need to be addressed if deaths from these causes are to be reduced. Certain themes recurred repeatedly in the assessment of these cases and are listed below.

Themes relevant to both ectopic pregnancy deaths and miscarriage deaths

Need for improved family planning / contraception services (see vignettes No. 2,3)

The ongoing problem of deaths following unsafe miscarriages as well as legal TOPs indicate that miscarriage deaths often result from unwanted pregnancies. Furthermore it is reasonable to assume that the great majority of the teenage pregnancies, which contributed to early pregnancy deaths, were unplanned pregnancies. This is evidence of poor functioning of contraception/ family planning services in this country. In particular, HIV-infected women are a group who need access to effective family planning services in order to maintain their health. Yet the great majority of tested women who died from miscarriage and ectopic pregnancy were HIV positive, suggesting that family planning is not adequately integrated into the management of chronic diseases such as HIV. New approaches are required to make contraception and family planning more accessible and acceptable to the community.

Need to maintain the intensity in the fight against HIV/AIDS (see vignette No. 4)

Over the course of this triennium (2011-13) the Department of Health in South Africa intensified the fight against HIV/AIDS. In 2013, new ARV guidelines ensured that all pregnant HIV positive women would receive highly active antiretroviral therapy from the time of the first antenatal visit. However, the data above demonstrate that there is still a long way to go. Many women who died from miscarriage and ectopic pregnancy had unknown HIV status, indicating that young women in society are still not given adequate education about HIV and an opportunity to test for HIV and maintain their health accordingly. It is too late for women to find out their HIV status when they are already pregnant or critically ill. Data from those who were HIV tested suggest that HIV is a major underlying risk factor for death from both miscarriage and ectopic pregnancy. Thus wide-ranging interventions to combat HIV in society, including primary prevention of infection, should reduce these early pregnancy deaths.

Need for community education about booking early, reporting early to hospital when early pregnancy complications arise, and about how to access safe TOP services (see vignette No.3)

Many patients delayed in presenting to a health care facility, often arriving in a critically ill condition. This was the most frequently documented patient behaviour-related avoidable factor for both ectopic pregnancy and miscarriage deaths. There is clearly a need for the Health Department to put more emphasis on educating the public about safe behaviour relating to reproductive health, including early booking and prompt and appropriate responses to danger signs. For cases where the pregnancy is unwanted, the community must be educated regarding how to access safe TOP services. An important strategy to achieve this will be the expansion of the ward-based outreach teams incorporating the community care givers' programme.

Need for improved resuscitative management of the shocked gynaecological patient, irrespective of the type of shock (see vignettes Nos. 1,2,3,4)

The great majority of women who died following early pregnancy loss, died due to circulatory shock. Hypovolaemic shock and septic shock both contributed, and in some cases it was not clear which was the predominant cause of shock. Sub-standard resuscitation by the health care workers was documented in over half of the cases. It appeared that there were a mixture of factors contributing to this failure of resuscitation, including failure to recognise shock and lack of insight about the urgency of treating shock. Sub-standard management of shock was a problem across all levels of care. This is clearly an area where there is a need for training and retraining of staff. Modules on the management of shock as well as of miscarriage are included in the ESMOE programme. Tools such as colour-coded observation charts to highlight danger signs and indicate appropriate action may help.

Need for shocked gynaecological patients to be prioritised in casualty departments. Shared responsibility of care between casualty staff and gynaecology team (see vignette No. 1)

When presenting to hospital, many of the women who died following early pregnancy loss were first received and assessed in a casualty department. There were often delays in assessment and delays in or lack of resuscitation for these patients while they remained in casualty. A common reason for this, particularly at regional hospitals, was that the casualty staff (doctors and nurses), once they had identified that the patient had a gynaecological problem, referred the patient on to the gynaecology team, and in the meantime did not take responsibility to assess and resuscitate the patient. There would often be delays before the gynaecology team would come to review the patient. This highlights the need for training of casualty staff as well as gynaecology department staff in the management of early pregnancy complications. Casualty department policies must ensure that a shocked gynaecological patient is given equal priority in resuscitation compared to other shocked patients, and that no patient is left unattended. Either the casualty or gynaecology staff taking must take responsibility to institute emergency care.

Need for facility managers to ensure that doctors and nurses are aware of their professional and ethical responsibilities on duty and to hold them accountable when they neglect these responsibilities (see vignette No. 4)

In many of the deaths, over and above a lack of knowledge or skill on the part of the doctors and nurses attending to the patient, there appeared to be a lack of interest or commitment to save the woman's life (see vignette 4). In such cases the death notification forms do not usually indicate that

this lack of professionalism or ethics has been acknowledged or addressed. It is the facility manager's responsibility to clarify the standards expected of those working in the facility and to take remedial action when these standards are not respected. This is one of the reasons why it is essential that on-site audit of major adverse incidents including maternal deaths must routinely occur and must be attended by the senior facility managers .

Themes specific to ectopic pregnancy deaths

Need for training on recognition of ectopic pregnancy, and management, particularly the need for prompt surgery if the patient is shocked (see vignettes Nos. 1 and 2)

There were two common health worker-related avoidable factors specific to deaths from ectopic pregnancy. The first was failure to diagnose the ectopic pregnancy. This was mainly a problem of the doctor failing to even consider the diagnosis. The second problem was the failure to make a decision to do an urgent laparotomy when the diagnosis of ruptured ectopic pregnancy was made, particularly when the patient was already shocked. A crucial mistake that was sometimes made was to defer the surgery, or to refer the patient to a higher level of hospital, because the patient was haemodynamically unstable. The principle in such cases is that the only way to stabilise the patient is to do a laparotomy and stop the bleeding. Delaying this step when the patient is already shocked is likely to result in death. The implication is that the emergency surgery should be performed at the district hospital, if referring the patient will create a delay.

These two issues need to be addressed by training and retraining all relevant doctors about these particular aspects of the management of ectopic pregnancy. The relevant doctors include not just those working in gynae departments, but also those who work in casualty departments and those who may be called upon to perform the laparotomy or provide anaesthesia for the laparotomy. Medical managers also need to be trained so that they understand their responsibility to ensure that their hospital can offer a laparotomy to women with ruptured ectopic pregnancy.

There were hospitals, particularly district hospitals, where the medical officers on duty were unable to perform a laparotomy for ectopic pregnancy (apparently due to lack of appropriate training), so that the patient with a ruptured ectopic pregnancy had to be referred, inevitably delaying the potentially life-saving surgery. Especially given the long inter-hospital transport delays experienced in many parts of the country, this lack of training needs to be addressed so that laparotomy can be performed (surgery and general anaesthetic) at all district hospitals. Medical officers at district hospitals must have these skills included in their job description, and medical managers must ensure that those medical officers who lack the skills are given the opportunity to acquire those skills. The medical managers should liaise with the District Clinical Specialist team or the local regional referral centre to arrange training in this regard.

Themes specific to miscarriage deaths

Need for access to safe legal termination of pregnancy (TOP) for all women (see vignette No. 3)

Fifteen years after the implementation of the Choice on Termination of Pregnancy Act of 1996, it is clear that many women in South Africa still do not have access to safe and legal TOP. The data in this report provides evidence for this, as there continue to be deaths following unsafe miscarriage. In addition it is well recognised that illegal TOP businesses are thriving. There were a small number of

women (6) who died following uterine trauma, which could have resulted from an illegal TOP using instruments. However, it appears that by far the most common method used for illegal TOPs in South Africa is now misoprostol, given in a variety of doses and regimes. While this may be safer than using unsterile instruments, it can still lead to life-threatening complications, particularly when the miscarriage is incomplete, and results in protracted blood loss and eventually sepsis. This happens because there is limited follow-up of the women after the TOP process has been initiated and no formal referral to hospital to take over the care of the incomplete miscarriage. It is not just unregistered practitioners who conduct this type of unsafe TOP. A common problem in this triennium was unsafe miscarriage conducted by general practitioners (GPs), again using misoprostol, and subsequently not following up or referring their patients.

Since 2012, mifepristone as well as misoprostol has been available for Department of Health (DOH) facilities to use to carry out medical TOP. The advantage of adding mifepristone to the regimen is that most cases of first trimester TOP can be successfully achieved without the need for any surgical procedure. A standard treatment guideline is available in the National Essential Medicines List book². This provides an opportunity to make safe TOP much more widely available at DOH facilities than it has been before. The TOP could be managed medically through an outpatient department, with any doctor authorized to prescribe the drugs. The procedure would not have to be restricted to a dedicated TOP unit. Even for dedicated TOP units with the capacity to conduct surgical TOPs, the medical method will be applicable in the majority of cases, and will allow the unit to manage a larger number of cases, as the medical method is less time-consuming than the surgical.

All hospitals should be able to provide medical TOP as a minimum. Furthermore all TOP units should have access to the drugs required for medical TOP. These two measures should greatly increase access to safe TOP for the community. Nonetheless, access may still be restricted because a large proportion of health workers are unwilling to be involved in the provision of a TOP service, for religious reasons. In several districts of South Africa the Department of Health has set up successful partnerships with accredited non-governmental reproductive health care organisations, who provide the TOP service at state expense. This is a model that could be investigated for all districts where the service cannot be adequately provided within the state institutions. There is potential for the GPs to also form partnerships with the hospitals so that the GPs are accredited to initiate TOPs according to a standard protocol and then formally refer the patients to the hospital should they require surgical management.

Need for training at all levels on recognition and management of different types of miscarriage (see vignettes Nos. 3,4)

Review of the case notes of women who died from miscarriage repeatedly demonstrated lack of insight regarding both assessment and management of women presenting with miscarriage. Training is required regarding how to recognize the “unsafe” miscarriage which needs to be referred for specialist care. For those requiring evacuation of the uterus, facilities for safe evacuation must be made available at all hospitals and at selected community health centres. There were several cases where death followed a long delay after admission to hospital with a diagnosis of incomplete miscarriage, where the patient was kept waiting for an evacuation procedure to be done. The delay was often due lack of availability of “theatre space”. Patients were often poorly monitored during this waiting period. Uncomplicated first trimester miscarriages can be safely and efficiently managed without having to undergo general anaesthesia and surgical curettage in a theatre complex. Options

include manual vacuum aspiration of the uterus under analgesia or conscious sedation in the casualty theatre or gynae side ward³, or alternatively medical management with misoprostol in selected cases⁴. All facilities which manage early pregnancy complications should be able to provide these options and should have clear protocols for how to manage uncomplicated miscarriage, as well as how to recognise and manage complicated miscarriage. These aspects of care are covered in the miscarriage ESMOE module.

Conclusion

Since the previous triennium, there has been an increase in maternal deaths related to ectopic pregnancy and no change in the numbers of deaths related to complications of miscarriage. Sixty-five percent of ectopic pregnancy deaths and 35% of miscarriage deaths were clearly avoidable within the health system. Many of these women bled to death in health institutions due to sub-standard management by the health care team. Unsafe and illegal terminations of pregnancy remain a major contributor to miscarriage deaths. HIV infection is an important underlying risk factor for both categories of early pregnancy deaths. In order to reduce deaths from these causes, more intensive and committed management of these patients by health care workers is needed when they present to health facilities. In addition, new approaches to giving the community access to contraception and safe TOP services will be required.

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Chapter 6 Pregnancy-related sepsis

Abstract

Deaths from pregnancy related sepsis (PRS) are those caused by infections in the genital tract or in tissues involved in the birth process in viable pregnancies. Deaths from septic miscarriage are described elsewhere in this report. There were 226 deaths from PRS in 2011-2013: 117 after vaginal birth, 88 after caesarean section, 11 after caesarean section complicated by bowel injury, and 10 caused by chorioamnionitis. HIV results were known in 208 women, of whom 137 (66%) were HIV-infected. The iMMR related to PRS has declined from 12.1 in 2002-2004 to 8.0 per 100 000 live births in 2011-2013. The iMMR for deaths after caesarean section (excluding cases of bowel injury) declined from 4.1 in 2008-2010 to 3.1 per 100 000 live births in 2011-2013. However, there were only two deaths following bowel injury in 2008-2010.

Forty-two per cent of PRS deaths in 2011-2013 occurred at regional hospitals, and 30% occurred at district hospitals. The three provinces with the highest iMMRs for PRS were the mainly rural provinces of Limpopo, Mpumalanga and North-west. The two provinces with the lowest iMMRs for PRS were the mainly urban provinces of Gauteng and the Western Cape.

Hysterectomy was done in 14% of the deaths. Seventy-eight per cent of deaths were considered possibly or probably avoidable. Delay in seeking professional care was the most frequent patient-related avoidable factor (31%), followed by non-attendance at antenatal clinic (16%). Common administrative-related avoidable factors were lack of appropriately trained doctors (24%), overburdened services (9%) and lack of intensive care facilities (6%). Frequent health-care provider avoidable factors included failures in initial clinical assessment and diagnosis, treatment at an inappropriate level of care, delay in referral, substandard clinical care, and prolonged monitoring of abnormal vital signs without taking action. Avoidable factors were more frequent at district hospitals.

While the rate of PRS deaths has shown a welcome decline in recent years, the high proportion of avoidable deaths is of concern. Failures in initial assessment and diagnosis, and a low proportion of hysterectomies, suggest underestimation of the severity of illness and delayed definitive treatment in these patients. The recent sharp increase in deaths from bowel injury at caesarean section may indicate a trend of increasing numbers of difficult repeat caesarean sections.

Recommendations

1. Ensure capacity and accessibility of facilities for outpatient postnatal care within 6 days of delivery in all districts. On discharge from the place of delivery, advise women on signs of infection, and what to do if these are noticed.
2. Strengthen systems to ensure detection and treatment of HIV infection as early as possible in pregnancy, including strategies to ensure initiation of antenatal care as early as possible in gestation (before 14 weeks).
3. Ensure that surgeons and operating theatre staff follow standard precautions before and during Caesarean sections, including asepsis, good and safe surgical technique, and routine

prophylactic antibiotics. Extended doses of antibiotics must be given in women with risk factors for PRS.

4. Remind and educate clinicians about suspecting and recognising severe PRS in ill postpartum women, using forums such as morbidity and mortality meetings, or formal ESMOE or other training. Hospital admission is advised in women with systemic inflammatory response syndrome (SIRS) related to PRS.
5. In district hospital protocols, especially in rural areas, emphasise recognition and grading of severe PRS and the need for early transfer women of such women to higher levels of care, after adequate fluid resuscitation and administration of high-dose broad-spectrum antibiotics.
6. In regional hospitals, audit the capacity of staff and facilities to manage women with severe PRS. Recommended norms and standards for staff and facilities, including intensive care units, should be followed.
7. Educate all doctors performing Caesarean sections about precautions for preventing bowel injury at repeat Caesarean section. Ensure protocols are in place for intraoperative management of bowel injuries, including general surgical help, and transfer to higher levels of care.

Introduction

From 2011-2013, 226 maternal deaths were attributed to pregnancy related sepsis (sepsis originating in the genital tract or in tissues involved in the birth process in pregnancies of viable gestational age). Pregnancy related sepsis (PRS) was the fifth commonest cause of maternal deaths, accounting for 10.5% of direct deaths, and 5.2% of all maternal deaths. The institutional maternal mortality ratio (iMMR) related to PRS declined from 12.1 in 2002-2004 to 8.0 per 100 000 live births in 2011-2013. The iMMR for deaths after Caesarean section (excluding cases of bowel injury) declined from 4.1 in 2008-2010 to 3.1 per 100 000 live births in 2011-2013.

Demographic data

Forty-two per cent of PRS deaths in 2011-2013 occurred at regional hospitals, and 30% occurred at district hospitals (Table 6.1). The three provinces with the highest iMMRs for PRS were the mainly rural provinces of Limpopo, Mpumalanga and North-west. The two provinces with the lowest iMMRs for PRS were the mainly urban provinces of Gauteng and the Western Cape (Figure 6.1). Overall, the ages and parities of women dying from PRS reflect those of pregnant populations and maternal deaths in general (Tables 6.2 and 6.3).

Table 6.1. Levels of care for deaths from pregnancy related sepsis (by place of death)

	Home %	Health care centre	Level 1 hospital	Level 2 hospital	Level 3 hospital	Private hospital	Total
All pregnancy related sepsis	1 (0%)	1 (0%)	68 (30%)	96 (42%)	56 (25%)	4 (2%)	226
- Chorioamnionitis	0 (0%)	0 (0%)	5 (50%)	4 (40%)	0 (0%)	1 (10%)	10
- Puerperal sepsis after vaginal birth	0 (0%)	0 (0%)	45 (38%)	45 (38%)	26 (22%)	1 (1%)	117
- Puerperal sepsis after Caesarean section	1 (1%)	1 (1%)	18 (20%)	39 (44%)	28 (32%)	1 (1%)	88
- Bowel trauma at Caesarean section	0 (0%)	0 (0%)	0 (0%)	8 (73%)	2 (18%)	1 (9%)	11

Figure 6.1. Institutional maternal mortality ratio for pregnancy related sepsis per 100 000 live births for all provinces

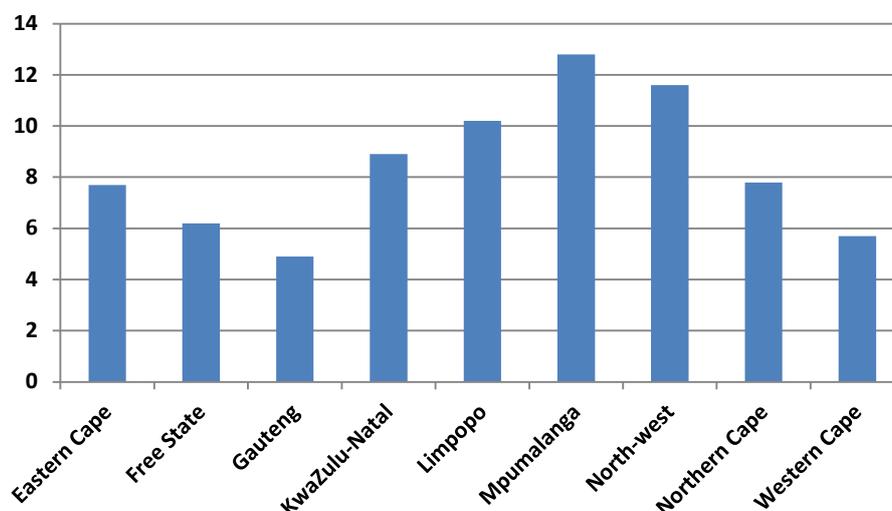


Table 6.2. Maternal age and deaths from pregnancy related sepsis

Age category (years)	N	%	General pregnant population* %
< 20	30	13.3	12.2
20 - 24	48	21.2	27.4
25 - 29	58	25.7	26.4
30 - 34	36	15.9	19.3
35 - 39	32	14.2	11.0
40 - 44	14	6.2	3.5
45+	8	3.5	0.3
Unknown	0	0.0	0.3
Total N	226	100.0	

* Data for general pregnant population are derived from Recorded Live Births 2012, Statistical release P0305, Statistics South Africa

Table 6.3. Parity and deaths from pregnancy related sepsis

Parity	n	%
0	79	35.0
1	60	26.5
2	40	17.7
3	23	10.2
4	8	3.5
5	4	1.8
6+	6	2.7
Unknown	6	2.7
Total	226	100.0

Causes of maternal death

The most frequent cause of maternal death from PRS was puerperal sepsis after vaginal birth (52% of deaths), followed by sepsis after Caesarean section (39%) (Table 6.4). There were 11 deaths

related to bowel injury occurring during Caesarean section; most of these events occurred in women with previous abdominal surgery, and the bowel injuries were not noticed at the time of Caesarean section. After bowel injury, presentation with symptoms and signs of sepsis was relatively early (≤ 3 days postoperatively) and HIV infection was not a feature (Table 6.5).

Septic shock was the final cause in almost 90% of deaths from PRS. Multi-organ dysfunction, involving mostly renal, respiratory, liver and clotting failures, was frequent (Table 6.6). Of 208 women tested for HIV, 137 (66%) tested positive. Ninety-seven women were eligible for combination antiretroviral therapy (ART), and 67 of these (69%) were receiving ART when they died (Table 6.7).

Table 6.4. Sub-categories of pregnancy related sepsis

	n	%
Chorioamnionitis with ruptured membranes	8	3.5
Chorioamnionitis without ruptured membranes	2	0.9
Puerperal sepsis after vaginal birth	117	51.8
Puerperal sepsis after Caesarean section	88	38.9
Bowel trauma at Caesarean section	11	4.9
Total	226	100.0

Table 6.5. Summary of seven deaths caused by bowel injury at caesarean section (CS)*

Case	Previous surgery	HIV status	Bowel injury noticed at CS	Adhesions noted at CS	Presented on postoperative day
1	CS	Negative	No	No	7
2	Ectopic	Negative	No	No	3
3	CS	Negative	No	Yes	7
4	None	Negative	No	No	3
5	CS	Positive	No	Yes	2
6	CS	Negative	No	Yes	2
7	CS and ectopic	Negative	No	No	2

*Excludes four deaths from bowel injury for which detailed clinical notes were not available

Table 6.6. Final causes of death in pregnancy related sepsis (n=226)

	n	%
Circulatory system	211	
- Hypovolaemic shock	11	4.9
- Septic shock	200	88.5
Respiratory failure	52	23.0
Cardiac failure	30	
- Pulmonary oedema	19	8.4
- Cardiac arrest	11	4.9
Acute collapse due to embolism	2	0.9
Renal failure	58	25.7
Liver failure	20	8.8
Cerebral complications	11	
- Intracranial haemorrhage	0	0.0
- Cerebral oedema resulting in coning	2	0.9
- Meningitis	1	0.4
- Cerebral emboli	0	0.0
- Brain death following hypoxic event	3	1.3
- Unspecified	5	2.2
Metabolic	43	
- Maternal ketoacidosis	6	2.7
- Electrolyte imbalance	18	6.9
- Thyroid crisis	0	0.0
- Lactic acidosis	13	5.0
- Other	6	2.7
Haematological	60	
- DIC	29	12.8
- Severe anaemia	31	13.7
Immune system	67	29.6

Table 6.7. HIV status and deaths from pregnancy related sepsis

Cause of death	Negative	Pos not qual. ART	AIDS not on ART	AIDS on ART	Unknown	Total
All pregnancy related sepsis	71 (31%)	40 (18%)	30 (13%)	67 (30%)	18 (8%)	226
- Chorioamnionitis	2 (20%)	1 (10%)	2 (20%)	2 (20%)	3 (30%)	10
- Puerperal sepsis after vaginal birth	28 (24%)	22 (19%)	17 (15%)	38 (32%)	12 (10%)	117
- Puerperal sepsis after Caesarean section	33 (38%)	15 (17%)	11 (13%)	26 (30%)	3 (3%)	88
- Bowel trauma at Caesarean section	8 (73%)	2 (18%)	0 (0%)	1 (9%)	0 (0%)	11

Avoidable factors, missed opportunities and substandard care

Fourteen percent of women dying from PRS underwent hysterectomy (Table 6.8). Patient orientated avoidable factors were identified in 52% of deaths, and administrative related avoidable factors in 46% of deaths (Table 6.9). Delay in seeking professional care was the most frequent patient related avoidable factor (31%), followed by non-attendance at antenatal clinic (16%) (Table 6.10). Common administrative related avoidable factors were lack of appropriately trained doctors (24%), overburdened services (9%) and lack of intensive care facilities (6%) (Table 6.11). Frequent health-care provider avoidable factors included failures in initial clinical assessment and diagnosis, treatment at an inappropriate level of care, delay in referral, substandard clinical care, and prolonged monitoring of abnormal vital signs without taking action. Avoidable factors were more frequent at district hospitals (Table 6.12). Resuscitation related avoidable factors were relatively infrequent, but, in 65 cases, resuscitation was not attempted (Table 6.12).

Table 6.8. Women dying from pregnancy related sepsis who underwent hysterectomy

All pregnancy related sepsis	32 (14%)
- Chorioamnionitis	0 (10%)
- Puerperal sepsis after vaginal birth	14 (12%)
- Puerperal sepsis after Caesarean section	16 (18%)
Bowel trauma at Caesarean section	2 (18%)

Table 6.9. Avoidable factors, missed opportunities and substandard care in pregnancy related sepsis

Category	Assessable cases (n)	% of avoidable factors in assessable cases
Patient orientated	197	52.3
Administrative factors	211	45.5
Health worker related emergency management problems		
Primary level	209	42.1
Secondary level	213	32.4
Tertiary level	217	12.4

Table 6.10. Patient orientated avoidable factors, missed opportunities and substandard care

Description	Number	% of assessable deaths (n=197)
Lack of information	29	
No avoidable factor	103	52.3
No antenatal care	32	16.2
Infrequent antenatal care	8	4.1
Delay in accessing medical help	62	31.5
Declined medication/surgery/advice	14	7.1
Family problem	0	0.0
Community problem	0	0.0
Unsafe abortion	1	0.5
Other	5	2.5

Table 6.11. Administrative related avoidable factors, missed opportunities and substandard care

Description	Number	% of assessable deaths (n=211)
Lack of information	27	
No avoidable factor	115	54.5
Transport problem: Home to institution	3	1.4
Transport problem: Institution to institution	8	3.8
Lack of accessibility: Barriers to entry	3	1.4
Lack of accessibility: Other	3	1.4
Delay initiating critical care (Overburdened service)	18	8.5
Lack of health care facilities: ICU	13	6.2
Lack of health care facilities: Blood/blood products	4	1.9
Lack of health care facilities: Other	3	1.4
Lack of appropriately trained staff: Doctors	51	24.2
Lack of appropriately trained staff: Nurses	29	13.7
Communication problems: Technical	1	0.5
Communication problems: Interpersonal	3	1.4
Other	14	6.6

Table 6.12. Health care provider related avoidable factors, missed opportunities and substandard care

Medical management problems	CHC & District Hospitals		Regional Hospitals		Tertiary Hospitals	
	N	%	N	%	N	%
Initial assessment	25	12.0	12	5.6	3	1.3
Problem recognition / diagnosis	47	22.5	31	14.6	12	5.5
Delay in referring the patient	36	17.2	4	1.9	2	0.9
Managed at inappropriate level	22	10.5	3	1.4	0	0.0
Incorrect management (Incorrect diagnosis)	12	5.7	8	3.8	3	1.3
Sub-standard management (Correct diagnosis)	32	15.3	38	17.8	18	8.3
Not monitored / Infrequently monitored	10	4.8	7	3.3	2	0.9
Prolonged abnormal monitoring with no action taken	17	8.1	12	5.6	8	3.7
Assessable cases	209		213		217	

Table 6.13. Problems with resuscitation in pregnancy related sepsis

Resuscitation problems	Number	% of problems in resuscitation (n=32)
Lack of information	25	
Resuscitation not attempted	65	
Assessable cases (wrt resuscitation)	136	
No avoidable factor	104	
Cases with avoidable factors	32	
Airway problems	3	9.4
Breathing problems	5	15.6
Circulation problems	12	37.5
Drug problems	3	9.4
Investigation problems	7	21.9
Monitoring problems	9	28.1

Table 6.14. Avoidability of death from pregnancy related sepsis

Percent per disease category	n	%
No suboptimal care	29	12.8
Suboptimal care, different management would have made no difference to the outcome	21	9.3
Suboptimal care, different management might have made a difference to the outcome	98	43.4
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	78	34.5

Vignettes

Case 1.

NM, an 18 year-old unbooked primigravida had an uncomplicated Caesarean section at a district hospital for fetal distress during labour. She was HIV infected but was not investigated or treated. NM was discharged on postoperative day 3 in good clinical condition. She returned on day 7 complaining of shortness of breath and abdominal pain. Her temperature was 38.3 degrees, her heart rate 148/minute and her blood pressure 93/66 mmHg. Her abdomen was distended and tender, and she had a foul-smelling vaginal discharge. The admitting doctor diagnosed puerperal sepsis, prescribed intravenous antibiotics and admitted NM to the adult female ward. On the ward round the next morning, her blood pressure was 78/52 mmHg, and she was severely dyspnoeic. Her oxygen saturation was 84% on room air. Blood tests revealed acute kidney injury, metabolic acidosis and a coagulopathy. The doctors tried to arrange transfer, but the regional hospital declined to

accept NM because she was too ill. A tertiary hospital accepted NM on condition that an intensive care unit (ICU) bed would be available when NM arrived. NM was only transferred in the evening, when the ICU at the tertiary hospital had agreed to keep a bed for her. On arrival at the tertiary hospital, NM was extremely ill and was resuscitated for septic shock and intubated. An abdominal hysterectomy was then done but NM died shortly after surgery while being prepared for transfer to the ICU.

Comments

- Being unbooked, NM was deprived of the opportunity to detect her HIV status and possibly receive antiretrovirals to help boost her immunity and prevent sepsis
- On admission, the district hospital doctors did not recognise that NM was in early septic shock, and underestimated the severity of her illness. Antibiotics alone were not sufficient treatment. She should have been resuscitated immediately and transferred for specialist care. This occurred too late, over 24 hours after admission.
- The referral system was dysfunctional, with the regional hospital unable to fulfil its obligation to provide specialist surgical care and ICU facilities

Case 2.

NT, a 23 year old para 1, had prelabour rupture of membranes followed by induction of labour and a normal vaginal birth at 34 weeks' gestation, at a combined regional/tertiary hospital. She was HIV infected with a CD4 count of 458/mm³, not on antiretrovirals. She received antibiotics during labour. On the day after delivery, she complained of abdominal pain and her temperature was 38.0 degrees. A doctor was informed and prescribed paracetamol. NT was discharged home on the next day, as she felt better. No medication was given. On day 5 after delivery, NT returned to the hospital complaining of general weakness and abdominal pain. Her temperature was 38.6 degrees with a blood pressure of 90/66 mmHg, a heart rate of 142/minute and a respiratory rate of 60/minute. She appeared jaundiced. NT's abdomen was non-tender, but there was vaginal bleeding with an offensive smell. An ultrasound scan suggested the presence of retained products of conception. The admitting doctor diagnosed puerperal sepsis caused by retained products, booked a uterine evacuation and prescribed intravenous antibiotics. Three hours later, the antibiotics were given. Four hours after admission, NT had a cardiac arrest and died despite appropriate attempts at resuscitation. Blood test results revealed acute kidney injury with severe metabolic acidosis.

Comments

- NT had risk factors for puerperal sepsis: prelabour rupture of membranes, preterm birth and HIV infection. She should have received antibiotics after delivery, especially when she was found to be pyrexial.
- NT should have been told to return for a postnatal check-up on day 3 after delivery. While this is routine and is recommended for all women, it was especially necessary for NT.
- Severe sepsis was not recognised as such by the admitting doctors. A systematic organ systems evaluation ('big 5, forgotten 4, core 1') should have been done, with goal-directed resuscitation as taught in the ESMOE (Essential Steps for Managing Obstetric Emergencies) course. Intravenous antibiotics should have been given within one hour of diagnosing sepsis.

Case 3

ZN, a 38 year old HIV-negative woman had an elective Caesarean section in a regional hospital. She had two previous Caesarean sections and a previous laparotomy for ectopic pregnancy. No problems were noted at the Caesarean section. On the morning of postoperative day 2, ZN complained of a bloated abdomen. She had not passed flatus. Her temperature was normal, but her heart rate was 137/minute. Lactulose and antispasmodic drugs were given. Later in the day, an offensive discharge from the wound was noted. In the evening, ZN started vomiting, and faeces were found emitting from the wound. Her blood pressure was unrecordable. After fluid resuscitation, an immediate laparotomy was booked. The surgeon found that a loop of intestine (ileum) had been impaled in the suture line of the sheath closure, with laceration of the bowel wall and free passage of faeces into the abdominal cavity. ZN remained unstable during and after the procedure, and failed to maintain an adequate blood pressure despite fluid and inotropic support. She died a few hours after the operation. No autopsy was done.

Comments

- Previous abdominal surgery is a risk factor for bowel injury at Caesarean section. In the case of ZN, it is likely that the obstetric surgeon impaled a loop of ileum that was adherent to the abdominal wall. If this had been noticed at the time of the Caesarean section, the injured bowel could have been repaired or resected, with a good clinical outcome for ZN. Obstetric surgeons must consider the possibility of adherent bowel while entering and closing the abdomen in cases with previous abdominal surgery. Unrecognised bowel injury can lead to rapid development of septic shock.
- According to the law, an autopsy should have been conducted in a government mortuary. All deaths associated with anaesthetic or surgical procedures must undergo an autopsy as part of a police investigation of an unnatural death. The deceased's family is not allowed to refuse autopsy in such cases.

Discussion

Maternal mortality from pregnancy related sepsis has shown a small decline in this triennium compared with 2008-2010. But the most striking difference is the sharp increase, although with small absolute numbers, of deaths resulting from bowel injury at Caesarean section. This will add to current concerns about the increasing role of Caesarean section trauma in maternal deaths in South Africa. While the overall decline in deaths from PRS is welcome, the proportion of avoidable deaths has increased from 71% in 2008-2010 to 78% in this triennium. Too many preventable maternal deaths still occur, and the greatest burden is still in district hospitals in mainly rural provinces.

Postnatal care

Almost all deaths from PRS occur postnatally, usually several days after postnatal discharge from a maternity unit. All clinics and hospitals must ensure compliance with postnatal care protocols, with close monitoring and vigilance for early evidence of puerperal sepsis, both after vaginal birth and after caesarean section. Nurses and doctors who attend to postnatal women must be aware of criteria for hospital discharge, for antibiotic prophylaxis and treatment, and for hospital re-admission. Women being discharged after delivery need information on danger signs suggesting puerperal infection.

The role of HIV

In this triennium, among women who died from PRS, 49% who tested HIV positive received antiretroviral treatment (ART), compared with 20% in 2008-2010. This improvement, albeit in women who died, illustrates the advances in HIV treatment coverage in recent years. Even so, 30 women who died qualified for ART but did not receive it. These women may have survived if they had received ART early in their pregnancies. Every district health service in South Africa must strengthen systems to ensure detection and treatment of HIV infection as early as possible in pregnancy, including strategies to ensure initiation of antenatal care as early as possible in gestation (before 14 weeks).

Safe caesarean section practice

A large proportion of deaths from PRS followed Caesarean sections. Adherence to the surgical safety check-list, strict asepsis precautions, and protocols on antibiotic prophylaxis, as well as good surgical technique will likely reduce the risk of caesarean section sepsis. Women considered to be especially at risk (HIV with immunosuppression, prolonged labour, prolonged rupture of membranes, suspected chorioamnionitis, and difficult surgery) should receive extended doses of antibiotics.

All doctors performing Caesarean sections need to be aware of risk factors, and precautions to prevent, bowel injury at Caesarean section. Women with previous major abdominal surgery are at greatest risk. Perhaps the most important step in prevention of death is recognition of the bowel injury. Peritonitis resulting from faecal contamination presents relatively early after the surgery and may progress rapidly to septic shock. Protocols should be in place to ensure correct intraoperative management of bowel injuries, including general surgical help, and transfer to higher levels of care.

Recognising severe pregnancy related sepsis

The most frequent health care provider avoidable factor in PRS deaths was recognition of the clinical problem, followed by delay in transferring the patient to a higher level of care. Too frequently, puerperal sepsis is diagnosed and treated, but its severity is not appreciated. Antibiotics are prescribed, but in severe sepsis and septic shock, the patient requires more – fluid support, intensive care and/or hysterectomy. The small proportion of women that underwent hysterectomy (14%) indicates that probably not enough was done.

Clinicians, especially in district and regional hospitals, need to be reminded and educated about recognising severe PRS in ill postpartum women, using forums such as morbidity and mortality meetings, or formal ESMOE training. Hospital admission, organ system evaluation and goal-directed resuscitation are needed for women with systemic inflammatory response syndrome (SIRS) related to PRS. In district hospitals, severely ill women require transfer to higher levels of care, after adequate fluid resuscitation, and administration of high-dose broad-spectrum antibiotics.

Providing critical care to women with severe PRS

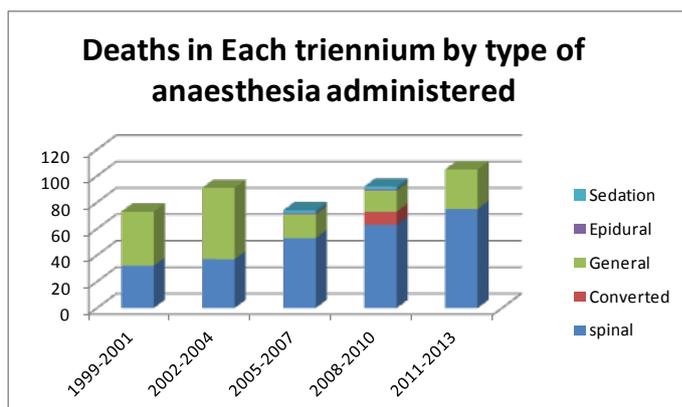
A significant number of deaths from PRS (n=31) was associated with problems in accessing critical care facilities in regional and tertiary hospitals. In these institutions, the capacity of staff and facilities to manage women with severe PRS should be audited. The hospitals should implement

recommended norms and standards for staff and facilities, including intensive care units, within the financial resources of the provincial health services.

Chapter 7 Anaesthetic related maternal deaths

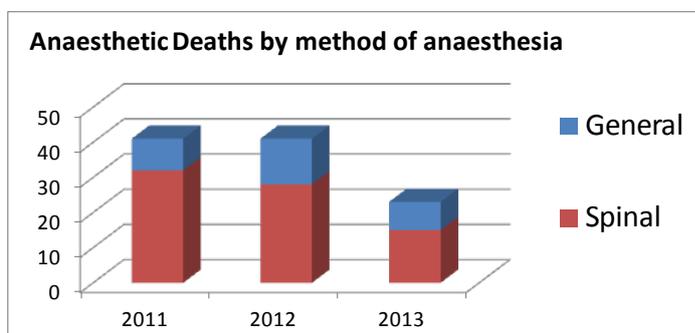
Disclaimer: This report is prepared mainly from data extracted from the obstetric database of the NCCEMD. Discrepancies may arise between this data and the full anaesthetic analysis from the original case files. The key findings of this review are:

1: The total number of Anaesthesia Related Deaths continues to rise (figure 1.)



The rising numbers due to spinal anaesthesia are of special concern. The widespread adoption of spinal anaesthesia has occurred because of perceived safety. However this has been accompanied by a loss of skills and a cavalier approach to the performance of spinal anaesthesia. These deaths are highly avoidable.

2: A remarkable apparent reduction in deaths has been reported in 2013 (figure 2)



This data needs further analysis for underreporting. If this is a true reduction it could represent the combined effect of the more intense two month anaesthetic internship program and the ESMOE program in improving anaesthesia safety.

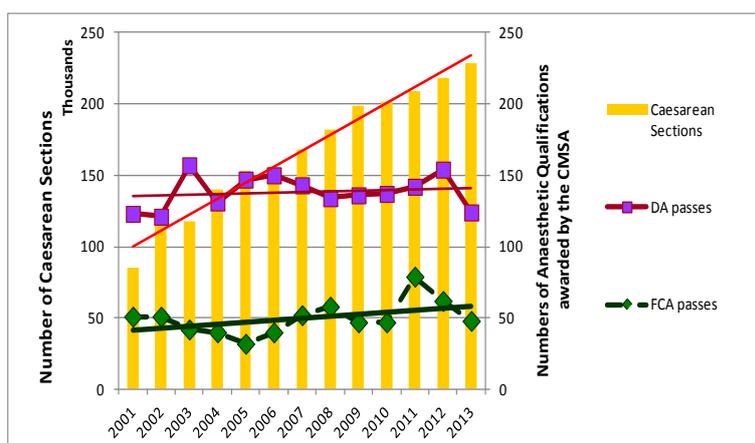
3: Potential understatement of the importance of anaesthesia contribution to Maternal Mortality

The current NCCEMD methodology is poor at assessing availability of competent anaesthesia services as a factor in Maternal Deaths. If a woman never receives an anaesthetic the case will not be assessed as an anaesthetic mortality. Table 1 gives an indication of this problem. The proportion of maternal deaths receiving anaesthesia and for conditions requiring surgery is shown.

Table 1

Primary Obstetric Problem	Cases recorded 2011 2013	Percentage receiving anaesthesia
Ectopic Pregnancy	102	47.1%
Ruptured Uterus with Previous Caesarean Section	52	63.5%
Ruptured Uterus without Previous Caesarean Section	51	51%
Uterine Atony	50	42%
Septic Miscarriage	114	50%

4: The training rate of anaesthetists lags behind the increasing Caesarean Sections rate (figure 3)



The Diploma in Anaesthesia (DA) a generalist qualification and the Fellowship of the College of Anaesthesia (FCA) a specialist qualification. The output of these two qualifications is relatively static. There is an increasing gap between available skilled anaesthesia providers and number of caesarean sections being performed.

5: There is a disproportionate representation of District Hospitals in Anaesthetic Maternal Deaths

Table 2

	District	Regional	Tertiary	Private
Total Deaths	1344	1653	972	114
	31.6%	38.9%	22.9%	2.7%
Anaesthetic Deaths	57	37	8	1
	55.3%	35.9%	7.8%	1.0%
Number of C/S	233501	248556	160269	?

Small district hospitals contribute disproportionately to Anaesthetic related maternal deaths. The low volumes of operative work, coupled with inexperienced staff leads to a progressive loss of skills. This is compounded by many district hospitals performing caesarean sections as their only significant theatre cases. The vast majority (>95%) of district hospital caesarean sections should be performed under spinal anaesthesia. These facts lead to a loss of skills in airway management and acute resuscitation, both essential components in the management of the obstetric disaster.

6: There is a provincial variation in iMMR for anaesthesia

Table 3

Province	iMMR
Limpopo	8.92
Mpumalanga	7.92
Eastern Cape	4.14
kwaZulu Natal	3.73
Free State	2.77
Northwest	1.73
Gauteng	1.47
Western Cape	0.36
Northern Cape	0
National Average	3.73

iMMR: Institutional Maternal Mortality ratio per 10000 live births

This variation probably represents the local exacerbation of the training issues in points (4) and (5).

7: The Proportion of cases referred for Medicolegal Autopsy is inappropriate

The National Health Act and the Inquest Act require procedure related mortality to be followed by Medico legal review. By definition Anaesthetic Deaths fall within this scope. In a sample of 71 anaesthesia death files analysed 33 cases were sent for medicolegal investigation as an “unnatural death” and 38 were not. Of the 38 cases not sent for medicolegal autopsy the hospital had classified 28 as “anaesthetic deaths”. In the other 10 cases the hospital had recorded other reasons for death. This issue was particularly marked in Mpumalanga where only 3 out of 17 anaesthetic deaths had been sent for medicolegal review.

Conclusion:

This interim analysis strongly suggests that improvements in training are required. The apparent drop in deaths in 2013 must be closely analysed so that this apparent success can be built upon. A strong drive must be instituted with regard to implementation of nationally agreed standards and protocols.

8. Acute collapse and pulmonary embolism

Abstract

During the triennium a total 202 cases were classified as acute collapse, 4.8% of all maternal deaths, similar to that in previous Saving Mothers Reports. A total of 82 deaths were classified as pulmonary embolism and 19 as amniotic fluid embolism. In the remainder (50%) cases, the cause of death was unknown or unsure and was therefore classified as acute collapse. Poor quality note keeping and a lack of observations made assessment very difficult in the large group of unknown deaths.

The number of deaths for embolism have remained unchanged, but there was a sharp decline in the number of acute collapse, cause unknown. This probably reflects better quality in observations. The provincial mortality rates varied between 1.95 and 14.5 per 100,000 live births for embolism and 1.3 and 6 for the acute collapse group. Sudden deaths occurred less likely in women diagnosed with the human insufficiency virus infection.

The number of cases with acute collapse where there was insufficient record keeping or abnormal observations without appropriate action remains a concern.

Pulmonary emboli occurred in the older population above the age of 35 years. Post mortems proved to be of value indicating that there are no typical risk factors or clinical presentation for women dying with pulmonary embolism during pregnancy or labour.

Obesity with a BMI of 30 or more was noted in 57% of women with embolism and a further 18% was probably overweight. Thromboprophylaxis was used only in 7% of cases.

Key recommendations

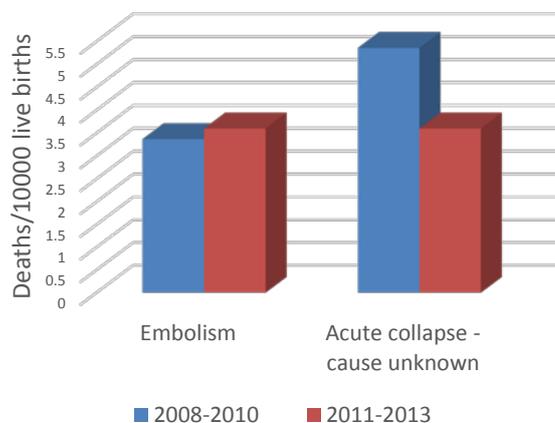
1. Obesity should be more carefully documented and noted as a risk factor. Routine thromboprophylaxis should be provided for
 - a. All women with a BMI of 40 or more.
 - b. All women with a BMI of 30 or more
 - i. After caesarean section delivery
 - ii. All antenatal admissions resulting in immobilisation
2. Thrombo-prophylaxis guidelines should be adhered to and available in all delivery units (2002-4 Saving Mothers report).
3. Post mortems should be performed on all women who die suddenly in pregnancy or within 42 days of being pregnant or where forensic post mortems is indicated (Saving Mothers 2005-7).

Introduction

In this 5th triennium report, acute collapse remains a distressing experience to both the health care workers and relatives of the deceased. During the past 3 reports the proportion of recorded maternal deaths due to acute collapse including embolism have been between 4-5% of maternal deaths. Sudden deaths were classified as either due to embolism (amniotic fluid embolism or pulmonary [thrombotic] embolism) or, if the diagnosis could not be established, acute collapse. Deaths that occurred suddenly or unexpectedly without a clear diagnosis were classified as acute collapse- cause unknown and account for 2.4 % of maternal deaths. Many deaths are assigned to acute collapse as cause of death purely because of poor documentation and lack of information with respect to the chain of events resulting in death. This group reflects poor care and should receive more focused attention in an effort to improve obstetric care in maternal sections.

During the triennium a total 202 cases were classified in this group presenting 4.8% of all maternal deaths, similar to previous reports. In this triennium there were 202 maternal deaths in the sudden death group, 39 cases (16%) less than the previous triennium. The main contributor to the reduction in the actual numbers was a 31% decrease (47 cases) in the acute collapse group. This impact could be seen in the institutional maternal mortality rates for embolism and acute collapse (Figure 8.1)

Figure 8.1 Trends in institutional maternal mortality ratio



The availability of post mortems to make a final diagnosis in cases with uncertain deaths still remains a problem as post mortems were only requested in a limited number of cases. Where postmortems were performed, the findings did assist in providing a more accurate account of the cause of death. In some, the finding of embolism was a surprise finding as no recorded clinical data suggested an embolism, especially in sudden deaths during the antenatal period or sudden intrapartum deaths.

Demographic data

During the reporting period 2202 cases were classified as acute collapse. The age distribution is summarized in table 8.1. The proportion of deaths in both embolism and acute collapse are greater than 15% above the general pregnant population in women older than 30 years for embolism and 40 years for acute collapse cause unknown. Compared to previous report, this age difference have

shifted 5 years earlier. The clinical significance of this need to be established. Parity at the time of death is listed in table 8.3. It is important to note that the parity was low (1 or less) in > 50% of cases, very similar to the previous saving mothers reports.

Table 8.1. Comparison of age distribution of acute collapse with general pregnant population (%)

Age category (years)	General pregnant population* %	Embolism		Acute collapse	
		N	%	N	%
< 20	12.5	7	6.9%	5	5.0%
20 - 24	28.1	14	13.9%	22	21.8%
25 - 29	26.3	20	19.8%	29	28.7%
30 - 34	18.5	26	25.7%	17	16.8%
35 - 39	10.7	19	18.8%	16	15.8%
40 - 44	3.4	10	9.9%	10	9.9%
45+	0.5	4	4.0%	2	2.0%
Unknown	0.1	1	1.0%	0	0
Total N		101		101	

* - Data for distribution of general pregnant population is derived from Recorded Live Births 2009, Statistical release P0305, Statistics South Africa. Green indicate less >15 below national average and red >15% above national average

Table 8.2. Parity and acute collapse and embolism

Parity	Embolism		Acute collapse	
	n	%	n	%
P0	30	29.7	28	27.7
P1	27	26.7	27	26.7
P2	16	15.8	13	12.9
P3	11	10.9	11	10.9
P4	7	6.9	12	11.9
P5	2	2.0	6	5.9
P6+	2	2.0	0	0.0
Unknown	6	5.9	4	4.0
Total	101		101	

The timing of the emergency as well as time of death is listed in Table 8.3. In the majority of cases with embolism(51%) the emergency occurred in the post partum period. It is important to note that the acute emergency for embolism occurred in 12 % during labour and also resulting is death during this period in 8%. More than one third (36%) of deaths due to embolism occurred prior to onset of labour and 25% died before delivery of the baby. In acute collapse -cause unknown, the emergency occurred prior to onset of labour in 45% of cases resulting in death in 40%.

Table 8.3. Timing of the emergency and death

	Embolism				Acute collapse			
	Timing of emergency		Timing of death		Timing of emergency		Timing of death	
	n	%	n	%	n	%	n	%
Early pregnancy	12	11.8	4	4.2	10	9.9	5	5.2
Antenatal period	25	24.5	20	21.1	36	35.6	35	36.1
Intrapartum period	13	12.7	8	8.4	13	12.9	11	11.3
Postpartum period	52	51.0	63	66.3	41	40.6	45	46.4
Anaesthesia	0	0.0	0	0.0	1	1.0	1	1.0

Of the 101 cases with embolism, 82 cases were classified as pulmonary (thrombotic) embolism (81.2%) while 19 cases were regarded as amniotic fluid embolism (19.8%). The majority of these women in both the embolism and acute collapse- cause unknown attended antenatal care during pregnancy (93.2 % and 93.1%). The distribution of these deaths by level of care is listed in table 8.4. The high proportion of embolism deaths at district facilities. Questions should be raised about the quality of antenatal care and the ability of our health system to identify women at risk and provide appropriate preventative care.

Table 8.4 Distribution embolism and acute collapse across level of care

	Home %	Health Care Centre %	District hospital %	Regional hospital %	Tertiary hospital %	Private hospital %	Total %
Embolism	2.0	5.4	40.9	17.2	25.8	7.5	100
Acute collapse - cause unknown	9.9	6.8	36.5	33.8	14.9	6.8	100.0

Acute collapses- cause unknown occurs mostly at the district and regional hospitals. This could indicate either a skills problem not able to identify an emerging problem, or this could be as a consequence of inadequate monitoring processes. In some of the cases reviewed, an underlying primary cause of death was prominent, although there were uncertainty about the final cause of death, or patients were found dead in the bed without information of the final chain of events. This uncertainty resulted in classification of acute collapse- cause unknown. Therefore this subgroup could be used as a measurement of quality of care and skills in facilities.

Cardiopulmonary factors remained the dominant systems resulting in final or contributory cause of death (table 8.5). The high numbers of cases where the final or contributory factors were unknown (56% of cases with acute collapse) indicate that there was poor clinical opinion or poor quality observations.

Table 8.5. Final and contributory causes of maternal deaths (%) for embolism and acute collapse

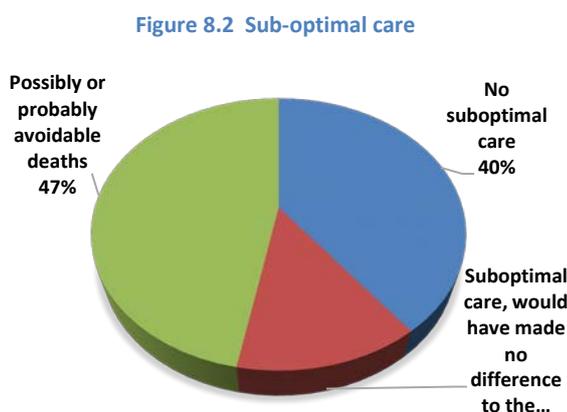
Organ system	Embolism		Acute collapse	
	n	%	n	%
Circulatory system	5	5.0	9	8.9
Respiratory failure	25	24.8	25	24.8
Cardiac failure	27	26.7	27	26.7
Acute collapse due to embolism	67	66.3	9	8.9
Renal failure	7	6.9	2	2.0
Liver failure	1	1.0	1	1.0
Cerebral complications	1	1.0	5	5.0
Metabolic	3	3.0	4	4.0
Haematological	7	6.9	13	12.9
Immune system	7	6.9	13	12.9
Unknown	3	3.0	57	56.4
Other	5	5.0	2	2.0
Total deaths in disease category	101		101	

NOTE: a patient can have more than one final and contributory cause of death

Avoidable factors, missed opportunities and substandard care

Assessing avoidable factors gives a reflection of quality of care. Suboptimal care reflects problems within the system and may contribute to poor outcome. Concentrating on factors leading to avoidable deaths will assist in reducing unnecessary deaths within the control of the health system.

Figure 8.2 illustrate the deaths with acute collapse classified according sub-optimal care. In only 40% of these deaths the maternal assessors could not find sub-optimal care. In a further 13% there were elements of sub-optimal care, but was thought not to have contributed to the death. In almost half of cases assessors indicated that different management might have made a difference to the outcome (34.7%) or different management would reasonably have been expected to have made a difference to the outcome (12.4%).



The distribution was fairly similar between the embolism group and the acute collapse- cause unknown group, but the category “management would reasonably have been expected to have made a difference to the outcome” was slightly higher in the cause unknown group (10% vs 13%).

Health care worker related avoidable factors remain around 20-30% of assessable cases, indicating that there is still a problem with clinical skills and resuscitation by health care workers. For the embolism group this is prominent at primary care level, but for the acute collapse group this is more noticeable at both primary and secondary level of care.

Table 8.6 Avoidable factors, missed opportunities and substandard care for Embolism

Category	Embolism		Acute collapse	
	Assessable cases (n)	% of assessable cases with avoidable factors in	Assessable cases (n)	% of assessable cases with avoidable factors in
Patient orientated	100	18	80	40
Administrative factors	95	30.5	84	32.1
Health worker related emergency management problems				
Primary level#	96	30.2	88	22.7
Secondary level#	93	14.4	91	24.2
Tertiary level#	94	13.8	92	7.6
Resuscitation	77	33.7	63	39.7

Assessors have only a copy of the patient records to comment on and therefore factors such as late booking are documented, but not underlying reasons for late bookings such as cultural, physical or

organizational barriers to the health system. It is interesting to note that in the embolism group there were only 18 % cases with patient related avoidable factors, compared to 40% in the acute collapse group. Non-attendance of antenatal clinics were similar in both groups, but infrequent antenatal visits and delay in access to medical help featured prominent in the acute collapse group. The patient related avoidable factors are listed in table 8.7.

A change in the patient related factors is a reduction in the numbers and proportion of cases where medication or advice was declined by the patients. In the last triennium this was only 1.25% compared to 10% in previous reports.

Table 8.7. Avoidable factors, missed opportunities and substandard care with respect to patient orientated problems for acute collapse and embolism

Description	Embolism		Acute collapse	
	Number	Percentage of assessable deaths	Number	Percentage of assessable deaths
No avoidable factor	82	82.0	48	60
No antenatal care	7	7.0	7	8.75
Infrequent antenatal care	3	3.0	10	12.5
Delay in accessing medical help	9	9.0	17	21.25
Declined medication/surgery/advice	0	0.0	1	1.25
Other	1	1.0	6	7.5

Assessment of the administrative factors was difficult as there were no records reflecting administrative issues. Assessors only made assessments based on the clinical notes and therefore issues such as transport and staffing levels were poorly documented and commented on. With the introduction of district clinical specialist teams in the districts, root cause analysis reports of maternal deaths could enhance the quality of the assessments of administrative factors in future. The documented administrative factors are listed in table 8.8.

Table 8.8. Distribution of administrative related avoidable factors

Description	Embolism		Acute collapse	
	Number	Percentage of assessable deaths	Number	Percentage of assessable deaths
Lack of information	6	6.3	17	20.2
No avoidable factor	66	69.5	57	67.9
Transport problem: Home to institution	0	0.0	3	3.6
Transport problem: Institution to institution	2	2.1	1	1.2
Lack of accessibility: Barriers to entry	2	2.1	1	1.2
Lack of accessibility: Other	2	2.1	0	0.0
Delay initiating critical care (Overburdened service)	4	4.2	5	6.0
Lack of health care facilities: ICU	2	2.1	2	2.4
Lack of health care facilities: Blood/blood products	0	0.0	0	0.0
Lack of health care facilities: Other	0	0.0	6	7.1
Lack of appropriately trained staff: Doctors	7	7.4	5	6.0
Lack of appropriately trained staff: Nurses	6	6.3	6	7.1
Communication problems: Technical	0	0.0	1	1.2
Communication problems: Interpersonal	1	1.1	2	2.4
Other	9	9.5	5	6.0

Lack of appropriately trained doctors and nurses are also biased as there are no norms against which this could be measured and human resource information is not available in the case records

provided to the assessors. In some cases the minutes of mortality meeting discussions did accompany the copy of the file.

The assessors made a more detailed analysis of health worker related avoidable factors. This is listed in tables 8.9 (embolism) and 8.10 (acute collapse) and stratified by level of care. The proportions of assessable factors in both groups was similar at primary care level, but more profound for acute collapse at level 2.

Table 8.9. Distribution of health worker related avoidable factors, missed opportunities and sub-standard care: Embolism

Medical management problems	1° Level		2° Level		3° Level	
	N	%	N	%	N	%
Lack of information	5		8		7	
No avoidable factor	67		80		81	
Initial assessment	6	20.7	2	15.4	0	0.0
Problem with recognition / diagnosis	15	51.7	5	38.5	7	53.8
Delay in referring the patient	10	34.5	1	7.7	0	0.0
Managed at inappropriate level	9	31.0	1	7.7	0	0.0
Incorrect management (Incorrect diagnosis)	10	34.5	2	15.4	0	0.0
Sub-standard management (Correct diagnosis)	11	37.9	5	38.5	4	30.8
Not monitored / Infrequently monitored	5	17.2	3	23.1	3	23.1
Prolonged abnormal monitoring with no action taken	2	6.9	3	23.1	1	7.7
Assessable cases with avoidable factor	29		13		13	
Total Assessable cases	96		93		94	

In both groups an alarming proportion of assessable cases with avoidable health worker related factor present there were problems with recognizing a problem or making appropriate diagnosis (38-68% of cases). Incorrect diagnosis with inappropriate management was listed in 15-34% of cases at level 1 and 13-15% of cases at level 2. Of greater concern is the 20-38% of cases at level 1, and 38-59% of cases at level 2 where appropriate diagnosis was made, but managed substandard. This suggests that protocols are not in place or lack of clinical discipline enforcing implementation of protocols. This may reflect on inadequate clinical leadership by specialists (or the lack of specialists), lack of professional accountability, or the quality of training of health professionals.

Table 8.10. Distribution of health worker related avoidable factors, missed opportunities and sub-standard care: Acute collapse

Medical management problems	1° Level		2° Level		3° Level	
	N	%	N	%	N	%
Lack of information	13		10		9	
No avoidable factor	68		69		85	
Initial assessment	12	60.0	5	22.7	4	57.1
Problem with recognition / diagnosis	12	60.0	15	68.2	4	57.1
Delay in referring the patient	7	35.0	2	9.1	0	0.0
Managed at inappropriate level	7	35.0	1	4.5	0	0.0
Incorrect management (Incorrect diagnosis)	3	15.0	3	13.6	0	0.0
Sub-standard management (Correct diagnosis)	4	20.0	13	59.1	4	57.1
Not monitored / Infrequently monitored	8	40.0	7	31.8	2	28.6
Prolonged abnormal monitoring with no action taken	5	25.0	6	27.3	1	14.3
Assessable cases with avoidable factor	20		22		7	
Total Assessable cases	88		91		92	

At level 1, one third of cases are thought to be managed at an inappropriate level and/or delays in transferring to an appropriate facility. Factors that could contribute to this observation may be related to delays in inter-facility transport, systems design problems and unrealistic expectations.

Facilities classified as a specific level, but not functional at that level, may result in at risk behavior because there are expectations for certain actions at the designated level. In the current assessment system, assessors have insufficient information to unpack underlying factors to this level.

Lack of discipline or accountability could also explain the unacceptable high proportion of assessable cases where monitoring was not documented (17-40%), or where abnormal observations was recorded, but without appropriate action (7-27%).

Resuscitation was attempted in 85% of women that died from embolism, and 70% of women who died from an acute collapse (table 8.11). In the majority of cases

Resuscitation (table 8.11) was attempted in most cases. The cases where resuscitation was not attempted, were those occurring at home, or where the patient was discovered dead in the hospital bed. In those that were resuscitated, health worker related factors were evident in 13-20% of cases. Besides problems with airways and circulation, there were problems identified with the monitoring processes. This implies that the observation of infrequent monitoring or prolonged abnormal observations without action observed in general, is extended to the resuscitation process.

Table 8.11. Distribution of problems with resuscitation in Embolism

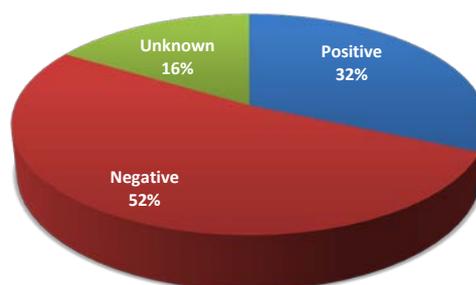
Resuscitation problems	Embolism			Acute collapse		
	Number	% where resuscitation attempted	Distribution of problems in resuscitation %	Number	% where resuscitation attempted	Distribution of problems in resuscitation %
Assessable cases where resuscitation was attempted	77	85.6		63	70.00	
No avoidable factor	51			25		
Airway problems	1		6.3	3		21.4
Breathing problems	9		56.3	5		35.7
Circulation problems	4		25.0	4		28.6
Drug problems	0		0.0	0		0.0
Investigation problems	1		6.3	0		0.0
Monitoring problems	1		6.3	2		14.3

As HIV infections are reported more effectively, the gap between HIV status in embolism and acute collapse cases narrows. The proportion of deaths diagnosed as embolism and acute collapse that were HIV negative was 55% and 48% respectively compared to 54% and 34% in the previous triennium. If the cases with unknown HIV status were excluded, the HIV positive rate was 35% for embolism compared to 40% for acute collapse. At least we could conclude that HIV seropositivity is not associated with more embolism. In the acute collapse group a few HIV positive deaths may have been associated with acidosis, but if that resulted in the death could not be said with certainty.

Table 8.15 Impact of HIV on embolism and acute collapse

	Embolism	Embolism %	Acute collapse - cause unknown	Acute collapse - cause unknown (%)	Total Embolism & collapse	Embolism & Acute collapse (%)
Negative	56	55.45%	49	48.51%	105	51.98%
Pos (not qual. HAART)	17	16.83%	21	20.79%	38	18.81%
AIDS, not on HAART	4	3.96%	5	4.95%	9	4.46%
AIDS on HAART	10	9.90%	7	6.93%	17	8.42%
Unknown	14	13.86%	19	18.81%	33	16.34%
Total	101	100.00%	101	100.00%	202	100.00%

Figure 8.3 HIV status in embolism and acute



The seropositive rates for HIV (Figure 8.3) corresponds with the national antenatal care survey results. During this triennium the treatment protocol for HIV in pregnancy changed with a more aggressive management during pregnancy for antiretroviral treatment. It was therefore difficult to comment on the numbers of cases that tested positive, but not initiated on HAART.

Classification of women to fall under the sudden death group, either as acute collapse or embolism is not without it's own difficulty. Identification of women at risk should receive more attention and hopefully this document may enhance focus in come of the areas.

Of the recorded 202 cases 157 files were available for review. Some valuable information could be extracted from the available files to enhance understanding of this group of deaths.

There was insufficient data documented to calculate a body mass index (BMI) in 35% of the files reviewed. In the cases where a BMI could be calculated 71% had a BMI of 25 or greater. Almost half of the women (45%) were obese with a BMI of 30.0 or more including 15% with a BMI of 40 or more.

Figure 8.4 BMI in acute collapse and embolism

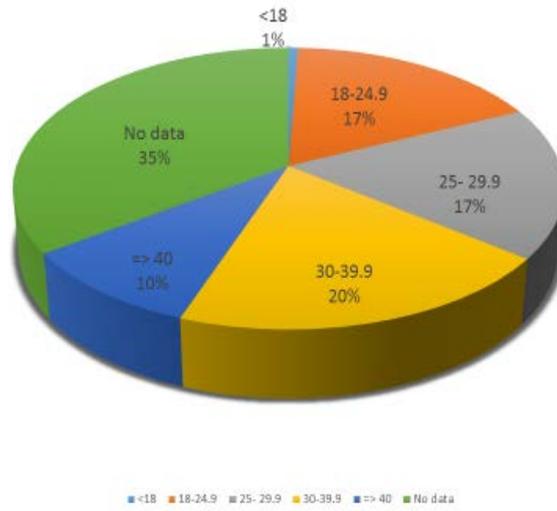
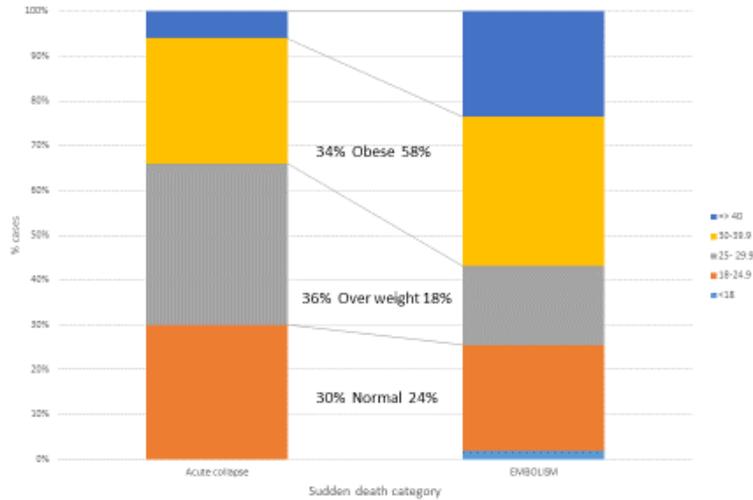


Table 8.16 Obesity and caesarean delivery

	Caesarean section	No Caesarean section
Embolism	66.7%	51.5%
Acute collapse	36.4%	33.3%

Figure 8.5 BMI in Acute collapse and embolism



The typical clinical signs associated with thromboembolism was present in only 7% of women with embolism. Persistent tachycardia and dyspnea is far more common and present in 42% and 52% respectively of women with embolism and acute collapse. Thirteen percent of women complained of acute chest pain and central cyanosis was recorded in only 3% cases. The most common factor associated with women dying of acute collapse or embolism, was an increased body mass index.

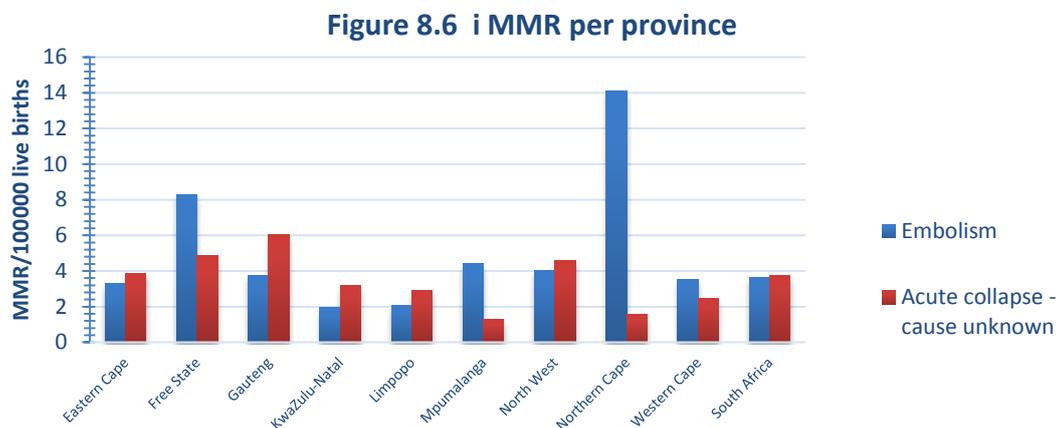
Figure 8.5 compares the weight distribution between the two groups. In the embolism group 75% of cases were overweight or obese and 57% were obese. 24% of cases were morbidly obese. The level of obesity was less profound in cases dying of acute collapse with 34% obese (12% morbidly obese). The impact of obesity per se on the respiratory system should not be underestimated.

The impact of nutritional abnormalities in the pregnant population need more scrutiny.

It is also of great concern that in only 3% of files reviewed there were any form of thromboprophylaxis prescribed. None were noted in the group with acute collapse. Thromboprophylaxis was used in only 7% of women with the diagnosis of pulmonary embolism. All of them was in the group with BMI >30. This included 2 cases where the diagnosis of thromboembolism was made during the pregnancy.

Two thirds of women with the diagnosis of embolism that had a caesarean delivery had a BMI more than 30 compared to 50% in those that did not have a caesarean delivery or died prior to delivery. In the acute collapse group a third had an obese BMI irrespective the mode of delivery.

Distribution of institutional maternal mortality varies between the different provinces. Figure 8.6 demonstrates the provincial differences for the two groups. Mortality related to embolism is well above the national means in 4 provinces. Provincial focus is required in those provinces to address the mortality.



Vignettes

Case 1:

31 year G2P1 with a history of one previous caesarean section and known to be HIV positive. She attended ANC and was on AZT and INH. Her BMI was 35.8 at the first visit. She was admitted for elective caesarean section complaining of episodes having difficulty in breathing for which antibiotic was prescribed 4 days prior to an elective Caesarean section under spinal anesthesia. Eight hours post delivery she started complaining of difficulty in breathing. She was taken to a side cubicle and nursed in semi-fowlers position. No respiratory distress was observed. She suddenly removed the oxygen, became aggressive and ran out of the ward complaining she cannot breathe. She was brought back to the ward where she foam was observed in her mouth. By the time the doctor arrived she was not breathing with dilated pupils. Did not respond to resuscitation. Frequent postoperative observations was normal.

Comment:

This case with increased BMI was at risk for pulmonary embolism and complained of episodes of dyspnea even prior to an elective caesarean section. Even though the acute event was within hours of an anesthetic and procedure, no attempt was made to do a forensic post mortem. She was admitted 5 days prior to surgery to

the antenatal ward. A better diagnostic work-up prior to elective surgery and thromboprophylaxis could have decreased the risk.

Case 2:

A 21 year old admitted to a district hospital with history that she had a caesarean section 5 days prior to the admission. The CS was done at a regional hospital and she was discharged on day 3. She was complaining of episodes of chest pain and shortness of breath. Her pulse was 130 bpm and the oxygen saturation 57%. She had basal crepitations in the lungs and the X-ray showed bilateral infiltrations. A diagnosis of a lower respiratory tract infection was made. Fever was never documented although she maintained a tachycardia between 120 and 140 bpm. Two days later she collapsed coming back from the toilet and could not be resuscitated.

Comment:

Most like this woman died of a pulmonary embolus which was not considered in the initial assessment. Chest pain is a significant feature of pulmonary embolus and must not be ignored.

Case 3:

24 year gravida 2 para 1 admitted in active phase of labour. Her vital signs was normal and she had no specific complaints. She progressed fast and delivered a live baby with normal Apgar scores. After attending to the baby, the patient complained she could not move the left leg and had numbness in the arm. She also complained of headache and her blood pressure was moderately elevated. She was given Panado. Two and a half hours later she vomited and was assessed by the doctor finding hemiparesis. An embolus was suspected and a CT scan requested. CT scan showed an intracranial hemorrhage with midline structure shift. Neurosurgeons suggested conservative management. She was admitted to ICU where she deteriorated and died.

Comment:

She was classified as an acute collapse – cause unknown although a CT scan demonstrated an intracranial hemorrhage. Her initial symptoms of headache and complaint that she could not move her foot was ignored. Neurosurgeons decided on conservative management although she was not assessed physically. Failure to recognize clinical problems and act upon it contributed.

Case 4

31 yr gravid 3 para2 booked HIV positive admitted with history of labour 4 hours later ?shock was diagnosed in latent phase of labour with BP 90/70 and pulse not recorded. This was treated with intravenous voluven. After 3 hours her she complained about severe pain and shortness of breath. No action was described other than U&E and FBC to be taken. After consultation with the referring hospital she was induced with Prostin PV an hour later. She remains restless with a heart rate of 100/m, but BP not recorded. After a further 1.5 hours the patient is reported to have low BP, skin cold and clammy and very restless.

Comment:

Even though a patient was admitted and suspected to be shocked, there were no observation program. After prostaglandins were inserted vaginally, the condition deteriorated and the patient collapsed.

Case 5:

25 year primigravida, known to be HIV positive attended antenatal clinic regularly. She was admitted to the labour ward with history of rupture of membranes 3 days prior to admission. She was admitted for intravenous antibiotics with a BP of 122/80 and a pulse of 118/min. The following day she went in labour with a persistent tachycardia of 120/min and delivered a live infant with Apgars 9/10. After transfer to the post natal ward she complained of dyspnea. The dyspnea and tachycardia persisted in spite of a normal blood pressure on observations done 4 hourly. 23 hours after the delivery her BP was recorded as 87/43 mm Hg with a pulse of 166. She complained of dizziness and shortness of breath. The baby was given to the mother for breast feeding. One and a half hours later she was found in the bed with extreme dyspnea and a BP of 108/66 and pulse 160/min. The doctor was called to resuscitate the patient. She was given oxygen and was intubated. After 2 hours resuscitation she was declared dead

Comment:

A potential risk was not identified with the persistent tachycardia, neither with the persistent complaints of dyspnoea. Even after shock developed the problem was not identified and managed. Early warning with active management of the abnormality could potentially have saved this case. The prolonged rupture of membranes may have contributed. A diagnostic work-up should have excluded potential lung pathology or development of septic shock.

Conclusion

In spite of actions taken and recommendations made over the past decade, embolism and acute collapses of unknown cause have remained fairly constant. Pregnancy as a risk factor for thrombo-embolism is frequently ignored and prophylactic measures are often not taken. Lessons learnt from post mortems in the cases with embolism as cause of death are of great value. During this triennium we have identified obesity as a major factor.

Acute collapses remains an important group as it is likely to reflect issues relating to poor quality of care, or challenges with resources or resource allocation. Unfortunately the assessment methodology is not very sensitive to assess systemic errors such as staff shortages and lack of supervision. The following aspects, however, remains a concern as listed in previous reports.

1. The numbers of sudden deaths where observations or clinical notes were lacking. This could indicate resource problems, problems with skills, or staff attitude.
2. A number of acute collapses occurred subsequent to abnormal observations where appropriate actions were not taken to address the abnormalities. This would reflect an inability to identify problems early.
3. Deaths, potentially of forensic nature, not referred for forensic post mortems or assessment, remains evident.
4. Obesity as a factor in women with embolism, especially those with morbid obesity

In the Saving Mothers report 2001-2003 a detailed comment was made with respect to prevention of thrombo-embolic events. In the 2007-2008 report medico-legal autopsies and anesthetic related procedures were discussed. There is no clear evidence in this report that those aspects made a significant impact on reduction of acute collapses. Lack of implementing thromboprophylaxis and the abnormal observations without action, reflect on poor skills, or more importantly, lack of professional accountability and or knowledge and skills.

In this report, we would like to place some emphasis on early identification of problems, especially with respect to deterioration of physiological changes. In very few files reviewed we could find evidence of implementation of the colour coded observation charts suggested in the previous triennium. Poor documentation of weight and length suggest that BMI as a risk factor is not considered at clinic level. The low level of thromboprophylaxis also suggest that risks were not identified and acted upon, especially seen against the high level of antenatal attendance.

We would recommend that more emphasis be placed on the nutritional status of women during pregnancy, and that capacity be enhanced to identify women at risk. High risk clinics need to be developed for all districts with appropriately skilled staff to be able to identify risk and act accordingly.

The current supermarket approach of antenatal care at primary health care level should be supported by a smaller group of appropriately skilled staff in advanced antenatal care.

A standardized reporting format should also be developed for forensic pathologists to ensure uniform and appropriate notification of maternal deaths in the sudden collapse group.

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THROMBOPROPHYLAXIS IN OBSTETRIC PRACTICE

INDICATIONS FOR THROMBOPROPHYLAXIS

A) High Risk

At least 6 weeks postnatal prophylactic LMWH or Warfarin

This category includes:

- Any previous VTE
- Anyone requiring antenatal LMWH

B) Moderate Risk

Minimum of 5 days postnatal LMWH or for duration of hospital admission

This category includes:

- Caesarean section in labour
- Asymptomatic thrombophilia
- BMI > 40 kg/m²
- Hospital admission ≥ 3 days
- Medical Co morbidities: eg heart or lung disease, SLE, cancer
- Intravenous drug user

OR ≥ 2 of the following risk factors:

- Age > 35 years
- BMI > 30 kg/m²
- Parity ≥ 3
- Smoker
- Elective caesarean section
- Any surgical procedure in the puerperium
- Gross varicose veins
- Current systemic infection
- Immobility e. paraplegia, long distance travel
- Pre-eclampsia
- Prolonged labour > 24 hours
- PPH > 1 litre or requiring blood transfusion

C) Low Risk

Mobilization and avoidance of dehydration

SUGGESTED THROMBOPROPHYLACTIC DOSES FOR POSTNATAL LMWH

Weight (kg)	Enoxaparin	Dalteparin
<50	20 mg daily	2500 units daily
50 - 90	40 mg daily	5000 units daily
91 - 130	60 mg daily	7500 units daily
131 - 170	80 mg daily	10 000 units daily
> 170	0,6 mg/kg/day	75 units/kg/day

First dose LMWH to be commenced 6 hours post surgery/ delivery

Chapter 9: Non-pregnancy related infections

Abstract

Non-pregnancy related infections (NPRIs) remain the leading cause of maternal mortality in South Africa as whole, and in all provinces. Previous reports have shown an increase in deaths from NPRI with each triennium; this trend has at last reversed, with a 25% reduction compared to 2008-2010. The iMMR for NPRI has now fallen below the 2002-2004 level. All provinces showed a reduction in iMMR from NPRI, except Limpopo, which was unchanged.

As in previous reports, the majority of deaths were related to HIV infection. In total, 89.8% of women were HIV positive, 6.6% HIV negative and 3.6% had an unknown HIV status. Overall, 54.7% of women were on HAART, an increase from 36.3% in the last triennium. However it is not known how many of these women had recently started HAART, had adherence problems, or were virologically suppressed. Only 21.7% of women who died were at tertiary hospitals; 41.6% were at level 2 and 33.2% at level 1. Of women with known parity, 37% were nulliparous, and 63% Para 1 or more.

The major cause of death remains respiratory diseases, with TB, Pneumocystis jirovecii pneumonia and other pneumonias responsible for 62% of deaths. However there has been a 29.2% reduction in deaths from respiratory diseases this triennium. TB remains the single most common cause of death from NPRI. However, as discussed in the separate summary on HIV and TB, a significant no. of deaths classified as 'other pneumonia' and PJP were likely due to pulmonary TB, which was undiagnosed and therefore untreated. The majority of other HIV related causes also showed a reduction in maternal deaths this triennium. These included cryptococcal meningitis, other causes of meningitis, and gastroenteritis. Other infectious diseases are known to be more severe in pregnant women. There were 6 deaths from Varicella pneumonia, which has not been noted in previous reports. There were 12 deaths from malaria in this triennium; although small in number, this is a doubling since the previous report.

Overall, 43% of deaths from NPRI were considered possibly or probably avoidable. Substandard care was identified in 60.6% of deaths. The most common healthcare provider associated avoidable factors included failure to recognise the problem, and substandard care in patients with a known diagnosis. The most common patient related factors were infrequent or no antenatal care, and delay in accessing medical help. However many women who presented critically ill had been at the same or another health care facility in the previous few days, and had been discharged without a diagnosis or treatment. Malaria needs highlighting in terms of substandard care. In most cases, there was a significant delay in recognising the diagnosis, despite all deaths being in malaria endemic provinces or in women who had recently returned from visits home to malaria endemic countries. None of the women received artesunate, which is the most effective treatment for severe malaria, but currently available only at designated hospitals as part of an access programme.

Recommendations

1. It is now 10 years since the national roll-out of HAART, and it needs to be recognised that HIV infection no longer inevitably leads to clinical AIDS and early death. Pregnant women who are HIV positive and unwell need investigation, diagnosis and optimal management of opportunistic infections.

2. HIV positive women of reproductive age have many points of contact with healthcare services.. These include those related to pregnancy and child health such as postnatal care and child health clinics, and those that are unrelated such as TB clinics, medical outpatient departments and medical wards. These all have a role in promoting the health of women who may planning a pregnancy, or at risk of unplanned pregnancy.
3. Contraceptive needs need to be addressed at every clinic consultation and during all hospital admissions. Basic pre-pregnancy advice should also be given. Prior to pregnancy, women should be well, on HAART if eligible, and virologically suppressed, and with opportunistic and sexually transmitted diseases treated.
4. Eligibility for HAART needs to include women of reproductive age who are planning a pregnancy. Almost two thirds of women who died from NPRI have had a previous pregnancy. The announcement by in July 2014 that all pregnant and breastfeeding women would be eligible for lifelong HAART is fully supported.
5. The systems issues contributing to defaulting HAART needs to be addressed. This includes women who start HAART in pregnancy, and those who start unrelated to pregnancy.
6. The full ART history needs to be documented at booking, during antenatal care and during hospital admission. This includes drug regimens, date of initiation of HAART, CD4 counts and viral loads. Viral load monitoring in pregnant women is essential to detect poor adherence, prevent resistance and prevent opportunistic infections, and reduce vertical transmission.
7. Vigilance needs to be maintained regarding adverse effects of antiretrovirals in pregnancy, and the effects of other drugs commonly used in HIV positive pregnant women, such as cotrimoxazole and isoniazid used for IPT.
8. Training is needed at all levels of care in the differential diagnosis, investigation and management of opportunistic infections. Women with low CD4 counts are at increased risk of opportunistic infections, and diagnosis is often challenging. Physicians, Infectious Diseases Specialists and other doctors experienced in HIV/TB management need to be involved early. Referral pathways need to be established for pregnant women needing internal medicine involvement, including access to tertiary hospitals and ICU care.
9. There needs to be increased awareness of the presentation, investigation and diagnosis of TB in HIV positive patients. Symptom screening for TB at all antenatal visits needs to be emphasised, and IPT be offered to all HIV positive women.
10. HIV positive pregnant women who are acutely or chronically unwell should all be investigated for TB. Women with neurological symptoms need investigating for CNS opportunistic infections, including TB meningitis and cryptococcal meningitis.
11. Infectious diseases that are more severe in pregnant women need recognition, and early diagnosis and treatment. These include varicella and malaria. The Department of Health must provide ongoing support for the Artesunate Access Programme; and make it available to all facilities in malaria endemic areas.

Introduction

This chapter is divided into two sections; Part 1 HIV and HAART in all maternal deaths and Part 2 Non-pregnancy related infections.

Part 1. HIV and HAART: all Maternal Deaths

The decrease in maternal mortality in the current triennium is largely due to a decrease in deaths in HIV positive women. More women were of known HIV status than in previous reports, and more women were on HAART. However HIV remains the most significant risk factor for maternal mortality, and HIV positive women are still substantially over-represented amongst maternal deaths.

HIV Counselling and Testing

HIV counselling and testing (HCT) increased with each Saving Mothers report. During 2011-2013, almost 87% of women had a documented HIV result, compared to 79.2 % in 2008-2010 (table 9.1). Overall, 56.5% of women were HIV positive, 30.3% negative and 13.1% of unknown status. For women of known HIV status, 65.1% were HIV positive, compared to 70.4% in 2008-2010.

Table 9.1. HIV testing, all maternal deaths: 1999-2013

HIV status	2008-2010		2011-2013	
	no.	%	no.	%
positive	2769	55.7	2516	56.5
negative	1166	23.5	1351	30.3
unknown	1031	20.8*	585	13.1*
total**	4966	100	4452	100
% positive of women with known status	2769	70.4	2516	65.1
% negative of women with known status	1166	29.6	1351	34.9
total, known HIV status	3935	100	3867	100

* includes those who declined: 39 pts declined HIV testing in 2008-2010, and 6 in 2011-2013.

** includes coincidental deaths

Repeated testing throughout pregnancy and breastfeeding of women initially testing negative is an important component of the PMTCT programme. In South Africa, 4% of women who test HIV negative early in pregnancy, test HIV positive at a later gestation. The date of the last HIV test was not documented for most of the women who died. Repeat HIV testing is also indicated for women previously testing negative test presenting with TB, other respiratory illnesses, meningitis or other medical problems in pregnancy.

HIV status was unknown in a smaller, but still significant, proportion of women than in previous reports. Only 6 women were documented as having declined testing, showing the overall success and acceptability of the antenatal counselling and testing programme.

HAART: all maternal deaths

The reduction in maternal deaths has occurred during a time of increased eligibility for HAART for pregnant women and all women of reproductive age. In 2010, eligibility for HAART for pregnant women increased from CD4 count ≤ 200 cells/ mm³ or stage 4 disease to CD4 count ≤ 350 cells/mm³ or WHO stage 3 or 4 disease. : increased from CD4 counts ≤ 200 cells/ mm³ or stage 4 disease. In 2011, the expanded criteria applied to all people living with HIV.

Information on whether women who died were on HAART was documented for the first time in 2008-2010.. In the current report, classification of HIV status and HAART remained the same as previously, despite the changed criteria for HAART. Women were categorised, 'AIDS on HAART' and 'AIDS not on HAART', and 'HIV positive not AIDS'. For the latter group, information on HAART status was not recorded.

AIDS was defined as CD4 count < 200 cells/mm³, or a WHO stage 4 defining illness. Analysis of maternal deaths in relation to HAART therefore allows comparison with the previous triennium, but the total number of women on HAART is likely underestimated in the following, where the total number of women known to be on HAART does not include women classified as 'HIV positive not AIDS' who were on HAART.

For 2001-2013, 49.3% of all HIV positive women were known to be on HAART, compared with 31.6% in the previous report (table 9.2). Overall, 75% of women who died were classified as AIDS, and 65.7% of these were on HAART, an increase from 48.5% in the previous triennium. Over a third of women categorised as AIDS were not on treatment. This data shows that many women are entering pregnancy with advanced HIV and not on HAART, and therefore with an increased risk of maternal death.

Table 9.2. Percentage of women on HAART, all maternal deaths, 2008-2010 and 2011-2013

HIV status	2008-2010		2011-2013	
	no.	%	no.	%
negative	1166	24	1351	30.3
HIV positive, not AIDS	949	19.5	629	14.1
AIDS not on HAART	938	19.3	647	14.5
AIDS on HAART	882	18.1	1240	27.9
total AIDS	1820	36.4	1887	42.4
total positive	2769	56.1	2516	56.5
% AIDS of positives	----	65.3	----	75
% on HAART of positives	----	31.6	----	49.3
% on HAART of AIDS	----	48.5	----	65.7
unknown	1031	21.2	585	13.1
total maternal deaths*	4996	100	4452	100

* includes coincidental deaths

No information is available of how many women were virologically suppressed, and so on effective HAART. Viral load was rarely requested, and results rarely documented. The 2015 National Guidelines for the first time emphasise the importance of viral load testing in pregnant and postpartum women, both to reduce vertical transmission and optimise maternal health.

Part 2. Non-pregnancy Related Infections

The iMMR for NPRIs decreased by 25% this triennium; from to 71.29 per 100000 live births in 2008-2010, to 53.7 per 100000 live births in 2011-2013 (table 9.3). Furthermore, there has been a year by year decrease from 2011 to 2013, falling to 47.49 per 1000 live births in 2013.

Table 9.3. Maternal mortality and NPRI for each triennia from 2002-2004 to 2011-2013, and year by year for 2011-2013.

	2002-2004	2005-2007	2008-2010	2011-2013	2011	2012	2013
iMMR NPRI	55	66.28	71.29	53.47	58.87	54.08	47.49
iMMR all maternal deaths	145.48	151.77	176.22	154.06	163.11	155.23	143.85
total number of deaths from NPRI	1246	1729	1969	1504	550	509	445
% of all maternal deaths	37.8	43.7	40.5	34.7	36.1	34.8	33.0

The majority of women who died were HIV positive. In total, 89.8% of women were HIV positive, 6.6% HIV negative and 3.6% unknown. Table 9.4 shows HIV status for women who died from NPRIs over time. In 2005-2007, 17.4% of deaths were of women of unknown HIV status. This has subsequently fallen, with a progressive increase in the percentage of HIV positive women, and a smaller increase in HIV negative women. Information on HIV status is not available for 1999-2001 and 2002-2004.

Table 9.4. HIV status for maternal deaths from NPRI, 2002-2004 to 2011-2013

HIV status NPRI	2005-2007		2008-2010		2011-2013	
	no.	%	no.	%	no.	%
positive	1309	79.7	1720	87.3	1350	89.8
negative	48	2.9	102	5.2	100	6.6
unknown*	286	17.4	147	7.5	54	3.6
total	1643	100	1969	100	1504	100

* includes women declining testing: 13 women in 2008-2010, and 4 women in 2011-2013. This data is not available for 2005-2007.

The decrease in mortality from NPRIs is due to a decrease in HIV related deaths. There were 465 fewer deaths from NPRI compared to 2008-2010. There were a 370 fewer deaths of HIV positive women, 93 fewer deaths of women of unknown HIV status, and only 2 fewer deaths of HIV negative women. The fall in maternal deaths from NPRI has occurred at all levels of care, in 8 of the 9 provinces, in almost all age groups, and for all of the major HIV related causes. However NPRIs remain overwhelmingly the leading cause of maternal mortality in South Africa,, and in all provinces.

Overall, 89% of HIV positive women had AIDS (table 9.5). A total 54.7% of HIV positive women were known to be on HAART, an increase from 36.3% in the last triennium; 61.5% of women classified as AIDS were on HAART, compared to the 46% previously .

Table 9.5 . Maternal deaths from NPRIs, HIV and HAART status, 2008-2010 and 2011-2013.

HIV status	2008-2010		2011-2013	
	no.	%	no.	%
negative	102	5.2	100	6.6
HIV positive, not AIDS	360	18.3	149	9.9
AIDS not on HAART	735	37.3	462	30.7
AIDS on HAART	625	31.7	739	49.1
total AIDS	1360	69.1	1201	79.9
total positive	1720	87.3	1350	89.8
% AIDS of positives	----	79.1	----	89
% on HAART of positives	----	36.3	----	54.7
% on HAART of AIDS	----	46	----	61.5
unknown	147	7.5	54	3.6
total maternal deaths	1969	100	1504	100

Distribution of subcategories of NPRI

Respiratory disease and meningitis remain the most common causes of maternal death from non-pregnancy related infections (table 9.6). In the current triennium, 62% of deaths were from respiratory disease, and 12.3% from meningitis. While percentages are largely unchanged from 2008-2011, the total number of deaths has significantly decreased. There were 1316 deaths from respiratory disease in 2008-2010, and 932 in 2010-2013, a reduction of 29%.

Table 9.6. Subcategories of NPRIs, 2008-2010 and 2011-2013.

Primary obstetric problem	2008-2010	2011-2013	2011	2012	2013
Non-pregnancy-related infections	1969	1504	550	509	445
All respiratory deaths	1316	932	338	288	306
- Pneumocystis jirovecii pneumonia	261	226	72	77	77
- Other pneumonia	526	310	127	92	91
- TB	529	396	139	119	138
- Endocarditis	1	4	2	1	1
- UTI	5	6	3	0	3
- Malaria	6	12	2	6	4
All meningitis deaths	223	185	55	80	50
- Cryptococcal meningitis	82	56	18	22	16
- Other meningitis	171	129	37	58	34
- Kaposi's sarcoma	22	26	10	8	8
- Hepatitis	17	20	5	6	9
- Gastroenteritis	103	63	17	23	23
- Wasting syndrome	80	57	23	26	8
- Complications of antiretroviral therapy	73	130	64	49	17
- Other	92	69	31	22	16

There has been a 25% reduction in deaths from TB this triennium, however TB remains the single most common cause of maternal death. There were 41% fewer deaths from 'other pneumonias'. In 2009, the H1N1 outbreak caused deaths from influenza, with pregnant women disproportionately affected. However this is not sufficient to explain the extent of the decrease. There were 6 deaths from varicella pneumonitis this triennium, 4 of whom were HIV positive, and one of unknown status. Varicella infection is more severe both in pregnancy and in HIV patients, and prompt diagnosis, treatment and infection control are essential.

Deaths from Pneumocystis jirovecii pneumonia decreased to a lesser extent, with 13% fewer deaths. All healthworkers caring for pregnant women need to be vigilant for evidence of respiratory signs and symptoms, and respiratory rate routinely checked in any woman who is unwell. All women with respiratory symptoms must be investigated for TB.

There were 68 fewer deaths from meningitis; a 31.7% decrease for cryptococcal meningitis, and 24.5% for 'other meningitis'. Deaths from gastroenteritis and wasting syndrome have also fallen substantially.

Some subcategories have shown an increase in the number of deaths. The most significant is complications of antiretrovirals. This is discussed below. Deaths from malaria have doubled from 6 to 12 since the previous triennium, which is of considerable concern.

Complications of antiretroviral therapy

There was a significant increase in deaths due to complications of antiretroviral therapy. There were 130 deaths this triennium, compared to 74 in 2008-2010 (figure 9.1, table 9.7). This is an increase from 3.7% to 8.8% of all deaths from NPRIs. However, deaths peaked in 2011 with 64 deaths, and fell each subsequent year to 49 in 2012, and 17 in 2013.

Table 9.7. Complications of ART

	2011	2012	2013	total
Total nevirapine	54	36	3	93
- nevirapine plus cotrimoxazole and/or isoniazid	8	4	0	12
lactic acidosis secondary to stavudine or zidovudine	2 ¹	2 ¹	1 ²	5
lactic acidosis secondary to other causes ³	2	3	0	5
efavirenz plus cotrimoxazole and/or isoniazid or sepsis	0	1	5	6
tenofovir and renal impairment	1	0	1	2
cases assessed as not ART related, excluding lactic acidosis ⁴	5	4	1	10
total no. of deaths from complications of ART	64	49	17	130
total no. of folders available for assessment	64	46	11	121

¹ both cases due to stavudine

² due to zidovudine

³ sepsis, respiratory failure

⁴ including sepsis, disseminated TB, pneumonia. Pregnancy related causes, for example acute fatty liver of pregnancy, may also be involved.

The majority of deaths involved nevirapine toxicity, causing liver failure, Steven Johnson's syndrome/toxic epidermal necrolysis or both. The increase in deaths correlates with the increased use of nevirapine containing ART in pregnant women, due to increased eligibility for HAART.

Nevirapine-containing regimens were first line for pregnant women and women of reproductive age until mid-2012, when the NCEMD highlighted a significant increase in deaths due to nevirapine. Efavirenz then replaced nevirapine as first line treatment, including for pregnant women. In the first half of 2012 there were 29 deaths due to nevirapine, and in the second half there were 7. The dramatic decrease in deaths has demonstrated that findings from the Saving Mothers reports can be rapidly implemented, and substantially reduce maternal deaths.

Cotrimoxazole and isoniazid cause the same hypersensitivity reactions as nevirapine, and were co-administered in 12 of the 93 deaths. However the reduction in deaths occurred when policy changed regarding nevirapine, without any restrictions on the use of cotrimoxazole, or isoniazid preventative therapy. This strongly supports the contention that nevirapine is the most strongly implicated drug in causing deaths from ART.

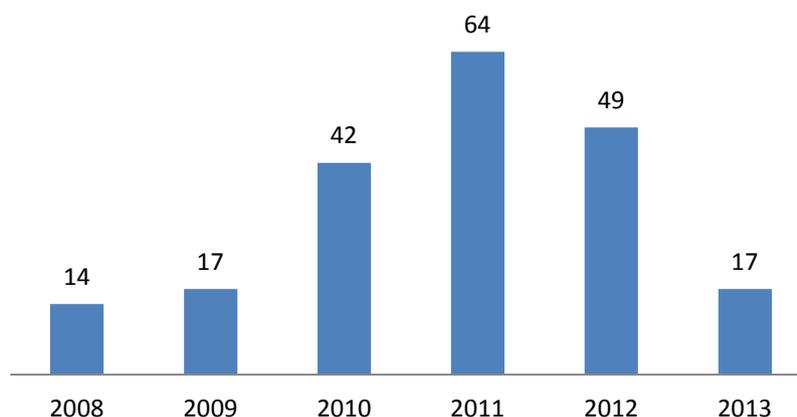
There were 5 deaths from nucleoside reverse transcriptase inhibitor (NRTI) related lactic acidosis 4 due to stavudine and one due to zidovudine. Five other deaths were attributed to lactic acidosis, however were more likely due to other causes, most commonly sepsis. The finding of lactic acidosis does not imply that NRTIs are necessarily implicated; other causes should be actively investigated. Tenofovir rarely causes lactic acidosis; cases of NRTI related lactic acidosis are now rare, but because of this, can easily be overlooked.

There were 6 deaths associated with efavirenz all involving other co-factors, including sepsis, and other drugs. It was difficult to assess the contribution of efavirenz to mortality in most of these cases however

vigilance must be maintained for maternal deaths in which efavirenz is implicated now that almost all pregnant women will be on efavirenz based HAART.

Two deaths from renal failure involved women on tenofovir. In one, multiple nephrotoxic drugs were started on the same day, and in the second creatinine was not checked at booking, as required by the national guidelines. Tenofovir has been widely used in pregnant women since 2010; this data is therefore reassuring regarding its safety.

Figure 9.1. Maternal deaths due to complications of ART, 2008-2013



HIV and subcategories of NPRI

Table 9.8 shows HIV status and subcategories of NPRI. As the vast majority of deaths from NPRI were amongst HIV positive women, not surprisingly most deaths in all major subcategories were HIV positive.

There were 100 deaths from NPRIs in HIV negative women in this triennium; a reduction of only 2 from 2008-2010. Almost two thirds of HIV negative women died from respiratory disease, with 36 deaths from other pneumonia, and 29 deaths from TB. Symptom screening at each antenatal visit must include all women, irrespective of HIV status. Meningitis was the second most common cause of death amongst HIV negative women, with 15 deaths from other meningitis.

Table 9.8. Subcategories of NPRI and HIV status

Primary obstetric problems	total	HIV negative		HIV positive		HIV unknown*	
		no.	%	no.	%	no.	%
Non-pregnancy-related infections	1504	100	6.6	1350	89.7	50	3.6
- PCP pneumonia	226	1	0.4	223	98.8	2	0.9
- Other pneumonia	310	36	11.6	249	80.3	24	8.1
- TB	396	29	7.3	354	89.4	10	3.2
- Endocarditis	4	1	25	3	75	0	0
- UTI	6	1	16.7	4	67	1	16.7
- Malaria	12	0	0	11	91.7	1	8.3
- Cryptococcal meningitis	56	0	0	55	98.2	1	1.8
- Other meningitis	129	15	11.6	108	83.7	6	4.7
- Kaposi's sarcoma	26	0	0	26	100	0	0
- Hepatitis	20	3	15	17	85	0	0
- Gastroenteritis	63	4	6.3	59	93.6	0	0
- Wasting syndrome	57	1	1.8	56	98.2	0	0
- Complications of antiretroviral therapy	130	0	0	130	100	0	0
- Other	69	9	13	55	79.7	5	7

* Includes those who declined testing; 3 women with TB and one with 'other pneumonia'

Distribution of NPRIs within provinces

Non-pregnancy related infections remain the leading cause of maternal mortality in all provinces (table 9.9). However, iMMR decreased this triennium in all provinces except Limpopo, which is unchanged. In 3 provinces, the iMMR has fallen by over 40%, which marks major progress in reducing maternal mortality. These provinces are the Free State, Northern Cape and North West Province.

The iMMR for NPRIs largely reflects the antenatal prevalence for each province. KwaZulu-Natal has the highest antenatal prevalence; it also has the highest no. of deaths from NPRI and the highest maternal mortality ratio. The Western Cape has the lowest prevalence, and the lowest maternal mortality.

Table 9.9. Distribution of NPRIs amongst provinces.

Province	Deaths from NPRI, 2011-2013		AN prevalence	iMMR by province		Reduction in iMMR
	no. of deaths	% of all NPRI	%	2011-2013	2008-2010	%
Eastern Cape	199	13.2	29.1	54.92	77.97	29.6
Free State	85	5.7	32	58.8	107.29	45.2
Gauteng	276	18.4	29.9	44.97	53.43	15.8
KZN	404	26.9	37.4	71.7	94.08	23.8
Limpopo	228	15.2	22.3	59.84	59.73	unchanged
Mpumalanga	126	8.4	35.6	55.43	74.06	25.2
North West	86	5.7	29.7	49.7	90.3	41.2
Northern Cape	33	2.1	17.8	51.76	93.54	44.7
Western Cape	67	4.5	16.9	23.79	31.65	24.8
South Africa	1504	100	29.5	53.47	71.29	24.9

Antenatal prevalence of HIV by province, 2012. Source NDoH, 2013

 Reduction in iMMR by over 40%

Subcategories of NPRI by province

In all provinces, respiratory disease was the most common causes of death from NPRI (table 9.10). Total deaths from respiratory disease varied from 58.8% in the Eastern Cape, to 68.2% in Mpumalanga. TB was the most common cause of death from respiratory disease in all provinces except the Free State and Gauteng, where there were more deaths from other pneumonias.

Deaths from meningitis were the second most common cause in Gauteng, Limpopo and Mpumalanga. Complications of antiretroviral disease and wasting syndrome were the second most common cause in other provinces.

Deaths from malaria occurred only in Gauteng, KwaZulu-Natal and Limpopo. The latter are both malaria-endemic provinces, together with Mpumalanga. In Gauteng, 4 of the 5 women who died had visited friends and relatives in neighbouring malaria-endemic countries.

Table 9.10. NPRI subcategories by province, expressed as percentage of total deaths from NPRI for each province.

The percentages of all respiratory deaths are highlighted.

Province	Total	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC
NPRIs total %	100	100	100	100	100	100	100	100	100	100
- PCP pneumonia	15.0	11.1	16.5	16.3	13.1	20.6	19.0	19.8	6.1	3.0
- Other pneumonia	20.6	18.6	24.7	24.6	20.8	15.8	15.9	18.6	21.2	31.3
- TB	26.3	29.1	23.5	17.0	28.2	28.1	33.3	22.1	39.4	28.4
All respiratory	61.9	58.8	64.7	58.9	62.1	64.5	68.2	60.5	66.7	62.7
- Endocarditis	0.3	0.5	0.0	0.4	0.2	0.0	0.0	0.0	0.0	1.5
- UTI	0.4	0.5	3.5	0.4	0.0	0.0	0.8	0.0	0.0	0.0
- Malaria	0.8	0.0	0.0	1.8	0.7	1.8	0.0	0.0	0.0	0.0
- Cryptococcal meningitis	3.7	4.5	2.4	4.0	3.7	3.9	1.6	7.0	0.0	3.0
- Other meningitis	8.6	5.0	8.2	14.1	6.9	9.6	11.1	5.8	6.1	3.0
All meningitis	12.3	9.5	10.6	18.1	10.6	13.5	12.7	12.8	6.1	6.0
- Kaposi's sarcoma	1.7	3.0	0.0	1.1	2.0	1.8	0.8	2.3	0.0	3.0
- Hepatitis	1.3	1.0	0.0	0.7	0.7	4.4	0.0	0.0	3.0	3.0
- Gastroenteritis	4.2	4.5	2.4	2.9	5.0	3.5	4.8	7.0	6.1	3.0
- Wasting syndrome	3.8	11.6	3.5	4.0	2.0	1.3	7.1	0.0	0.0	0.0
- Complications of ART	8.6	4.5	15.3	8.3	11.6	6.6	4.8	12.8	6.1	6.0
- Other	4.6	6.0	0.0	4.3	5.0	2.6	0.8	4.7	12.1	14.9

Antenatal attendance

Table 9.11 shows antenatal attendance for women who died from NPRI. Overall, 64% of women had attended for antenatal care, 26.2% had not, and attendance was unknown for the remaining 9.8%. There is little change from the 2008-2010 report.

Table 9.11. Antenatal attendance for subcategories of NPRI

Antenatal care	Attended %	Did not attend %	unknown %
All NPRI	64	26.2	9.8
- PCP pneumonia	63.7	27.4	8.8
- Other pneumonia	61.9	28.7	9.4
- TB	59.6	28.3	12.1
- Endocarditis	75	25	0
- UTI	66.7	0	33.3
- Malaria	58.4	16.7	25
- Cryptococcal meningitis	62.5	26.7	10.7
- Other meningitis	58.9	31	10.1
- Kaposi's sarcoma	76.9	23.1	0
- Hepatitis	70	25	5
- Gastroenteritis	66.7	27	6.3
- Wasting syndrome	64.9	29.8	5.3
- Complications of ART	85.4	6.9	7.7
- Other	60.9	27.5	11.6

Timing of the emergency and timing of death

The timing of the onset of the emergency event and timing of death are shown in table 9.12. In approximately two thirds of women the emergency began in the antenatal period, and almost 60% of deaths occurred postpartum. The length of time between the onset of the emergency, delivery and death has not been documented; however many women delivered spontaneously during the course of the emergency, with onset of labour precipitated by maternal illness. Both acute and chronic infections can result in miscarriage and premature labour. It is important that HIV positive women presenting with pregnancy loss are assessed to identify if maternal illness is the underlying cause.

Table 9.12. Timing of emergency and timing of death of NPRIs

Timing of emergency	Timing of emergency		Timing of death	
	no.	%	no.	%
Early pregnancy	208	13.78	109	7.5
Antenatal period	783	51.9	455	31.3
Intrapartum period	47	3.1	18	1.2
Postpartum period	470	31.1	869	59.8
Anaesthesia	2	0.1	2	0.1
total	1510*	100	1453**	100

* the emergency may involve more than one time frame, therefore the total is more than the total no. of cases

** Data is not available for all cases

Perinatal outcome

Perinatal outcomes were poor (table 9.13). One third of women delivered a liveborn infant who subsequently survived, and over a third of women died undelivered. Deaths from complications of ART had the poorest outcomes; 18.5% of pregnancies resulted in liveborn infants, and 40% were stillborn.

Table 9.13. Perinatal outcome

Outcome	Liveborn %	Stillborn %	Neonatal death	Undelivered	Miscarriage, ectopic
NPRI	34.3	16.6	3.1	36.4	9.5
- PCP pneumonia	35.8	14.2	2.7	42	5.3
- Other pneumonia	35.2	15.2	2.6	38.4	8.7
- TB	41.4	11.9	3	31.8	11.9
- Endocarditis	50	25	0	25	0
- UTI	66.7	0	0	33.3	0
- Malaria	33.3	41.7	0	25	0
- Cryptococcal meningitis	26.8	16.1	1.8	51.8	3.6
- Other meningitis	38.8	10.1	2.3	45	3.9
- Kaposi's sarcoma	34.6	19.2	7.7	30.8	7.7
- Hepatitis	20	25	0	40	15
- Gastroenteritis	25.4	19	6.3	31.7	17.5
- Wasting syndrome	29.8	17.5	5.3	22.8	24.6
- Complications of ART	18.5	40	3.1	32.3	6.2
- Other	24.6	17.4	5.8	34.8	17.4

Level of Care

Table 9.14. Level of care by subcategory of death from NPRI

Primary obstetric problem	home	CHC	District1 hospital	Regional hospital	Tertiary hospital	Private hospital	Total no.
% of total maternal deaths	1.8	2.2	31.6	38.4	23.2	2.7	100.0
% Medical and surgical disorders	0.8	2.0	23.7	32.0	37.9	3.4	100.0
% NPRIs	0.7	0.9	33.2	41.6	21.7	2.0	100.0
NPRI - total no.	10	13	499	626	326	30	1504
- PCP pneumonia	0	2	75	99	44	6	226
- Other pneumonia	2	1	123	117	60	7	310
- TB	5	3	141	161	77	9	396
- Endocarditis	0	0	0	1	2	1	4
- UTI	0	0	2	3	0	1	6
- Malaria	0	0	1	5	5	1	12
- Cryptococcal meningitis	0	0	15	26	14	1	56
- Other meningitis	1	0	37	62	29	0	129
- Kaposi's sarcoma	0	0	4	9	13	0	26
- Hepatitis	0	0	7	6	7	0	20
- Gastroenteritis	1	3	31	23	5	0	63
- Wasting syndrome	1	2	28	13	12	1	57
- Complications of antiretroviral therapy	0	1	17	73	38	1	130
- Other	0	1	18	28	20	2	69

Only 21.7% of women were admitted to level 3 hospitals (table 14). Over a third died at community health clinics or level 1 hospitals, and 40.1% at level 2 hospitals. However 37.9% of women with medical and surgical disorders were admitted to level 3. This category mostly involves deaths from medical causes; pregnant women with medical problems that unrelated to HIV are therefore more likely to be admitted to level 3 than women with HIV-associated medical problems.

Patient oriented avoidable factors

Patient oriented avoidable factors were identified in 60.3% of deaths (table 9.15). The most common factor was delay in accessing medical help, followed by no antenatal care. This is unchanged from the last report. Table 9.15. Distribution of patient oriented avoidable factors, missed opportunities and substandard care

Table 9.15. Distribution of patient oriented avoidable factors, missed opportunities and substandard care

Description	All maternal deaths		NPRI	
	no.	%	no.	%
Lack of information	501		145	
Assessable cases	3951		1359	
No patient oriented avoidable factor	2037	51.6	527	38.8
patient oriented avoidable factor identified	1914	48.4	802	60.3
No antenatal care	700	17.7	323	23.8
Infrequent antenatal care	258	6.5	117	8.6
Delay in accessing medical help	1145	29.0	538	39.6
Declined medication/surgery/advice	198	5.0	92	6.8
Family problem	27	0.7	7	0.5
Community problem	6	0.2	2	0.1
Unsafe abortion	36	0.9	2	0.1
Other	173	4.4	67	4.9
Total cases	4452		1504	

Administrative Avoidable Factors

Table 9.16. Distribution of administrative related avoidable factors, missed opportunities and substandard care

Description	All maternal deaths		NPRI	
	no.	%	no.	%
Lack of information	325.0		115.0	
Assessable cases	4127		1389	
No avoidable administrative factor	2456	59.5	1004	72.3
Avoidable administrative factor identified	1671.0	40.5	385.0	27.7
Transport problem: Home to institution	62	1.5	6	0.4
Transport problem: Institution to institution	204	4.9	25	1.8
Lack of accessibility: Barriers to entry	38	0.9	5	0.4
Lack of accessibility: Other	27	0.7	5	0.4
Delay initiating critical care (Overburdened service)	258	6.3	53	3.8
Lack of health care facilities: ICU	254	6.2	69	5.0
Lack of health care facilities: Blood/blood products	130	3.1	8	0.6
Lack of health care facilities: Other	125	3.0	30	2.2
Lack of appropriately trained staff: Doctors	643	15.6	116	8.4
Lack of appropriately trained staff: Nurses	365	8.8	101	7.3
Communication problems: Technical	62	1.5	16	1.2
Communication problems: Interpersonal	113	2.7	35	2.5
Other	273	6.6	78	5.6
Total deaths	4452		1504	

Administrative avoidable factors were identified in 27.7% of deaths (table 9.16). Lack of appropriately trained doctors and nurses, lack of ICU availability and delay in initiating critical care were the most

common causes. However each category is less common for deaths from NPRI than for maternal deaths as a whole. This may reflect expectations of a poor outcome for pregnant women with HIV related complications. This has been noted in previous reports. If health care workers expect HIV positive pregnant women will inevitably die, then lack of appropriate training may not be recognised.

Medical management problems

Medical management problems are assessed according to the level of care (table17). Problem recognition and diagnosis, and substandard management with the correct diagnosis were the most common avoidable factors at all levels of care. Medical management problems were most common at level 1 hospitals. There were many examples of suboptimal care that were not recognised either by health workers, or the assessors. Women were frequently poorly assessed, inadequately investigated and sub-optimally managed.

Problems with initial assessment included lack of history taking and examination; obstetric doctors concentrated on the fetus, and often did not examine the mother. HIV and ART history were poorly documented, with 'HIV positive on HAART' often the only information given. The ART regimen was frequently not stated. CD4 counts and viral load results were rarely documented.

Lack of problem recognition included medical staff failing to recognise that a pregnant woman was unwell. This was particularly so for women admitted with second trimester miscarriage and preterm labour. The focus of care was solely on obstetric issues. It was not recognised that the underlying cause for early delivery was maternal illness, and women died without investigation or treatment.

Failure to recognise the mother had a treatable condition was also found. Acute and chronic presentations were attributed to 'terminal AIDS', and no further investigations performed. It is now 10 years since the national roll-out of HAART, and pregnant women should no longer die from 'terminal AIDS'. In particular, many deaths classified as wasting syndrome did not fit the accepted case definition, and instead were deaths where appropriate investigations had not been performed and no diagnosis established.

TB was under-recognised and under-investigated. Deaths classified as other pneumonia, *Pneumocystis jirovecii* pneumonia, other meningitis and wasting syndrome all included women who likely had TB, either as an additional or alternative diagnosis. There needs to be increased awareness of the presentation, investigation and diagnosis of TB in HIV positive patients. At low CD4 counts, extra-pulmonary TB is more common, chest xray may be normal, and TB may present with involvement of any major organ system or as a non-specific febrile or wasting illness. All HIV positive women who are acutely or chronically unwell need investigating for TB. Symptom screening needs to be carried out at all antenatal visits, emphasised, and isoniazid preventative therapy be offered if symptom screen is negative.

Lack of problem recognition was also evident in the majority of deaths from malaria. Travel history was often missed, and women were diagnosed with other conditions such as meningitis, abruption, severe pre-eclampsia, and investigated for malaria only after considerable delays, which contributed to their death.

Problems with referral and patient management at an inappropriate level were most common at level 1 hospitals. The need for more involvement from physicians and infectious diseases specialists is apparent when assessing avoidable deaths from NPRIs. Many women managed at level 1 should have been referred to level 2 or 3 hospitals for assessment by internal medicine. Referral pathways for HIV positive pregnant women needing management by internal medicine need to be clear and accessible, both within hospitals

and between hospitals. There needs to be recognition that HIV positive pregnant women needing hospital admission frequently have complex problems, beyond the skill and resources available at level 1 hospitals.

Physicians and infectious diseases specialists have a responsibility of care for pregnant women with HIV related-medical problems, and need to take a leading role in training, outreach and support.. There were many examples of optimal care and excellent joint management. However this was not always the case. Medical problems in HIV positive pregnant women may be HIV-related, HIV-unrelated or due to obstetric causes, and are a challenge for both obstetricians and physicians.. Obstetric doctors often lack experience and confidence in investigating and managing complex problems in pregnant women. Physicians have little training in maternal medicine, and often consider that pregnant women don't fall within their domain. Maternal medicine needs to be incorporated into undergraduate and postgraduate training, in both internal medicine and obstetric rotations.

Distribution of avoidability in NPRI

If all avoidable factors are assessed, 43.4% of deaths from NPRI were considered possibly or probably avoidable (table 9.17). NPRIs are the most common cause of maternal mortality, and avoidable deaths from NPRI constitute 25% of all avoidable maternal deaths. This is a conservative estimate, and does not include suboptimal care not recognised by healthcare workers, or the assessors.

Table 9.17. Distribution of avoidability in NPRI

	no.	%
No suboptimal care	596	39.6
Suboptimal care, different management would have made no difference to the outcome	256	17.0
Suboptimal care, different management might have made a difference to the outcome	514	34.2
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	138	9.2
	1504	100.0
total: different care might have and would reasonably expected to have made a difference	652	43.4
% of all avoidable avoidable deaths	25.0	

Case histories

Case 1: Severe dyspnoea, not investigated.

A 22 year old gravida3 para 2 was admitted at 23 weeks gestation to a level 1 hospital with difficulty breathing and swollen legs. She was HIV positive on HAART, and normotensive. No further history was taken. She was not examined. Management was 'to keep in casualty overnight, for maternity mane'. The following morning she was noted to be 'dyspnoeic +++', and prescribed nebulisers and intravenous hydrocortisone, without any clinical examination; these were not given. . She was referred to the gynaecology outpatient clinic, and prescribed oral amoxicillin, which was not given. She died later that day. Later that afternoon she was found gasping on the ward. There was no attempt at resuscitation.

Comment

This case shows a complete lack of care. The Casualty doctor clearly felt no responsibility for her care, because she was pregnant, and therefore 'belonged' to the maternity department. In the 24 hours from admission to her death, a history was not taken, she was not examined, a chest x ray was not requested, and no investigations were done. No diagnosis was made, and she received no treatment. The differential diagnosis of a pregnant woman presenting with dyspnoea and oedema includes obstetric causes, medical causes and HIV related causes. She should have been stabilised, and initial investigations and management implemented, and , and referred to a higher level of care.

Case 2. Wasting syndrome.

A 40 year old gravida 5 para 4 booked at 26 weeks, and was started on AZT monotherapy. . She was admitted 5 weeks later to a level 1 hospital with general body pains, tachycardia, and bilateral lung creptiations. Her HIV status was not documented, HCT was planned. Baseline blood tests were taken, including a full blood count. She was started on intravenous ceftriaxone. Two days later she developed vaginal bleeding. She was noted by a doctor to look 'extremely ill', and having an inevitable miscarriage. She delivered a stillborn premature infant.. Blood tests were repeated; previous blood results were not obtained.

The following day, she was discharged by a doctor. Nursing staff documented that she was weak and confused, and did not discharge her.. She was found dead in bed the following day. Resuscitation was not attempted. After her death, blood results were obtained; on both occasions the platelet count was $0 \times 10^9/L$.

Comment.

This death was categorised as wasting syndrome, and is typical of many deaths ascribed to wasting syndrome in that there was no attempt to make a diagnosis.. She delivered prematurely during her admission, and this was not recognised to be a consequence of maternal illness. She was then discharged, because she was no longer pregnant. A platelet count of $0 \times 10^9/L$ in this context reflects a serious multisystem problem; thrombotic thrombocytopenia purpura, bacterial sepsis, malaria, early onset pre-eclampsia/HELLP syndrome and disseminated TB all need to be considered. She should have been referred to a level 3 hospital.

Case 3: Cryptococcal meningitis.

A 22 year old primigravida booked at 23 weeks, having previously defaulted ART. Two days later she was seen at the antenatal clinic, where she complained of headache, neck stiffness and vomiting. She was referred to the emergency department, and was assessed as having no neck stiffness. No history was taken, and no further examination recorded. She was discharged with paracetamol.

Three days later she presented to a tertiary hospital with headache, neck stiffness and seizures. Her blood pressure was raised on one occasion, with a trace of proteinuria. She was treated for eclampsia, labour induced with misoprostol, and she delivered a preterm infant.

The following day she developed a 6th cranial nerve palsy. A CT brain was normal, and lumbar puncture showed cryptococcal meningitis. Amphotericin B was prescribed, but given only the following day. . CSF opening pressure and therapeutic lumbar punctures were not performed. She died on day 4 of admission.

Comment

There was suboptimal care at all steps in investigation and management of this patient. Lumbar puncture was indicated when the patient initially presented with a headache. When she re-presented, her compliant of neck stiffness meant meningitis was more likely than eclampsia.

This patient had clear evidence of raised intracranial pressure, and therapeutic lumbar punctures were an essential part of her management.

Case 4: Pneumocystis jirovecii pneumonia.

A 17 year old primigravida booked at 15 weeks gestation. She was HIV negative booking. She presented 2 weeks later with a dry cough, and was noted to be ill-looking and dyspnoeic. Oxygen saturation was 92% on face mask oxygen, and chest Xray showed 'small changes' in the left lung base. The next day she was said to be undistressed, and she was discharged home with amoxicillin. Eleven days later she presented with severe shortness of breath, oxygen saturation of 70%, and bilateral infiltrates on CXR. Pneumocystis jirovecii pneumonia was considered, and an HIV ELISA test requested. Ceftriaxone and clarithromycin were prescribed, and face mask oxygen given. She continued to deteriorate, and 2 days later was admitted to the intensive care unit for intubation and ventilation. The following day, the HIV ELISA result was reported as positive, and high dose cotrimoxazole and prednisone started. She died on day 8 of admission, despite full intensive care.

Comment:

A window of opportunity was missed when this teenager first presented with respiratory symptoms. The level of alert may have been higher had she been known to be HIV positive. She was either in the window period at booking, or the initial rapid test was incorrect. All pregnant women who have previously tested negative and with respiratory symptoms should have a repeat HIV test. Performing a rapid test would have avoided a 2 day wait for the repeat HIV result, and a delay in definitive treatment.

Case 5; Malaria.

A 28 year old gravid 2 para 1 at 31 weeks gestation, presented with respiratory distress, jaundice, severe anaemia, thrombocytopenia and renal failure. Intrauterine death was diagnosed, and she was treated for septic shock. She was first seen at a rural clinic, then a district hospital, and then a regional hospital. She delivered a stillborn infant. Her clinical condition further deteriorated; she was intubated and ventilated, and transferred to an ICU at a private hospital, where . She became ionotrope dependant. Hysterectomy was performed because of concern that uterine sepsis was the underlying cause.

A malaria film was finally requested, and was available after the hysterectomy had been performed, and 3 days after her initial presentation. This was positive, with an extremely high parasite count of 20%.. She was started on intravenous quinine, however died 3 days later.

Comment:

This death was in a malaria endemic province, and malaria should have been considered on admission. Diagnosis and treatment initiation within hours of her presentation may have resulted in a very different outcome.

Resources in HIV Medicine

National consolidated guidelines for the prevention of mother-to-child transmission of HIV (PMTCT) and the management of HIV in children, adolescents and adults. National Department of Health, 24 December 2014. Available from:

http://www.health.gov.za/docs/Policies/2014/HIV_Guidelines_Jan2015-final_edits-YP.pdf

Médecins Sans Frontières. MSF HIV/TB Clinical Guide. 8th ed. Available for free download from www.samumsf.org

Southern African HIV Clinicians Society website, for guidelines and resources, including free access to the Southern African Journal of HIV Medicine: <http://www.sahivsoc.org>

Chapter 10. Medical and surgical conditions

Abstract

Deaths due to medical and surgical disorders were the 4th most common cause of maternal deaths during this triennium. There were 493 deaths reported in this category during 2011-2013 and this has increased from 237 in 2005-2007 and 430 in 2008-2010. Medical and surgical deaths made up 11.4% of total maternal deaths as compared with 5.8% in 2005-2007 and 8.7% in 2008-2010. This gives an institutional maternal mortality rate for medical and surgical conditions of 17.54 per 100 000 live births. The most common causes of death were cardiac (34.2%, n=169), respiratory (14.4%, n=71) and disorders of the central nervous system (10.1%, n=50).

One hundred and thirty-one (26.5%) women were treated at a District or lower level of care. Assessors believed that 255 (51.7%) deaths were possibly or probably avoidable and in 78 (15.8%) cases medical care was suboptimal and different management would have reasonably expected to have made a difference to outcome. Lack of appropriately trained staff, lack of health care facilities such as ICU beds and delays in initiating critical care were important factors that were indentified that may have influenced outcome. Delay in accessing medical help and non-attendance of ante-natal care made up 39% of patient – orientated avoidable factors.

There has been a steady increase in the institutional maternal mortality rate for cardiac disease over the last 3 triennia. The iMMR for cardiac disease in 2005-2007 was 3.73 and this has increased to 5.64 during 2008-2010 and to 6.00 per 100 000 in this triennium. Cardiac disease is therefore, after non-pregnancy related infections, the second most common cause of indirect maternal death. The most important causes of cardiac death were peripartum cardiomyopathy, complications of rheumatic heart disease and dilated cardiomyopathy.

Key recommendations

- Health professionals at primary health care clinics should be trained to screen all pregnant patients for underlying medical or surgical conditions
- All patients with cardiovascular disease need to be risk assessed based on algorithm 1.
- Patients with other medical conditions need to be referred to an ante-natal high risk clinic at a regional or tertiary hospital (algorithm 2). A follow up and delivery plan must be communicated back to the regional hospital.
- Women presenting with difficulty in breathing, systolic blood pressure of <100mmHg, heart rate >120 beats per minute or appearing cyanotic need to be transferred with an ambulance to a tertiary centre within 24 hours.
- Patients presenting with signs of fluid overload (pulmonary or pedal oedema or a raised JVP) should receive a bolus of lasix 40mg IVI and oxygen per face-mask prior to transfer.
- Clinicians should have a low threshold for investigating pregnant or recently delivered (up to 6 months post-partum) women, especially those with cardiovascular risk factors (hypertension, diabetes), suspected rheumatic heart disease or with symptoms such as shortness of breath or

chest pain. Appropriate investigations include: ECG, chest x-ray, echocardiogram and CT pulmonary angiography. If a clinician is not confident/competent in interpreting any of the above investigations they should ask for help.

- An educational booklet with information on how to recognise symptoms and signs of heart failure should be provided to health-workers at level 1 and level 2 antenatal units.
- Hospitals with internal medicine specialists should set up a joint obstetric medicine clinic. This should be done with urgency and is particularly important as the iMMR has increased from 8.1% (2000-2004) to 17.5% (2011-2013).
- Preconceptual risk assessment clinics for patients with underlying medical disease should be established at tertiary centres.
- All women should receive appropriate counselling about contraception and future pregnancy risks after delivery.

Introduction

There were 493 deaths due to medical and surgical disorders reported during this triennium forming 11.4% of the total maternal deaths. The iMMR has increased from 8.1% in 2000-2004 to 17.5% in 2011-2013. The most common causes of death were cardiac (34.07%, n=169), respiratory (14.4%, n=71) and disorders of the central nervous system (10.1%, n=50). There has been a steady increase in the institutional maternal mortality rate for cardiac disease over the last 3 triennia and after non-pregnancy related infections, cardiac disease is the second most common cause of indirect maternal death.

Demographic data

Most deaths occurred in women between the ages of 20 and 34 years (Table 10.1). It is however important to note that women between the ages of 40-44 years had a 1.7 times greater risk than the general population of dying due to a medical or surgical condition and this risk increased to 4.6 times in women older than 45. Majority (82.8%) of the deaths occurred in women with a parity of 2 or less (Table 10.2). This is increased from the previous triennium when the rate was 76.1%

Table 10.1 Relationship of medical and surgical disorders to maternal age.

Age	n	%	General pregnant population (%)
<20	47	9.5	12.2
20-24	101	20.5	27.4
25-29	144	29.2	26.4
30-34	97	19.7	19.3
35-39	68	13.8	11.0
40-44	29	5.9	3.5
45+	7	1.4	0.3

Table 10.2 Relationship of medical and surgical disorders to parity

Parity	n	%
0	195	39.6
1	119	24.1
2	94	19.1
3	35	7.1
4	24	4.9
5	11	2.2
6+	5	1.0

Causes of medical and surgical deaths

The most common causes of death were cardiac (34.2%, n=169), respiratory (14.4%, n=71) and disorders of the central nervous system (10.1%, n=50) (Table 10.3). Respiratory failure (33.3%), pulmonary oedema (23.1%) and cardiac arrest (28.1%) were the most common final causes of death in this group (Table 10.4). Together these 3 causes contributed to 84.5% of deaths.

Table 10.3 Distribution of sub-categories of medical and surgical deaths.

Medical/surgical disorder	n (total = 493)	%
Cardiac disease	169	34.2
Respiratory	71	14.4
CNS	50	10.1
GIT	35	7.1
Haematological	24	4.9
Neoplasm	32	6.5
Endocrine	20	4.1
Psychiatric	11	2.2
Genito-urinary	9	1.8
Auto-immune	3	0.6
Skeletal	1	0.2
Other	68	13.7

Table 10.4. Final cause of death

Cause of death	n	%
Hypovolemic shock	37	7.5
Septic shock	45	9.1
Respiratory failure	164	33.3
Pulmonary oedema	114	23.1
Cardiac arrest	142	28.1
Acute collapse due to embolism	16	3.2
Renal failure	55	11.2
Liver failure	53	10.8
Intra-cranial haemorrhage	19	3.9
Cerebral oedema resulting in coning	6	1.2
Meningitis	4	0.8
Cerebral emboli	3	0.6
Brain death following hypoxia	10	2.0
Unspecified CNS complications	37	7.5
Maternal ketoacidosis	11	2.2
Electrolyte imbalance	33	6.7
Thyroid crisis	3	0.6
Lactic acidosis	18	3.7
Other metabolic causes	15	3.0
DIC	19	3.9
Severe anaemia	70	14.2
Immune system failure	91	18.5

There has been a steady increase in the institutional maternal mortality rate for cardiac disease over the last 3 triennia. The iMMR for cardiac disease in 2005-2007 was 3.73 and this has increased to 5.64 during 2008-2010 and to 6.00 per 100 000 in this triennium. Cardiac disease is therefore, after non-pregnancy related infections, the second most common cause of indirect maternal death. One-hundred and eighteen files were available for assessment.

The causes of cardiac death were:

Cardiac condition	N (%)
peripartum cardiomyopathy	41 (34%)
complications of rheumatic heart disease	19 (16%)
other cardiomyopathy	10 (8.4%)
prosthetic heart valves	9 (7.6%)
pulmonary hypertension	9 (7.6%)
congenital heart disease	6 (5.1%)
myocardial infarction	3 (2.5%)
infective endocarditis	2 (1.7%)
other	6 (5.1%)
no diagnosis made	13 (11.0%)

Previous reports (2002-2004 and 2005-2007) grouped all cases of cardiomyopathy (peripartum cardiomyopathy and other cardiomyopathies) together and during these triennia complications of rheumatic heart disease and cardiomyopathy were the most important and equal contributors to cardiac deaths. In this triennium the number of deaths due to peripartum cardiomyopathy was more than double that of complications related to rheumatic heart disease and formed 34% of the total number of cardiac deaths. Gestational hypertension and HIV disease were identified as important risk factors for peripartum cardiomyopathy. Thirty-five mothers (85.3%) who died of peripartum cardiomyopathy presented with acute symptoms in the post-partum period. Clinicians should therefore have a high index of suspicion when a patient presents in the post-partum period with symptoms and signs of cardiac failure.

Twenty-nine (24.5%) cases were managed at level 1 hospitals and the problems of failure to make a diagnosis, incorrect management and delaying in referring patients to the appropriate level of care were important factors that contributed towards cardiac mortality. In 21.2% of cases assessors believed that different management would reasonably have been expected to have made a difference to outcome.

Respiratory disease

Seventy-one cases were reported in this category. Thirty-one files were available for review. Twenty-five cases were misclassified as these cases should have formed part of the non-pregnancy related infections group. Only 6 files were correctly classified – 3 cases of bronchial asthma, one case each of cor pulmonale, sarcoidosis and cysticfibrosis. The numbers therefore in each disease category are too small to discern any trends.

Central nervous system

Fifty cases were reported in this category compared to 36 for the last triennium – an increase of 38.9%. Three cases were misclassified – 1 case each of eclampsia, meningitis and brain abscess. The most common condition in this category was convulsive disorders. Fourteen files related to convulsive disorders were available for review. Only 1 was a known case of epilepsy in a patient who presented with status epilepsy. The patient died within 24 hours of admission to hospital and this was the only case folder that contained a documented negative HIV serology. In 3 cases the HIV status was unknown while the rest of the patients were HIV positive. Raised intracranial pressure due to hydrocephalus was the cause of epilepsy in 3 cases. In most cases the sequence of events were: paralysis of mainly the lower limbs, deteriorating to convulsions and finally death. One impediment in reaching a diagnosis was reluctance by radiologists to performing CT scans. This was mainly due to fear of harming the fetus.

Levels of care

Fifty-five percent (n=127) of maternal deaths occurred at level 1 and level 2 institutions. This reflects the failure to recognise the severity of underlying medical or surgical condition resulting in a delay in referral for tertiary care.

Table 10.5. Proportion of medical and surgical deaths per level of care

Level	Number of deaths (n)	% of deaths per level of care
Home	4	0.8
Health care centre	10	2.0
Level 1 hospital	117	23.7
Level 2 hospital	158	32.0
Level 3 hospital	187	37.9
Private hospital	17	3.4

HIV disease-status

Fifty-seven (11,6%) women did not have their HIV status known. This rate is too high as a positive status could influence the underlying disease condition. Knowing your status provides an opportunity to optimise disease condition prior to pregnancy. Sixty-percent of women with underlying respiratory disease, 62% of women with central-nervous system disorders and 48.5% of women with cardiac disease were HIV-infected or had unknown HIV-disease status.

Table 10.6 Relationship between death due medical and surgical disorders and HIV-disease status.

Medical/surgical disorder	Total	Negative	Positive	AIDS NOT ON HAART	AIDS ON HAART	Unknown
Cardiac	169	87	23	9	39	11
Endocrine	20	8	4	2	2	4
GIT	35	14	6	2	9	4
CNS	50	19	7	6	12	6
Respiratory	71	29	14	7	10	11
Haematological	24	10	4		6	4
Genito-urinary	9	3	1		5	
Auto-immune	3	2	1			
Skeletal	1	1				
Psychiatric	11	3	2	1		5
Neoplasm	32	13	3	2	12	2
Other	68	26	12	3	17	10

Avoidable factors

The avoidable factors, missed opportunities and substandard care for 2011-2013 are summarised in Tables 10.7-10.11. Delay in accessing medical help and non-attendance of ante-natal care made up 39% of patient-orientated avoidable factors (Table 10.7).

Administrative problems form an important component of avoidable factors and this is an area that should be worked on in order to improve our health care system. There were administrative-related problems in 38.7% of cases (Table 8). Lack of appropriately trained doctors (n=60, 13%), lack of ICU-beds (n=44, 9.5%) and delay in initiating critical care as a result of an overburdened service (n=24, 5.2%) formed the bulk of administrative problems. Together these 3 factors made up 27.7% of avoidable administrative factors and this is almost a doubling from the previous triennium when these factors together were 15.6%.

Problem recognition and delay in referring patients were important health worker-related avoidable factors in primary and secondary level institutions (Table 9). This was especially noted in cardiac related deaths when often the diagnosis of cardiac failure was missed and patients received inappropriate care. Two-hundred and fifty-five deaths (51.7%) were possibly or probably avoidable and in 78 (16%) of cases medical care was sub-optimal and different management would have reasonably expected to have made a difference (Table 10.11).

Table 10.7 Patient-related avoidable factors

Description	n	%
No ante-natal care	57	13
Infrequent ante-natal care	20	4.7
Delay in accessing medical help	111	25.9
Declines medication/surgery/advice	25	5.8
Family problems	3	0.7
Other	15	3.5

Table 10.8 Administrative-related avoidable factors

Description	2011 – 2013		2008 - 2010	
	n	%	n	%
Transport problem: Home to institution	6	1.3	1	0.3
Transport problem: Institution to institution	19	4.1	15	3.8
Lack of accessibility: Barriers to entry	6	1.3	5	1.3
Lack of accessibility: other	3	0.6	2	0.5
Delay in initiating critical care (overburdened service)	24	5.2	10	2.5
Lack of health care facilities: ICU	44	9.5	23	5.8
Lack of health care facilities: Blood/blood products	2	0.4	5	1.3
Lack of health care facilities: other	14	3.0	11	2.8
Lack of appropriately trained staff: doctors	60	13.0	29	7.3
Lack of appropriately trained staff: nurses	22	4.8	13	3.3
Communication problems: technical	5	1.1	4	1.0
Communication problems: interpersonal	16	3.5	13	3.3
Other	26	5.6	34	8.6

Table 10.9. Distribution of health worker-related avoidable factors, missed opportunities and substandard care.

Medical management problems	Primary level		Secondary level		Tertiary level	
	N	%	N	%	N	%
Initial assessment	31	20.8	20	18.0	9	9.9
Problem with recognition/diagnosis	62	41.6	53	47.7	26	28.6
Delay in referring the patient	51	34.2	16	14.4	1	1.1
Managed at inappropriate level	55	36.9	14	12.6	0	0.0
Incorrect management (Incorrect diagnosis)	25	16.8	16	14.4	10	11.0
Sub-standard management (correct diagnosis)	35	23.5	34	30.6	41	45.0
Not monitored/infrequently monitored	11	7.4	11	9.9	3	3.3
Prolonged abnormal monitoring with no action taken	11	7.4	15	13.5	14	15.4
Patients with avoidable factors	149	100.0	111	100.0	91	100.0

Table 10.10 Distribution of problems related to resuscitation

Resuscitation problems	Number	% distribution of problems
Lack of information	46	
No avoidable factor where resuscitation attempted	164	47.3
Airway problems	9	10.7
Breathing problems	28	33.3
Circulation problems	24	28.6
Drug problems	4	4.8
Investigation problems	6	7.1
Monitoring problems	13	15.5
Total avoidable factors	84	100.0

Table 10.11 Distribution of avoidability in medical/surgical conditions

Overall avoidable factors	n	%
No suboptimal care	181	36.7
Suboptimal care, different management would have made no difference to outcome	57	11.6
Suboptimal care, different management might have made a difference to outcome	177	35.9
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	78	15.8

Vignettes

Case 1

A 28-year old primigravid patient was a known patient at a level 3 hospital where she was followed-up at the anti-coagulation clinic for a mechanical prosthetic heart valve replacement. She had surgery for aortic and mitral valve replacements 10 years ago. She was treated with warfarin prior to pregnancy and when the pregnancy was diagnosed at 8 weeks the warfarin was switched to enoxaparin 40mg daily. This dose was continued until 18 weeks when the dose was increased to 40mg twice daily. Anti-coagulant levels were monitored once during the ante-natal period by means of INR. An echocardiogram was performed at 18 weeks which showed normal functioning prosthetic valves. She presented to the emergency unit at 22 weeks with chest pain and shortness of breath. On examination she was found to be in acute respiratory distress due to pulmonary oedema. A diagnosis of cardiac failure was made and the patient was transferred to the intensive care unit. Here she was treated with anti-failure therapy and enoxaparin 40mg once daily was continued. She was not intubated and her blood pressures remained persistently low and unfortunately demised after 2 days.

Comment

Ante-natal management at the level 3 facility was sub-standard. Patients with mechanical valve prosthesis are at an increased risk of valve thrombosis and should be followed up every 2 weeks with meticulous monitoring of anti-coagulation levels. If low-molecular-weight heparins are used, anti Xa levels must be monitored. This patient was treated with sub-therapeutic doses of enoxaparin with inappropriate monitoring of the anti-coagulant used.

During the acute emergency, the patient was treated in the intensive care unit however there was a poor attempt made to diagnose the cause of cardiac failure. Again, she was treated with prophylactic rather than therapeutic doses of enoxaparin.

Case 2

A 40-year old P5G6 patient at 25 weeks gestation presented to a level 1 hospital with a 1-day history of dyspnoea and shortness of breath. She had one ante-natal visit at 20 weeks during this pregnancy where she had a normal blood pressure but was noted to be obese (weight – 110kg). On examination her blood pressure was 140/90, pulse 110, respiratory rate 40. On cardiovascular examination, she had a raised JVP, pedal oedema and bi-basal lung crepitations. She was admitted to hospital and treated with oral methyldopa and oxygen per face mask. A chest X-ray could not be done as there was no water in the hospital. Four-hours later the patient was restless, her blood pressure was 170/103 and pulse 116bpm. She was diagnosed with anxiety and bronchial asthma. She was treated with diazepam, nifedipine and methyldopa. An hour later the referring hospital was contacted but she demised in the ambulance en route. The cause of death was cardiac failure due to pulmonary oedema.

Comment

This patient had several identifiable risk factors prior to pregnancy, advanced maternal age, grande multiparity and maternal obesity. She should have been offered contraceptive advice after the last pregnancy. If she wanted another child, she should have been counselled about possible risk reduction (weight loss) prior to pregnancy.

This patient should not have been admitted to a level 1 facility but rather should have been given a stat dose of lasix and immediately transferred for specialist care.

Special investigations should have been performed to exclude a pulmonary embolus and myocardial infarction. She also needed an urgent echocardiogram to determine the cause of cardiac failure.

Case 3

A 27-year old primigravid patient presented to a level 2 hospital with an intra-uterine fetal demise at term. The patient's ante-natal record was not available for assessment however on presentation she had mild-moderate hypertertension (BP 140/90-100) for which she was treated with methyl-dopa. The patient underwent an induction of labour at the level 2 hospital and 3 days later delivered a macerated stillborn baby weighing 3,2kg. The obstetrical clinical record book does not show any record of urine dipstix testing or maternal blood glucose testing. The patient was discharged on the first post-partum day. The patient presented again 3 weeks later in respiratory distress and a clinical picture of diabetic keto-acidosis. She had raised blood glucose, ketonuria and arterial blood gas showed a pH of 6.7 and base excess of -31. She was admitted to the high care unit where an intravenous drip of Ringer's Lactate was given to her and she was treated with actrapid which was titrated according to a glucose sliding scale. The patient was seen again by an attending physician more than 24 hours later when she was found to be gasping but demised within minutes.

Comment

When a patient presents with an intra-uterine fetal demise, careful investigation of the mother, stillborn infant and placenta is required to try to establish the cause of fetal death. In this case, a random blood glucose, fasting blood glucose or HBA1C should have been done before the mother was discharged.

The correct diagnosis was made at the level 2 hospital but the severity of the condition was not recognised by the managing physician.

A patient with diabetic keto-acidosis should be managed by a specialist trained to manage the condition. The patient should have therefore been transferred to a tertiary hospital.

Although the patient was admitted to a high care ward, she was only seen twice over a 24-hour period by the treating physician. The care in the high care ward was sub-standard and only 1 blood gas was done. The patient did not receive the correct treatment for keto-acidosis as the prescribed treatment was appropriate for a patient with hyperglycemia only rather than for keto-acidosis.

Protocols should be used for the management of all emergency obstetric medical conditions. (See guideline for the management of diabetic ketoacidosis)

Case 4

A 19-year old primigravida was admitted with a 2-week history of focal seizures involving her left lower limb. She had been treated for tuberculosis and cryptococcal meningitis the in previous year. At that time she tested positive for HIV and her CD4 count was 48. There were no other findings noted on admission. A request for a CT scan was declined by the radiologist citing concern for the fetus. No abnormality was found on examination of cerebrospinal fluid. The patient underwent a termination of pregnancy and a CT scan was done post-delivery. The CT scan showed hypodense areas in the left and right parietal areas suggestive of an inflammatory process. Her focal seizures progressed to generalised convulsions which were unresponsive to all treatment. The patient demised 1 month after admission.

Comment

It is possible that many patients who presented with convulsive disorders did not suffer from a primary neurological condition but rather sequelae of HIV infection. This may be creating a false impression of an increase in proportion of maternal deaths due to medical and surgical conditions.

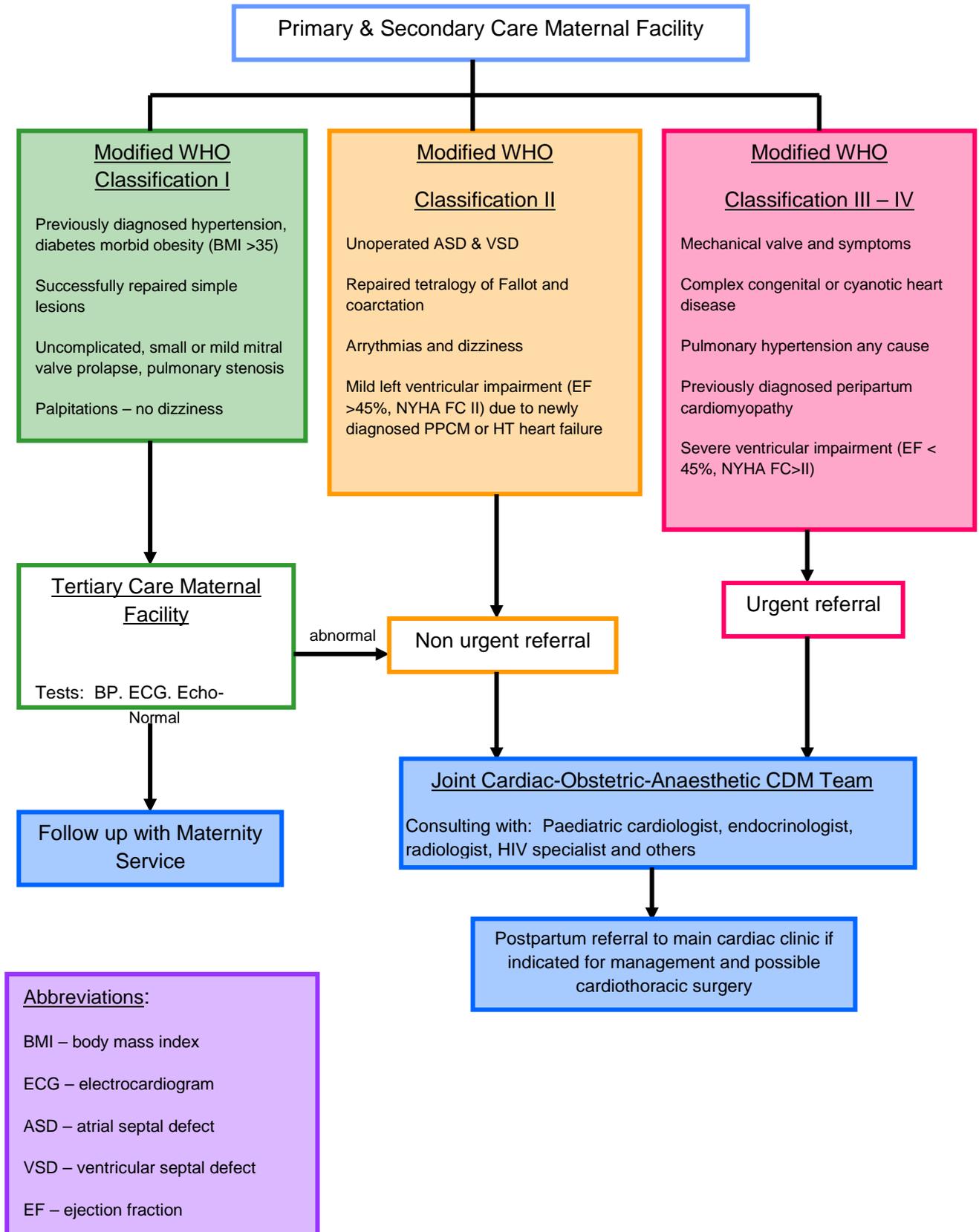
Conclusion

Medical and surgical conditions remain an important cause of maternal death in South Africa. Death due to peripartum cardiomyopathy was the most important cause of cardiac related maternal death.

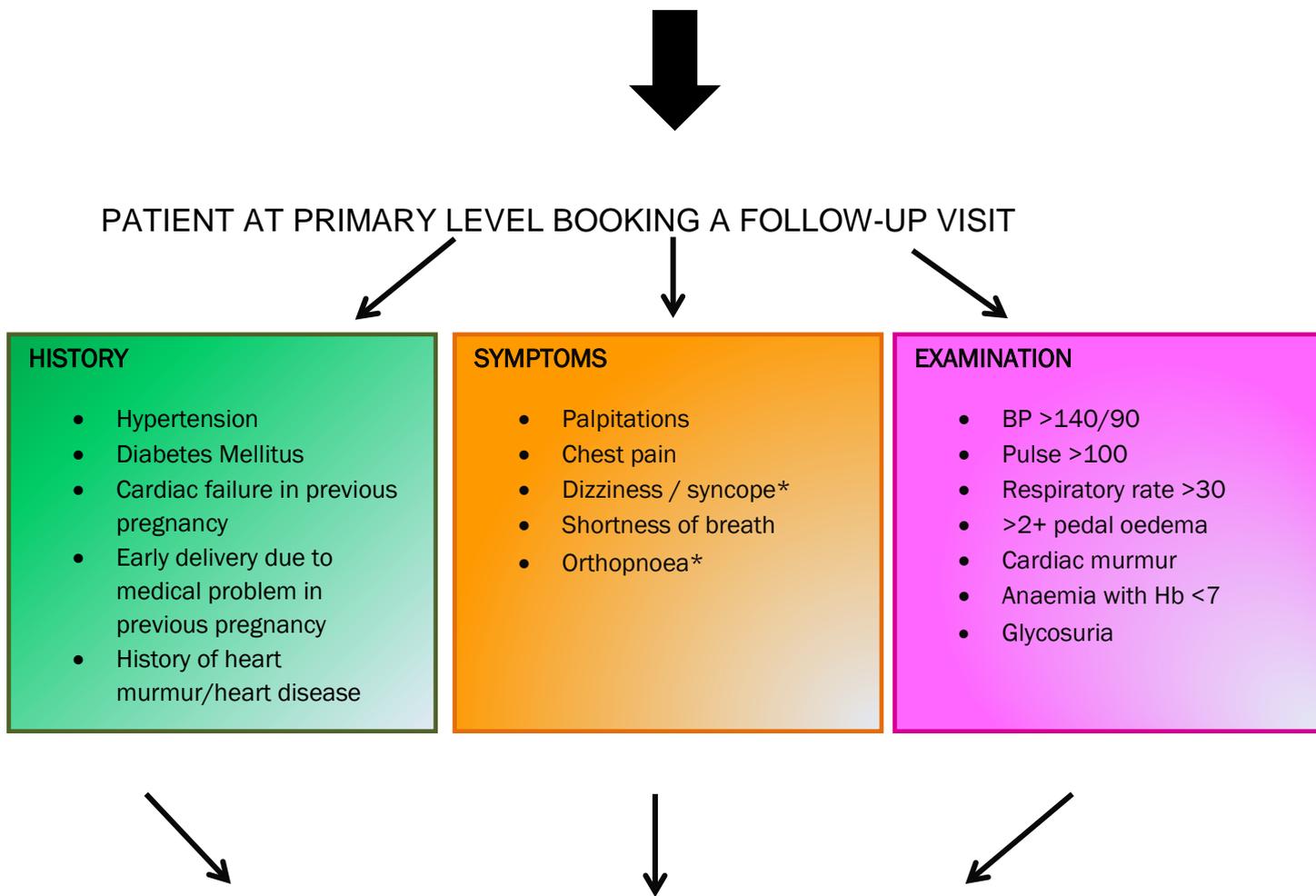
Unfortunately there was also a significant mis-classification of deaths related to respiratory and central nervous system disorders with several cases being complications of retroviral disease. Health care professionals should be trained to screen all pregnant patients for underlying medical or surgical disease. These patients should be managed at joint obstetric medicine clinics at a secondary to tertiary level hospital.

Algorithm 1

Referral Algorithm for suspected and previously known Cardiovascular Disease in Maternity (CDM)



RISK ASSESSMENT FOR REFERRAL TO MATERNAL MEDICAL CLINIC AT A SECONDARY LEVEL HOSPITAL



ACTION PLAN FOR REFERRAL OF PATIENTS WITH POSSIBLE MEDICAL PROBLEMS IN PREGNANCY

Patients with any of the above conditions should be referred to the obstetrician at a secondary level hospital. The obstetrician will decide on the degree of urgency and will liaise with the maternal medical clinic

Women presenting with difficulty in breathing, systolic blood pressure of <100mmHg, heart rate of >120 beats per minute or appearing cyanotic need to be transferred with an ambulance to a tertiary centre within 24 hours

Patients presenting with signs of fluid overload (pulmonary or pedal oedema or a raised JVP) should receive a bolus of Lasix 40mg IVI and oxygen per face mask prior to transfer

Primary care staff should have a low threshold for referring pregnant or recently delivered (up to 6 months post-partum) women especially those with cardiovascular risk factors (hypertension, diabetes), suspected rheumatic heart disease or symptoms such as shortness of breath or chest pain

*Definitions

Syncope – partial or complete loss of consciousness with interruption of awareness of oneself and ones surroundings.

Orthopnoea – difficulty in breathing that occurs while patient is lying down.

Algorithm 3

DIABETIC KETOACIDOSIS (DKA) – (modified American Diabetic Association protocol)

Diagnostic criteria and severity of DKA

	Mild	Moderate	Severe
Plasma glucose (mmol/L)	> 13.9	> 13.9	> 13.9
Arterial pH	7.25 – 7.30	7.00 – 7.24	< 7.00
Serum bicarbonate (mmol/L)	15 – 18	10 – 14.9	< 10
Urine ketones	Positive	Positive	Positive
Serum ketones	Positive	Positive	Positive
Anion gap	> 10	> 12	> 12
Sensorium	Alert	Alert/drowsy	Stupor/coma

Suggested frequencies of monitoring laboratory and bedside parameters

Monitoring parameter	Suggested frequency
Blood glucose	Hourly until glucose < 14mmol/l Thereafter 2-4 - hourly Once the patient is off an insulin infusion and eating: monitor glucose before each meal and 2 hours after)
Electrolyte and venous pH or bicarbonate	2 – 4 hourly
Urine or blood ketones	2 – 4 hourly
Blood urea and creatinine	6 – 8 hourly
Serum magnesium and phosphate	2 – 4 hourly

Calculating the fluid deficit:

Fluid deficit = (0.6 x body weight in kg) x (corrected Na ⁺ / 140)
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Management of DKA in Adults:

Timing	IV fluids	Insulin	Electrolytes
Admission	<p><i>0.9% NaCl:</i></p> <ul style="list-style-type: none"> 1 – 1.5l in the first hour (infusion rate: 15-20 ml/kg) 	<p><i>IV bolus:</i></p> <ul style="list-style-type: none"> Regular insulin 0.1-0.15 IU/kg followed by a continuous infusion at a rate of 0.1 IU/kg per hour <p><i>Usually prepared as follows:</i></p> <ul style="list-style-type: none"> 20 IU in 200ml 0.9% saline (0.1IU/ml) 	<p><i>Bicarbonate (Controversial):</i></p> <ul style="list-style-type: none"> If pH <7.0 50mmol/l NaHCO₃ in 200 ml of 0.45% NaCl over one hour If pH <6.9: 100mmol/l NaHCO₃ in 400ml 0.45% saline over one hour This can be repeated 2-hourly
After 1 hour	<p><i>Reassess:</i></p> <ul style="list-style-type: none"> Hydration status hourly – sNa⁺ concentration <p><i>If sNa⁺ is normal or low:</i></p> <ul style="list-style-type: none"> 0.9% NaCl 250-500ml/h (4 -14ml/kg depending on hydration status) <p><i>If sNa⁺ is elevated:</i></p> <ul style="list-style-type: none"> change to 0.45% NaCl <p>Replace half the fluid deficit in the first 12 hours</p> <p>(serum osmolality should not change >0.3 osmol/kg)</p>	<p><i>Reassess blood glucose:</i></p> <ul style="list-style-type: none"> Increase the insulin infusion rate if the blood glucose concentration does not decrease by 3-4 mmol/h <p><i>Adjust infusion rate 2-hourly based on blood glucose:</i></p> <ul style="list-style-type: none"> sGluc <5.6 mmol/L - decrease by 10ml/h; give 25ml of 50% dextrose IV sGluc 5.6-8.9mmol/l - decrease by 10ml/h (1IU/hr) sGluc 9-12.2 mmol/l - no change sGluc 12.3-15.6mmol/l -increase by 10ml/h (1IU/h) sGluc >15.6mmol/l -increase by 10ml/h; give a bolus of regular insulin of 8U IV 	<p><i>Potassium:</i></p> <p>Always check the K⁺ concentration before commencing with insulin administration.</p> <ul style="list-style-type: none"> If sK⁺ >5.0mmol/l - no K⁺ supplement but check K⁺ 2-hourly If sK⁺ 3.0-5.0 mmol/l - add 20mmol in each litre of IV fluid in order to maintain the sK⁺ between 4.0-5.0mmol/l If sK⁺ <3.0mmol/l - add 40mmol to the initial IV fluid (withhold insulin until K⁺ >3.0mmol/l) <p><i>Phosphate:</i></p>
Blood glucose <14mmol/l	<p>Change to 5% dextrose or 5% dextrose in 0.45% NaCl solution</p>	<p><i>When the patient is able to eat:</i></p> <ul style="list-style-type: none"> meal-related boluses of regular insulin in addition to the IV insulin infusion 	<ul style="list-style-type: none"> Replacement only necessary if PO⁴ is <0.33mmol/l. Replace with potassium phosphate solution IV 14mmol (10ml) in 1l rehydration fluid

11: Provincial Reports

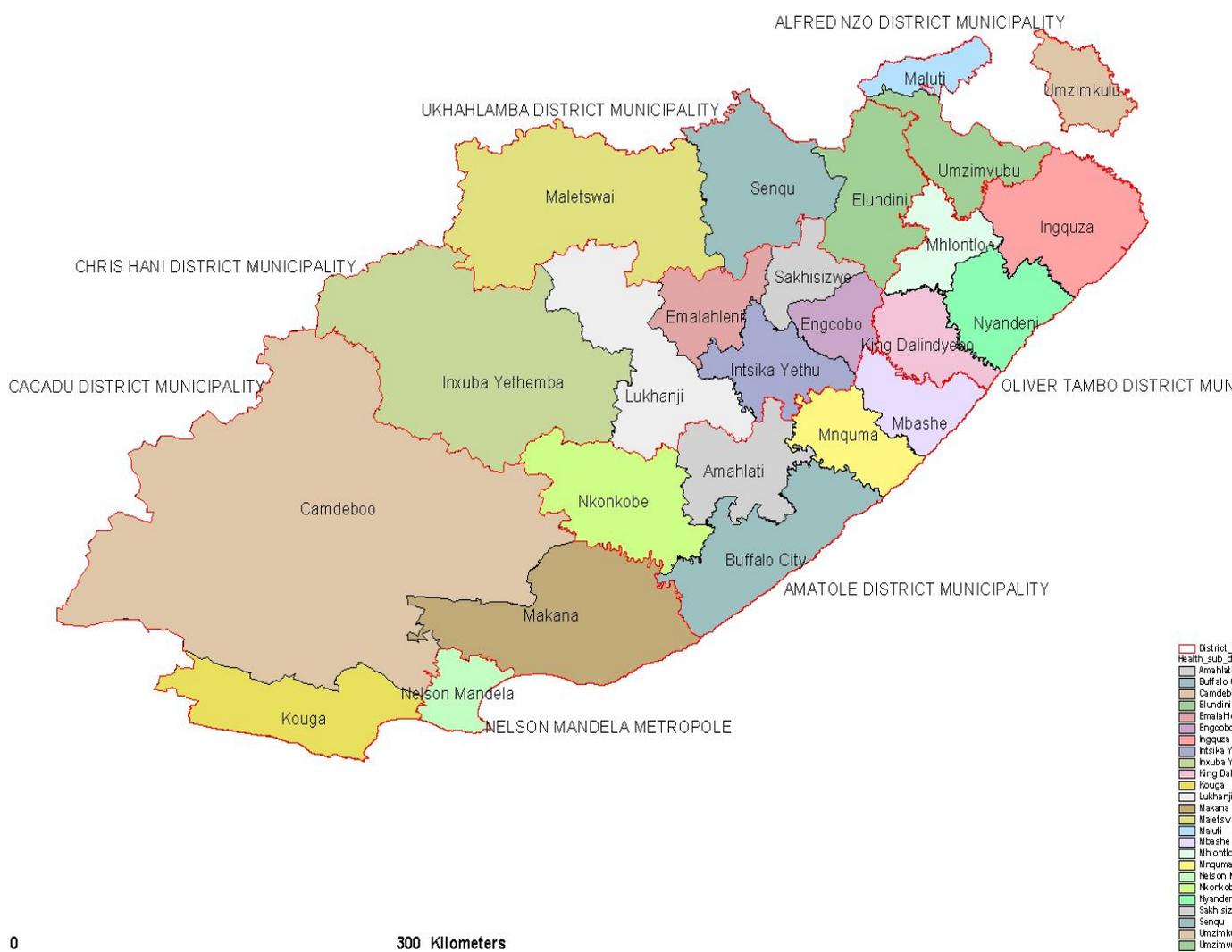
Chapter 11.1: Eastern Cape

Introduction

The Eastern Cape is the third populous province with the total population of 6,562,053 (Stats SA, Nov 2012).Province is divided into 6 Districts and 2 Metro. It has one medical school (Walter Sisulu University) based in Mthatha and three tertiary complexes, in Mthatha, East London and Port Elizabeth. The province also has 2 level 2 hospitals, 65 District hospitals, 37 Community health centres and 806 clinics. Has increased level of poverty and unemployment. There is also underdeveloped infrastructure. Conducting about **118,728** deliveries in all health facilities.



Eastern Cape Province - District Municipalities and Health Sub-districts



Deaths Reported

Eastern Cape reported in total 593 deaths for the triennium. Table 1 shows the cases reported per year.

The following series of Tables and Statistics are self-explanatory with further comment in the discussion.

Table 11.1.1: Cases reported per year

Year	Number reported
1998	56
1999	95
2000	120
2001	103
2002	113
2003	112
2004	145
2005	149
2006	154
2007	160
2008	215
2009	263
2010	230
2011	210
2012	183
2013	200

The 593 deaths in this triennial report mark a decrease of deaths from the 708 of the preceding triennium. The decrease is probably related to a decrease in deaths due to HIV & AIDS.

Demographic data

Table 11.1.2: Comparison of age and parity in the two triennial reports: 2011-2013 and 2008- 2010

Age	2011--2013		2008- 2010		Parity	2011- 2013		2008-2010	
	n	%	n	%		n	%	n	%
<20	64	10.8	86	12.1	0	200	33.7	253	35.7
20 – 24	136	22.9	151	21.3	1	151	25.5	163	23
25 - 29	131	22.1	162	22.9	2	109	18.4	127	17.9
30 - 34	117	19.7	153	21.6	3	70	11.8	61	8.6
35 - 39	99	16.7	104	14.7	4	31	5.2	50	7.1
40 - 44	36	6.1	50	7.1	5	16	2.7	20	2.8
45+	10	1.7	1	0.1	6+	8	1.3	15	2.1
Unknown	0		1	0.1	Unknown	8	1.3	19	2.7

There is a decrease in the percentage of deaths in all age groups except 35-39 where there's a 2% increase and the 45+ group where there is a tenfold increase in the number and 0.7 % increase percentage wise. The tenfold increase in women 45 years and falling pregnant is a surprise and worrying. It may be related that women are career driven and they defer pregnancy for later in favour of their careers .This may pose a problem as pregnancy and advanced age don't go well together.

Parity: There is a 2% decrease in the para 0 (53 less in numbers).There is an increase in para 1,2 &3 and decrease in para 4,5.& 6. It was a surprise and a worry that we still have women para 6+ although there is a decrease from this category in this triennium.

Table 11.1.3: Comparison of levels of care where maternal death occurred between 2011-20103 and 2008-2010

<u>Level of care</u>	2011-2013		2008 -2010	
	<u>n</u>	<u>%</u>	<u>N</u>	<u>%</u>
Home	2	0.3	2	0.3
Health Care Centre	17	2.9	8	1.1
Level 1 Hospital	223	37.6	268	37.9
Level 2 Hospital	53	8.9	75	10.6
Level 3 Hospital	292	49.2	344	48.6
Private Hospital	6	1.10	11	1.6

The 0.3% deaths at home are similar to the 0.3% of the provinces previous triennial report. This may indicate that there are few deaths occurring at home or that deaths at home do not get reported or both. Which one of these possibilities it is, not clear as we do not have a method for collecting that data.

There is a significant drop from 10.6% to 8.9% deaths in level 2 hospitals and a corresponding increase in deaths at level 3 institutions from 48,6% to 49.2%. We hope that this is related to better recognition at level 2 hospitals of patients that need to be referred to a higher level of care.

Table 11.1.4: Comparison of HIV status between 2011-2013 and 2008- 2010

<u>HIV status</u>	2011-2013		2008-2010	
	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>
Negative	210	35.4	196	27.7
Positive	77	13.0	113	16
Declined testing	1	1.2	4	0.6
AIDS not on HAART	97	16.4	172	24.3
AIDS on HAART	153	25.8	115	16.2
Unknown	55	9.3	108	15.3

HIV/AIDS

In this triennial report only one patient 1.2% was reported to have declined testing. There is also a marked decrease in the proportion of women with unknown HIV status from 15.3% to 9.3% . This is in keeping with our perception that HIV testing has become universally acceptable. It has become rare to find any pregnant woman declining testing. The accelerated program of nurse initiated treatment is probably responsible for reduction from 24.3% to 16.4% with HIV & AIDS not on HAART.

Table 11.1.5: Antenatal care attendance between 2011-2013 and 2008-2010

<u>Antenatal care</u>	2011-2013		2008-2010	
	<u>n</u>	<u>%</u>	<u>N</u>	<u>%</u>
Received antenatal care	434	73.2	501	70.8
No antenatal care	125	21.1	125	17.7
Unknown	34	5.7	82	12

There is an increase in the number of women who received Antenatal care from 70% to 73.2%

Table 11.1.6: Comparison of method of delivery of maternal deaths between 2011-2013 and 2008-2010

<u>Route of delivery</u>	2011-2013		2008-2010	
	<u>n</u>	<u>%</u>	<u>N</u>	<u>%</u>
Vaginal	200	33.7	299	42.2
Assisted	10	1.7	11	1.6
Caesarean section	174	29.3	171	24.2
Undelivered	167	28.2	180	25.4
Not applicable	42	7.1	47	6.6

The percentage of patients delivering by Caesarean Section (C/S) has increased to (29.3%) from 24.2% of the the previous triennium. 28.2%.of the patients died undelivered compared to 25.4% in the last triennium.

Table 11.1.7: Pregnancy outcome, comparison between 2011-2013 and 2008-2011.

Pregnancy outcome	2011-2013		2008-2010	
	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>
Liveborn	260	43.8	303	42.8
Stillborn	102	17.2	134	18.9
Neonatal death	20	3.4	40	5.6
Miscarriage	37	6.2	39	5.5
Ectopic pregnancy	4	0.7	8	1.1
Undelivered	170	28.7	184	26%

43.8% liveborn marks an improvement for the 42.8% of the previous report. The higher number of undelivered women 28.7% compared to 26% probably means the 2011-2013 women were sicker. There is also a high perinatal mortality associated with maternal mortality.

Table 11.1.8: Comparison of anaesthesia between 2011-2013 – and 2008-2010

Anaesthetic performed at level	2011-2013		2008-2010	
	<u>n</u>	<u>% of anaesthetic performed</u>	<u>N</u>	<u>% of anaesthetic performed</u>
Health care centre	0		1	0.5
Level 1 Hospital	62	30.5	47	25
Level 2 Hospital	19	9.4	22	11.7
Level 3 Hospital	111	54.7	105	55.9
Private Hospital	5	2.5	7	3.7

There's a worrying rise in anaesthetic deaths at level 1 hospitals from 25% to 30.5%, this figure probably indicates that level 1 hospitals. are undertaking more complicated cases inadvisedly. There is a minor decrease at level 3.This seems to indicate that more effort is indicated in training doctors in anaesthesia at this level of care.

Primary cause of death, Final, and contributory causes of death

Table 11.1.9: A comparison of primary obstetric causes of death between 2011-2013 and 2008-2010

	2011-2013		2008-2010	
	n	%	n	%
DIRECT				
Ectopic pregnancy	6	1.0	5	0.7
- Less than 20 weeks	5	0.9	5	0.7
- More than 20 wks	1	0.2	-	-
Miscarriage	9	1.6	10	1.4
Septic miscarriage	6	1.0	6	0.8
Haemorrhage (non-traumatic)	1	0.2	3	0.4
Uterine trauma	2	0.3		
GTD	-	-	1	0.1
Hyperemesis gravidarum	0		0	0
Pregnancy-related sepsis	28	4.8	40	5.6
Chorioamnionitis with ruptured membranes	1	0.2	1	0.1
Chorioamnionitis without ruptured membranes	-	-	1	0.1
Puerperal sepsis after NVD	14	2.4	19	2.7
Puerperal sepsis after Caesarean section	12	2.1	19	2.7
Bowel trauma at caesarean section	1	0.2	-	-
Obstetric haemorrhage	88	15.2	102	14.4
- Abruptio with hypertension	4	0.7	7	1
- Abruptio without hypertension	11	1.9	4	0.6
- Placenta praevia	2	0.3	2	0.3
- Other APH not specified	3	0.5	1	0.1
- Ruptured uterus with previous c/s	2	0.3	8	1.1
- Ruptured uterus without previous c/s	9	1.6	14	2
- Retained placenta	3	0.5	12	1.7
- Morbidly adherent placenta	1	0.2	4	0.6
- Uterine atony	8	1.0	4	0.6
- Cervical trauma	4	0.7	1	0.1
- Bleeding during c/s	7	1.2		
- Bleeding after Caesarean section	20	3.5	22	3.1
- Other PPH not specified	13	2.2	23	3.2
Hypertension	106	18.3	107	15.1
- Chronic hypertension	3	0.5	5	0.7
- Proteinuric hypertension	25	4.3	29	4.1
- Eclampsia	67	11.6	56	7.9
- HELLP	10	1.7	14	2
- Liver rupture	1	0.2	2	0.3
- Acute fatty liver			1	0.1
Anaesthetic complications	15	2.6	13	1.8
- General anaesthetic	1	0.2	3	0.4
- Spinal anaesthetic	14	2.4	10	1.4
Embolism	12	2.1	17	2.4
- Pulmonary embolism	12	2.1	17	2.4
Acute collapse - cause unknown	0		23	3.2

	2011-2013		2008-2010	
	n	%	n	%
INDIRECT				
Non-pregnancy-related infections	199	34.4	279	39.4
- PCP pneumonia	22	3.8	40	5.6
- Other pneumonia	37	6.4	42	5.9
- TB	58	10.0	99	14
- Appendicitis	-	-	1	0.1
- Endocarditis	1	0.2	-	-
- UTI	1	0.2	-	-
- Cryptococcal meningitis	9	1.6	8	1.1
- Other meningitis	10	1.7	25	3.5
- Kaposi's sarcoma	6	1.0	4	0.6
- Hepatitis	2	0.3	2	0.3
- Gastroenteritis	9	1.6	14	2
- Wasting syndrome	23	4.0	19	2.7
- Complications of antiretroviral therapy	9	1.6	5	0.7
- Other	12	2.1	20	2.8
Medical and surgical disorders	76	13.1	81	11.4
- Cardiac disease	27	4.7	31	4.4
- Endocrine	-	-	1	0.1
- GIT	2	0.3	4	0.6
- CNS	4	0.7	6	0.8
- Re-spiratory	21	3.6	24	3.4
- Haematological	1	0.2	2	0.3
- Skeletal	1	0.2	-	-
- Psychiatric	1	0.2	-	-
- Genito-urinary	-	-	1	0.1
- Neoplasm	-	-	1	0.1
- Other	19	3.3	11	1.6
- unknown	-	-	-	-
Coincidental cause	15	2.6	16	2.3
- MVA	4	0.7	2	0.3
- Assault	1	0.2	3	0.4
- Herbal medicine	1	0.2	4	0.6
- Other	9	1.6	7	1

Ectopic pregnancy

At less than 20 weeks gestation there was a 0.3% increase and at below 20 weeks gestation there were no deaths in 2008-2010 and 1 death in 2011-2013 triennium.

Although few patients died from ectopic pregnancy no women should die from ectopic pregnancy..

Miscarriage

Percentage wise there was a 0.2% rise in 2011-2013 but a drop from 10 to 9 in numbers. The low numbers of deaths associated with miscarriage are as a result of the availability of CTOP services. It is reasonable to assume that full coverage of CTOP services would eliminate deaths from this cause.

Pregnancy related sepsis

There was a decrease from 5.6% to 4.8%. Chorioamnitis with intact membranes is rare. There was a decrease in puerperal sepsis both after vaginal delivery as well as following C/S. This may relate to a more widespread use of prophylactic antibiotics at C/S. There was only 1 death related to bowel trauma a happy surprise given the rise in C/S rate.

Table 10 : Final and Contributory Causes Of deaths comparison between 2011-2013 and 2008-2010

	2011-2013		2008-2010	
	N	%	N	%
Circulatory system	146	24.6	218	30.7
- Hypovolaemic shock	100	16.9	133	18.7
- Septic shock	46	7.8	85	12
Respiratory failure	179	30.2	235	33.1
- Respiratory failure	179	30.2	235	33.1
Cardiac failure	101	17	99	13.9
- Pulmonary oedema	56	9.4	66	9.3
- Cardiac arrest	45	7.6	33	4.6
Embolism	18	3	18	2.5
- Acute collapse due to embolism	18	3	18	2.5
Renal failure	27	4.6	29	4.1
Liver failure	16	2.7	33	4.6
Cerebral complications	101	17	112	15.8
- Intracranial haemorrhage	41	6.9	25	3.5
- Cerebral oedema resulting in coning	10	1.7	14	2
- Meningitis	21	3.5	38	5.4
- Cerebral emboli	3	0.5	4	0.6
- Brain death following hypoxic event	9	1.5	16	2.3
- Unspecified	17	2.9	15	2.1
Metabolic	6	1	9	1.3
- Maternal ketoacidosis	1	0.2	6	0.8
- Electrolyte imbalance	3	0.5	2	0.3
- Other	2	0.3	1	0.1
Haematological	37	6.2	57	8
- DIC	21	3.5	31	4.4
- Severe anaemia	16	2.7	26	3.7
Immune system	130	21.9	217	30.6
- Immune system failure	130	21.9	217	30.6
Unknown	54	9.1	67	9.4
- Home death	19	3.2	15	2.1
- Unknown	35	5.9	52	7.3
Other	6	1	16	2.3

Obstetric haemorrhage (88) 15.2% increased from (102 14.4%) last triennial.

There was an increase in the % of deaths from obstetric haemorrhage in the triennium 2011-2013 compared to 2008-2010 though numbers have decreased from 102 to 88. The major contributors are deaths associated with C/S. This shows the importance of close adherence to the guidelines of postoperative care especially in the first few hours post C/S.

Ruptured uterus is the second commonest contributor to the deaths. The problem remains the diagnosis of ruptured uterus or rather misdiagnosis of the condition despite efforts to improve the problem. The four (4) deaths attributed to cervical trauma could be cases of misdiagnosed ruptured uterus. Misoprostol is still used injudiciously in induction of labour especially in cases of intrauterine fetal deaths leading to ruptured uterus.

Hypertension (106 (18.3%))

18.3% marks an increase from 15.1% of the previous report. This is the second commonest cause of Maternal mortality in the Eastern Cape. Eclampsia remains the major cause of death and this may be because high blood pressure is not treated aggressively enough. More widespread use of calcium supplementation preferably calcium carbonate (not calcium gluconate) might help reduce the incidence of pregnancy hypertension.

Embolism (3% from 2.5%)

There is a slight increase in deaths from this cause. Prophylaxis should always be remembered in patients with predisposing factors. Pregnancy itself not only in the puerperium but also in the early trimesters is thrombogenic.

NPRI (199) 34.4%

This is down from 39.4%. The majority of the patients die from TB and Pneumonia most of which are PCP. This emphasises the importance of treatment and Prophylaxis against PTB and PCP. The decrease in deaths is probably related to the use of the fixed dose combination tablet. Less drug related deaths have also contributed to the decrease in deaths

Pre-existing medical and surgical conditions (76) 13.1% from (81) 11.4%

Cardiac disease is the major contributor in this category accounting for 27 Of the 76 deaths. This is a cause for concern as cardiac disease is amenable to treatment if referred timeously to the appropriate level of care. Failure to do this points to poor history taken at Ante Natal Care, significant number of the cases are due to cardiomyopathy which has a high mortality rate. Cardiomyopathy is associated with pregnancy hypertension in many cases which shows the importance of preventing hypertension in pregnancy.

Table 11.1.11: Avoidable factors, missed opportunities and substandard care

	2011- 2013		20008-2010	
	n	%	n	%
Patient orientated problems	269	45.4		43.6
Administrative Problems	227	38.3		30.4
Medical care at :Primary level	221	37.3		30.4
:Secondary level	38	6.4		6.2
:Tertiary level	87	14.7		15.4
Resuscitation Problems	221	37.3		30.2
Clearly avoidable cases	133	22.4		20.6

The above factors remained at a high level as in previous reports and in fact increased to 45.4% with regard to patient oriented problems. Similarly administrative problems increased from 30.4% to 38.3%. Substandard care improved marginally at level 3. There was deterioration in medical care at all levels of care in the category of clearly avoidable deaths. There was deterioration in the area of resuscitation which increased (from 30.2% to 37.3%)

Table 11.1.12: Avoidable factors, missed opportunities and substandard care with respect to Patient orientated problems for all cases

<i>Patient orientated</i> <u>Description</u>	2011-2013		2008-2010	
	<u>N</u>	<u>% Of deaths</u>	<u>n</u>	<u>% of deaths</u>
Lack of information	57	9.6	72	10.2
No avoidable factor	274	46.2	330	46.6
No antenatal care	98	16.5	94	13.3
Infrequent antenatal care	30	5.1	43	6.1
Delay in accessing medical help	130	21.9	163	23
Declined medication/surgery/advice	25	4.2	21	3
Family problem	1	0.2	1	0.1
Community problem	0		0	0
Unsafe abortion	2	0.3	1	0.1
Other	39	6.6	23	3.2

There was an improvement in “**patient oriented problems**” which decreased except unsafe abortion which rose

by 0.2% .There is deterioration in NO ANC ,declined medication and unsafe abortion but some improvement in other aspects.

Table 11.1.13: Avoidable factors, missed opportunities and substandard care with respect to administrative problems for all cases

<i>Administrative</i>	2011-2013		2008- 2010	
	<i>n</i>	%	<i>n</i>	%
Lack of information	31	5.2	65	9.2
No avoidable factor	336	56.7	429	60.6
Transport problem: Home to institution	21	3.5	13	1.8
Transport problem: Institution to institution	44	7.4	42	5.9
Lack of accessibility: Barriers to entry	5	0.8	2	0.3
Lack of accessibility: Other	4	0.7	4	0.6
Delay initiating critical care (Overburdened service)	29	4.9	22	3.1
Lack of health care facilities: ICU	20	3.4	27	3.8
Lack of health care facilities: Blood/blood products	19	3.2	17	2.4
Lack of health care facilities: Other	11	1.9	16	2.3
Lack of appropriately trained staff: Doctors	55	9.3	41	5.8
Lack of appropriately trained staff: Nurses	32	5.4	29	4.1
Communication problems: Technical	1	0.2	7	1
Communication problems: Interpersonal	2	0.3	3	0.4
Other	55	9.3	73	10.3

In the Administrative factor there was deterioration in most areas. In only five (5) of the fifteen (15) areas was there improvement administratively the Province has not done well in this triennium.

Table 11.1.14: Health Worker orientated problems per level of care.

	2011-2013			2008-2010		
	Levels 1	2	3	Levels 1	2	3
Lack of information	2.5	0.5	1.0	4.4	0.4	0.7
No avoidable factor	60.9	93.4	94.5	65.8	93.4	83.9
Initial assessment	3.9	0.7	0.5	2.3	0.1	0.3
Problem with recognition/diagnosis	15.5	2.0	6.1	9.6	2.1	4.1
Delay in referring the patient	12.5	1.3	0.2	7.8	0.4	0.1
Managed at inappropriate level	10.8	0.8	0	5.4	0.4	0
Incorrect management/diagnosis	4.6	0.3	1.5	3.4	0.4	0.7
Substandard management/correct diagnosis	11.6	3.0	5.7	13.3	3.7-10	9.9
Not monitored /infrequently monitored	3.4	0.8	2.2	2.7	0.7	0.7
Prolonged abnormal monitoring with no action	6.1	1.2	3.5	2.5	0.3	1.8

In only three(3) of the fields was there improvement , in other seven (7) fields there was deterioration including problem recognition at level 3 which is disappointing.

Table 11.1.15: Health Worker Orientated Resuscitation Problems in all cases

	<i>2011-2013</i>		<i>2008-2010</i>	
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
Lack of information	49	8.3	48	6.8
No avoidable factor	323	54.5	448	63.3
Airway problems	8	1.3	7	1
Breathing problems	16	2.7	23	3.2
Circulation problems	20	3.4	32	4.5
Drug problems	6	1.0	2	0.3
Investigation problems	1	0.2	1	0.1
Monitoring problems	4	0.7	4	0.6
Resuscitation not attempted	174	29.3	150	21.2

There was deterioration in all areas in “circulation problems” and breathing problems. There seems to be a high % of maternal deaths where resuscitation was not attempted which might be related to the nature of mortality.

Table 16: Avoidability of deaths comparison between 2011-2013 and 2008-2010

	<i>2011-2013</i>		<i>2008-2010</i>	
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
No suboptimal care	239	40.3	139	45.1
Suboptimal care, different management would have made no difference to the outcome	47	7.9	52	7.3
Suboptimal care, different management might have made a difference to the outcome	174	29.3	191	27
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	133	22.4	146	20.6

There was deterioration in all fields in this section in percent terms.

Summary

There is a decrease in maternal deaths from 708 in the previous triennium to 593 in this triennium. The decrease is probably due to a decrease in deaths caused by HIV& AIDS although HIV&AIDS remains the major contributor to maternal deaths.

Deaths from HIV& AIDS have decreased and this is probably related to the fixed dose combination. We still need to strengthen the prophylaxis and treatment of opportunistic infections. In the 2013 deaths we noted that most preventable factors were patient related. This indicates that community mobilisation is of utmost importance in this regard.

Hiv & AIDS has played a major role in puerperal sepsis. We believe using therapeutic instead of prophylactic doses of antibiotics at caesarean section may be advisable at inpatients with HIV/AIDS.

Hypertensive disease of pregnancy is the second cause of deaths in our Province and remains the major direct cause of death. This may be related to the high incidence of the disease. Prevention of the disease should be scaled up by the reliable availability in our clinics of calcium supplementation. In this regard calcium carbonate is the better drug compared calcium gluconate.

Obstetric haemorrhage remains the second direct cause of death. Caesarean section is the major cause especially

postoperatively. Substantial reduction in this regard can be achieved by strict adherence to postoperative routine.

Cardiomyopathy has emerged as the major contributor to the category of pre-existing medical conditions. A major associated factor is PIH and therefore prevention of PIH may help mitigate this problem. Cardiomyopathy has a high mortality.

Recommendations

1. DEATHS DUE TO HIV/AIDS
Community mobilisation by the ward based teams should be strengthened. In the 2013 HV/AIDS deaths 75% of the preventable factors were patient related e.g late booking and defaulting treatment. Testing and treating opportunistic infections should also be strengthened
2. DEATHS DUE TO HYPERTENSION
 - a. Ensure regular availability of Calcium supplementation may decrease the occurrence of hypertensive deaths.
 - b. Early booking so that supplementation is initiated as early as possible in pregnancy. For pregnant women with low dietary calcium intake in the second half pregnancy, Calcium 1.5g daily provided there are sufficient resources to supply all women at this dosage. If insufficient resources to provide full coverage at 1.5g daily, use calcium 500mg daily.
 - c. Ensure that BP is taken at all visits. In this regard appropriate preferably non-electronic equipment should be utilised.
 - d. Ensure urine is tested for protein at all ANC visits. In this respect avoid stock-outs of test strips.
 - e. As a province where pregnancy hypertension is still very high, and the No.1 direct cause
 - f. maternal mortality we suggest a review of the length of the intervals between ANC visits with a view to reducing the intervals in later pregnancy as hypertension related deaths tend to occur during these intervals.
 - g. Screening in the 1st trimester would be the best way to assess, diagnose and manage problems and reduce maternal morbidity and mortality. This can be achieved with the use biochemical tests such PIGF (Placental Growth factor) and PAP-A (Pregnancy Associated Protein –A) and early ultrasound ,uterine artery, doppler studies. These tests are said to be able to detect up to 90% of cases destined to develop Pre-Eclampsia in later pregnancy
3. Regarding obstetric haemorrhage
 - a. Strengthen C/S skills which should include inreach activities and strict Post C/S monitoring.
 - b. Use of the early warning charts
 - c. Full coverage of ESMOE and especially EOST
 - d. Strict applications of post-op guidelines.
 - e. Therapeutic doses of antibiotics for C/S done for obstructed and labour, prolonged ruptured membranes and immuno compromised patients.
4. Pre-existing medical & surgical conditions. This category remains a significant contributor to maternal deaths. Good history taking at ANC is essential in the identification of these patients so that timeously these patients can be referred for appropriate ante natal care, delivery and post natal care.
5. Pregnancy related sepsis
 - a. Availability of choice for Termination of Pregnancy has almost eliminated deaths from septic abortion. Therefore accessibility to these facilities need to be maintained and in locations where they are not available these facilities should be established. This might also reduce the proliferation of illicit abortion activities and reduce the incidence of illicitly induced early preterm labour patients we now see in the province .
 - b. Therapeutic doses of antibiotics for
 1. prolonged / obstructed labour
 2. immuno-compromised patients are advised
 3. Meticulous haemostasis especially in Caesarean Section for obstructed labour will also help reduce post-op sepsis.

6. Establishing from the current district hospitals, comprehensive emergency obstetric centres (CEOCs) by clustering hospitals would go a long way towards reducing deaths from C/S complications.
7. Interfacility obstetric transport is an essential part of CEOCs that has been shown substantially to reduce maternal deaths.
8. Family planning is central in the reduction of avoidable maternal deaths. In this regard proficiency in the provision of all forms of family planning is of central importance e.g.
 - a. LARC and emergency contraception especially for the adolescents.
 - b. Puerperal Tubal Ligation for the high parity patients following delivery before discharge.
 - c. Accessibility of interval Tubal Ligation for people needing or seeking this service.
9. All patients with indications for thrombophylaxis during pregnancy or during the puerperium should be looked out for, and dealt with appropriately.

Chapter 11.2. Free State

Abstract

The Free State is the eighth largest province and has a mix of urban, peri-urban and rural population. All districts in the province was previously listed among the top ten worst performing districts in the country.

During the triennium 2011-2013 a total of 293 maternal deaths were notified in the Free State compared to 428 in the previous triennium, a 31.5 % decrease in the numbers of deaths notified compared to the previous triennium. A total of 281 were included on the database after assessment by maternal death assessors. The institutional maternal mortality for live births in public health facilities as updated on the district health information system is 206.9/100000 live births compared to 287.6 in the previous triennium. If the number of deaths entered onto the assessment system is used, the MMR is 198.4/100,000 live births.

The major primary causes of death include non-pregnancy related infections, hypertension, obstetric haemorrhage and medical and surgical conditions in pregnancy. Respiratory failure, cardiovascular collapse and neurological conditions are the major final cause of death.

Improvement in the inter-facility transport, training of obstetric emergencies and ensuring surgery at facilities with appropriate capacity assisted in the reduction of maternal deaths.

The large number of cases with avoidable factors remains a concern within the province and systems need to be developed to reduce unnecessary maternal deaths. This may include restructuring of services.

Introduction

The Free State is the eighth largest province and has a mix of urban, peri-urban and rural population. Geographically it is divided into five districts with and is supported currently by the following health institutions: one level 3 (tertiary) hospital, five secondary hospitals, 24 district hospitals, 10 community health centres and 225 clinics. In addition to the provincial formal structures, specialist services also receive formal and informal referrals across boarders and boundaries from adjacent provinces (mainly from the Northern Cape and Eastern Cape) and Lesotho.

Maternal deaths reporting systems are generally well developed in the province. Since the previous triennium workshops were held to discuss the key recommendations and a business plan for effective management was introduced.

The province introduced a provincial specialist unit and district clinical specialist teams during 2012 assisted in improving maternal care. During this triennium there was aggressive training of doctors and nurses on the essential steps in the management of obstetric emergencies (ESMOE) during 2012 and 2013. In 2012 the province introduced dedicated inter-facility transport that resulted in reduction of maternal deaths. Maternal and women's health technical advisory committees were established in all districts and at provincial level. Reducing maternal deaths remains a priority in the province with full support from the provincial executive management.

Deaths reported

During the triennium 2011-2013 a total of 293 maternal deaths were notified in the Free State compared to 428 in the previous triennium, a 31.5 % decrease in the numbers of deaths notified

compared to the previous triennium. A total of 281 were included on the database after assessment by maternal death assessors. The 12 cases not included was as a result of file being forwarded to the national department before assessment and failure to receive copies of the files in time. This decrease is obvious since 2012. At the end of 2011 a total of 47 ambulances were introduced in the province to improve inter-facility transport. The monthly mortality correlated with the inter-facility call dispatch intervals and it is most likely that the improved transport to appropriate facilities resulted in the reduction in mortality. Table xxx.1 stratifies the numbers of maternal deaths notified per annum since the beginning of the reporting system. The live births recorded include all live births in a facility, and since 2005, the number of live births outside a health facility was also documented. The number of deliveries in the private sector is not known at this stage. The institutional mortality rate includes all deaths (including home deaths and those notified from the private sector) per 100,000 live births in the public sector facilities. The total mortality rate is calculated on all live births within and outside public facilities.

Table 11.2..1. Maternal deaths notified in the province

Year	Deaths Notified	Born alive before arrival at facility	Live birth in facility	Total live births	iMMR	tMMR
2000	96					
2001	119		38859		306.2	
2002	100		47546		210.3	
2003	171		50190		340.7	
2004	161		55939		287.8	
2005	150	2322	51551	53873	291.0	278.4
2006	170	5232	51374	56606	330.9	300.3
2007	164	5267	51868	57135	316.2	287.0
2008	137	5781	52125	57906	262.8	236.6
2009	171	5375	48941	54316	349.4	314.8
2010	120	4959	47738	52697	251.4	227.7
2011	128	4527	47136	51663	271.6	247.8
2012	77	3989	48411	52400	159.1	146.9
2013	88	3724	46044	49768	191.1	176.8

Delivery data from 2005-2012 on DHIS June 2014. Data 2014 DHIS updated corrected data 6 June 2014

The province experienced some problems with data capturing during 2013. The quality of data was questioned and processes changed to capture data on a more regular basis. This resulted in data gaps in delivery statistics that was present at the time the information for the saving mothers report was analysed. This was corrected and updated on the district health information system. The updated data was used for the provincial chapter. Data used in this chapter may differ from elsewhere in the report.

The dramatic change in the mortality during the mid-triennium was likely as a result of improved inter-facility transport and should be regarded as an important find in the strategy to reduce maternal mortality. The province placed emphasis on conducting caesarean sections at facilities with capacity to do so safely. Transporting patients to facilities with appropriate capacity was therefore an important issue to peruse.

The institutional mortality for the province was calculated based on all notified deaths per 100,000 live births recorded in the public health sector. For the last triennium this was calculated as

Demographic data

The demographic profile of age distribution and parity are listed in table 11.2.2.

Table 11.2.2. Comparison of age and parity in the past 4 reports (2002-1013)

Age	2011-2013		2008-2010		2005-2007		2002-2004		%Gen pop	Parity	2011-2013		2008-2010		2005-2007		2002-2004	
	n	%	n	%	n	%	n	%			n	%	n	%	n	%	n	%
<20	27	9.6%	9.3	8.7	7.4	11.3	0	99	35.2	30.1	32.9	39.4						
20-24	54	19.2%	18.5	21.1	25	29	1	69	24.6	29.2	26.4	22.2						
25-29	72	25.6%	31.3	26.4	25.2	25.2	2	56	19.9	19.2	20	17.6						
30-34	66	23.5%	23.4	23.6	23.8	19.5	3	28	10	7.7	10.5	7.2						
35-39	48	17.1%	13.3	15.1	12.5	10.7	4	10	3.6	5.4	3.5	4.6						
40-44	12	4.3%	3.3	4.5	4.6	3.6	5	2	0.7	1.4	1.4	1.9						
45+	2	0.7%	0.5	0.4	1.2	0.6	6+	2	0.7	1.6	0.2	0.9						
Unknown	0	0	0.5	0.2	0.2		Unknown	15	5.3	5.4	5	6.3						

Demographic data with reference to age and parity are tables in 11.2.2 for the periods 2008-2010, 2005-7 and 2002-4. The age and parity distribution are similar to those reported in previous trienniums highlighting the risk in women above the age of 30.

Table 11.2.3. Comparison of levels of care where maternal death occurred between 2002-2013

	2011-2013		2008-2010		2005-2007		2002-2004	
	n	%	n	%	n	%	n	%
Home	5	1.8	7	1.6	12	2.5	11	2.5
CHC	0	0	6	1.4	1	0.2	3	0.7
Level 1	75	26.7	139	32.5	177	36.6	124	28.7
Level 2	161	57.3	229	53.5	247	51	234	54.2
Level 3	33	11.7	41	9.6	42	8.7	55	12.7
Private	7	2.5	6	1.4	5	1	5	1.2

Of the 281 cases analysed, the majority of deaths occurred at level 1 and 2 facilities. The bulk of deaths are reported at level 1 and level 2 hospitals (table 12b.4). This pattern have remained constant over the past 9 years The number of deaths at tertiary level reflects an on-going bottleneck to access of care at that level. Deaths in the private sector are similar to previous years with a slow trend to increase.

During the past few years there was a huge drive for provider initiated testing of HIV. It is encouraging to see a decrease in the numbers of maternal deaths where the HIV status was unknown. Unfortunately the majority of deaths occur in women testing HIV positive.

Table 11.2.4. Comparison of HIV testing between 2012-2013

HIV Status	2011-2013		2008-2010		2005-2007		2002-2004	
	N	%	N	%	n	%	n	%
Positive	158	56.4	231	50	208	43	152	35.2
Negative	85	30.2	111	25.9	46	9.5	42	9.7
Unknown	37	13.2	86	20.1	230	47.5	238	55.1

With the increased testing, the proportion of maternal deaths in the province with a positive HIV test increased to 50%. If the seropositivity is assessed for those where the status is known, 65% of maternal deaths are HIV positive, illustrating the burden of HIV in the province. Since antiretroviral therapy became available in 2007, it is disappointing to note the high number of deaths due to AIDS where antiretroviral therapy was not initiated (10.7%, including 2.5% that attended routine antenatal care)). The province trained a large number of doctors and nurses on initiation of ARV, but still cases are seen where treatment was not initiated in time. During this triennium there was also a change in policy towards liberal treatment during pregnancy.

The slight increase in the ANC attendance seen in the previous report was not sustained. Much more effort should be made to ensure that women have access to antenatal care especially early antenatal care. The ability to do early risk identification in the province is limited.

Table 11.2.5. Antenatal care attendance between 2002-2013

ANC	2011-2013		2008-2010		2005-2007		2002-2004	
	n	%	N	%	N	%	N	%
Attended	174	61.9	293	68.5	309	63.8	259	60
Not attended	66	23.5	74	17.3	87	18	82	19
Unknown	41	14.6	61	14	88	18.2	91	21.1

The mode of delivery in women dying during pregnancy or puerperium did not change significantly since 2002, although recently the proportion of women dying undelivered decreased. This could be attributed to reporting more early deaths in pregnancy where the mode of delivery is not applicable.

Table 11.2.6. Comparison of method of delivery of maternal deaths between 2002-2013

Method of delivery	2011-2013		2008-2010		2005-2007		2002-2004	
	n	%	N	%	N	%	N	%
Vaginal	87	31	146	34.1	178	36.8	160	37
Assisted	7	2.5	9	2.1	13	2.7	3	0.7
Caesarean sections	74	26.3	108	25.2	130	26.9	101	23.4
Undelivered	76	27	128	29.9	163	33.7	168	38.9
Not applicable	37	13.2	37	8.6				

Primary cause of death and Final and contributory causes of death

The primary causes of death is listed in table xxx.7. Although the proportions of deaths due to hypertension, obstetric haemorrhage and non-pregnancy related infections did not change substantially, the actual numbers decreased by 50%. A downward trend is noticed in non-pregnancy related infection that could be because of improved testing and a more aggressive approach of antiretroviral treatment.

Table 11.2.7. A comparison of primary obstetric causes of death between 2002-2013

Primary Obstetric Cause	2011-2013		2008-2010		2005-2007		2002-2004	
	n	%	N	%	N	%	N	%
Direct	130		206	48.1	236	49.4	232	54.5
Hypertension	48	17.1	81	18.9	91	19	100	23.5
Obstetric Haemorrhage	34	12.1	61	14.3	66	13.8	43	10.1
Ectopic pregnancy	7	2.5	3	0.7	5	1	6	1.4
Abortion	9	3.2	13	3	17	3.6	17	4
Preg. Related Sepsis	9	3.2	21	4.9	25	5.2	27	6.3
Anaesthetic related	4	1.4	3	0.7	22	4.6	18	4.2
Embolism	12	4.3	6	1.4	3	0.6		
Acute coll.	7	2.5	18	4.2	7	1.5	21	4.9
Indirect	125	46.8	182	42.5	216	45.2	182	42.7
Non preg. Infect.	85	30.2	157	36.7	199	41.6	161	37.8
Pre-exist Med Dis	40	14.2	25	5.8	17	3.6	21	4.9
Unknown	12	4.3	32	7.5	26	5.4	12	2.8
Total	267		428	100	478	100	426	100

There is a noticeable increase in the proportion of deaths due to pre-existing medical and surgical disease. This increase in proportion in real as there is also an increase in the actual numbers of women classified into this category. Anaesthetic related primary cause increased since the previous triennium, but the actual numbers are lower than prior to 2008. A more detailed analysis of anaesthetic factors will be required to make clear recommendations in this category.

The impact of HIV on the primary cause of death is illustrated in table 11.2.8. The burden of non-pregnancy related infections is clearly illustrated in the group of deaths where the women is known to be infected with HIV. It is interesting to note that the proportion of women with hypertension and obstetric haemorrhage were less in women testing HIV positive.

Table 11.2.8. A comparison of primary obstetric causes of death between 2011-2013 and 2008-2010

Cause of death	2011-2013					2008-2010						
	Number HIV+	% of total	Number HIV neg	% of total	Number HIV unknown	% of total	Number HIV+	% of total	Number HIV neg	% of total	Number HIV unknown	% of total
Coincidental cause	6	3.8	1	1.2			1	0.4	2	1.8	4	4.7
Medical and surgical disorders	24	15.2	15	17.6			11	4.8	9	8.1	5	5.8
Non-pregnancy-related infections	69	43.7	6	7.1			132	57.1	7	6.3	18	20.9
Ectopic pregnancy	3	1.9	2	2.4			2	0.9	0	0	1	1.2
Miscarriage	3	1.9	3	3.5			2	0.9	1	0.9	10	11.6
Hyperemesis gravidarum	1	0.6	1	1.2			0	0	1	0.9	0	0
Pregnancy-related sepsis	7	4.4	2	2.4			13	5.6	7	6.3	1	1.2
Obstetric haemorrhage	14	8.9	16	18.8			22	9.5	24	21.6	15	17.4
Hypertension	14	8.9	28	32.9			24	10.4	38	34.2	19	22.1
Anaesthetic complications	1	0.6	3	3.5			1	0.4	2	1.8	0	0
Embolism	7	4.4	5	5.9			1	0.4	5	4.5	0	0
Acute collapse - cause unknown	2	1.3	3	3.5			8	3.5	5	4.5	5	5.8
Unknown	7	2.4	0				14	6.1	10	9	8	9.3
Total deaths:	158		85		37		231	54%	111	25.90%	86	20.10%

There is also a higher trend of pregnancy related infection in HIV positive women.

The final cause of death or contribution to death are listed in table 11.2.9 stratified by HIV status. This is important to plan for strategies to reduce the deaths. Respiratory problems are the most prevalent problem that would require some planning for supportive strategies.

Respiratory problems and liver failure was more prevalent in the HIV positive women. Deaths were caused by problems of the respiratory system, cardio-circulatory system and cerebral system in the majority of cases. Improving resuscitation skills and early intervention and problem recognition protocols for patients with respiratory system involvement, might lessen impact of deaths due to respiratory system failure. More aggressive TB screening and prophylaxis in HIV positive women could also lessen the impact on the respiratory system.

Table 11.2.9 A comparison of final causes of death between 2008-2010 and 2011-2013

Cause of death	2011-2013					2008-2010						
	Number HIV Pos	%	Number HIV Neg	%	Total HIV unknown	%	Number HIV Pos	%	Number HIV Neg	%	Total HIV known	%
Circulatory system	31	19.6	19	22.4	8	21.60%	51	22.1	36	32.4	87	14.10%
Respiratory failure	45	28.5	17	20	12	32.40%	121	52.4	24	21.6	145	23.50%
Cardiac failure	18	11.4	19	22.4	1	2.70%	32	13.9	42	37.8	74	12.00%
Embolism	8	5.1	8	9.4	1	2.70%	4	1.7	9	8.1	13	2.10%
Renal failure	1	0.6	1	1.2	0		10	4.3	10	9	20	3.20%
Liver failure	9	5.7	1	1.2	0		12	5.2	6	5.4	18	2.90%
Cerebral complications	17	10.8	15	17.6	6	16.20%	24	10.4	19	17.1	43	7.00%
Metabolic	6	3.8	2	2.4			14	6.1	3	2.7	17	2.80%
Haematological	5	3.2	0				13	5.6	16	14.4	29	4.70%
Immune system	8	5.1	0				131	56.7	0	0	131	21.20%
Unknown	10	6.3	4	4.7	8	21.60%	18	7.8	14	12.6	32	5.20%
Other	1	0.6	0		1	2.70%	8	3.5	0	0	8	1.30%

Although the majority of deaths (61%) occur in the postpartum period, the majority of emergencies (64%) occur prior to the postpartum period. Deliveries in complicated cases are expedited explaining the increase in deaths in the postpartum period. It is important to note that deaths occur in 34% prior to delivery and in 4% during the intrapartum period.

Figure 11.2.1

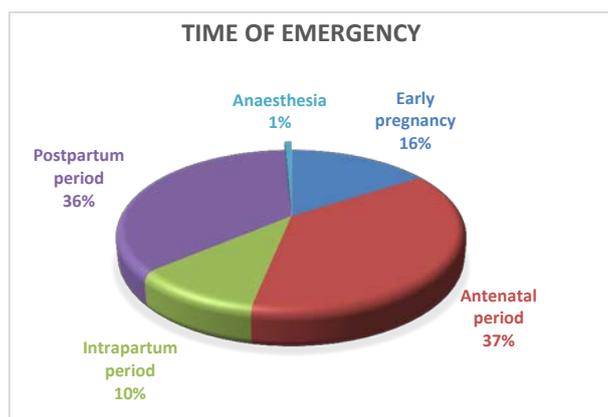
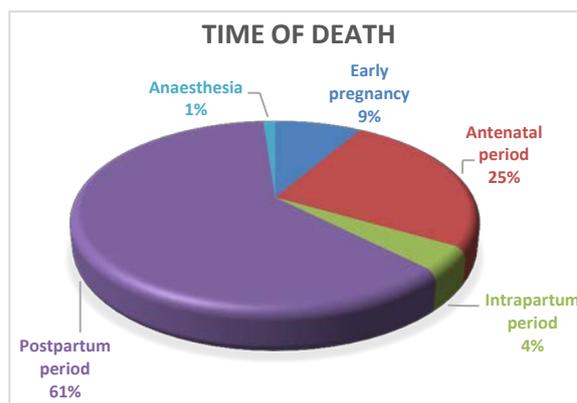


Figure 11.2.2



Avoidable factors, missed opportunities and

substandard care

Maternal deaths are always a tragic event and therefore it is important to look at avoidable factors and elements of substandard care. Maternal deaths assessors can only make comments on what is observed in the copies of files provided to them. The proportion of assessable cases is listed in table xxx.10.

Table 11.2.10 Avoidable factors, missed opportunities and substandard care for all cases

Category	% of avoidable factors in assessable cases			
	2011-2013	2008-2010	2005-2007	2002-2004
Patient orientated	37.7	27.3	33.5	39.7
Administrative factors	23.8	22.2	24.5	18.3
Health worker related emergency management problems				
- Primary level	28.8	24.5	41.1	40.1
- Secondary level	26	14.3	21.8	33.8
- Tertiary level	0.2	0	2	12.3
Resuscitation	33.8	34.6	17.4	12

It is of concern that the proportion of assessable cases with avoidable factors remained the same in the administrative and health worker related category, with an increase in the patient orientated factors. The low proportion of avoidable factors at tertiary level should also be noted. Bias towards tertiary care, or simply too little access to tertiary care could explain this trend is not in line with avoidable factors at this level seen elsewhere.

Table 11.2.11. Avoidable factors, missed opportunities and substandard care with respect to patient orientated problems for all cases

Description	Number	Percentage of cases	% in women with avoidable factors
Lack of information	47	16.7%	
No avoidable factor	128	45.6%	
Number cases with avoidable factors	106	37.7%	
No antenatal care	48		45.3%
Infrequent antenatal care	10		9.4%
Delay in accessing medical help	56		52.8%
Declined medication/surgery/advice	12		11.3%
Family problem	1		0.9%
Community problem	1		0.9%
Unsafe abortion	4		3.8%
Other	8		7.5%

Within the province it was lack of antenatal care and delay in accessing medical help was identified as the most important patient related factors. This should be seen against known practices, in at least

some clinics, where the doors of clinics is closed when the number of clients outnumber the capacity of the clinics. This results in discouraging patient to attend clinics, or results in late bookings. There is unfortunately no documented mechanism where the maternal deaths assessors could obtain this information. It should also be noted that in more than 10% of cases advice, or medication was declined by women. This reflects on the quality of counselling within the provincial services.

In 23% of maternal deaths administrative issues were identified. Lack of appropriately trained doctors and nurses were identified as leading avoidable factors. This was followed by delays in initiating critical care due to overburdening of services.

Table 11.2.12. Avoidable factors, missed opportunities and substandard care with respect to administrative problems for all cases

Description	Number	Percentage of cases	Percentage of avoidable factors
Lack of information	20	7.1%	6.3
No avoidable factor	196	69.8%	61.8
No cases with avoidable factor	65	23.1%	
Transport problem: Home to institution	5		7.7%
Transport problem: Institution to institution	4		6.2%
Lack of accessibility: Barriers to entry	1		1.5%
Lack of accessibility: Other	0		0.0%
Delay initiating critical care (Overburdened service)	13		20.0%
Lack of health care facilities: ICU	11		16.9%
Lack of health care facilities: Blood/blood products	3		4.6%
Lack of health care facilities: Other	2		3.1%
Lack of appropriately trained staff: Doctors	37		56.9%
Lack of appropriately trained staff: Nurses	16		24.6%
Communication problems: Technical	1		1.5%
Communication problems: Interpersonal	6		9.2%
Other	2		3.1%

This should be viewed against lack of documented staff allocations and availability of beds. Many of these views are based on the impressions of the maternal deaths assessors. To improve on these assessments there need to be clear known staffing norms and information of the human resource status at facilities to allow maternal death assessors to make an objective opinion.

Health workers are often blamed when outcomes are less optimal. Table xxx.13 stratifies the numbers of health worker related problems by level of care. In 25-26% of cases at primary or secondary level care there were avoidable factors involving health care professionals.

Table 11.2.13. Health Worker orientated problems per level of care

	1° Level Number	1° Level % of cases	1 level % avoid. cases	2° Level Number	2° Level % of cases	2 level % avoid. cases	3° Level Number	3° Level % of cases	3° Level % of avoid able cases
Medical management problems									
Lack of information	16	5.7%		11	3.9%		3	1.1%	
No avoidable factor	191	68.0%		197	70.1%		276	98.2%	
Cases with avoidable factors	74	26.3%		73	26.0%		2	0.7%	
Initial assessment	19		25.7%	6		8.2%	0		0.0%
Problem with recognition / diagnosis	33		44.6%	26		35.6%	1		50.0%
Delay in referring the patient	33		44.6%	7		9.6%	0		0.0%
Managed at inappropriate level	24		32.4%	7		9.6%	0		0.0%
Incorrect management (Incorrect diagnosis)	14		18.9%	10		13.7%	0		0.0%
Sub-standard management (Correct diagnosis)	32		43.2%	43		58.9%	1		50.0%
Not monitored / Infrequently monitored	13		17.6%	10		13.7%	0		0.0%
Prolonged abnormal monitoring with no action taken	4		5.4%	7		9.6%	1		50.0%

Substandard care, problem recognition or diagnostic problems and failure to monitor are the most important factors in cases where avoidable factors were identified. Delay in referral and managing cases

at an inappropriate level was a major issue at primary health level, but also relevant in about 10% of level 2 deaths. This should be looked into more carefully as there are various factors affecting this assessment. This could indicate barrier to access at a higher level, knowledge and skills gaps of professionals, or a design flaw in our system. Lower level facilities are dysfunctional, yet regarded as the level of care to provide a service. This mismatch leads to at risk behaviour where practitioners practice in a way that is expected from a fully functional facility, but when complications develop they are unable to execute the appropriate actions. Delays in the inter-facility transport systems may also affect these assessments.

Since the last triennium, the proportion of assessable cases with problems relating to resuscitation increased. This should be seen against the huge effort of the province to train health professionals on the essential steps in the management of obstetric emergencies.

Table 11.2.14. Health Worker Orientated Problems in all cases

Description	% of assessable deaths with avoidable factors	Distribution of avoidable factor	% of assessable deaths with avoidable factors	Distribution of avoidable factor	% of assessable deaths with avoidable factors	Distribution of avoidable factor	% of assessable deaths with avoidable factors	Distribution of avoidable factor
	2011-2013	2008-2010	2005-2007	2002-2004				
Resuscitation	10.6		5.6		13.4		7.6	
- Airway not secured		36.6		25		18.5		18.2
- Circulation not corrected		50		60		63.1		0
- Inappropriate drugs given		13.3		20		0		63.6
- Incompletely investigated		23.3		10		0		0
- Not appropriately monitored		23.3		5		0		0

The most important assessment is the proportion of deaths with avoidable factors per disease category (Table 11.2.15) as well as the actual numbers. This gives an idea where training efforts should concentrate on in order to make an impact on decreasing mortality. The conditions with the highest proportion of avoidable deaths in the province are Miscarriages (77%), Anaesthetic related incidents (75%), Hypertension (73%), ectopic pregnancy (71%). This is followed by obstetric haemorrhage (67%), pregnancy related infection (67%) and medical conditions (57%).

Table 11.2.15. Avoidable deaths per disease category

Primary Obstetric Cause	2011-2013		2008-2010		2005-2007		2002-2004	
	n	%	n	%	n	%	n	%
Direct	87				92		113	
Hypertension	35	72.9%	28	34.5	21	23.1	35	35
Obstetric Haemorrhage	23	67.6%	42	68.9	37	56	32	74
Ectopic pregnancy	5	71.4%	2	66.7	3	60	3	50
Abortion	7	77.8%	6	46.2	5	29.4	9	52.9
Preg. Related Sepsis	6	66.7%	12	57.1	8	32	12	44.4
Anaesthetic related	3	75.0%	2	66.7	16	72.7	17	94.4
Embolism	5	41.7%	2	33.3	1	33.3		
Acute coll.	3	42.9%	4	22.2	1	14.3	5	23.8
Indirect	74				10		11	
NPRI	39	45.9%	34	21.7	10	5	7	4.3
(AIDS)					3	2.7	0	0
Pre-exist Med Dis	23	57.5%	7	28	0	0	4	19
Unknown	4	33.3%	6	18.8	2	7.7		
Other	8	57%						
Total	161		145		104		125	

The priority of focus could be calculated using the impact factor (number of cases with avoidable factors multiply by the percentage of cases with avoidable factors). This allows a risk assessment based on the prevalence of a disease and will indicate those conditions that would save the most lives. This is illustrated in table 11.2.16. The conditions that should receive priority intervention and funding are: Non-pregnancy related infection, hypertension, pre-existing medical conditions and obstetric haemorrhage. Other sources also suggest that HIV and TB should receive top priority attention. The rise in the proportion of deaths relating to medical and surgical conditions is interesting. This is not just a proportional increase due to shifting of priorities, but a real increase as the actual numbers of this condition have almost doubled. This could relate to a greater awareness of medical conditions in pregnancies with improved diagnosis, or late diagnosis of medical conditions resulting in complications during pregnancy and an increased risk. The patient profile may also have changed with more women in the older category falling pregnant.

Table 11.2.16. Avoidable deaths per disease category

Primary Obstetric Cause	2011-2013		Avoidable deaths	Cause avoidability	Risk score	Rank	
	n	%	n	% of avoidable deaths	% avoidable in cause	Occ x avoidability	
Direct	130					Risk score	
Hypertension	48	17.1	35	23.6%	72.9%	1680	2
Obstetric Haemorrhage	34	12.1	23	15.5%	67.6%	782	4
Ectopic pregnancy	7	2.5	5	3.4%	71.4%	35	
Abortion	9	3.2	7	4.7%	77.8%	63	
Preg. Related Sepsis	9	3.2	6	4.1%	66.7%	54	
Anaesthetic related	4	1.4	3	2.0%	75.0%	12	
Embolism	12	4.3	5	3.4%	41.7%	60	
Acute coll.	7	2.5	3	2.0%	42.9%	21	
Indirect	125	44.5				0	
Non preg. Infect.	85	30.2	39	26.4%	45.9%	3315	1
Pre-exist Med Dis	40	14.2	23	15.5%	57.5%	920	3
Unknown	12	4.3	4	2.7%	33.3%	48	
Miscellaneous	14	9	8	5.4%	57.1%	112	
Total	281		161			45241	

During the last triennium the Free State made some progress with reduction in maternal deaths. This resulted in

Discussion

The province made significant progress in the reduction of maternal mortality. The major factors that resulted in the reduction during the last triennium could be described as follow:

- Improvement in inter-facility transport
- Performing caesarean sections at sites with the appropriate skills and resources
- Extensive training of health professionals on the management of Obstetric emergencies (ESMOE)

The anaesthetic deaths remains low. Only 4 anaesthetic related deaths were captured for this triennium. This may be under-reporting if the assessment of the anaesthetic assessor is evaluated where 6 deaths were regarded as relating to anaesthesia. More importantly, a total of 20 deaths undergoing anaesthesia was classified as due to other conditions, but where the anaesthetic may have contributed to the death. More emphasis should be placed in the next triennium focusing on anaesthesia contributing to maternal deaths, especially in facilities with low surgical turn-over.

Access to specialist care is also a problem in the province. The bottleneck to access to tertiary care remain and is related to organisational and structural design of the services. During this period there were only 2 hospitals that could effectively provide specialist care. None of the other specialist hospitals were in a position to provide quality specialist care. Cases were referred to levels of care based on provincial classifications and not on functional available expertise to care. There are also multiple facilities with inadequate number of medical practitioners to provide a comprehensive emergency obstetric care. Improved inter-facility transport to get pregnant women to facilities with expertise could explain the impact of inter-facility transport on the reduction of maternal deaths.

Health worker orientated problems at level 1 and 2 remains of serious concern with the main problems being substandard management, problem recognition/diagnosis and delay in referring the patient to a higher level of care. There seems to be a lack of resuscitation skills especially in correcting circulation problems. It is also suggested that a more intensive effort should be made to ensure that all sites are appropriately trained to manage retained placentas and products of conception. During the triennium more than 1000 professional nurses and doctors have been trained on ESMOE.

Inter-facility transport has also been identified as an administrative factor contributing to deaths. Dedicated inter-facility vehicles with staff have been procured, but maintenance of the system is problematic. Rostered vehicles have been absorbed in the pre-facility emergency services to fill critical gaps. The inter-facility transport has been outsourced to a private contractor to maintain services, but with operational difficulties.

With the increase in the number of medical and surgical conditions as a cause of death in pregnancy, the importance of a dedicated obstetric physician cannot be under-estimated. There is a need to develop this skills and expand the skills throughout the province.

The province has a good system of reporting adverse events and maternal deaths have been listed by default as adverse events. It is suggested the root cause analysis done by district clinical specialists on the causes of maternal deaths be forwarded to the maternal death assessor teams to enhance their ability to identify problems relating to maternal deaths.

Recommendations

1. Policy

- 1.** Provincially need to establish at least 1 facility adequately resourced to manage the obstetric emergencies in the district
- 2.** Develop a hot-line to document all cases of barrier to entry into a service
- 3.** Fully implement the emergency obstetric simulation training policy
- 4.** Develop and implement policy on advanced antenatal care support

2. Health care promotion

- 1.** Provide all facilities with IEC material on
 - a.** Risk factors during pregnancy and after delivery
 - b.** Value of early booking at ANC
 - c.** Delivery with skilled birth attendance-
 - d.** Importance of knowing HIV status and the value of PMTCT and ART during pregnancy
 - e.** Value of family spacing /contraception

3. Communication with the community

- 1.** Establish specific campaigns to inform the local communities of maternity related issues

4. Access to care by the community (includes ensuring that patients have access to specialist advice or care)
 1. All patients to have access to basic antenatal care at clinic close to home
 2. Effective transport system to ensure access to appropriately skilled maternal care site
 3. Include private sector in antenatal care access
 4. All districts provide outreach advanced antenatal care support services
5. Appropriate allocation of resources to health system
 1. Maintain midwifery register and expand to include medical staff
 2. Implement policy on delivery sites and caesarean section sites
 3. Reshape service design to optimally utilize existing resources
6. Knowledge and skills of health care provider
 1. Establish ESMOE maintenance training schedules
 2. Implement privileging of obstetric surgery and delivery services
 3. Improve supervision of interns through optimal service design
 4. Prioritise provider initiated contraception
 5. Establish physicians with expertise in medical disease in pregnancy
7. Develop skills to enable implementation of the signal functions of basic and comprehensive emergency obstetric sites
8. Consultation skills
 1. Clinical outreach and in-reach for training
 2. Implement outreach sterilisation support.
 3. Improve open communication with specialists at specialist hospitals
9. Monitoring and evaluation
 1. Use dashboards to identify problematic areas in the province
 2. Routine audit of files at all levels of care for compliance with protocols
 3. Scheduled MM meetings to be audited including morbidity discussions
 4. Improve quality control of the maternal deaths notification and assessment process

Chapter 11.3: Gauteng

Introduction

DEMOGRAPHIC AND SOCIO ECONOMIC PROFILE

Population:

South Africa's population now stands at just over 54 million. This is the main finding of Stats SA's latest Mid-year Population Estimates report, which was released on Thursday, 14th August 2014. Based on the 2014 series, the country's population experienced an estimated net increase of 844 000 individuals (1.58% growth) from July 2013 to July 2014. Gauteng remains the most populous province, with almost 13 million inhabitants, which is (12,914 800), 23.9% of entire South African population; followed by KwaZulu-Natal with a population of almost 10.7 million.

The Gauteng population aged younger than 15 years is about 18.8% (3,05 million) whilst the Northern Cape remains the least populated province, with just under 1.2 million people.

For the period 2011–2016, it is estimated that Gauteng Province will experience an inflow of migrants of approximately 1,106,375.

Deaths reported

Gauteng, for the triennium 2011 – 2013, had a total of 625 923 deliveries. The total number of live births was 613 004³. There were 889 deaths reported in this triennium of which 795 were at provincial institutions and 841 deaths were captured on the MAMMAS program by the time it was closed, 31 May 2013, for the compiling of the Saving Mother's Report. This is a decrease of 50 deaths compared to the 2008– 2010 triennium. The institutional Maternal Mortality Ratio for this triennium is 145 / 100 000 live births. There were some difficulties with report and a maternal deaths verification programme indicated additional deaths: 2011= 286; 2012 = 338; 2013 = 265

Table 11.3.1 Comparison of iMMR from beginning of confidential enquiries

Gauteng	Number	iMMR
1998	131	
1999	138	
2000	171	
2001	184	
2002	213	
2003	205	
2004	251	
2005	222	136.0
2006	257	147.6
2007	190	111.9
2008	268	136.0
2009	319	160.2
2010	293	159.2
2011	270	136.4
2012	339	163.7
2013	240	115.0

Table 13c.2. Cases reported per year and percentage of deaths in SA

Year	Number reported	% of deaths in SA
1998	131	19.4
1999	138	17.1
2000	171	16.5
2001	184	19.6
2002	213	21.0
2003	205	16.8
2004	251	21.4
2005	222	17.6
2006	257	17.7
2007	190	13.9
2008	267	17.2
2009	319	18.0
2010	290	17.8
2011	286	17.3
2012	338	22.5
2013	265	17.3

The increase in the deaths from 2008 – 2010 corresponds with the increase in the female population from 2008 – 2010, and with the countrywide increase in maternal deaths during that time.

Demographic data

Table 11.3.3. Comparison of age in the two triennial reports: 2011 – 2013 and 2008-2010

Age	Number	2011- 2013 %	Number	2008- 2010 %
<20	42	5.0	45	5.1
20-24	155	18.4	148	16.9
25-29	228	27.1	256	29.2
30-34	231	27.5	205	23.4
35-39	126	15.0	160	18.3
40-44	50	5.9	53	6.1
45+	6	0.7	7	0.8
Unknown	3	0.4	2	0.2

Table 11.3.3 shows comparison of age over the two triennia 2011-2013 and 2008-2010. In this triennium there was an increase in the proportion of deaths in the age category 20 – 24 and 30-34. It is noted that 54.6% of deaths occurred in the age categories 25 – 29 and 30 – 34. There was a decline in the proportion of deaths in the age category 35-39.

Table 11.3.4. Comparison of parity in the two triennial reports: 2011 – 2013 and 2008-2010

Parity	Number	2011- 2013 %	Number	2008-2010 %
0	243	28.9	258	29.5
1	212	25.2	236	26.9
2	207	24.6	190	21.7
3	87	10.3	90	10.3
4	24	2.9	37	4.2
5	16	1.9	9	1.0
6+	6	0.7	3	0.3
Unknown	46	5.5	53	6.1

Table 11.3.4 shows comparison of parity over the two triennia 2011-2013 and 2008-2010. In this

triennium there was a decrease in the proportions of deaths in the age category 35-39 years. A decline was seen in the proportion of deaths in the 20-24 years age category. Just under a third of all maternal death occurred in the 25-29 year age group. Women of low parity (0-2) account for just over three quarters of all deaths.

Table 11.3.5. Comparison of levels of care where maternal death occurred between 2008 – 2010 and 2011-2013

Level	2011 - 2013		2008-2010	
	N	%	N	%
Home	5	0.6	1	0.1
CHC/ MOU	15	1.8	9	1.0
Level 1	85	10.1	92	10.1
Level 2	426	50.7	484	52.9
Level 3	264	31.4	308	33.7
Private	46	5.5	21	2.3

As shown in table 13c.3 most deaths occurred at level 2 facilities. There is still a decline in the proportion of deaths at level 3, with an increase in level 1 and 2.

Circulatory = 290/34.5%; Respiratory failure = 220/26.2%; Cardiac failure = 137/16.3%; Cerebral complication = 139/16.5%; Haematological = 58/6.9%; Immune system = 36/4.3%; Unknown = 49/5.8

Table 11.3.6a. Comparison of HIV testing between 2011 – 2013 and 2008 – 2010

HIV Status N	2011 - 2013		2008-2010	
	N	%	N	%
Negative	218	25.9	172	19.6
Positive (not AIDS)	103	12.2	146	16.7
Decline testing	0	0	7	0.8
AIDS not on HART	126	15.0	169	19.3
AIDS on HART	218	25.9	143	16.3
Unknown	176	20.9	239	27.3

The proportion of women with unknown HIV status has declined significantly and proportion of those with known HIV status remained unchanged.

Table 11.3.5. Antenatal care attendance between 2011 -2013, and 2008-2010

ANC	2011 - 2013		2008-2010	
	N	%	N	%
Attended	503	59.8	517	59.0
Not attended	229	27.2	225	25.7
Unknown	109	13.0	134	15.3

Over 95% of women who deliver at Gauteng's institutions have had at least one antenatal clinic visit ⁶. Table 11.3.5 shows that over a quarter of those who died had not initiated ante natal care attendance.

Patient Oriented

Description	#	%
Lack of information	138	16.4
No avoidable factors	341	40.5
No antenatal care	157	18.7
Infrequent antenatal care	52	6.2
Delay in accessing medical help	254	30.2
Declined medication/surgery/advise	22	2.6
Family problem	7	0.8
Communication problem	4	0.5
Unsafe abortion	11	1.3
Other	29	3.4

Table 11.3.6. Comparison of method of delivery of maternal deaths between 2011 – 2013 and 2008 – 2010

Method of delivery	2011 - 2013		2008-2010	
	N	%	N	%
Vaginal	233	27.7	281	30.7
Assisted	11	1.3	12	1.3
Caesarean section	250	29.7	295	32.2
Undelivered	223	26.5	224	24.5
N/A	124	14.7		

There has been a slight decrease in the percentage of women who died that had caesarean sections as a mode of delivery. At the same time there has been a slight increase in the proportion of women who died undelivered. Women, who are at higher risk during pregnancy, may have been referred for caesarean section more readily, and this increased mortality, may be a result of higher risk patients being operated on at lower levels of care.

Table 11.3.7. Comparison of anaesthesia between 2011 – 2013 and 2008-2010

Level	N	2011 -2013		2008-2010	
		% of anaesthetic performed	% of total deaths occurring at this level	% of anaesthetic performed	% of total deaths occurring at this level
CHC	0	0		0.3	11
Level 1	33	10.0		10.1	43
Level 2	141	42.6		46.9	38
Level 3	124	37.5		38.1	48
Private	31	9.4		32	71

A total of 331 patients had an anaesthetic (39.4% of all deaths). The trend is very similar to the previous triennia.

Primary cause of death and final and contributory causes of death

Table 11.3.8. A comparison of primary obstetric causes of death between 2011 - 2013 and 2008-2010

Primary Obstetric Cause	2011 - 2013	2008-2010
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	N	%	N	%
Direct			452	51.6
Hypertension	117	13.9	132	15.1
Obstetric Haemorrhage	145	17.2	129	14.7
Ectopic pregnancy	26	3.1	20	2.3
Abortion	53	6.3	43	4.9
Preg. Related Sepsis	29	3.4	62	7.1
Anaesthetic related	9	1.1	14	1.6
Embolism	21	2.5	15	1.7
Acute coll.	38	4.5	37	4.2
Indirect			383	43.7
Non preg. Infect.	272	32.3	309	35.3
Medical and Surgical disorders	97	11.5	74	8.4
Unknown	15	1.8	19	2.2
Coincidental cause	19	2.3	22	2.5
Total	841	100	876	100

The top 5 causes of maternal deaths in Gauteng have remained unchanged from the previous triennium. There has been a significant decrease in the deaths due to hypertension. Hypertension is no more the leading direct cause of death in Gauteng however postpartum haemorrhage.

Table 11.3.9 Common causes in order of importance in Gauteng are as follows:

Causes of Maternal Deaths	iMMR	iMMR
	2011 – 2013	2008 - 2010
NPRI	32.3	35.3
HPT	13.9	15.1
Obstetric haemorrhage	17.2	14.7
Pre-existing medical conditions	8.7	8.4
PRS	3.4	7.1
Acute collapse	4.5	4.2
Anaesthetic related	1.1	1.6

A greater proportion of women who died in this triennium had caesarean sections. Bleeding after caesarean section has been a major contributor to deaths due to obstetric haemorrhage. 2008- 2.6%; 2009- 2.8%; 2010 6.2%. Of the applicable deaths, 10, 2% had prolonged labour.

Avoidable factors, missed opportunities and substandard care

Table 13c.10. Avoidable factors, missed opportunities and substandard care for all cases

Category	2011- 2013	2008-2010
Patient orientated	47.7	44.3
Administrative factors	40.9	31.1
Health worker related emergency management problems		
Medical management and resuscitation problems - Primary level	18.0	16.1
- Secondary level	35.8	35.5
- Tertiary level	12.8	13.7
Resuscitation	47.3	25.5

	2011-2013	2008-2010
No suboptimal care	27.9	31.8
Suboptimal care, different management would have made no difference to the outcome	13.1	14.0
Suboptimal care, different management might have made a difference to the outcome	33.8	27.5
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	25.2	26.6

The number of deaths where no sub optimal care was found has decreased from 31.8% to 27.9%. The category:” suboptimal care, different management would reasonably have been expected to have made a difference to the outcome” has decreased from 26.6% to 25.2% when compared with 2008-2010.

Table 13c.12. Avoidable factors, missed opportunities and substandard care with respect to Patient orientated problems for all cases

Major Problems	2011 - 2013 (n = 841)	2008 - 2010 (n = 763)
No avoidable factor	40.5	42.5
No antenatal care	18.7	18.7
Infrequent antenatal care	6.2	7.0
Delay in seeking medical help	30.2	21.9
Unsafe abortion*	1.3	18.6
Lack of information	16.4	14.5
Family problem	0.8	0.7
Community problem	0.5	0.5
Declined medication/surgery/advice	2.6	4.0
Other	3.4	

* Denominator is women who died due to abortions, not all maternal deaths

** Highlighted categories are newly added for this report

There has been a decline in avoidable deaths due to unsafe abortion. Probably some have been differently classified under the new categories.

Table 11.3.13. Avoidable factors, missed opportunities and substandard care with respect to administrative problems for all cases

Major Problems	2011 - 2013 (n = 841)	2008-2010 (n=826)
No avoidable factor	49.3	63.0
Transport problem home to institution	1.1	0.5
Transport problem between institutions*	3.4	8
Barriers to entry	0.8	0.6
Lack of accessibility (Other)	0.8	0.3
Delay in initiating critical care (overburdened services)	9.0	3.9
Lack of information*	14.5	
Lack of health care facilities		
Lack of Health Care facilities other		1.8
Lack of ICU	10.7	8.2
Lack of blood products**	4.5	13.3
Lack of staff		
Lack of appropriately trained staff	14.5	11.6
Lack of appropriately trained staff: Doctors	10.0	8.3
Lack of appropriately trained staff: Nurses	4.5	3.3
Communication problems	4.1	2.4
Communication problems: Technical	1.5	0.7
Communication problems: Interpersonal	2.6	1.7
Other	8.4	5.7

* Denominator is the number of cases that were referred between institutions.

** Denominator was the number of cases which require urgent blood transfusions namely ectopic pregnancies, abortions due to trauma, ante and postpartum haemorrhage

The marked improvement in the availability of blood products, as an avoidable factor, may be related to underreporting in the 2005-2007 triennium. Blood products seem to be more accessible for the past year. The impact of this will only be seen in the next triennium. Emergency blood is available at all times for 24 hours in all the labour wards.

Transport between institutions remains a challenge.

There has been a change in classification of lack of staff and appropriately trained staff; therefore this cannot be compared with previous trienniums.

Table 13c.14. Health Worker Orientated Resuscitation Problems in all cases (2011 – 2013)

Resuscitation in Gauteng
Gauteng resuscitation problems

Resuscitation problems	Number	Percentage of total
Lack of information	102	12
No avoidable factor	356	41.9
Airway problems	26	3.1
Breathing problems	67	7.9
Circulation problems	121	14.3
Drug problems	6	0.7
Investigation problems	15	1.8
Monitoring problems	29	3.4
Resuscitation not attempted	152	17.9

Total Deaths during pregnancy childbirth and puerperium	849
Cases with information	747 (849-102)
Cases where resuscitation attempted	595 (747-152)
Cases with avoidable factors	239 (595-356)

	Distribution of resuscitation problems (%) Note there may be more than one avoidable factor per case
Airway problems	10.9%
Breathing problems	28.0%
Circulation problems	50.6%
Drug problems	2.5%
Investigation problems	6.3%
Monitoring problems	12.1%
Cases with avoidable factors	239

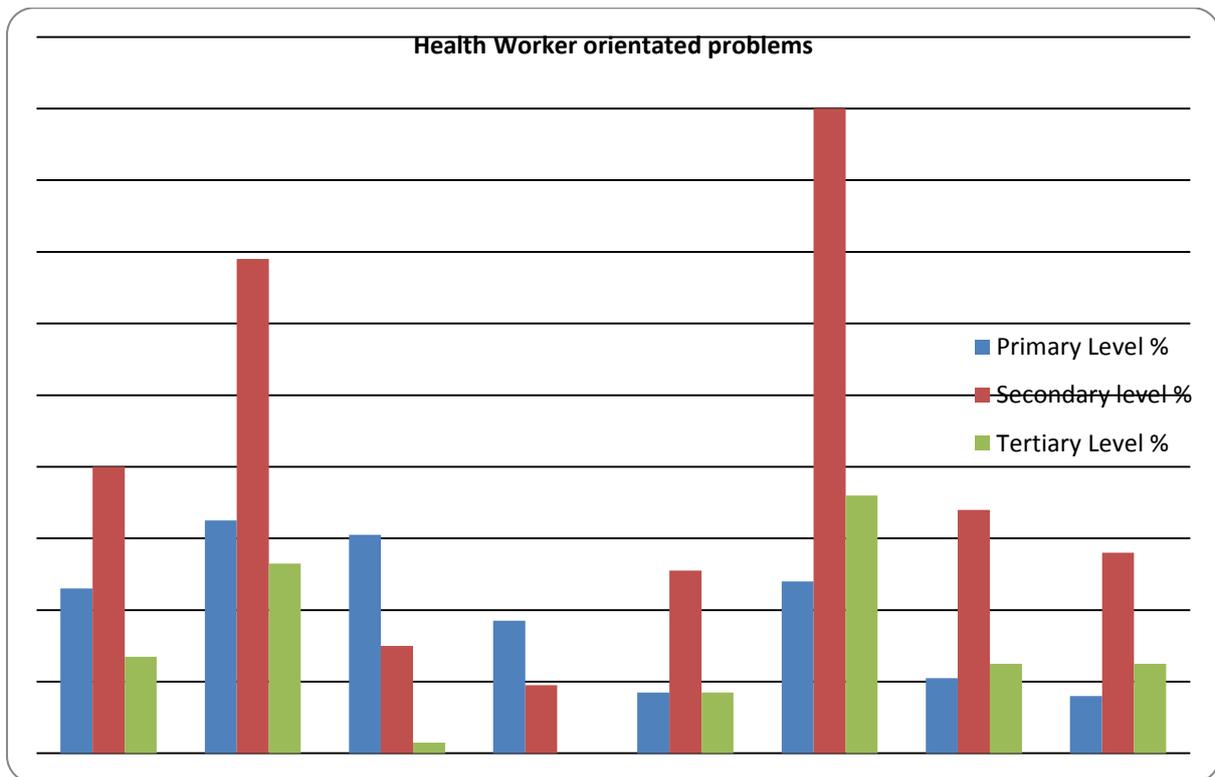
Data from MaMMAS database closed June 2014.

Health worker related resuscitation problems have increased from 16.3 in the 2002 – 2004 triennium to 25.5 in the 2008 – 2010 triennium this is a serious concern that need to be addressed.

Resuscitation was not attempted in mainly Primary and Secondary levels of care. This needs further analysis, in the next triennium as to what is meant by resuscitation and rationale for not attempting.

Table 13c. 14. Health Worker orientated problems per level of care

2011 – 2013	Primary Level	%	Secondary Level	%	Tertiary Level	%
Initial assessment	43	5.1	65	7.7	21	2.5
Problem with recognition / diagnosis	55	6.5	114	13.6	39	4.6
Delay in referring patient	43	5.1	23	2.7	3	0.4
Managed at inappropriate level	31	3.7	13	1.5	0	0
Incorrect management (Incorrect diagnosis)	17	2.0	42	5.0	16	1.9
Substandard management (Correct diagnosis)	47	5.6	192	22.8	57	6.8
Not monitored / Infrequently monitored	15	1.8	40	4.8	16	1.9
Prolonged abnormal monitoring without action	18	2.	32	3.8	18	2.1
Assessable deaths	[852		[731			



Notes by Anaesthetic Assessor

In 2010, the Gauteng DoH and Social Development embarked on a training programme for medical officers at level 1 and 2 hospitals in the province on obstetric anaesthesia. The first phase, theoretical programme was a great success, however the 2nd phase of practical training was not carried out due to a number of factors (the most important being the human resource limitations).

If Gauteng is to achieve a decrease in anaesthetic related obstetric deaths in the next triennium, the DoH must fast track the Minister's vision of district obstetric teams. The Anaesthesiologist in these teams can then ensure there is repetitive and appropriate practical training for obstetric anaesthesia at level 1 and level 2 hospitals.

In addition, the heads of Anaesthesiology departments at the tertiary hospitals in Gauteng must ensure that there is adequate training for registrars and medical officers who administer anaesthetics to obstetric patients. In addition, each of these hospitals should have a dedicated Head of unit for Obstetric Anaesthesia.

Comments

1. Anaesthesia-related deaths ranked lowest in the order of frequency of Gauteng deaths, but the percentage is still significant and anaesthesia-related deaths are mostly avoidable. The difficulty of Obstetric anaesthesia is often underestimated by all doctors involved in obstetric care.
2. More deaths are occurring in level 1 and 2 institutions, mainly due to NPRI. The care in level 2 hospitals needs to be strengthened.
3. Inter- and multidisciplinary care must be implemented for patients with NPRI antenatal and postnatal.

4. The number of deaths related to bleeding after caesarean section has increased over the past 3 years. Training, recruitment, retention and supervision of junior medical practitioners need improvement, and postnatal monitoring must be emphasised to medical and nursing staff
5. Lack of monitoring may reflect a lack of staff and supervision, and enough evidence is available to suggest a serious shortage in numbers of nursing staff.
6. There has been an increase in the number of deaths in the older women. The significance of this is uncertain, but contraception and termination of pregnancy services must be freely available in all districts
7. Early attendance of pregnant women and booking at the clinic before 20 weeks will allow detection of high-risk conditions and HIV-infection early in pregnancy. .
8. It appears that patients at level one hospitals are not being timeously referred to higher levels of care. As a result, poor management occurs at the level one hospital, where medical practitioners are probably not adequately equipped to deal with the complicated cases.
9. The high mortality at the level three hospitals is most likely a result of these hospitals having to deal with the most complicated cases which are referred from the level one and two hospitals.
10. The high percentage of deaths at private hospitals, associated with anaesthesia, is most probably due to an insufficient sample size. There may still be gross under reporting from the private sector

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Recommendations for Saving Mothers: Province: Gauteng. / Chapter 11.3

Interface	Level of interaction	Action	Facilitator	Motivation
<p>1.Policy level</p> <p>Aim</p> <p>The health sector must provide four identifiable and measurable outputs with the ultimate objective of ensuring a “Long and Healthy Life for the Community of Gauteng Province”</p>	<p>Politicians, Civil Society, Provincial Department of Health</p>	<ul style="list-style-type: none"> • Policy documented from the MEC’s office on the following: <ol style="list-style-type: none"> 1. Uniform birth register to be used throughout the province 2. Obstetric ambulances availability in the districts 3. Staffing and Equipment norms and implementation of the set norms and OSD for midwives employed in maternity units 4. Responsibilities of the CEOs on monitoring of ESMOE fire drills, Mortality and Morbidity meetings and staffing of labour wards 5. Budget and resource allocation prioritised for Maternal Health Services 6. Functioning of the Community Health Workers to be geographically based and not program based 	<p>Chairpersons of MEC committees, Provincial office; Maternal, Neonatal and Child Health Committee.</p>	<ol style="list-style-type: none"> 1. Obstetric haemorrhage and Hypertension are two of the main causes of Maternal Mortality in Gauteng. 2. Availability of Obstetric Ambulances will improve the response time for inter facility transfers of obstetric patients 3. Lack of appropriately trained staff was identified as an important avoidable factor in Maternal Mortality 4. Adequate resources are needed for monitoring and quality care of the maternity patient. 5. Women of childbearing age need health education on: contraceptive use, attending antenatal clinic early and postnatal clinic within 6 days of delivery.

Interface	Level of interaction	Action	Facilitator	Motivation
<p>2. Health Care promotion</p> <p>Aim: To educate women and their families in appropriate, healthy behaviour during pregnancy, child birth and the postnatal period</p>	<p>Provincial office, District Offices, Health Promoters, Ward PHC Team</p>	<p>Educational messages and material developed, but not limited to, and to include the following:</p> <ol style="list-style-type: none"> 1. Immediate attendance of a Health Facility with any bleeding antenatal and postnatal 2. Early booking during pregnancy <20 weeks 3. The use of contraception especially in the teenagers and older women 4. Availability and requirements of Termination of Pregnancy services 5. The importance of HIV testing during pregnancy 6. Planning of transport during labour 7. Attendance at appropriate level of care 	<p>Provincial Office, District Office with the Health Promotion Teams, Hospitals</p>	<ol style="list-style-type: none"> 1. An increase in the number of deaths in older women 2. Late booking at Antenatal Clinics lead to delayed treatment and diagnosing of complications 3. Delayed transport from home to institutions results in complications not being attended to timeously 4. Postnatal attendance of clinics within 6 days of delivery needs to be improved
<p>3. Communication with the Community</p> <p>Aim</p> <p>To involve women, families and communities at large must be empowered, involved and participate actively in activities, projects and programmes aiming at improving maternal as</p>	<p>Provincial Department of Health, (Communications and Health Promotion)</p> <p>District Offices, Ward PHC Team, School Health Programme</p>	<ol style="list-style-type: none"> 1. Community health care workers to be trained on Maternal, Neonatal and Reproductive Health issues. 2. Implement the health promoters guidelines 3. Develop and distribution of IEC material, pamphlets and leaflets 4. Disseminate information through the community radio stations on maternal and reproductive health issues 	<p>Provincial MCWH Directorate, Provincial Health Promotion Directorate, District offices, Ward PHC Team</p>	<p>Current educational messages are inadequate for women to make informed decisions regarding pregnancy and contraception choices.</p>

Interface	Level of interaction	Action	Facilitator	Motivation
<p>well as reproductive health in general</p> <p>4. Access to care by the community</p> <p>Aim: Provide access to all pregnant women to appropriate health care</p>	<p>Provincial Emergency Services PDOH, District, Ward PHC Team, District Clinicians</p>	<ol style="list-style-type: none"> 1. Emergency Obstetric Ambulances must be available in each district, with 2 ambulances available in the larger districts 2. Obstetric Ambulances to be based at the district hospitals 3. Referral routes to be utilised appropriately. 4. Implementation of the Situation, Background, and Assessment Recommendation (SBAR) charts at all level 1 facilities. 	<p>Provincial EMS management. Provincial MCWH directors, District clinicians</p>	<ol style="list-style-type: none"> 1. Referral of patients from level 1 care not done timeously 2. More deaths are occurring at level 1 and 2 hospitals
<p>5. Appropriate allocation of resources to health system</p> <p>Aim: To ensure that each institution has the human and other resources and skills needed to achieve MDG 5</p>	<p>PDOH, District</p>	<ol style="list-style-type: none"> 1. Implementation of the Staffing Norms available and filling of all vacant posts 2. Audit of basic equipment available and supply of needed equipment as per basic equipment norms as published in the Guidelines for Maternity Care in South Africa 2007⁷ 3. Support for all ESMOE fire drills in the institutions and districts, and monitoring by the Hospital CEOs of monthly ESMOE training taking place in the institutions 	<p>Provincial MCWH directors, Provincial HR Directors, Hospital CEOs, Provincial pharmaceutical services, District Health Teams</p>	<ol style="list-style-type: none"> 1. Lack of staff, doctors and midwives 2. Shortage of equipment 3. Lack of ICU facilities 4. Lack of blood products

Interface	Level of interaction	Action	Facilitator	Motivation
<p>6. Knowledge and skills of health care provider</p> <p>Aim: To provide health care users with the essential knowledge and skills necessary for achieving MDG 5</p>	<p>District Clinicians, Ward PHC team, Provincial Office, District Office</p>	<ol style="list-style-type: none"> 1. Increase the number of Master trainers in ESMOE to at least 1 at each Regional Hospital 2. Monitor the number of interns and other staff trained in ESMOE at all Hospitals 3. Ensure saturation training in ESMOE within one Health District in Gauteng 4. Introduce practical training in the performance of Caesarean Sections, at District and Regional Hospitals 5. Training in Anaesthesia especially in level 1 institution. Implement Obstetric, Anaesthetic module in ESMOE program at all regional and district hospitals. 6. Provide training on Contraception to all nursing staff at HIV/AIDS and TOP Clinics 7. Strengthen Postnatal Care through extensive training to all Health Professionals on examination of the mother and infant within 6 days and 6 weeks of the delivery. 8. Implement Early Warning Charts 	<p>District Clinicians, District office, Provincial Office, Provincial Anaesthetic facilitator</p>	<ol style="list-style-type: none"> 1. Anaesthesia Related Deaths and deaths due to bleeding Post Caesarean Section still contributes to a significant proportion of the Maternal Deaths 2. Poor management at level 1 hospital occur where the staff is not adequately equipped to manage complicated high risk patients. 3. Delayed reaction to abnormal observations lead complications and maternal deaths.
<p>7. Consultation Skills</p> <p>Aim: To effectively use the health care user – health care provider interface to improve the quality of health of all pregnant women and their babies.</p>	<p>Managers of the Health Care Institutions</p>	<ol style="list-style-type: none"> 1. Monitor client satisfaction through the Quality Assurance Directorate 2. Support the Batho Pele Programme Implementation 3. Promote work ethics among health care workers 	<p>District Clinical Specialists, Ward based health teams</p>	<ol style="list-style-type: none"> 1. Infrequent use of Antenatal Care 2. Substandard Care in the level 1 and level 2 institutions 3. 23% of women are not tested for HIV

Interface	Level of interaction	Action	Facilitator	Motivation
<p>8. Monitoring and Evaluation</p> <p>Aim: To monitor and evaluate progress on MDG 5</p>	<p>Provincial and District offices, and DHIS</p>	<ol style="list-style-type: none"> 1. Monitor Hypertension and Obstetric Haemorrhage in the facilities 6 monthly to identify local modifiable factors to implement remedial action 2. Implement standardised birth register 3. Quality control of data submitted at institutional level. 	<p>District Clinical Specialist teams, District office and Provincial office</p>	<ol style="list-style-type: none"> 1. Hypertension and Obstetric Haemorrhages are still the major direct obstetric causes of maternal mortality 2. Incorrect data leads to incorrect planning and implementation of corrective measures.

Chapter 11.4 KwaZulu-Natal

Introduction

Although KwaZulu-Natal is the third smallest Province in South Africa, it is the country's second most highly populated Province with an estimated population (in 2011) of 10.8 million, making up about 21% of the country's population. 52% of the population is female. Although the majority of the population still live in rural areas, there is a rapidly increasing concentration of residents in the urban areas. In the State sector, with regard to hospitals providing obstetric services, KZN has three Tertiary hospitals, ten Regional hospitals, 38 District hospitals, 19 Community Health Centres and about 580 Primary Health Clinics. These facilities are spread over 11 Districts, with some Districts having only District hospitals and having to refer to another District for regional or tertiary care. Of particular relevance to the causes of maternal death seen in the Province, KZN has the highest prevalence rates of HIV infection of any Province in South Africa (37.4% of antenatal attendees in 2011-12)¹.

Notification of maternal deaths

This report is based on information collected by the Province through the system of notification of maternal deaths. Since 1997, when it became a legal requirement to notify maternal deaths in South Africa, there has been concern about the under-reporting of maternal deaths in the Province, particularly with regard to deaths occurring in the community as opposed to deaths occurring in health facilities. In the 2011-13 triennium, less than 1% of the notified maternal deaths occurred outside health institutions. As there is still no reliable method in place for identifying all the community deaths, it can be assumed that the majority of the community maternal deaths have not been notified, and are therefore missing from this report.

Over the course of the triennium in question (2011-2013), there was, however, an improvement in the identification and timely notification of deaths in the KZN government health facilities. This was evident in the fact that there were fewer late notifications received at the Provincial level. By 2013, there was also good correlation between the deaths recorded in the District Health Information System (DHIS) and the maternal death notifications from the KZN government health facilities.

The improved notification of maternal deaths from KZN government health facilities can at least partly be attributed to the introduction of the District Clinical Specialist Teams (DCSTs) midway through 2012. These teams have had a role of keeping track of the occurrence of maternal deaths within the facilities in their respective districts and of ensuring that the facilities comply with the notification process, irrespective of the site or hospital ward where the woman died.

Some of the private hospitals in KZN have not been routinely reporting maternal deaths. During the triennium, there was some improvement in the communication between the Provincial Office and the private hospitals with several of the private hospitals taking initiative to report their maternal deaths. Meetings between the Provincial MCWH department and private hospital group managers have also taken place with a view to guiding the private hospitals in how to review and notify their maternal deaths. DCSTs have also been liaising with private hospitals in their Districts to encourage an appropriate response to the maternal deaths occurring in the private sector. However, in the

majority of cases, the notifications from the private hospitals are still provided by administrative staff and nursing staff; very few by the obstetrician who managed the case. Overall the number of deaths reported from the private sector in 2011-13 decreased to 18 compared to 30 in the previous triennium (2008-10). It is not clear whether this represents failure to notify the deaths or a genuine reduction in maternal deaths at private hospitals.

From the discussion above, it should be clear that the data presented in this chapter should not be regarded as an accurate epidemiological survey of all maternal deaths in the Province. There is little point in trying to work out an overall maternal mortality ratio (MMR) for the Province, as neither the numerator (number of maternal deaths) nor the denominator (number of live births) is accurately known. However, as we are now confident that the great majority of deaths occurring at KZN government health facilities are being notified, we are able to calculate an institutional MMR, using the number of live births recorded in the DHIS as the denominator. We can assess the Province's progress towards reducing maternal mortality by tracking the trends in this institutional MMR.

The data in this report also provides valuable information about the important causes of maternal death in the Province, and the avoidable factors associated with these deaths. **The value of the data is that it highlights which maternal deaths are most avoidable, and why. This should guide the planning and implementation of strategies to reduce the number of maternal deaths occurring in the future.**

Assessment of maternal deaths

Each notified case was assessed by a pair of Provincial assessors (one midwife and one doctor), who decided on the cause of death, avoidable factors associated with the death, and whether the death was probably or possibly avoidable within the health system. Over the course of the triennium, there were a few changes of personnel within the KZN group of assessors, but overall the numbers of assessors remained stable at about twenty. In addition there were three anaesthetic assessors and one quality assurance assessor. The assessors meet once a month to conduct assessments and discuss problem cases.

Data entry into MaMMAS database

Once a case has been assessed, it must be entered into the computerised MaMMAS database. The statistics presented below are all derived from the database including all data entered up to June 30th 2014. This cut-off date is slightly later than that that used for the overall National report. This allowed an extra case from 2013 (late notification) to be entered. The number of notified cases and MaMMAS-entered cases per year are documented in Table 1 below. From 2011 to 2013 there were only four notified maternal deaths (0.4%) which for various administrative reasons could not be entered into the MaMMAS programme. This discrepancy between the notified cases and the number entered into MaMMAS is smaller than in previous triennia, and reflects more timely notification by facilities and better efficiency in the case assessment and data entry processes.

Table 11.4.1. Number of maternal deaths notified and number entered into MaMMAS per year:

	Maternal deaths notified	Maternal deaths entered into MaMMAS
2011	361	360
2012	328	326
2013	280	279
2011-2013	969 (2008-2010: 1157)	965 (2008-2010: 1133)

Coincidental deaths in pregnancy included

Number of maternal deaths

Compared to the previous triennium (2008-2010), there were 188 fewer maternal deaths notified (16.2% decrease). This is the first triennium since the start of the confidential enquiry where there has been a decrease in notifications, and this no doubt represents a true decrease in maternal deaths as compliance with notification of deaths from government health facilities has gradually improved over the years of the confidential enquiry. Table 2 lists year by year the numbers of KZN maternal deaths reported. It demonstrates that by 2013 the KZN maternal deaths made up a smaller proportion (20.2%) of the total South African maternal death numbers than ever before, indicating a more rapid decrease in maternal deaths in KZN than the National rate of decrease.

Table 11.4.2. Cases reported per year in KZN and percent of deaths in SA

Year	Number reported	% of deaths in SA
1998	188	27.8
1999	252	31.3
2000	238	23.0
2001	243	24.6
2002	262	25.3
2003	280	22.8
2004	280	22.5
2005	273	21.5
2006	389	26.2
2007	362	26.1
2008	370	23.7
2009	394	22.1
2010	393	23.8
2011	361	23.1
2012	328	21.6
2013	280	20.2

Note: the numbers of deaths quoted in the table above are the most up to date figures available in the Province, and include cases which were reported late and hence did not get reported in the previous Saving Mothers reports and cases which were reported after the cut-off date for inclusion elsewhere in the current report. Coincidental deaths in pregnancy included

Institutional Maternal Mortality Ratio

The institutional MMR (iMMR) is calculated using the District Health Information System (DHIS) data to provide the number of live births in the state institutions (the denominator), while the numerator is the number of maternal deaths as captured on the MaMMAS programme. The overall iMMR for KZN (excluding coincidental deaths in pregnancy) **decreased from 192 per 100,000 live births in 2008-10 to 169 in 2011-13**, a 12% decrease, which correlates with the overall decrease in the number of deaths notified (see tables 1 and 2). The KZN iMMR is 10% higher than the South African National iMMR for 2011-13, which is 154 per 100,000 live births.

District analysis

Table 11.4.3 lists the numbers of live births per KZN District, as captured on the DHIS system

Table 11.4.3. Numbers of live birth per KZN District

	Facility live births (DHIS)			
	2011	2012	2013	2011-2013
Amajuba (DC25)	8395	8874	9023	26292
eThekwini (Durban)	57242	58103	57220	172565
iLembe (DC29)	10265	10633	10553	31451
Sisonke (DC43)	8493	8583	8385	25461
Ugu (DC21)	11206	13423	13573	38202
uMgungundlovu (DC22)	16596	17031	16280	49907
Umkhanyakude (DC27)	13733	14430	14847	43010
Umzinyathi (DC24)	11262	11566	11209	34037
Uthukela (DC23)	12579	12583	12323	37485
Uthungulu (DC28)	18068	19949	20129	58146
Zululand (DC26)	14345	16377	16168	46890
KwaZulu-Natal	182184	191552	189710	563446

Table 11.4.4. Numbers of maternal death notified per KZN District and iMMR per District

	Maternal Deaths				iMMR			
	2011	2012	2013	2011-2013	2011	2012	2013	2011-2013
Amajuba (DC25)	14	7	11	32	166.77	78.88	121.91	121.71
eThekwini (Durban)	124	114	103	341	216.62	196.20	180.01	197.61
iLembe (DC29)	12	11	20	43	116.90	103.45	189.52	136.72
Sisonke (DC43)	13	14	11	38	153.07	163.11	131.19	149.25
Ugu (DC21)	22	20	23	65	196.32	149.00	169.45	170.15
uMgungundlovu (DC22)	49	59	29	137	295.25	346.43	178.13	274.51
Umkhanyakude (DC27)	10	10	3	23	72.82	69.30	20.21	53.48
Umzinyathi (DC24)	12	7	7	26	106.55	60.52	62.45	76.39
Uthukela (DC23)	17	23	16	56	135.15	182.79	129.84	149.39
Uthungulu (DC28)	58	53	33	144	321.01	265.68	163.94	247.65
Zululand (DC26)	29	8	22	59	202.16	48.85	136.07	125.83
KwaZulu-Natal	360	326	278	964	197.60	170.19	146.54	171.09

All notified deaths including coincidental deaths are included, as the MaMMAS programme cannot filter out coincidental deaths per District

The overall trend is a steady, but modest decline in iMMR across the triennium. However, not all Districts have followed this steady decline. Of particular concern is Ilembe District where the iMMR increased markedly in 2013. Referral patterns for regional and tertiary level services should be taken into account when comparing the iMMR in different Districts. For example it is expected that Uthungulu and Umgungundlovu Districts have a higher iMMR than other Districts as they each provide regional obstetric services for two neighbouring Districts as well as their own. Sisonke (now renamed Harry Gwala), Umkhanyakude, Umzinyathi and Zululand Districts, on the other hand, have only District hospitals, and are expected to refer regional level cases to neighbouring Districts. These four Districts would therefore be expected to have lower iMMR than the others. The iMMR of over 100 per 100,000 in Sisonke and Zululand are therefore are concern.

Distribution of maternal deaths according to age

Table 11.4.5 presents the distribution of maternal deaths according to age of the woman at the time of death. The numbers of deaths reduced in all age categories except at the extremes of maternal

age. The proportion of maternal deaths in the under-20 and over 44 age groups both increased, emphasizing the importance of contraception in these age groups, as most of these pregnancies were probably unplanned

Table 11.4.5. Age of maternal deaths 2011-2013 (2008-10 figures in brackets)

Age at death (years)	Number of deaths	%
<20	111 (110)	11.5 (9.7)
20-24	216 (258)	22.4 (22.8)
25-29	285 (319)	29.5 (28.2)
30-34	199 (243)	20.6 (21.4)
35-39	106 (155)	11.0 (13.7)
40-44	34 (39)	3.5 (3.4)
>44	13 (7)	1.3 (0.6)
Unknown	1 (2)	0.1 (0.2)

Distribution of maternal deaths according to parity

Table 6 presents the distribution of maternal deaths according to parity before delivery. The one noticeable trend is an increase the number of deaths amongst nullipara, who now making up 31% of KZN maternal deaths in 2011-13 compared to 24% in 2008-10. This correlates with the increased proportion of maternal deaths in the under 20 year old age group (see table 5).

Table 11.4.6. Parity of maternal deaths 2011-2013 (2008-10 figures in brackets)

Parity before delivery	Number of deaths	%
0	300 (271)	31.1 (23.9)
1	303 (351)	31.4 (31.0)
2	178 (247)	18.4 (21.8)
3	79 (111)	8.2 (9.8)
4	41 (55)	4.2 (4.9)
5	16 (17)	1.7 (1.5)
6 or more	11 (14)	1.1 (1.2)
Unknown	37 (67)	3.8 (5.9)

Distribution of maternal deaths according to level of care

Table 7 presents the distribution of maternal deaths according to level of care at which the patient died in the 2011-13 triennium, and compares this to the data from 2008-10.

Table 11.4.7. Levels of care at which maternal deaths occurred: 2011-2013 (2008-10 in brackets)

Place of death	Number of deaths 2011-13 (2008-10 in brackets)	% total deaths 2011-13 (2008-2010 in brackets)
Outside health institution	7 (10)	0.7 (0.9)
PHC / CHC	9 (13)	0.9 (1.1)
District hospital	286 (409)	29.6 (36.1)
Regional hospital	550 (572)	57.0 (50.5)
Tertiary hospital	95 (99)	9.8 (8.7)
Private	18 (30)	1.9 (2.6)
All	965 (1133)	100

The main trend seen here is an increase in the proportion of deaths occurring at regional hospitals, with a corresponding decrease in the proportion of deaths at district hospitals. This trend is in keeping with the National finding that unlike the overall iMMR which is decreasing, the iMMR for

regional hospitals is still increasing. This finding raises concern about the quality of care pregnant women are receiving at regional hospitals.

Antenatal booking status of maternal deaths

Table 8 presents the antenatal booking status of women who died.

Table 11.4.8. Antenatal care for maternal deaths 2011-2013

	Number of deaths	%
Received antenatal care	658	68.2
No antenatal care	200	20.7
Unknown	107	11.0

Route of delivery of mothers who died

Table 11.3.9 presents the route by which mothers who died delivered, where applicable. Excluding the undelivered or route of delivery “not applicable” cases, caesarean section was associated with 47% of maternal deaths, compared to 37% of deaths in 2008-10. The background caesarean section rate for all deliveries in the KZN government facilities was about 29% during 2011-13. Caesarean section is increasing in importance as a risk factor for maternal death in KZN.

Table 11.4.9. Route of delivery for maternal deaths 2011-2013 (2008-10 figures in brackets)

	Number of deaths	%
Vaginal (not assisted)	300 (422)	31.1 (37.2)
Assisted vaginal	11 (12)	1.1 (1.1)
Caesarean section	273 (255)	28.3 (22.5)
Undelivered	241 (314)	25.0 (27.7)
Not applicable (miscarriages, ectopic pregnancies)	140 (130)	14.5 (11.5)

Timing of the death

Table 11.4.10 presents the period of the pregnancy in which the maternal deaths occurred. The preponderance of deaths occurring in the post-partum period draws attention to the general need for more intensive post-natal care than tends to be provided currently.

Table 11.4.10. Period of pregnancy when maternal death occurred 2011-13

	Number (%)
Early pregnancy	123 (12.7%)
Antenatal period	197 (20.4%)
Intrapartum	21 (2.2%)
Postpartum	615 (63.7%)
Under anaesthesia	9 (0.9%)

Post-mortems

One hundred and four women who died had a post-mortem examination (10.8%). Although this was only a small proportion of all maternal deaths, it was an increase from the eighty (7.1%) post-mortems that were conducted for maternal deaths in 2008-10.

Anaesthesia

Overall, the number of women (maternal death cases) who had an anaesthetic was 342 (35.4% of all maternal deaths). The anaesthetic may or may not have been related to the death. Table 11 presents the different levels of care at which these anaesthetics were performed.

Table 11.4.11. Level of care at which anaesthetic performed for women who died: 2011-2013

Anaesthetic performed at level	number	% of total maternal deaths who received anaesthetic
Health care centre	1	0.3
District Hospital	98	28.7
Regional Hospital	192	56.1
Tertiary Hospital	24	7.0
Private Hospital	9	2.6

Primary Cause of Maternal Death

Note: The version of the MaMMAS programme used for the 2011-13 database does not allow for easy analysis of causes of maternal death according to Provincial District. Thus all the analysis of causes of death in this chapter refers to KZN Province as a whole.

Table 11.4.12 lists the top five causes of maternal death in KZN in 2011-13.

Table 11.4.12. Primary cause of maternal death 2011-13 (Top 5 causes listed)

	Number (%)
Non-pregnancy-related infections	405 (42.0)
Obstetric haemorrhage	122 (12.6)
Medical and surgical disorders	114 (11.8)
Hypertensive disorders	79 (8.2)
Miscarriage	53 (5.5)

Table 11.4.13 gives a complete breakdown of the primary cause of death for all maternal deaths reported from KZN in 2011-13. The table divides the causes into major categories, under which the causes are broken down into more specific disease entities. For example, the most common subcategory of deaths due to hypertension was **eclampsia**; for obstetric haemorrhage it was **bleeding after caesarean section**; for medical and surgical disorders it was **cardiac disease**.

Table 13. Primary Causes of death, and their subcategories: 2011-2013

Cause of death	Number	% of total
Coincidental cause	14	1.5
- MVA	4	0.4
-Other accidents	2	0.2
-Assault	1	0.1
- Herbal medicine	2	0.2
-Other	5	0.5
Medical and surgical disorders	114	11.8
- Cardiac disease	49	5.1
- Endocrine	2	0.2
- GIT	10	1.0
- CNS	16	1.7
- Respiratory	13	1.3
- Haematological	3	0.3
-Genito-urinary	2	0.2
- Auto-immune	1	0.1
-Psychiatric	7	0.7
-Neoplasm	7	0.7
- Other	4	0.4
Non-pregnancy-related infections	405	42.0
- PCP pneumonia	53	5.5
- Other pneumonia	84	8.7
- TB	114	11.8
- Endocarditis	1	0.1
- Malaria	3	0.3
- Cryptococcal meningitis	15	1.6
- Other meningitis	28	2.9
- Kaposi's sarcoma	9	0.9
- Hepatitis	3	0.3
- Gastroenteritis	20	2.1
- Wasting syndrome	8	0.8
- Complications of antiretroviral therapy	47	4.9
- Other	20	2.1
Ectopic pregnancy	21	2.2
- Less than 20 weeks	18	1.9
- More than 20 weeks	3	0.3
Miscarriage	53	5.5
- Septic miscarriage	35	3.6
- Haemorrhage (non-traumatic)	13	1.3
- Uterine trauma	1	0.1
- Gestational trophoblastic disease	2	0.2
- Following legal TOP	2	0.2
Hyperemesis gravidarum	2	0.2
Pregnancy-related sepsis	50	5.2
- Chorioamnionitis with ruptured membranes	3	0.3
- Puerperal sepsis after NVD	23	2.4
- Puerperal sepsis after Caesarean section	17	1.8
- Bowel trauma at Caesarean section	7	0.7

Cause of death	Number	% of total
Obstetric haemorrhage	122	12.6
- Abruptio with hypertension	9	0.9
- Abruptio without hypertension	8	0.8
- Placenta praevia	5	0.5
- Ruptured uterus with previous c/s	10	1.0
- Ruptured uterus without previous c/s	7	0.7
- Retained placenta	6	0.6
- Morbidly adherent placenta	5	0.5
- Uterine atony	10	1.0
- Vaginal trauma	1	0.1
- Inverted uterus	1	0.1
- Bleeding during Caesarean section	9	0.9
- Bleeding after Caesarean section	38	3.9
- Other PPH not specified	12	1.2
Hypertension	79	8.2
- Chronic hypertension	4	0.4
- Proteinuric hypertension	19	2.0
- Eclampsia	53	5.5
- HELLP	2	0.2
- Liver rupture	1	0.1
Anaesthetic complications	21	2.2
- General anaesthetic	7	0.7
- Spinal anaesthetic	14	1.5
Embolism	11	1.1
- Pulmonary embolism	9	0.9
- Amniotic fluid embolism	2	0.2
Acute collapse - cause unknown	18	1.9
Unknown	55	5.7
- Death at home or outside health services	4	0.4
- No primary cause found	15	1.6
- Lack of information	36	3.7
Total deaths:	965	

Trends in primary cause of death

Table 11.4.14 categorises the primary causes of death into direct and indirect causes, and looks at trends in numbers across the three years of the 2011-13 triennium, as well as comparing these numbers to the previous triennium (2008-10).

With regard to the top five causes of death in KZN, there was a steady drop in non-pregnancy-related infection (NPRI) deaths across the 2011-13 triennium with 141 fewer deaths than in the previous triennium. Hypertensive deaths also fell, with 31 fewer deaths than in 2008-10, and a particularly big drop in 2013. There were fewer miscarriage deaths in 2012 and 2013, compared to the previous three years, leading overall to a modest drop of 12 miscarriage deaths compared to the previous triennium.

On the other hand, deaths due to obstetric haemorrhage and to medical and surgical disorders increased compared to the previous triennium, with an excess of 23 and 28 deaths respectively compared to 2008-10.

Table 11.4. 14. Primary Cause of Maternal Death: numbers and (% of all deaths) for 2011-13 and 2008-10

	2011	2012	2013	2011-13	2008-10
Direct causes				377(39%)	401(35%)
Obstetric haemorrhage	42(12%)	42(13%)	38(14%)	122(13%)	99(9%)
Hypertensive disorders	35(10%)	31(10%)	13(5%)	79(8%)	110(10%)
Miscarriage	24(7%)	14(4%)	15(5%)	53(5%)	65(6%)
Pregnancy-related sepsis	20(6%)	11(3%)	19(7%)	50(5%)	49(4%)
Anaesthetic complications	10(3%)	7(2%)	4(1%)	21(2%)	28(2%)
Ectopic pregnancy	8(2%)	4(1%)	9(3%)	21(2%)	15(1%)
Acute collapse-cause unknown	5(1%)	6(2%)	7(3%)	18(2%)	30(3%)
Embolism	4(1%)	4(1%)	3(1%)	11(1%)	3(<1%)
Hyperemesis gravidarum	0	1(<1%)	1(<1%)	2(<1%)	2(<1%)
Indirect causes				519(54%)	632(56%)
Non-pregnancy-related infections	157(44%)	131(40%)	117(42%)	405(42%)	546(48%)
Medical and surgical disorders	32(9%)	45(14%)	37(13%)	114(12%)	86(8%)
Coincidental causes	5(1%)	6(2%)	3(1%)	14(1%)	17(2%)
Unknown	18(5%)	24(7%)	13(5%)	55(6%)	83(7%)
Total	360	326	279	965	1133

Trends in Institutional Maternal Mortality Ratios (iMMR) per cause of death

Table 15 presents estimates of the iMMR in KZN, both overall and per disease category, for both 2011-13 and 2008-10. The trends in iMMR are similar to the trends in maternal death numbers per cause described above.

Table 11.4.15. Comparison of iMMR per cause of death: 2011-2013 and 2008-10

Cause of death	MMR	MMR
	2008-2010	2011-2013
Direct	68.66	66.91
Hypertension	18.85	14.02
Obstetric haemorrhage	17.12	21.65
Ectopic pregnancy	2.42	3.73
Miscarriage	11.41	9.41
Pregnancy-related sepsis	8.47	8.87
Anaesthetic complications	4.84	3.73
Embolism	0.52	1.95
Hyperemesis gravidarum	0.35	0.35
Acute collapse - cause unknown	5.02	3.19
Indirect	108.95	92.11
Non pregnancy-related infections	94.08	71.88
Medical and surgical disorders	14.87	20.23
Unknown	14.35	9.76
Total institutional MMR	192.31	168.78

Note: maternal mortality ratio (MMR) is calculated per 100,000 live births. Coincidental deaths excluded

More detail on trends in the most common causes of maternal death are presented below:

Trends in deaths due to non-pregnancy-related infections (NPRI)

Table 16 provides a more detailed analysis of the subcategories of deaths due to NPRI, including a year by year analysis over the 20011-13 triennium.

Table 11.4.16. Non pregnancy-related infections (NPRI): subcategories: numbers (% of all maternal deaths): 2011-13

	2011	2012	2013	2011-13
Tuberculosis	47(13)	32(10)	35(13)	114(12)
Other pneumonia	33(9)	27(8)	24(9)	84(9)
Pneumocystis carinii pneumonia	19(5)	18(6)	16(6)	53(5)
Complications of ARV therapy	30(8)	12(4)	5(2)	47(5)
Other meningitis	8(2)	11(3)	9(3)	28(3)
Gastroenteritis	5(1)	7(2)	8(3)	20(2)
Cryptococcal meningitis	4(1)	5(1)	6(2)	15(2)
Kaposi's sarcoma	1(<1)	4(1)	4(1)	9(1)
Wasting syndrome	1(<1)	5(2)	2(<1)	8(<1)
Hepatitis	0	1(<1)	2(<1)	3(<1)
Malaria	0	2(<1)	1(<1)	3(<1)
Endocarditis	0	1(<1)	0	1(<1)
Other	9(3)	6(2)	5(2)	20(2)
Total	157(44)	131(40)	117(42)	405(42)

Implementation of the new national guidelines for ARV therapy began about half-way through 2010, and the results are clearly demonstrated in the table above. The new guidelines raised the CD4 count cut-off for initiating HAART therapy in pregnant women from 200 to 350 cells/mm³, meaning that a much larger proportion of HIV-positive pregnant women were started on HAART than in previous years. This is the major factor that has resulted in the decrease in NPRI deaths in almost all the sub-categories. We should, however, not lose sight of the fact that despite this decrease, NPRIs, and respiratory infections specifically, remain the most common cause of maternal death in KZN.

Deaths due to adverse drug reactions to ARVs

Also clearly demonstrated in table 16 is the unfortunate adverse impact of the new 2010 ARV guidelines, namely an increase in deaths due to complications of ARV therapy. The 2010 ARV guidelines recommended a nevirapine(NVP)-containing HAART regimen as the first-line regimen for pregnant women. NVP was recommended specifically for use by pregnant women as there was concern about possible teratogenic effects of the alternative non-nucleoside reverse transcriptase inhibitor, efavirenz(EFV). NVP, however, was known to have a high risk of skin reactions and hepatitis. With the implementation of these new guidelines, NVP-related reactions led to an unacceptably high number of maternal deaths. Deaths due to complications of ARVs in KZN reached a peak in 2011, with 30 cases notified. An analysis of these 30 cases revealed the following:

- 1 death probably stavudine-related (lactic acidosis)
- 1 death probably tenofovir-related (renal failure)
- 28 deaths probably nevirapine-related (21 liver failure, 6 Stevens-Johnson syndrome, 1 both)
- Of these 28 deaths, recent initiation of a NVP-containing HAART regimen was documented in 23, while in the other 5, recent HAART initiation was documented, without specifying exactly which ARVs were used. However, as the National guideline at the time recommended initiating a NVP-containing regimen, it is highly likely that these 5 women were initiated on a NVP-containing regimen
- Few of these 28 women used other drugs that could have caused their adverse reactions (4 were on isoniazid prophylactic therapy, 2 were on cotrimoxazole)
- Of these 28 women, 13 had a CD4 count above 250cells/mm³, 10 had a CD4 count below 250, and CD4 was not documented in 5.

- Of these 28 pregnancies, only five were documented to have resulted in liveborn babies (three of these were low birth weight-their long-term outcome unknown); in 22 cases the pregnancy ended with fetal loss (including one case of stillborn twins), while in one case the fetal outcome was not documented.

In summary, it became clear that NVP initiated in pregnancy was associated with numerous cases of life-threatening adverse reactions, occurring within a few weeks of initiation. Furthermore, the reactions were not restricted to women with higher CD4 counts, and also had a negative impact on fetal outcome. Thus the objective of preventing adverse fetal outcomes by using NVP instead of EFV was not achieved.

In response to these deaths related to NVP, the National Department of Health amended its ARV guidelines in April 2012. The amendment now recommended that EFV be used rather than NVP in the first-line HAART regimen for pregnant women. This amendment was fully implemented in KZN by the middle of 2012, and has had an obvious impact in reducing the numbers of deaths due to complications of ARVs (see table 16). However, deaths due to complications of ARVs have not been eliminated. There were still five in 2013, by which time another new National ARV guideline was released, now recommending that all pregnant women irrespective of CD4 count be on a HAART regimen during pregnancy. The new first-line regimen is in the form of a single fixed dose combination tablet comprising efavirenz, tenofovir and emtricitabine.

Trends in deaths due to haemorrhage

Table 11.4.17 provides some more detail about the increasing trend in deaths due to obstetric haemorrhage.

Table 11.4.17. Trends regarding deaths due to obstetric haemorrhage

	2008-10	2011-13
Total Haemorrhage deaths	99	122
Previous caesarean section	25 (25%)	45 (37%)
Ruptured uterus with previous CS	3 (3%)	10 (8%)
Death due to bleeding at or post CS	35 (35%)	47 (39%)
Delivered by CS	55 (56%)	80 (66%)
Death at Level 1 facility	47 (47%)	45 (37%)

There is an increasing association between maternal death and caesarean section (CS) overall (see section on **route of delivery** above), but particularly with regard to obstetric haemorrhage deaths. In 2011-13, 39% of haemorrhage deaths were classified as deaths from bleeding at or post CS, but this statistic underemphasizes the relation between CS and haemorrhage deaths, as in fact 66% of all haemorrhage deaths in 2011-13 occurred at or post CS. This apparent contradiction is explained by the fact that some of the deaths which follow CS are classified under other sub-categories of haemorrhage death, such as abruption deaths. Furthermore CS has long-term consequences which are increasingly contributing to maternal death, as demonstrated by the increasing proportion of haemorrhage deaths where there was a previous caesarean section. This includes increasing numbers of deaths due to rupture of the uterus.

These facts about haemorrhage deaths send some clear messages. There is a need to ensure that unnecessary caesarean sections are avoided to reduce both immediate and long-term complications of CS. Interventions are also needed to ensure that there are adequate skills and resources for CS to

be performed safely at all sites designated as CS sites. It is often assumed that most haemorrhage deaths (especially those due to bleeding after CS) occur at district hospital level, but the trend is that an increasing number are occurring at regional or tertiary level. While some of these cases were referred in a critical condition from district hospitals, in many cases the emergency and its management all occurred at the higher level hospital. This indicates the need to focus on all levels of care with regard to preventing and managing obstetric haemorrhage.

Trends in Deaths due to medical and surgical disorders

Table 11.4.18 lists the top three sub-categories of medical and surgical disorders and provides some more detail about the increasing trend in deaths due to medical and surgical disorders.

Table 11.4.18. Trends regarding deaths due to medical and surgical disorders

	2008-10	2011-13
Total deaths due to medical and surgical disorders	86	114
Cardiac disease	37(43%)	49(43%)
CNS disease	8(9%)	16(14%)
Respiratory disease	10(12%)	13(11%)
HIV positive	34(40%)	62(54%)
HIV negative	37(43%)	41(36%)

The reasons for the increase in deaths due to medical and surgical disorders are not obvious and deserve further investigation. To some extent it may reflect better notification of maternal deaths which occur outside maternity units, rather than a true increase. The majority of these deaths being in HIV positive women suggests that at least some of these cases may have been misclassified and should have been in the non-pregnancy-related infections section. However the increasing trend does raise concern about the ability of health care workers and in particular maternity care workers to identify medical disorders such as cardiac disease through basic history taking and examination.

Trends in deaths due to hypertension

Table 19 shows some of the trends regarding hypertensive deaths between 2011-13 triennium and the previous triennium

Table 11.4.19. Trends regarding deaths due to hypertensive disorders of pregnancy

	2008-10	2011-13
Total Deaths due to hypertensive disorders	110	79
Eclampsia	73(66%)	53(67%)
Proteinuric hypertension	26(24%)	19(24%)
Death at Level 1 facility	36(33%)	19(24%)

Fewer deaths from pre-eclampsia and eclampsia in 2011-13 have resulted in a lower institutional maternal mortality ratio for hypertensive deaths in KZN than in any other Province except the Western Cape. Possible factors which have contributed to this encouraging trend are:

- Widespread implementation of calcium carbonate supplementation for all antenatal clients from the booking visit, which may have reduced the incidence of pre-eclampsia and eclampsia
- Clear referral criteria indicating the criteria for referral of pregnant women with hypertension to higher levels of care

- Good compliance with these referral criteria, both from the referring and receiving facilities
- Use of magnesium sulphate prophylaxis for all pregnant women with severe pre-eclampsia, including a loading dose before transfer to a higher level facility
- High care management of severe pre-eclampsia at regional level, with low threshold for delivery

HIV as a risk factor for maternal deaths

HIV status, including numbers on HAART treatment

Table 20 presents the HIV status of mothers who died in 2011-13, as well as a year-by-year breakdown.

Table 11.4.20. HIV Status of mothers who died: 2011-2013

HIV status (categories mutually exclusive)	2011 Numbers (% of all deaths)	2012 Numbers (%)	2013 Numbers (%)	2011-13 Numbers (%)
Negative	76 (21.1%)	80 (24.5%)	75 (26.9%)	231 (23.9%)
Positive (not AIDS, not on HAART)	58 (16.1%)	57 (17.5%)	48 (17.2%)	163 (16.9%)
AIDS not on HAART	80 (22.2%)	67 (20.6%)	25 (9.0%)	172 (17.8%)
HIV Positive on HAART	112(31.1%)	101(31.0%)	115(41.2%)	328 (34.0%)
Declined testing	0	1 (0.3%)	0	1 (0.1%)
Unknown	34 (9.4%)	20 (6.1%)	16 (5.7%)	70 (7.3%)

Note: The wording of the classification of HIV status in the table above is slightly different to that in the main report. The wording as above is to clarify how, by consensus, the KZN assessors interpreted the various categories of HIV status when doing their assessments.

92.7% of the maternal deaths had known HIV status. This compares with 85% in 2008-10, indicating reduced barriers to HIV testing. In particular, women who decline HIV testing are now rarely encountered. Those whose HIV status remained unknown were mostly unbooked patients who died before HIV could be tested, or post-natal patients who presented in a critical condition, and whose antenatal records could not be accessed to confirm HIV status. 74.2% of maternal deaths with known HIV status were HIV positive, compared to 79% in the previous triennium (2008-10). This compares with a background HIV seroprevalence of about 37% for antenatal attendees in KZN during 2011-13. Thus the impact of HIV on maternal death is slightly declining, but it remains a major risk factor for maternal deaths. The numbers of women who had AIDS but died before starting HAART declined through the triennium, suggesting improving efficiency in initiating HAART. However many women still died after starting HAART. This suggests that many women are still starting HAART too late, when they are already critically ill with AIDS-related conditions. A proportion of the deaths in women on HAART were due to complications of HAART.

Causes of death according to HIV status

Tables 11.4.21-23 list the top five causes of maternal death according to HIV status: negative, positive and unknown.

Table 11.4.21. Primary cause of maternal death 2011-2013 (HIV negative women only). Top 5 causes listed.

	Number (%)
Obstetric haemorrhage	57 (24.7)
Medical and surgical disorders	41 (17.7)
Hypertensive disorders	33 (14.3)
Non-pregnancy-related infections	24 (10.4)
Pregnancy-related sepsis	15 (6.5)

Table 11.4. 22. Primary cause of maternal death 2011-13 (known HIV positive women only). Top 5 causes listed

	Number (%)
Non-pregnancy-related infections	375 (56.6)
Medical and surgical disorders	62 (9.4)
Obstetric haemorrhage	57 (8.6)
Miscarriage	35(5.3)
Hypertensive disorders	30 (4.5)
Pregnancy-related sepsis	30 (4.5)

Table 11.4.23. Primary cause of maternal death 2011-13 (for women with HIV status unknown). Top 5 causes listed

	Number (%)
Hypertensive disorders	16 (22.5)
Miscarriage	11 (15.5)
Medical and surgical disorders	11 (15.5)
Obstetric haemorrhage	8 (11.3)
Non-pregnancy-related infections	6 (8.5)

These tables demonstrate that HIV positive pregnant women are at a greatly increased risk of dying from non-pregnancy-related infections than HIV negative women. Otherwise, HIV positive and negative pregnant women are dying from similar causes, but greater numbers of deaths do still occur in HIV positive women for a range of causes including medical and surgical disorders, miscarriage and pregnancy-related sepsis.

Avoidability of deaths

The KZN assessors felt that there was substandard care provided to the patient by the Health System in 688 of the maternal deaths (71.3%) in 2011-13. Of these, 294 maternal deaths (30.5% of all the maternal deaths) were clearly avoidable within the healthcare system (this excludes patient behaviour-related avoidable deaths) (see table 24). Table 25 breaks these avoidable deaths down according to level of care where the death occurred, showing that avoidable deaths occurred at all levels of institution. Table 26 breaks the same avoidable deaths down according to the primary cause of death.

Table 11.4.24. Assessment of avoidability of maternal deaths 2011-13

		Number	Percentage of deaths
1	No suboptimal care	277	28.7
2	Suboptimal care, different management would have made no difference to the outcome	84	8.7
3	Suboptimal care, different management might have made a difference to the outcome	310	32.1
4	Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	294	30.5

Table 11.4.25. Clearly avoidable deaths (category 4 in table 24) within the healthcare system according to level of care where death occurred 2011-13

Place of death	Total number of deaths	Avoidable deaths (%of deaths at that site)
Outside health institution	7	2 (29%)
PHC / CHC	9	3 (33%)
District hospital	286	105 (37%)
Regional hospital	550	161 (29%)
Tertiary hospital	95	19 (20%)
Private hospital	18	4 (22%)

Table 11.4.26. Clearly avoidable deaths within the healthcare system according to primary cause of death 2011-13

Cause of death	Total number of deaths 2011-13	Number of avoidable deaths			Number (%) of deaths avoidable per cause 2011-13
		2011	2012	2013	
Obstetric haemorrhage	122	26	33	29	88(72%)
Non-pregnancy-related infections	405	16	21	15	52(13%)
Hypertensive disorders	79	18	12	6	36(46%)
Miscarriage	53	10	6	9	25(47%)
Medical and surgical disorders	114	8	10	4	22(19%)
Pregnancy-related sepsis	50	6	7	5	18(36%)
Ectopic pregnancy	21	8	3	7	18(86%)
Anaesthetic complications	21	7	4	1	12(57%)
Acute collapse	18	2	2	2	6(33%)
Embolus	11	0	0	1	1(9%)
Hyperemesis gravidarum	2	0	1	0	1(50%)
Coincidental causes	14	0	0	1	1(7%)
Unknown cause	55	5	9	0	14(25%)
Total	965	106	108	80	294(30%)

Table 26 above lists the causes of death in order of absolute number of clearly avoidable deaths (category 4 in table 24). Obstetric haemorrhage contributes the largest number of avoidable deaths. Avoidable deaths due to obstetric haemorrhage, NPRI, and hypertension make up the majority (60%) of all avoidable deaths. The cause of death where the highest proportion of deaths is avoidable is ectopic pregnancy, followed by obstetric haemorrhage and anaesthetic complications.

Avoidable factors

Each maternal death is assessed to see whether there were avoidable factors or missed opportunities which contributed to the death, and whether substandard care was rendered by the health system. The avoidable factors are classified separately according to whether they are patient behaviour-related, administrative or health worker-related. For health-worker-related factors, they were separately analysed according to level of care where the avoidable factor took place. Problems with resuscitation during the acute emergency which directly led to the death are assessed

separately. If inadequate information is available from the case notes to make an assessment about avoidable factors / substandard care, then it is documented that there is lack of information. The remainder of the cases are referred to as assessable cases.

Patient behaviour-related avoidable factors

Table 11.4.27. Patient behaviour-related avoidable factors 2011-13 (Assessable cases: 868)

Description of avoidable factor	Number	Percentage of assessable deaths
No avoidable factor	414	47.7
No antenatal care	152	17.5
Infrequent antenatal care	74	8.5
Delay in accessing medical help	286	32.9
Declined medication/surgery/advice	64	7.4
Family problem	8	0.9
Unsafe termination of pregnancy	11	20.1*
Other	38	4.4

***Note:** the assessable deaths for the avoidable factor “unsafe termination of pregnancy” are restricted to all deaths due to miscarriage (53 cases)

The three most common patient behaviour-related factors overall were:

1. Delay in accessing medical help 286 cases (32.9%)
2. No antenatal care 152 cases (17.5%)
3. Infrequent antenatal care 74 cases (8.5%)

Specifically for deaths from miscarriage, unsafe termination of pregnancy was an important patient-related avoidable factor, occurring in 11 cases (20%) of miscarriage deaths. However, this figure has reduced from 23 cases (35%) in the 2008-2010 report.

Administrative avoidable factors

Table 11.4.28. Administrative avoidable factors 2011-13 (assessable cases: 913)

Description of avoidable factor	Number	Percentage of assessable deaths
No avoidable factor	620	67.9
Transport problem: Home to institution	17	1.9
Transport problem: Institution to institution	55	6.0
Lack of accessibility: Barriers to entry	11	1.2
Lack of accessibility: Other	4	0.4
Delay initiating critical care (Overburdened service)	41	4.5
Lack of health care facilities: ICU	55	6.0
Lack of health care facilities: Blood/blood products	32	16.3*
Lack of health care facilities: Other	41	4.5
Lack of appropriately trained staff: Doctors	72	7.9
Lack of appropriately trained staff: Nurses	28	3.1
Communication problems: Technical	10	1.1
Communication problems: Interpersonal	48	5.3
Other	32	3.5

***Note:** the assessable deaths for the avoidable factor “lack of blood/blood products” are restricted to all deaths due to obstetric haemorrhage, miscarriage and ectopic pregnancy (196 cases)

The three most common administrative factors were:

1. Lack of appropriately trained doctors 72 cases (7.9%)

- | | |
|--|-----------------|
| 2. Transport problem: institution to institution | 55 cases (6.0%) |
| 2. Lack of ICU facilities | 55 cases (6.0%) |

Specifically for deaths from obstetric haemorrhage, miscarriage and ectopic pregnancy (196 cases combined) lack of blood or blood products was the third most common administrative avoidable factor, occurring in 16% of deaths.

Healthcare provider-related avoidable factors

Although the MaMMAS programme does allow for entry of these factors per level of care, there were inconsistencies in the MaMMAS data for KZN regarding the healthcare provider-related avoidable factors per level of care. Therefore the healthcare provider-related avoidable factors are presented in table 29, indicating the number of cases where the specific avoidable factor was present at any level of care, as a percentage of all deaths

Table 11.4.29. Health care provider avoidable factors 2011-13

Category of substandard medical management	Number of deaths where the factor occurred	% of all deaths (965)
Initial assessment	190	19.7
Problem with recognition / diagnosis	313	32.4
Delay in referring the patient	152	15.8
Managed at inappropriate level	103	10.7
Incorrect management (Incorrect diagnosis)	67	6.9
Sub-standard management (Correct diagnosis)	298	30.9
Not monitored / Infrequently monitored	72	7.5
Prolonged abnormal monitoring with no action taken	145	15.0

Overall the three most common healthcare provider-related avoidable factors were (percentages refer to all the maternal deaths):

- | | |
|---|-------------------|
| 1. Failure to recognise the problem or make the diagnosis | 313 cases (32.4%) |
| 2. Substandard management (correct diagnosis) | 298 cases (30.9%) |
| 3. Delay in referring or failure to refer patient to a higher level of care | 255 cases (26.4%) |

Resuscitation problems

Table 30 lists the substandard areas with regard to resuscitation of the patient during the acute emergency which directly led to the death. It is of concern that over a quarter of women were not resuscitated at all. This probably reflects a mixture of lack of competence, and a lack of commitment to patient care on the part of the health care workers.

Table 11.4.30. Substandard aspects of resuscitation 2011-13

Resuscitation problems	Number	% of assessable cases
Lack of information	94	n/a
No avoidable factor	523	60.0
Airway problems	25	2.9
Breathing problems	26	3.0
Circulation problems	76	8.7
Drug problems	14	1.6
Investigation problems	3	0.3
Monitoring problems	15	1.7
Resuscitation not attempted	231	26.5

Summary

- 969 maternal deaths were notified in KZN in the triennium 2011-2013. This is a 16% decrease compared to the previous triennium, and no doubt represents a genuine decrease in the numbers of maternal deaths in the Province.
- The institutional maternal mortality ratio (iMMR) for KZN has dropped from 192 per 100,000 in 2008-10 to 169 in 2011-13, which remains 10% above the National average iMMR.
- The proportion of deaths occurring in under 20 year-olds and in nulliparous women has increased
- 57% of maternal deaths in KZN occurred in regional hospitals, and the proportion of maternal deaths occurring at regional level is increasing. Conversely, the proportion of maternal deaths occurring at District hospitals (30%) has decreased
- There was an increase in the number and proportion of maternal deaths which followed delivery by caesarean section
- 64% of maternal deaths occurred in the post-partum period.
- The most common category of maternal death by far was Non pregnancy-related infections (NPRI), which accounted for 42% of all deaths. These deaths are mostly due to HIV-related infections, with the most common sub-category being deaths due to tuberculosis (12% of all maternal deaths)
- The next most common causes of death in order were: obstetric haemorrhage (biggest contributor: bleeding during or after caesarean section), medical and surgical disorders (biggest contributor: cardiac disease), hypertensive disorders of pregnancy (biggest contributor: eclampsia) and miscarriage (biggest contributor: septic miscarriage).
- Compared to the last triennium, there was a large decrease in the number of deaths from NPRIs. This is the main reason for the overall reduction in maternal mortality
- There was a peak of deaths due to complications of ARVs (mainly nevirapine (NVP)-related) in 2011, which then declined rapidly in 2012 and 2013 due to an amendment in the National ARV guidelines, which removed NVP from the first-line HAART regimen for pregnant women, replacing it with efavirenz
- Compared to the last triennium, there was a marked decrease in the number of deaths due to hypertensive disorders of pregnancy
- Compared to the previous triennium, deaths due to obstetric haemorrhage and deaths due to medical and surgical conditions increased
- 92.7% of the maternal deaths had known HIV status. Of these 74% were HIV positive, which is a lower proportion than in 2008-10
- 294 deaths (30.5%) were assessed as being definitely avoidable within the healthcare system. This was fewer than in 2008-10 (334 avoidable deaths)
- The most common causes of definitely avoidable death were obstetric haemorrhage (88 deaths), NPRI (52), and hypertensive disorders (36)
- The most common patient-related avoidable factor was delay in accessing medical help, which in many cases probably indicates that the patient had a transport problem. No antenatal care or infrequent antenatal care were also common avoidable factors.

- The most common avoidable factors within the healthcare system were: failure to recognise the problem or make the diagnosis; substandard management (correct diagnosis); delay in referring or failure to refer the patient to a higher level of care. In many of these cases this must imply that the doctors managing the patient were incompetent or inadequately trained. Lack of appropriately trained doctors was specifically documented in 72 cases (7.9%) of maternal deaths
- Resuscitation was substandard in 40% of maternal deaths, including 26.5% of deaths where resuscitation was not even attempted.

Recommendations

- Facility CEOs and Heads of obstetric departments must ensure that every maternal death that occurs in their facility is promptly reviewed. The review of the death must lead to a practical action plan for preventing a recurrence. Relevant role players including those involved in the management of the case, facility senior management and the District clinical specialist team should be involved in the review, and together agree on the plan. Implementation of the plan must be monitored and reviewed for example at the facility or District perinatal meetings.
- Emphasis must be put on making appropriate contraception and family planning methods available to vulnerable groups to prevent unwanted or unplanned pregnancy. These groups include teenagers, over 35s, and those with chronic medical conditions including HIV infection and cardiac disease. Innovative strategies are needed to achieve this, for example taking family planning services to high schools and work places, and using community care givers to improve uptake of and compliance with family planning methods. Family planning must be integrated into all levels of health care which encounter women of reproductive age including specialist medical clinics (eg cardiology clinics and HIV clinics). The newly available sub-dermal implant must be promoted as it is a highly effective contraceptive method. All family planning providers must be trained in its insertion and removal including all doctors working at District hospitals and in specialist obstetrics and gynaecology departments.
- Obstetric care at regional hospitals across the Province needs to be supported and improved. This will require prioritisation of the filling of specialist obstetrics and gynaecology (O+G) posts and O+G medical officer posts at regional hospitals so that a functional regional level service can be provided. This is essential for supporting the service at District level as well as for providing quality training for medical students, interns and registrars.
- On-site midwife-run delivery units should be set up at those regional hospitals whose labour wards are currently overcrowded with large numbers of low-risk women in labour. This will ease the burden on the hospital labour ward and allow appropriate care to be given to high-risk women. New midwife posts need to be created for this, and priority put on filling them.
- Senior doctors working in maternity departments at hospitals must regularly audit the indications for the caesarean sections (CS) performed with a view to reducing the numbers of unnecessary CS, and ensuring that CS are performed timeously when indicated
- Hospital CEOs must ensure that the caesarean section (CS) service in their hospital complies with South African guidelines for safe CS. If this is not possible due to a lack of resources then the District/Province must consider closing the CS service at that site and moving it to a site where a safe CS service can be provided.

- Post-natal care in general needs to be intensified. Policies and protocols governing post-natal care must be available in all facilities conducting deliveries and post-natal care, and must be followed. Pregnant women need to be linked to their community care giver who must be involved in providing post-natal care to strengthen the facility-based post-natal care service
- The scope of duties of community care givers with respect to pregnant women must include: diagnosis of pregnancy (urine pregnancy tests), encouraging early antenatal booking and compliance with antenatal visits, encouraging compliance with medications and supplements, and post-natal home visits.
- Maternity waiting homes should be available at all delivery sites where pregnant women experience transport difficulties in accessing the hospital when in labour. Community care givers could be involved with maintaining these shelters and ensuring they are used appropriately.
- Facility managers must ensure that HIV care of pregnant women is integrated into maternity care, including initiation and management of ARVs, and screening for, diagnosis and management of opportunistic infections including TB. This requires all midwives and doctors managing maternity care to be trained in the latest National ARV guidelines and to be competent in all aspects of the routine care of HIV positive pregnant women.
- District clinical specialists must ensure that clear and consistent referral patterns and referral criteria for risk factors and problems in pregnancy are available to all health care practitioners caring for pregnant women. These criteria must be available both at the referring site and at the receiving site. Facility managers must ensure that they are followed.
- Ongoing training on the recognition and management of conditions commonly causing maternal deaths must be provided for doctors and midwives working at all levels of care. This must include training in resuscitation skills. Facility managers must ensure that regular ESMOE fire drills are conducted (at least monthly) for all relevant staff. District Clinical specialists must support this process.
- All State facilities in KZN must be able to either offer TOP services or refer eligible clients to a site within the District which offers free TOP services. All sites providing TOP must be able to provide the option of medical TOP for suitable clients.

Reference

1. The 2012 National Antenatal Sentinel HIV and Herpes Simplex type-2 Prevalence Survey South Africa, National Department of Health.

Chapter 11.5: Limpopo

Introduction

The Province of Limpopo is situated in the north of the Republic of South Africa. It shares borders with the provinces of Gauteng, Mpumalanga and North West. It also shares borders with the Republics of Mozambique in the east, Zimbabwe in the north and Botswana in the west. The province covers an area of 123 910 km² with an estimated population of 5.4 million people, accounting for 10.9% of the population in the Republic of South Africa which is estimated at close to 50 million. This makes Limpopo the fourth most populated province in the country. Approximately 80% of the population in Limpopo province is rural based this situation greatly impacts on the population's capacity to acquire education which in turn influences the potential for employment in the formal economic sector.

The province consists of five districts with 443 clinics, 27 Community health centres, 30 district hospitals, 4 regional hospitals and one tertiary which is a complex of 2 hospitals.

Despite the increase in the number of clinics providing a full package of PHC services the Department still experience challenges of shortage of nurses, doctors and allied health professionals visiting clinics.

Maternal death notification process has improved because deaths taking place at home and in the private sector are reported, however there is a need to strengthen the flow of files.

Previous reports reflected non pregnancy related infections as the leading cause of deaths, in line with the challenge faced by the country in overcoming HIV and AIDS. Hypertensive disorders in pregnancy were the highest direct causes of maternal deaths.

Deaths reported

Limpopo reported 255, 257 and 247 maternal deaths in 2011, 2012 and 2013 respectively adding up to 759, but only 749 files for the triennium were entered in the national data base.

Table 11.5.1. Cases reported per year and percent of deaths in SA

Year	Number reported	% of deaths in SA
1998	27	4.0
1999	63	7.8
2000	88	8.5
2001	71	7.2
2002	72	7.1
2003	108	8.8
2004	101	8.6
2005	181	14.3
2006	199	13.7
2007	211	15.4
2008	232	14.3
2009	229	11.1
2010	210	12.0
2011	255	13.5
2012	257	13.3
2013	247	12.2

Demographic data**Table 11.5.2. Comparison of age and parity in the two reports 2011 – 2013 and 2008-2010**

Age	Number	2011-2013		2008-2010	
		%	%	%	%
<20	45	6.1	7.6		
20-24	135	18.2	18.8		
25-29	199	26.8	23.7		
30-34	190	25.6	24.2		
35-39	112	15.1	18.3		
40-44	49	6.6	6.5		
45+	12	1.6	1.0		
Unknown	1	0.1	0		

Parity	Number	2011-2013		2008-2010	
		%	%	%	%
0	221	29.5	34.7		
1	186	24.8	13.6		
2	148	19.8	19.5		
3	91	12.1	12.2		
4	47	6.3	7.7		
5	23	3.1	3.5		
6+	21	2.8	2.5		
Unknown	12	1.6	6.2		

Compared to the 2008-2010 triennium, in 2011-2013 there was a significant reduction in the percentage of mothers who died in the age group of 35-39 (3.2%) and a significant increase of maternal deaths in the age group 25-29 (3.1%)¹. A significant reduction of deaths was marked for nulliparous group in 2011-2013 triennium-5.2% with relative increase (11.2%) of deaths noted in the parity 1 group. Anc survey

Table 11.5.3. Comparison of levels of care where maternal deaths occurred between 2011-2013 and 2008-2010

Level	2011-2013		2008-2010	
	N	%	N	%
Home	30	4.0	8	1.3
CHC	9	1.2	10	1.7
Level 1	369	49.3	297	49.8
Level 2	125	16.7	131	22.0
Level 3	208	27.8	141	23.7
Private	8	1.1	9	1.5

In 2011-2013, the majority of deaths continue to occur in level one while there is a significant increase of deaths reported from home-outside facility deaths as compared to 2008- 2010 triennium. Deaths reported from level 2 have reduced (7.3%) while those reported from level 3 have increased (4.1%) in 2011-2013 triennium.

Table 11.5.4. Comparison of HIV testing between 2011-2013 and 2008-2010

HIV Status	2011-2013		2008-2010	
	N	%	N	%
Positive (not AIDS)	78	10.4	97	16.3
Negative	272	36.3	166	27.9
Decline testing	3	0.4	1	0.2
AIDS not on HAART	91	12.1	86	14.4
AIDS on HAART	203	27.1	108	18.1
Unknown	102	13.6	138	23.2

The proportion of women who die with an unknown status has reduced by 9.6% in the 2011-2013 triennium as compared to 2008-2010 indicating an improved effort to screen mothers for HIV, while the deaths of mothers with a known status but on HAART have increased by 9.0%-(possibly due to the challenge of treatment started late)

Table 11.5.5. Antenatal care attendance between 2011-2013 and 2008-2010

ANC	2011-2013		2008-2010	
	N	%	N	%
Attended	516	68.9	365	61.2
Not attended	171	22.8	145	24.3
Unknown	62	8.3	86	14.0

In the 2011-2013 triennium, the proportion of mothers who attended antenatal care has increased, while there is a slight reduction in the proportion of those that did not attend. The proportion of those with unknown status has reduced; correlating with the increase in those that attended.

Table 11.5.6. Comparison of method of delivery of maternal deaths between 2011-2013 and 2008-2010

Method of delivery	2011-2013		2008-2010	
	N	%	N	%
Vaginal	252	33.6	244	40.9
Assisted	10	1.3	5	0.8
Caesarean sections	188	25.1	123	20.6
Undelivered	217	29.0	173	29.0
Not applicable	82	10.9	51	8.6

In 2011-2013 triennium, the number of mothers who died undelivered remains the same, while deaths associated with caesarean sections have increased; indicating the need to improve surgical skills and probably influencing an increase in the number of deaths due to the obstetric haemorrhage as the 1st direct cause of maternal deaths (in the 2011-2013 triennium).

Table 11.5.7. Comparison of anaesthesia between 2011-2013 and 2008-2010

Level	2011-2013			2008-2010		
	N	% of anaesthetic performed	% of total deaths occurring at this level	N	% of anaesthetic performed	% of total deaths occurring at this level
Health care centre	0	0	0	2	1.5	20
Level 1	95	43	25.8	67	51.5	22.6
Level 2	41	18.6	32.8	25	19.2	19.1
Level 3	79	35.8	38	26	20.0	18.4
Private	6	2.7	75	5	3.8	55.6

There is an increase in the number of mothers who had anaesthesia performed at level 3 of care and a relative increase in the % of mothers who had anaesthesia performed and died at all levels of care in 2011-2013 triennium as compared to 2008-2010 triennium.

Primary cause of death and Final and contributory causes of death

Table 11.5..8. A comparison of primary obstetric causes of death between 2011-2013 and 2008-2010

Primary Obstetric Cause	2011-2013		2008-2010	
	N	%	N	%
Direct	394	54.2	297	50.9
Hypertension	119	15.9	82	14.0
PPH	82	11	68	11.6
APH	46	6.1	37	6.3
Ectopic pregnancy	22	2.9	9	1.5
Abortion	31	4.1	23	3.9
Preg. Related Sepsis	39	5.2	22	3.8
Anaesthetic related	36	4.8	34	5.8
Embolism	8	1.1	16	2.8
Acute coll.	11	1.5	7	1.2
Indirect	295	40.6	273	46.7
Non preg. Infect. (AIDS)	229	30.6	212	35.3
Pre-exist Med Dis	66	8.8	61	10.4
Unknown	38	5.2	14	2.3
Total	727	100	577	100

The causes of death in the triennium 2011-2013, are the same as in the previous triennium - obstetric haemorrhage is still the first highest direct cause of death at 17.1% (shortages or inconsistent supplies of haematenics and challenges with competence in surgical skills). Compared to 2008-2010, hypertensive disorders in pregnancy have increased by 1.9% (inconsistent supplies of calcium) and anaesthetic related deaths have reduced by 1% in 2011-2013 triennium. Deaths due pregnancy related sepsis have increased by 2.6% in 2011-2013 (triennium) calling for intensified measures in managing postnatal care.

Avoidable factors, missed opportunities and substandard care

Table 11.5..10. Avoidable factors, missed opportunities and substandard care for all cases

Category	% of avoidable factors in assessable cases	
	2011-2013	2008-2010
Patient orientated	47.8	50.1
Administrative factors	60.6	37.8
Health worker related emergency management problems		
- Primary level	55.5	48.1
- Secondary level	14.4	30.8
- Tertiary level	13.6	16.8
Resuscitation	65.8	31.0
Clearly avoidable deaths	21.0	

In the 2011-2013, there was an increase in administrative related avoidable factors, suggestive of the need to strengthen health worker training and health systems in the province.

Table 11.5.11. Avoidable factors, missed opportunities and substandard care with respect to Patient orientated problems for all cases

Major Problems	% of assessable deaths with avoidable factors	
	2011-2013	2008-2010
	(n=749)	(n=596)
No avoidable factor	43.9	44.3
No antenatal care	15.9	16.1
Infrequent antenatal care	7.6	3.7
Delay in seeking medical help	23.5	25.2
Unsafe abortion*	0.5	29.1
Other	3.7	9.4

The 2011-2013 triennium data reflect a significant reduction in unsafe abortion by 28.9% probably due to an improvement in access to safe abortion and use of contraception by women. However, patient education and community empowerment need to be strengthened to reduce delay in seeking medical attention.

Table 11.5.12. Avoidable factors, missed opportunities and substandard care with respect to administrative problems for all cases

Major Problems	% of assessable deaths with avoidable factors	
	2011-2013	2008-2010
	(n=749)	(n=596)
No avoidable factors	33.4	58.1
Transport problem home to institution	0.9	1.2
Transport problem between institutions*	4.3	4.7
Barriers to entry	0.8	1.0
Lack of accessibility	1.3	0.5
Lack of health care facilities	3.1	1.3
Lack of ICU	6.3	1.3
Lack of blood products**	2.0	16.2
Lack of personnel	0.0	0.0
Lack of appropriately trained staff	57.2	15.6
Communication problems	2.9	1.8
Other	7.2	10.6

* Denominator number of people transferred

** Denominator number of women requiring urgent blood transfusion (obstetric haemorrhage, ectopic pregnancy and miscarriage with haemorrhage)

In the 2011-2013 triennium, there was a significant reduction of maternal deaths associated with shortage of blood and blood products due to improved service of the South African National Blood Service. Lack of personnel was not cited although reported staff experiences in facilities indicate this as a major problem-both doctors and midwives at all levels of care. Lack of appropriately trained staff in 2011-2013 is reflected to be significantly increased (41.6%) probably due to the ESMOE-EOST training started late in 2012 coupled with improved assessment noting the fact and lack of clinically competent staff.

Table 11.5.13. Resuscitation problems

Resuscitation problems	Number	Percentage of deaths where information available and resuscitation attempted	Distribution of resuscitation problems
Lack of information	47		
No avoidable factor	209	41.1	
Airway problems	20	3.9	6.7
Breathing problems	69	13.6	23.0
Circulation problems	140	27.5	46.7
Drug problems	18	3.5	6.0
Investigation problems	30	5.9	10.0
Monitoring problems	23	4.5	7.7
Resuscitation not attempted	242		
Resuscitation attempted and have information	509	100.0	
Cases with resuscitation problems	300		

Circulation problems at 27,5% were cited to be the main resuscitation problems correlating with obstetric haemorrhage as the 1st direct cause of maternal deaths in 2011-2013 and 2008-2010 triennia

Table 11.5.14. Health Worker orientated problems per level of care

Medical management problems	1° Level Number	1° Level % of deaths	2° Level Number	2° Level % of deaths	3° Level Number	3° Level % of deaths
Initial assessment	74	13.1	12	8.5	12	8.7
Problem with recognition / diagnosis	118	20.9	34	23.9	25	18.1
Delay in referring the patient	51	9.0	13	9.2	4	2.9
Managed at inappropriate level	51	9.0	11	7.8	0	0.0
Incorrect management (Incorrect diagnosis)	47	6.0	6	4.2	8	5.8
Sub-standard management (Correct diagnosis)	158	8.3	46	32.4	62	44.9
Not monitored / Infrequently monitored	25	4.4	10	7.0	8	5.8
Prolonged abnormal monitoring with no action taken	42	7.4	10	7.0	19	13.8
Number assessable cases	566		142		138	

The health worker related avoidable factors remain high- problem recognition and initial assessment at level 1; substandard management (with correct diagnosis) and problem recognition at both levels two and 3 in the triennium 2011-2013 are the most contributory factors of maternal deaths related to medical management problems that may result in inappropriate interventions. Audits of records confirm the findings as cited above and training in ESMOE-EOST will probably improve the outcomes in the future.

Table 11.5.15. Avoidable deaths per disease category

Primary Obstetric Cause	2011-2013	
	n	%
Direct	331	84.0
Hypertension	89	74.8
Obstetric haemorrhage	119	93.0
Ectopic pregnancy	19	86.4
Miscarriage	23	74.2
Preg. Related Sepsis	36	92.3
Anaesthetic related	35	97.2
Embolism	5	62.5
Acute coll.	5	62.5
Indirect	175	59.3
NPRI	96	41.9
Pre-exist Med Dis	36	54.5
Unknown	16	3.1
Total	522	

Discussion

Limpopo reported 759 maternal deaths for the triennium 2011-2013 but only 749 were captured on MaMMAS. Reporting of maternal deaths that occurred outside facility were 30 in the 2011-2013 triennium and maternal deaths in early pregnancy were also reported (<13weeks).

Demographic data indicates that deaths between the ages 25-29 have increased by 3.1% whereas for the ages 35-39 have reduced by 3.2% for the triennium 2011-2013; with more maternal deaths in age groups 25-29 and 30-34 compared to other age groups; indicating a need to strengthen contraception services.

Obstetric haemorrhage remains the highest direct cause of maternal deaths at 17.1% in the triennium 2011-2013 reflecting the challenge faced by the province in respect of availability of skilled health workers (lack of appropriately trained staff 57.2 %) and drug supply in primary health care facilities. The avoidable deaths for this category were 93 %.

The five major causes of maternal deaths in Limpopo in the triennium 2011-2013 are:

1. Non Pregnancy related infections (30.6%)
2. Obstetric haemorrhage (17.1%)
3. Hypertensive disorders (15.9%)
4. Pre - existing Medical and Surgical disorders (8.8%)
5. Pregnancy related sepsis (5.2%)

Deaths of mothers with a positive HIV status were at 49.6% probably due to poor management of HIV status and opportunistic infections or delayed initiation of ART during antenatal, intrapartum and postnatal care. Deaths of mothers due to an unknown HIV status were reduced significantly from 23.2% in 2008-2010 to 13.6% in 2011-2013.

Committed efforts to trace defaulters and test women would contribute significantly towards reduction of maternal mortality.

Shortage of skilled midwives and doctors including specialists continue to be a challenge faced by the province in the reduction of maternal deaths as evidenced by health worker related avoidable factors due to problems in medical management of cases- core of clinical competence- that affects the quality of management of clients.

Recommendations

- Strengthen the Implementation of training on Essential Steps in Managing Obstetric Emergencies (ESMOE-EOST).
- Improve the audit of implementation of Basic Ante Natal Care (BANC) and labour records
- Drills on management of obstetric emergencies to be conducted at all levels of care.
- Strengthen Postnatal Care
- Strengthen contraception services
- Implement 2nd trimester termination of pregnancy.
- Promote the use of guidelines during training of doctors and midwives
- Appoint Obstetrician and Gynaecology specialist in regional hospitals
- Emergency obstetric ambulances to be made available per municipality.
- Maternity waiting homes to be established

- Haematinics to be consistently available at all levels of care
- Essential equipment and surgical supplies to be consistently available at all levels of care
- WBOTS
- PARTNERSHIP WITH PRIVATE SECTOR
- HIV

Chapter 11.6: Mpumalanga

Introduction

Mpumalanga Province is in the northeastern part of South Africa and is bordered by two countries; Mozambique to the east and Swaziland to the south-east. Mpumalanga shares common borders with the Limpopo Province to the north, Gauteng Province to the west, Free State Province to the south-west and KwaZulu-Natal to the south east. The Mpumalanga Province has a land surface area of 76 495 km square that represents 6.3% of South Africa's total land area.

According to the 2011 South African Census, Mpumalanga experienced a 20% growth in population from 3,365,554 of 2001 to 4,039,939 in 2011, which makes the province to have the sixth largest share of the South African population. About 66% of its total population lives in rural areas. Poverty is prevalent. Unemployment is rife with the highest percentage of unemployment being at Ehlanzeni (35%), followed by Gert Sibande with 33% and Nkangala at 32% (Census 2001); about 88% of the population relies on the Public Health sector for provision of health services. (StatsSA; Community Survey 2007). In 2013 the population was estimated at 4127071.

Mpumalanga's economy is primarily dependent agriculture, mining, manufacturing, tourism and electricity generation. The capital city of Mpumalanga is Nelspruit, which is one of the fastest growing cities in South Africa. Other main towns and their economic activities, include:

- Emalahleni – mining, steel manufacturing, industry, agriculture;
- Ermelo – forestry, agriculture and mining
- Middelburg – stainless steel production, agriculture;
- Secunda – power generation, coal processing;
- Mashishing – agriculture, fish farming, mining, tourism;
- Malelane – tourism, sugar production, agriculture; and
- Barberton – mining town, correctional services, farming centre.

Census 2011 indicates that Mpumalanga population grew from 3 365 554 to 4 039 939. The province comprises of three districts and nineteen municipalities.

The topology of the country is characterized by the Drakensberg mountain range that make seemingly short distances difficult to traverse (see map). There is also the lowveld, home to the Kruger National Park, wild animals and mosquitoes, while the Highveld is known for the cold and polluted air because of coal and other mines. Professional health workers find these conditions unattractive, thus Mpumalanga suffers from paucity of professional and managerial leadership with frequent change in the leadership, especially within the health sector. This is the environment in which women of Mpumalanga fall pregnant and deliver; it is under these circumstances that they access help when in need. It is under these circumstances that babies are born and nurtured till adulthood. It is under these circumstances that the majority of women in Mpumalanga die. Major transport routes, such as the N3 and N4, traverse the province, making transmission of HIV easy

low number of births at referral (secondary) level is further evidence of the non-functionality of the regional hospital in general. There is also no tertiary hospital in Gert Sibande district; district hospitals refer their cases to the tertiary hospital (Witbank Hospital) in Nkangala District.

Nkangala District, while having a tertiary hospital, has no regional hospital. The tertiary hospital, while not equipped to meet the challenges, accepts referrals from district hospitals and CHCs from Nkangala and Gert Sibande hospitals.

Table 11.6.2. The population per district

District	Population	
	Community survey	Maternal deaths 2011-2013
Ehlanzeni	1714048	156
Gert Sibande	1056179	109
Nkangala	1357744	134
Total	4127971	399

The most populous district in Mpumalanga is Ehlanzeni. It contributes the greatest number of maternal deaths, but is the lowest in terms of the maternal mortality ratio. Gert Sibande district refers most complicated cases to Nkangala (Witbank Hospital) and the remaining cases to Ehlanzeni district (Rob Ferreira Hospital). Taking this fact into consideration, the maternal mortality ratio in Gert Sibande is high. Long distances and poverty make it difficult for many people to have access to health services when in need. Patients rely on the Emergency Medical Services (ambulances) and public transport.

Deaths reported

The deaths reported are those that either happened in the health facilities or that happened outside health facilities but were known to the health care system. Community maternal deaths are not recorded, nor are they interrogated properly. Deaths that occur in the private sector, however, are recorded. Mpumalanga is one of the few provinces that include deaths in private in the overall mortality statistics. The process for the review of these deaths, however, is varied.

Table 11.6.3. Cases reported per year and percentage of deaths in SA

Year	Number reported
1998	66
1999	72
2000	128
2001	97
2002	98
2003	120
2004	75
2005	74(89)
2006	108(107)
2007	87(98)
2008	127
2009	122
2010	145
2011	148
2012	136
2013	115

The mortality statistics in general reflect the contribution of the population to the national populace, namely about 8 percent. Low figures of maternal mortality contribution may be due to

underreporting rather than a reflection of improved survival. The figures in general show very little change in the mortality patterns.

Demographic data

Table 11.6.4. Comparison of the deceased's age and parity in the two triennial reports 2011-2013 and 2008-2010

Age	Number	2011-2013 %	2008-2010 %	Parity	Number	2011-2013 %	2008-2010 %
<20	38	9.5	10.4	0	126	31.6	28.2
20-24	66	16.6	21.1	1	97	24.3	28.5
25-29	124	31.1	25.7	2	74	18.5	21.4
30-34	79	19.8	21.9	3	48	12.0	6.4
35-39	66	16.5	14.2	4	26	6.5	6.6
40-44	25	6.3	5.3	5	5	1.3	2.3
45+	1	0.3	0.8	6+	7	1.8	2.8
Unknown	0	0	0.5	Unknown	16	4.0	3.8

More than 75% of the women who died were under the age of 35 years, making this period a tragedy, as these are young lives that are lost in terms of productivity and development for the province. Women who die are also mostly those who had four (4) previous births and less; not necessarily those who would be considered to be at high risk by orthodox considerations! Those less than 20 years did not contribute inordinately to the total mortality burden.

Table 11.6.5. Comparison of level of care where maternal death occurred between 2011-2013 and 2008-2010

Level	2011-2013		2008-2010	
	N	%	N	%
Place				
Home	11	2.8	11	2.8
CHC	3	0.8	4	1.0
District	211	52.9	240	61.1
Regional	59	14.8	95	24.2
Tertiary	90	22.6	30	7.4
Private	25	6.3	14	3.6

Most women died at **District Hospital level**. There has been no marked change with regard to this aspect. The marked change in places of death of women is at regional and tertiary hospital. While the majority of women died at district hospital level during both trienna, a greater proportion died in tertiary hospital level in 2011-2013 (22.6%) compared to 2008-2010 (7.4%).

Women should not be dying at a district level facility; there should be an effective referral mechanism to a facility of higher care. These figures highlight the persistent gap in the provision of continued care (figure 11f). Some of the hospitals at district level have limited human and material resources. There are those who deliver very few women; their skills and proficiency in caring for women and newborns is therefore suspect giving the extent of exposure. Some of the hospitals should be considered for downgrading to community health centre status.

Table 11.6.6 Comparison of HIV testing between 2011-2013 and 2008-2010

HIV Status	2011-2013		2008-2010	
	N	%	N	%
Positive	83	20.3	219	54.9
Negative	93	23.3	80	20.3
Unknown	64	16.0	95	24.3
AIDS not on HAART	43	10.8	65	16.5
AIDS on HAART	116	29.1	64	16.3
Declined testing	0	0	3	0.8

Testing for HIV infection amongst the deceased had improved, with no one having declined testing. The HIV positive rate decreased from 54.9% to 20.3%. There has been an improvement in the proportion of those who were on HAART (29.1% vs. 16.3%). While it is encouraging that the overall HIV positivity rate has decreased, one in 5 of the maternal deaths were associated with HIV infection. It is of concern that there were women who were not on HAART yet they died within health facilities.

Table 11.6.7 Antenatal Care attendances between 2011-2013 and 2008-2010

ANC	2011-2013		2008-2010	
	N	%	N	%
Attended	252	63.2	275	70
Not attended	83	20.8	68	17.0
Unknown	64	16.0	51	13.0

Antenatal attendance among the deceased women was lower in the current triennium compared to 2008-2010. About one in 5 women who died did not have evidence that they attended for antenatal care. This is a high number, although it reflects a higher risk of dying if one didn't attend for antenatal care for whatever reason.

Table 11.6.8 Comparison of route of delivery of maternal deaths between 2011-2013 and 2008-2010

Method of delivery	2011-2013		2008-2010	
	N	%	N	%
Vaginal	129	32.3	142	36.1
Assisted	4	1.0	6	1.5
Caesarean section	117	29.3	106	27.0
Undelivered	112	28.1	122	31
Not applicable	37	9.3	18	4.3

There was no marked difference in the method of delivery in the two triennia. The low assisted vaginal delivery rate is cause for concern; vacuum extraction is under-utilised, leading to either higher caesarean section rates or higher perinatal morbidity and mortality rates. Although caesarean sections were performed (about 29.3% compared to 27.0% in 2008-2010), the higher caesarean section case fatality rate shows that caesarean section is not necessarily a safe option (Short report, page 35). Mpumalanga, like Limpopo, Northwest and Eastern Cape need to improve on the provision of safe caesarean sections.

The morbidity from caesarean section is also the result of not having ready access to operating theatre. The major hospitals in the province do not have dedicated obstetric operating theatres; cases have to take turns in the general surgical operating theatre complex.

During this period, there appears to have been an increase in the proportion of women died who died from complications of either ectopic or abortion.

Table 11.6.9 Comparison of anaesthesia between 2008-2010 and 2011-2013

Level	2011-2013			2008-2010		
	Number	% anaesthesia performed	% total deaths occurring at this level	Number	% anaesthesia performed	% total deaths occurring at this level
Total	151	37.8		128		
Health Care Center	0	0	0	0	0	0
District	73	48.3	(211) 34.59%	72	55.8	(240) 30%
Regional	28	18.5	(59) 47.45%	37	28.7	(95) 38.9%
Tertiary	36	23.8	(90) 40%	7	4.7	(30) 23.3%
Private	11	7.3	(25) 44%	12	9.3	(14) 85.7%

The majority of anaesthetic related deaths occurred at district hospital level, with a tendency of less in the current triennium. There was also a decrease in anaesthesia related deaths in the private sector (7.3% in 2011-2013 compared to 9.3% in 2008-2010). This highlights the need for doctors to be skilled in anaesthesia and resuscitation in order to help reduce mortality and morbidity from the anaesthetic and the surgical interventions. Notable improvements occurred at all levels of care in the latest triennium.

Primary cause of death and final and contributory causes of death

Table 11.6.10 Comparison of primary obstetric causes of death between 2008-2010 and 2011-2013

Primary obstetric cause	2011-2013		2008-2010	
	N	%	N	%
Direct	233		203	51.5
Hypertension	70	17.5	52	13.2
PPH See list below	53	13.5	55	14.0
APH See list below	22	5.7	21	5.3
Ectopic pregnancy	13	3.3	6	1.5
Abortion	15	3.8	12	3.0
Preg. Related Sepsis	29	7.3	23	5.8
Anaesthetic related	18	4.5	15	3.8
Embolism	10	2.5	14	3.8
Acute coll.	3	0.8	5	1.3
Indirect	146	36.6	169	43.0
Non preg. Infection	126	31.6	157	40.2
(AIDS)			129	32.7
Medical and surgical disorder	20	5.0	12	3.1
Coincidental cause	6	1.5	4	1.0
Unknown	14	3.5	18	4.6
Total			394	100

Hypertension, bleeding (before and after delivery) and sepsis related to pregnancy are the major causes of maternal deaths. There is an increase in the proportion of women dying from these causes. Deaths from ectopic pregnancy and unsafe abortion show a tendency to increased incidence. This reflects the poor accessibility of contraception and safe termination of pregnancy services in the province. Anaesthetic related causes also show an increase – although marginally so given the small numbers thus considered.

Indirect causes are mainly due to HIV related diseases such as AIDS and tuberculosis. Early diagnosis and prompt initiation of chemotherapy has helped reduce the number and proportion of women

dying from HIV related conditions. The final causes of death are attributed to circulatory collapse/failure, with hypovolaemic shock leading with septic shock being second (table 11f).

Table 11.6.11 Final causes of death

Cause of death	No	%
Circulatory system	182	45.6
Hypovolaemic shock	116	29.1
Septic shock	66	16.5
Respiratory failure	119	29.8
Respiratory failure	119	29.8
Cardiac failure	134	33.6
Pulmonary oedema	55	11.3
Cardiac arrest	89	22.3
Embolism	9	2.3
Renal failure	14	3.5
Liver failure	16	4.0
Cerebral complications	71	17.8
Intracranial haemorrhage	27	6.8
Cerebral oedema resulting in coning	8	2.0
Meningitis	17	4.3
Brain death following hypoxia event	12	3
Unspecified	7	1.8
Metabolic	19	4.8
Maternal keto-acidosis	3	0.8
Electrolyte imbalance	13	3.3
Thyroid crisis	0	0
Lactic acidosis	2	0.5
Other	1	0.3
Haematological	70	17.5
DIC	44	11.0
Severe anaemia	26	6.5
Immune system	111	27.8
Unknown	16	4.0
Home death	11	2.8
Unknown	5	1.3
Other	8	2.0

Table 11.6.12 Avoidable factors, missed opportunities and substandard care for all cases

Category	% avoidable factors in assessable cases	
	2011-2013	2008-2010
Patient orientated	37.8	43
Administrative factors	28.8	25.4
Health worker related emergency management problem	33.8	40.5
- Primary level		
- Secondary level	18.8	8.9
- Tertiary level	1.8	14
Resuscitation	35.8	30.5

Patient oriented factors were identified in about 38% of the cases. The majority of factors were within the health system (administrative, health worker factors). As an example, the majority of women attend for antenatal care, with only about 11.8 percent not having documented any antenatal care. Yet there are cases of no interventions despite abnormal findings. Prophylactic haematenics are often out of stock, and high risk patients not being referred to a higher levels of care. The majority of factors occur in the primary health care level (33.8%) while less are in the secondary level (18.8%).

Table 11.6.13 Avoidable factors, missed opportunities and substandard care with respect to patient orientated problems for all cases

Description	2011-2013		2008-2010
	N	%	%
Lack of information	31	7.8	6.1
No avoidable factors	219	54.9	52.2
No antenatal care	47	11.8	10.4
Infrequent antenatal care	15	3.8	4.3
Delay in accessing medical help	100	25.1	27.7
Declined medication/ surgery/ advice	10	2.5	4.1
Family problems	2	0.5	4.1
Community problem	0		4.1
Unsafe abortion	1	0.3	0.3
Other	0		2

There has been no change in the occurrence of avoidable factors between the two trienniums. Of the avoidable factors, the greatest contributor is the delay in accessing appropriate medical help, followed by lack of antenatal care. These two factors may indicate two problems: the long distances to and among health care facilities and the level of poverty in the province. Antenatal care in some areas is a reflection of ability to travel where facilities are situated.

Table 11.6.14 Avoidable factors, missed opportunities and substandard care with respect to administrative problems for all cases

Description	2011-2013		2008-2010
	N	%	%
Lack of information	26	6.5	3.6
No avoidable factors	260	65.2	71.5
Transport problem: Home to institution	0		0.8
Transport: Institution to institution	18	4.5	1.8
Lack of accessibility: Barriers to entry	4	1.0	0.8
Lack of accessibility: Other	1	0.3	0.5
Delay in initiating critical care (Overburdened service)	19	4.8	3.6
Lack of health care facilities: ICU	13	3.3	3.8
Lack of health care facilities: Blood/ blood products	15	4.0	2.8
Lack of health care facilities: Other	3	0.8	1.0
Lack of personnel			
Lack of appropriate trained staff: Doctors	46	11.5	7.9
Lack of appropriate trained staff: Nurses	17	4.3	5.3
Communication problems: Technical	11	2.8	0.5
Communication problems: Interpersonal	8	2	1
Other	10	2.5	4.8

There continue to be avoidable factors associated with maternal deaths. There is no appreciable difference from the one triennium (2008-2010) to the next (2011-2013). Of concern is the continued human resource shortage. There is a tendency of less availability of doctors in the current triennium.

Clinical associates were trained in order to assist doctors. Mpumalanga has a number of clinical associates. There is, however, no reflection of their role in facilities where there is a severe staff shortage

Table 11.6.15 Health worker orientated problems in all cases

Medical management problems	District		Regional		Tertiary	
	Number	% of deaths	Number	% of deaths	Number	% of deaths
Lack of information	19	4.8	7	1.8	4	1.0
No avoidable factor	246	61.7	318	79.7	389	97.5
Initial assessment	27	6.8	17	4.3	2	0.5
Problem with recognition/ diagnosis	52	13	34	8.5	3	0.8
Delay in referring the patient	20	5.0	8	2.0	0	0
Managed at inappropriate level	23	5.8	4	1.0	0	0
Incorrect management (incorrect diagnosis)	27	6.8	15	3.8	1	0.3
Substandard management (correct diagnosis)	63	15.8	41	10.3	5	1.3
Not monitored/ infrequently monitored	26	6.5	6	1.5	1	0.3
Prolonged abnormal monitoring with no action taken	10	2.5	7	1.8	1	0.3

There is a large number of deaths where there were no avoidable factors (61.7% at district hospital; 79.7% at regional level; 97.5% at tertiary level). This may reflect the degree of rigor applied in investigating the causes of these deaths. In a large number of deaths there was delay in making a diagnosis (52 cases); in 20 cases there was a delay in referring to a higher level. In 15.8% (a rise when compared to 10.3% in 2008-2010) there was substandard management. This may reflect lack of diagnostic and management skills at service delivery level.

However it appears that quality of care increases with the level of care, being low in the district hospitals and highest in the tertiary hospitals. Incorrect management and substandard care remain major contributors to mortality among avoidable factors.

Problem identification also continues to be a challenge at district hospital level. Even when problems are identified, there are problems relating to the further management of these patients, as the hospitals are not appropriately resourced (material and human resources). This leads to inappropriate management

Table 11.6.16 Resuscitation

Resuscitation problems	2011-2013		2008-2010
	Number	% of deaths	% of deaths
Lack of information	18	4.5	3.1
No avoidable factors	243	60.9	66.9
Airway problems	6	1.5	2.5
Breathing problems	21	5.3	6.1
Circulation problems	41	10.3	9.9
Drug problems	4	1.0	1
Investigation problems	4	1.0	0.5
Monitoring problems	12	3.0	3.3
Resuscitation not attempted	71	17.8	12.2

Resuscitation forms part of the interventions. However not all patients were resuscitated or documented to have received what kind of interventions. It is of concern that in the 2011-2013 period the number of those dying has increased.

Table 11.6.17. Avoidable deaths per disease category

Primary obstetric cause	2011-2013		2008-2010	
	N	%	N	%
Direct	197	49.8	203	51.5
Hypertension	55	13.8	52	13.2
Obstetric haemorrhage	67	16.8	76	19.3
Ectopic pregnancy	11	2.8	6	1.5
Abortion	12	3.0	12	3.1
Preg. Related sepsis	24	6.1	23	5.8
Anaesthetic related	18	4.6	15	3.8
Embolism	8	2.1	14	3.6
Acute coll.	2	0.6	5	1.3
Indirect	87	22.4	169	43.0
NPRI	62	15.8	157	39.9
(AIDS)	-	-	129	32.7
Pre-exist Med Dis	12	3.0	12	3.1
Unknown	9	2.3	18	4.6
Coincidental	4	1.3	4	1
Total	284	71.4	394	100

Non-pregnancy related infections were the commonest indirect causes of maternal deaths. However it is probable that there is a real decrease in the proportion of women dying from HIV-related conditions (15.8% vs. 39.9% in 2008-2010).

Discussion

Mpumalanga continues to experience maternal mortality from hypertension, pregnancy related haemorrhage and HIV related conditions. In the triennium 2011 – 2013 49.8% of the women died from hypertension related causes, compared with 51.5% in 2008-2010.

Underlying all these are poor human resources (both quantity and quality), poor infrastructure and unsustainable commodity supply and distribution. The continuing trend in the causes and distribution of maternal deaths may indicate that previous recommendations have not been optimally implemented

Haemorrhage also claimed a lot of lives. There was documentation of instances when women, despite attending for antenatal care on numerous occasions, did not receive haematenics because of stock-outs. In other cases, there were no functioning blood pressure machines. Sometimes the available equipment gave wrong readings because of lack of maintenance.

Infrastructure with debilitated buildings and poor equipment contribute to the inappropriate management of women in pregnancy and childbirth. There were delays in instituting effective and appropriate interventions because of low number of operating theatres. In general, Mpumalanga has low caesarean section rates and high caesarean section case fatality rates. These are due to waiting too long for indicated caesarean intervention, with resultant morbidity and mortality. There are facilities that should not be performing caesarean sections as they fail to provide for timely, appropriate and safe surgical interventions when and if indicated.

The management at facility level needs to be responsive to the identified needs.

Recommendations

The 5 Hs are applicable in Mpumalanga.

Hypertension must be managed appropriately at all levels of care. The equipment for the monitoring of blood pressure must be easy to maintain and use. It is recommended that the baumanometer or sphygmomanometer, rather than the electronic machines, be utilized in the maternity wards because of their dependability and low maintenance. The province must ensure the sustained supply of rapid acting and other hypotensive drugs.

Haemorrhage requires rapid, effective and efficient management if death or severe morbidity is to be avoided. Optimum haemoglobin levels (Hb > 10G%) must be promoted and maintained, especially towards the end of pregnancy.

Primary health care clinics must have oral iron and folic acid supplements and haemoglobinometers. Hospitals must have both oral and injectable iron and folic acid at all times. All hospitals and CHCs must have fresh dried plasma and emergency blood.

Health workers must be capable and equipped to effect life-saving measures. All doctors and midwives must be able and ready to manage bleeding during pregnancy and after childbirth.

Doctors must improve their skills in doing caesarean sections as well as the management of complications arising from this surgical intervention. They also need to have skills in managing patients who would benefit from assisted vaginal delivery (vacuum extraction; forceps) in order to avoid unnecessary caesarean section.

Human Immunodeficiency Viral infection is a major challenge in the whole province, especially in Gert Sibande district. The prevention and early diagnosis and management of HIV are critical for prolonging quality of life for women and children. HIV complicates presentation and management of many conditions; continued professional development is essential for the optimization of the knowledge and skills required to function in this complex environment. The dual epidemics of HIV and TB require committed and consistent effort

Human resources – Mpumalanga must invest in attracting and retaining skilled health care professionals. This will entail making conditions more favourable than they currently are. The infrastructure is also not supportive of promotion of the province among professionals. The high case fatality rate (see C/S case fatality rates per province) points to the need for rationalizing the hospitals so that only hospitals that can assure women of safety following interventions are allowed to offer comprehensive emergency obstetric care.

Doctors and nurses must be trained/retrained in basic management of pregnancy, labour and the postnatal period. They must be able to manage the common complicated pregnancies and deliveries. ESMOE training must be part of the basic training for midwives and doctors, especially interns.

Retired professionals should be recruited in order to fill in the large gaps in the human resource capital. These professionals will also mentor the junior health professionals who often feel neglected and left to deal with complex cases and situations. Clinical associates are a resource and can help in

reducing maternal and neonatal deaths. The current national and provincial political leaderships must be more vocal in supporting the deployment of this cadre of professional health worker.

More advanced midwives must be appointed in Mpumalanga. The continued non-response to abnormal clinical observations and measurements would be avoided.

Decreasing maternal deaths in Mpumalanga entails the following:

1. Attracting and equipping professional health workers by identifying and providing incentives for the scarce resources
2. Continued professional development for clinical associates, doctors, midwives and nurses and the provision of incentives in order to retain scarce resources
3. Rationalizing infrastructure for the management of complicated pregnancy and childbirth conditions. Hospitals need to be rationalized according to the national guidelines as gazetted nationally. Hospitals must provide services 24/7. Dedicated obstetric emergency theatre must be made available in each hospital.
4. Reducing the distance for the patients to get assistance through efficient EMS, functional maternity waiting homes and facility-based transport especially for isolated clinics in hard-to-reach areas.
5. Preventing and managing major contributors to maternal deaths through community engagement and mobilization, and the entrenchment of protocols for the management of HIV, TB and Malaria

There are no new recommendations. Consistent political and administrative visionary leadership is necessary to prevent premature deaths. The frequent changes within the higher echelons of power mean that initiatives are not supported consistently and sustainably.

Chapter 11.7 North West Province

Introduction

North West Province has an estimated population size of 3,597,592 compared to 3,397,363 in the previous triennium. The total female population is estimated at 1,769,938 and 932,869 represent the number of women in reproductive age (15-49). The largest part of the population is living mainly in rural areas as North West is a rural Province. The Province provides some tertiary services at Klerksdorp Hospital and has no medical schools. There are four Regional Hospitals that provide some specialised services with Obstetricians and Anaesthetists appointed in those hospitals. There are 4 Districts, 308 clinics, 62 Community Health Centres and 17 District hospitals. There are 2 Specialised Hospitals that provide Mental Health and Children with Disabilities Health services.

Deaths reported

During the triennium 2011-2013 a total of 284 deaths were reported compared to 392 in 2008-2010. All deaths reported were captured into MaMMAS except for one (1) in 2013 which the patient's file was untraceable. From table 11.7.2. of Demographic Data until the last table 11.7.15 of Assessment of Avoidability, the information is calculated on 280 deaths as the three (3) were lost in the system when the computer was attacked by viruses. The table 11.7.1 below provides detailed information of maternal deaths reported from 1998 until 2013.

Table 11.7.1. Maternal deaths in North West Province

Year	Cases reported per year	% of deaths in South Africa
1998	58	8.6
1999	54	6.7
2000	115	11.1
2001	106	10.7
2002	80	7.9
2003	135	11.1
2004	111	9.5
2005	105	8.3
2006	100	6.9
2007	84	6.1
2008	97	6.2
2009	161	9.1
2010	134	8.8
2011	95	6.3
2012	92	6.4
2013	97	7.0

Demographic Data

Table 11.7.2. Comparison of age and parity in the two reports 2008-2010 and 2011-2013

Age	2008-2010		2011-2013		Parity	2008-2010		2011-2013%	
	No	%	No	%		No	%	No	%
<20	14	3.6	16	5.7	0	141	36	82	29.3
20-24	72	18.4	34	12.1	1	78	19.9	57	20.4
25-29	108	27.6	68	24.3	2	66	16.8	67	23.9
30-34	102	26	59	21.1	3	40	10.2	35	12.5
35-39	59	15.1	43	15.4	4	26	6.6	18	6.4
40-44	17	4.3	14	5.0	5	4	1	14	5.0
45+	19	1	46	16.4	6+	9	2.3	2	0.7
Unknown	1	0.3	0	0.0	Unknown	28	7.1	5	1.8

Table 11.7.3 Comparison of levels of care where maternal death occurred between 2008-201 and 2011-2013

Level	2011-2013		2008-2010	
	N	%	N	%
Home	3	1.1	1	0.3
CHC	26	9.3	34	8.7
Level 1	74	26.4	175	44.6
Level 2	171	61.1	159	40.6
Level 3	1	0.4	21	5.4
Private	5	1.8	2	0.5

Table 11.7.4 Comparison of HIV testing between 2008-2010 and 2011-2013

HIV Status	2008-2010		2011-2013	
	N	%	N	%
Negative	63	16.1	98	35.0
Positive	87	22.2	37	13.2
Declined	2	0.5	0	0
AIDS not on HAART	51	13	48	17.1
AIDS on HAART	86	21.9	72	25.7
Unknown	103	26.3	25	8.9

Table 11.7.5 Antenatal care attendance between 2008-2010 and 2011-2013

ANC	2008-2010		2011-2013	
	N	%	N	%
Received	272	69.4	204	72.9
Not attended	52	13.3	49	17.5
Unknown	68	17	27	9.6
Total	392	100	280	100

Table 11.7.6 Comparison of route of delivery of maternal deaths between 2008 -2010 and 2011-2013

Route of delivery	2008-2010		2011-2013	
	N	%	N	%
Vaginal	154	39.3	95	33.9
Assisted delivery	1	0.3	5	1.8
Caesarean section	64	16.3	69	24.6
Undelivered	135	34.4	82	29.3
Not applicable	38	9.7	29	10.4

Table 11.7.7 Comparison of anaesthesia between 2008 -2010, and 2011 – 2013

Level	2008-2010			2011-2013		
	N	% of anaesthetic performed	% of total deaths occurring at this level	N	% of anaesthetic performed	% of total deaths occurring at this level
Health Care centre	0	0	0	0	0.0	0.0
Level 1	24	35.3	35.3	22	25	25
Level 2	43	63.2	63.2	44	50.0	50.0
Level 3	1	1.5	1.5	0	0	0
Private	0	0	0	5	5.7	5.7

Table 11.7.8 Comparison of primary obstetric causes of death 2008-2010 and 2011-2013

Conditions	2008-2010		2011-2013	
	N	%	N	%
Medical and surgical disorders	33	8.5	23	8.2
Non-pregnancy-related infections	153	39.2	80	28.6
Ectopic pregnancy	7	1.8	5	1.8
Miscarriage	9	2.3	9	3.2
Hyperemesis gravidarum	1	0.3	-	-
Pregnancy-related sepsis	23	5.9	19	6.8
Obstetric haemorrhage	78	20.0	60	21.4
Hypertension	54	13.8	52	18.6
Anaesthetic complications	8	2.1	3	1.1
Embolism	2	0.5	7	2.5
Acute collapse - cause unknown	5	1.3	8	2.9
Unknown	17	4.4	11	3.9
Coincidental Causes	2		3	1.1
Total Deaths	392		280	

Table 13g.9 Causes of death 2011-2013

Cause of death	Number	% of total
Coincidental cause	3	1.1
- MVA	1	0.4
-Other	2	0.7
Medical and surgical disorders	23	8.2
- Cardiac disease	2	0.7
- Endocrine	1	0.4
- GIT	1	0.4
- CNS	2	0.7
- Respiratory	8	2.9
- Haematological	3	1.1
- Psychiatric	1	0.4
- Other	5	1.8
Non-pregnancy-related infections	80	28.6
- PCP pneumonia	15	5.4
- Other pneumonia	15	5.4
- TB	18	6.4
- Cryptococcal meningitis	6	2.1
- Other meningitis	5	1.8
-Kaposi's Sarcoma	1	0.4
- Gastroenteritis	6	2.1
- Complications of antiretroviral therapy	10	3.6
- Other	4	1.4
Ectopic pregnancy	5	1.8
- Less than 20 weeks	5	1.8
Miscarriage	9	3.2
- Septic miscarriage	8	2.9
- Haemorrhage (non-traumatic)	1	0.4
Hyperemesis gravidarum	0	

Cause of death	Number	% of total
Pregnancy-related sepsis	19	6.8
-Chorioamnionitis with ruptured membranes	1	0.4
- Puerperal sepsis after NVD	12	4.3
- Puerperal sepsis after Caesarean section	6	2.1
Obstetric haemorrhage	60	21.4
- Abruptio with hypertension	4	1.4
- Abruptio without hypertension	2	0.7
- Placenta praevia	1	0.4
- Ruptured uterus with previous c/s	3	1.1
- Ruptured uterus without previous c/s	6	2.1
- Retained placenta	8	2.9
- Uterine atony	4	1.4
- Vaginal trauma	1	0.4
- Cervical trauma	3	1.1
- Bleeding during Caesarean section	5	1.8
- Bleeding after Caesarean section	14	5.0
- Other PPH not specified	9	3.2
Hypertension	52	18.6
- Chronic hypertension	1	0.1
- Proteinuric hypertension	18	6.4
- Eclampsia	22	7.9
- HELLP	11	3.9
Anaesthetic complications	3	1.1
- General anaesthetic	2	0.7
- Spinal anaesthetic	1	0.4
Embolism	7	2.5
- Pulmonary embolism	5	1.8
-Amniotic fluid embolism	2	0.7
Acute collapse - cause unknown	8	2.9
Unknown	11	3.9
- Death at home or outside health services	7	2.5
- No primary cause found	1	0.4
- Lack of information	3	1.1
Total deaths:	280	100

Table 11.7.10 Primary obstetric causes of death

Primary Obstetric causes	2008-2010		2011-2013	
	N	%	N	%
Direct	187	48.0	163	58.3
Hypertension	54	13.8	52	18.6
Obstetric haemorrhage	78	20.0	60	21.4
Ectopic pregnancy	7	1.8	5	1.8
Miscarriage	9	2.3	9	3.2
Pregnancy related sepsis	23	5.9	19	6.8
Anaesthetic related	8	2.1	3	1.1
Embolism	2	0.5	7	2.5
Acute collapse	5	1.3	8	2.9
Indirect	186	47.7	117	41.7
Non pregnancy infections	153	39.2	80	28.6
Medical & surgical disorders	25	8.5	23	8.2
Coincidental causes			3	1.1
Unknown	17	4.4	11	3.9
Total	390	100	280	100

Table 11.7.11 Comparison institutional MMR 2008-2010 and 2011—2013

MMR per disease category	2008-2010	2011-2013
Direct	109.45	95.3
Hypertension	31.78	30.5
Obstetric haemorrhage	45.90	35.83
Ectopic pregnancy	4.12	2.89
Miscarriage	5.30	5.2
Pregnancy-related sepsis	13.53	11.56
Anaesthetic complications	4.71	1.73
Embolism	1.18	4.05
Acute collapse - cause unknown	2.94	4.62
Indirect	109.45	63.57
Non-pregnancy-related infections	90.03	49.7
AIDS MMR	80.62	0
Medical and surgical disorders	19.42	13.87
Unknown	10.00	6.93
iMMR	229.50	166.3

Table 11.7.12 Avoidable factors, missed opportunities and substandard care for all cases

Category	2008-2010	% of avoidable factors in assessable cases	2011-2013	% of avoidable factors in assessable cases
Patient orientated	370	47.3	118	42.1
Administrative factors	380	41.1	154	55
Health worker related emergency management problems				
- Primary level	385	39.7	97	34.6
- Secondary level	243	37.9	90	32.1
- Tertiary level	239	3.3	4	1.4
Resuscitation	340	48.5	129	46.1

Table 11.7.13 Patient orientated avoidable factors 2008-2010 and 2011-2013

Description	Number	Percentage of assessable deaths	
		2008-2010	2011-2013
Lack of information	36		5.0
No avoidable factor	195	52.7	52.9
No antenatal care	60	16.2	10.4
Infrequent antenatal care	16	4.3	4.3
Delay in accessing medical help	107	28.9	22.1
Declined medication/surgery/advice	13	3.5	3.2
Family problem	2	0.5	
Community problem	2	0.5	
Unsafe abortion	3	33.3	11.1
Other	9	2.4	6.8
Total			100

Table 11.7.14. Administrative avoidable factors

Description	N	2008-2010		2011-2013	
		Percentage of assessable deaths		N	Percentage of assessable deaths
Lack of information	14		4	1.4	
No avoidable factor	224	58.9	122	43.6	
Transport problem: Home to institution	4	1.1	0		
Transport problem: Institution to institution	18	8.1	13	3.8	
Lack of accessibility: Barriers to entry	4	1.1	2	0.6	
Lack of accessibility: Other	0	0.0	1	0.3	
Delay initiating critical care (Overburdened service)	27	7.1	22	6.4	
Lack of health care facilities: ICU	3	0.8	6	1.7	
Lack of health care facilities: Blood/blood products	7	8.1	3	0.9	
Lack of health care facilities: Other	2	0.5	5	1.4	
Lack of appropriately trained staff: Doctors	84	22.1	70	20.2	
Lack of appropriately trained staff: Nurses	44	11.6	60	17.3	
Communication problem: Technical	0	0.0	4	1.2	
Communication problem: Interpersonal	6	1.6	5	1.4	
Other	12	3.2	29	8.4	
Total			280	100	

Table 11.7.15 Health care provider avoidable factors, 2008-2010 and 2011-2013

	1° Level Number	1° Level % of assessable deaths	2° Level Number	2° Level % of assessable deaths	1° Level Number	1° Level % of assessable deaths	2° Level Number	2° Level % of assessable deaths
Initial assessment	15	3.9	5	2.1	18	6.4	12	4.3
Problem with recognition / diagnosis	41	10.6	22	9.1	28	10	26	9.3
Delay in referring the patient	41	10.6	4	1.6	30	10.7	3	1.1
Managed at inappropriate level	24	6.2	3	1.2	22	7.9	0	0
Incorrect management (Incorrect diagnosis)	33	8.6	11	4.5	11	3.9	13	4.6
Sub-standard management (Correct diagnosis)	69	17.9	52	21.4	37	13.2	49	17.5
Not monitored / Infrequently monitored	11	2.9	17	7.0	10	3.6	6	2.1
Prolonged abnormal monitoring with no action taken	14	3.6	5	2.1	8	2.9	6	2.1

Table 11.7.16 Resuscitation problems Comparison between 2008-2010 and 2011-2013

Description	2008-2010		2011-2013	
	Number	%	Number	%
Lack of information	55		25	8.9
No avoidable factor	175	62.7	127	45.4
Airway problems	6		11	3.9
Breathing problems	28		10	3.6
Circulation problems	54		25	8.9
Drug problems	9		8	2.9
Investigation problems	10		2	0.7
Monitoring problems	25		13	4.6
Resuscitation not attempted	58		72	25.7

Table 11.7.17 Assessment of Avoidability – 2011-2013

	Number	Percentage of deaths
No suboptimal care	82	29.3
Suboptimal care, different management would have made no difference to the outcome	18	6.4
Suboptimal care, different management might have made a difference to the outcome	73	26.3
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	107	38.2
Total	280	100

Discussion

1. Maternal death notification has improved probably due to DCST Outreach programmes that are carried out, maternal morbidity and mortality meetings at facility level, ESMOE and BANC trainings.
2. The MCWH Forum initiated by the MEC for Health and active participation of all Districts has helped to identify areas of substandard care and lessons learnt from these discussions are used to guide health care professionals in avoiding repeating identified occurrences and missed opportunities leading to improved maternity health services and to reduce maternal mortality ratio. These forums are conducted on quarterly basis.
3. More deaths occurred in women in the age category of 25 to 35 years with primigravidae contributed to a large proportion in this group followed by patients who were Para 2 and 1 in that order.
4. The number of patients whose HIV status was unknown and those whose HIV test results were positive have decreased when compared to the numbers in the previous triennium. This decrease can be accounted for by the HCT and other campaigns conducted in the Province.
5. There is improvement in the time of booking as shown by an increase in the number of women booking before 20 weeks and again CARMMA dialogues and awareness campaigns are thought to contribute to this improvement.
6. The unknown ANC has improved due to the inclusion of ANC card in maternity case record, CARMMA dialogues and BANC implementation.
7. The numbers of deaths occurring at Regional Hospitals were noted to have increased and those occurring at District Hospitals to have decreased when compared to the ratio in the previous triennium. This change in the ratios is thought to be due to improvement in transport services through accessing Private ambulances at times when Public ambulances are not available. Availability of referral criteria, outreach of DCST and O&G Specialists, procurement of dedicated helicopter and Obstetric Ambulances by the Province for transportation of patients from District Hospitals to Regional Hospitals were amongst the other things. The helicopter and Obstetric Ambulances are operational and have significantly eased the burden of transport.
8. The cause of concern is the number of deaths following Caesarean sections and the National caesarean section monograph has been launched in the Province to address this concern.
9. The number of women dying undelivered has decreased due to improved access to health services enabling early and timely identification of problems and delivery of those women.

10. Non-pregnancy related infections have decreased dramatically and almost by half because more pregnant women were put on ARVs’.
11. Non-pregnancy infections, Obstetric Haemorrhage and Hypertension are still leading causes of maternal deaths in the Province as it is the situation Nationally although a decreasing trend has been noted in the Province.
12. To address the shortage of ICU beds, the Province is utilizing the concept of Private Public Partnership to access Private ICU facilities.
13. The number of woman dying of unsafe abortion has decreased from 3 to 1 compared to the previous triennium due to Anti-Illegal Abortion marches conducted across the Province led by the Hon. MEC for Health and the availability of reproductive health services.
14. Assessors felt that about a quarter of women would have been saved as different management might have made a difference to the outcome.

Recommendations

The North West Chapter 2011-2013 has clearly identified three conditions that contribute to the majority of preventable maternal deaths, namely Non-pregnancy related infections, Obstetric haemorrhage and Hypertension in pregnancy. These conditions comprise 68.6% of the possibly and probably preventable maternal deaths. The three conditions have many common preventable factors which are mostly related to the knowledge and skills of the health care providers and the challenges within the health care system.

To **Save Mothers Lives** three key aspects of a health system are essential

- Knowledgeable and skilled health care providers
- Appropriately resourced and accessible health care facilities (including equipment and human resources)
- Rapid inter-facility emergency transport system

These three basic building blocks of the health system must be available to all pregnant women; especially the less informed and most disadvantaged people. When all these aspects are in place, rapid declines in the iMMR can be expected, as demonstrated by the drastic reduction of deaths at District Hospitals.

The NCEMD has come up with the **5H's** recommendations and decided to further strengthen these recommendations by adding the **5Cs**, which are aimed more specifically at improving implementation and targeting specific interventions.

The 5 H's are summarised as follows:

- **H**IV
- **H**aemorrhage
- **H**ypertension
- **H**ealth worker training and

- **H** Health system strengthening

The last two (Health worker training and Health system strengthening) are part of the three Basic Building Blocks of a health system as described above. They are essential to achieving the first three Hs (HIV, Haemorrhage, and Hypertension). The **5 Cs** give implementation strategies to move from the two Hs (Basic Building Blocks of the health system) to achieve the three Hs (reduction in maternal deaths due the HIV and TB, Haemorrhage and Hypertension).

The **5 Cs** are summarised as:

- **C**are: Commitment to Quality
- **C**overage
- **C**aesarean section safety
- **C**ontraception
- **C**ommunity involvement

In the North West Province the implementation of the 5C's is as shown in the table below:

How	Who
Care: Commitment to quality	<ul style="list-style-type: none"> - Managers (especially Maternity Operational Managers) and DCST supervise and evaluate HCP to ensure emergency drills are performed regularly and that they have appropriate skills. - Consultative meetings to be conducted with HCP (midwives and Drs) to discuss issues around quality care. - HCPs to make themselves available for training, to participate in drills and to behave in a professional manner. - Operational managers to conduct continuous in-service training on protocols and guidelines. - Hospital and PHC senior managers must visit maternity units, attend M&M meetings and these activities must be included in their KPA's. - Provincial Maternal Death Assessors to share Recommendations at assessors meetings with Districts at DMT's. - Audits to form part of facility managers PMAs - Monthly verification of data by program managers and Local Area Managers must be done at all levels of care.
Coverage	<ul style="list-style-type: none"> - Senior managers have established new facilities to improve accessibility of maternity services and old facilities have been refurbished. - District senior managers and Hospital CEO's have

	<p>established Maternity Waiting Homes and are functional, for example: Dr RSM (8), Bojanala (5), NMM (3) and Dr KK (4).</p> <ul style="list-style-type: none"> - Senior managers to Creation advanced midwifery posts in all the Hospitals and CHC's. - The Province has procured Ten Obstetric Ambulances and distributed them to all Districts in addition to the existing fleet of ambulances and there is a plan in place to procure another ten. - HCP and the community have been trained on MomConnect and pregnant women are registered in the programme. - Doula strategy is practiced at Klerksdorp hospital to support pregnant women, during ANC, labour and PNC and is to be rolled out to other facilities in the Province. - Senior managers to finalize and provide the correct staff establishment according to areas of high priority (including retention strategies). - District senior managers and the DCST TO establish High Risk Clinics in Hospitals & CHCS.
Caesarean section safety	<ul style="list-style-type: none"> - Community Doctors and interns are sent for anaesthetic skills development at Regional Hospitals under the supervision of Specialists to improve safety of caesarean section. - C/section and PPH monographs have been launched and implemented at all Districts. - DCST's are training, monitoring and evaluate drills at all delivery facilities.
Contraception	<ul style="list-style-type: none"> - Learner pregnancy awareness campaigns are conducted at all Districts to promote contraception use to prevent unwanted pregnancies. - HCP are trained on the new contraception policy, Intra Uterine Device and Implanon insertion. - All HCP motivate pregnant women, teenagers and all women of child bearing age to prevent unwanted pregnancies by the use of contraceptives. - Managers at all levels of care ensure availability and access of various modalities of contraceptives at all facilities. - WBOTs use pregnancy screening tool to identify women requiring contraception, and refer them appropriately. - Communities are educated on the importance and the use of MoMConnect.
Community involvement	<ul style="list-style-type: none"> - Awareness campaigns, CARMMA dialogues are conducted on quarterly basis at sub-District level to address maternal and child issues.

	<ul style="list-style-type: none"> - PHC Re-engineering teams continue with Community Based Outreach at all Wards across the Province. - CHW's are conducting 6 days post natal care at all Wards. - Extensive consultation done with multiple stakeholders, including Traditional Health Practitioners, Traditional Leaders, Church Leaders and broader community on maternal health issues. - Communities and pregnant women educated on the importance and the use of MoMConnect
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The “what” consists of the **5Hs** as shown below:

What	Priority activities to be implemented.
- Three Basic Building Blocks for the Health system	
Improve Health worker training	<ul style="list-style-type: none"> - In-service trainings, ESMOE and BANC trainings, sending nurses for advanced midwifery courses are done. - Continued Professional Development of Medical Officers and Presentations is conducted. - Evaluation of proper utilisation, recording and plotting of partogram to be continuously conducted. - Onsite training and replacement strategy during training period be done. - HCP are trained on HIV screening and treatment protocols. - ESMOE training to be implemented at Nursing Colleges. - Enforce monthly fire drills at all delivery sites.
Strengthen Health system	<ul style="list-style-type: none"> - Maternity dedicated inter facility transport system within health care facilities and centralisation of maternity services with adequate human resources and equipment be implemented. - Ensure that hospitals practice non rotation of staff in Maternity units. - Maternal mortality and morbidity meeting are conducted regularly and minutes are documented. - Referral criteria and routes to be available and be communicated. - Ensure functionality of established Maternity Waiting Homes in all Districts. - Managers at all levels of care ensure availability and access of various modalities of contraceptives at all facilities. - Hospital and PHC senior managers must visit maternity units, attend M&M meetings and this activities must be in their KPA's - Recommendations at assessors meetings should be shared with the District at DMT's. - Consultative meetings to be with HCP (midwives and dr's) be conducted. - Conducting continuous in- service training on protocols and guidelines.

	<ul style="list-style-type: none"> - IEC material to be developed in local languages. - Continue with Community Based Outreach Teams in all Wards. - Motivate for doula training for District hospitals and CHC's - Creation of more posts of Advanced Midwives at Regional Hospitals, District Hospitals and CHC's. - Procurement and placement of obstetric ambulances at all sub-Districts. - To advance joint venture with private facilities. - Audits to form part of facility managers PMA's - Monthly verification of data by Program Managers and Local Area Managers.
<p>- Targeted activities</p>	
<p>Reduce deaths due to HIV and TB</p>	<ul style="list-style-type: none"> - Promote the “know your status” and “plan your pregnancy” messages. - Awareness campaigns are conducted through appropriate channels, e.g. circumcision is promoted and a caution is always given about use of condoms in addition to circumcision. - Familiarization of HCP on an ongoing basis with new and latest HIV Guidelines is to be conducted. - HCP must actively screen HIV co-infections and treat especially TB. - HIV as the leading cause of maternal deaths in the Province has been prioritized and continuous in-service trainings on the management of this condition is done in the form of current guidelines. - Management of HIV positive pregnant women must be started at first contact. - Mortality and morbidity meetings where patients have succumbed to non-pregnancy related infections, all areas of importance, substandard care and missed opportunities are emphasized and discussed. - Adherence to protocols, guidelines and referral criteria is ensured.
<p>Reduce deaths due to Haemorrhage</p>	<ul style="list-style-type: none"> - Availability of blood and blood products, e.g. Fresh Frozen Plasma (FFP) or Bioplasma in all delivery facilities is ensured. - Availability of PPH boxes in all maternity units is ensured. - Post-Partum Haemorrhage monograph has been launched, HCP inducted and it is implemented in all delivery facilities. - Skills on the basic nursing care are imparted to nurses especially pertaining to monitoring of vitals in the first 6 hours after normal and caesarean section deliveries. - Active management of the third stage of labour and recognizing early signs of Haemorrhage are emphasized at ESMOE trainings. - Adherence to protocols, guidelines and referral criteria is ensured.
<p>Reduce deaths due to Hypertension</p>	<ul style="list-style-type: none"> - All pregnant women are given Calcium supplementation during ANC. - Early Warning Chart is distributed and is implemented in all

	<p>delivery facilities.</p> <ul style="list-style-type: none">- All facilities performing deliveries have Eclampsia boxes readily available and emphasis is made on refilling them as soon as opened and used.- ESMOE trainings emphasize on proper management of Hypertension complications.- Awareness campaigns, CARMMA dialogues are conducted on quarterly basis at sub-District level to promote family planning.- Adherence to protocols, guidelines and referral criteria is ensured.
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Chapter 11.8 Northern Cape

Introduction

The Northern Cape is the largest province in South Africa, but has the smallest population. 372,889 km² (30.5% of South Africa) is inhabited by only 1,162,914 people⁷ (2.2% of the total population of South Africa). This implies that we have vast distances to travel, sparse populations and largely a rural province. The province is faced with specific challenges related to high transport costs, referral routes that sometimes do not favour the patient's condition and poor quality rural roads. Primary Health Clinics and Community Health Centres which are themselves poorly staffed refer to Level 1 hospitals, which are equally poorly staffed and often lack essential equipment. Surgical services are non-functional at a large number of primary care facilities due to under-skilled doctors and insufficient nursing and medical staff. Dr Harry Surtie Hospital in Upington is the only Regional hospital in the Province and Kimberley Hospital tertiary hospital are the only specialised health care facilities that render services for complicated maternity cases and small and sick neonates

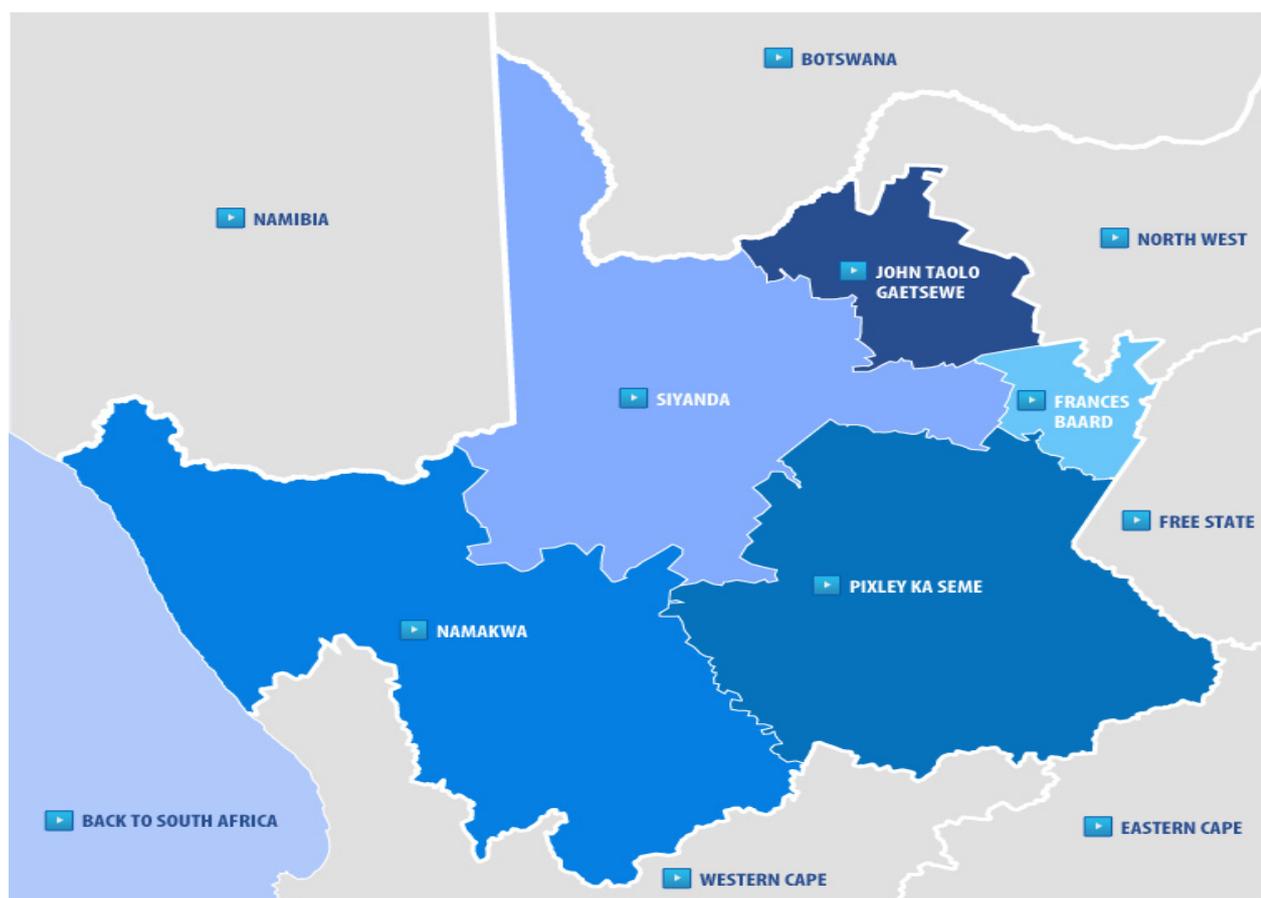
The province consists of five districts, which are largely rural, with high levels of unemployment, seasonal employment and poverty. Despite the fact that antenatal care is offered free of charge at the public health facilities, it is not really "free" for women in the rural/farming areas as a large proportion of their meagre income is spent on transport to access services. This probably contributes to no and/or infrequent antenatal care attendance, home deliveries and thus women seeking help from traditional birth attendants / healers and eventually the use of traditional medications like "Khaba" in pregnancy to speed up labour especially in JTG. Emergency transport is an ongoing challenge, long distances and poor road conditions put a strain on the available fleet, and lead to a large proportion of the province's emergency vehicles being in operational. Only one district (JT Gaetsewe) has dedicated obstetric ambulances, but these also often fill other gaps in the transport service. The use of maternity waiting areas may help to alleviate this problem, but facilities for this is not always available.

There are serious challenges with regard to human resource provision and development as well as to recruit and retain personnel in the Northern Cape's rural facilities. Currently two districts have MCWH district coordinators, while plans are underway to appoint three more in the remaining districts. District Clinical Specialist teams have been appointed in all the districts to give clinical guidance in facilities but the teams are incomplete in all the districts. All the districts have an Advanced Midwife and Family physician in place, with one Paediatrician, one Obstetrician/Gynaecologist, one Advanced Paediatric nurse, one Primary Health Care Nurse and one Anaesthetist in some of the districts. Only two districts have complete dyads: JT Gaetsewe District (Family Physician and Advanced Primary Health Care Nurse) and ZF Mgcawu District (Obstetrician / Gynaecologist and Advanced Midwife).

⁷ Statistics SA Mid-year Population Estimate: 2013

MAP OF THE NORTHERN CAPE PROVINCE

Please note: Siyanda district has since been changed to ZF Mgawu



Deaths reported

Table 11.8.1. Cases reported per year and percent of deaths in SA

Year	Number reported	% of deaths in SA
1998	22	3.3
1999	18	2.2
2000	29	2.8
2001	23	2.3
2002	38	3.8
2003	28	2.3
2004	40	3.4
2005	53	4.2
2006	53	3.7
2007	58	4.2
2008	58	3.3
2009	54	2.2
2010	57	2.8
2011	40	3.6
2012	36	3.2
2013	34	3.1

The total number of deaths reported for this triennium is 110 registered on the MaMMAS programme. The number of live births in South Africa is 2011=1109926; 2012=1095669; 2013=1084397

Table 12h.1.(a) Comparison of mortality rates per district

Districts	PNMR	SBR	ENNDR	DHIS - Ins. MMR
Frances Baard DM	84.7	26.1	12.9	210.3
J T Gaetsewe DM	67.2	32.2	6.9	118.1
Pixley ka Seme DM	32.4	19,1	9.9	33.1
ZF Mgcawu DM	68.9	28.9	16.9	77.6
Namakwa DM	27.7	16.3	10.4	0.0

The PNMR in Frances Baard remains high due to referrals to Kimberley hospital from the other districts followed by ZF Mgcawu and JT Gaetsewe. Still birth rate are the highest at JT Gaetsewe followed by ZF Mgcawu, Early neonatal deaths are are higher at ZF Mgcawu ,Frances Baard and Pixley ka Seme.

Demographic data

Table 11.8.2. Comparison of age and parity in the two triennial reports: 2008-2010 and 2011-2013

Age	Number	2008-2010		2011-2013		Parity	Number	2008-2010		2011-2013	
		Number	%	Number	%			Number	%	Number	%
<20	16	16	9.7	7	6.4	0	43	24	26.1	24	21.8
20-24	28	28	17	19	17.3	1	44	24	26.7	24	21.8
25-29	44	44	28.5	23	20.9	2	35	26	21.2	26	23.6
30-34	35	35	21.2	30	27.3	3	21	11	12.7	11	10.0
35-39	33	33	20	19	17.3	4	7	4	4.2	4	3.6
40-44	4	4	2.4	9	8.2	5	2	8	1.2	8	7.3
45+	2	2	1.4	1	0.9	6+	2	3	1.2	3	2.7
Unknown	3	3	1.7	2	1.8	Unknown	11	10	6.7	10	9.1

Most deaths still occur in the age groups: 30 -34 years followed by age groups 25 -29 years, however a significant decrease is also marked in the age group 20 -24 and 35 – 39 yrs. Most deaths were reported in the groups Parity 0 – 2. The increase in deaths in women above 35 is a concern highlighting the need for prevention of pregnancy in this group of women.

Table 11.7.3. Comparison of levels of care where maternal death occurred between 2008-2010 and 2011-2013

Level	2008-2010		2011-2013	
	N	%	N	%
Home	10	6.1	14	12.7
CHC	12	7.3	9	8.2
Level 1	70	42.4	37	33.3
Level 2	62	37.6	22	20
Level 3	0	0	25	22.7
Private	11	6.7	3	2.7

The delivery profile in this triennium is similar to that of the previous triennium. Most deaths occur at Level 1 hospitals probably due to late referrals and/or managing at inappropriate levels. Of particular concern is the increase in deaths that occurred at home and in community health centres. It is unsure what contributed to this increase. There is a decrease in the total number of deaths reported by the private sector. During the 2008-2010 period, and during the first part of the second

triennium, the Northern Cape did not have a tertiary level hospital. In 2012 Kimberley hospital was upgraded to a tertiary hospital; the 25 deaths at tertiary level therefore occurred at this hospital during the latter part of the 2011-2013 triennium.

Table 12h.4. Comparison of HIV status between 2008-2010 and 2011-2013

HIV Status	2008-2010		2011-2013	
	N	%	N	%
Positive	75	45.4	15	13.6
Negative	59	35.8	40	36.3
Declined testing			0	
AIDS not on HAART			13	1.8
AIDS on HAART			24	21.8
Unknown	31	18.8	18	16.4

The percentage of women who died where the HIV serology was positive remained unchanged at 47.3%. (15 HIV positive, 13 with AIDS, not on HAART and 24 with AIDS on HAART.) The 16.4% of women who died with unknown HIV serology is a reason for concern.

Table 12h.5. Antenatal care attendance between 2008-2010 and 2011-2013

ANC	2008-2010		2011-2013	
	N	%	N	%
Received antenatal care	114	69.4	75	68.2
No antenatal care	30	18.2	18	16.4
Unknown	21	13	17	15.5

Table 12h.6. Comparison of method of delivery of maternal deaths between 2008-2010 and 2011-2013

Method of delivery	2008-2010		2011-2013	
	N	%	N	%
Vaginal	62	37.6	45	40.9
Assisted	0	0	2	1.8
Caesarean sections	35	21.2	20	18.2
Undelivered	48	29.1	33	30
Not applicable	20	12.1	10	9.1

There is no significant change in this data over the reporting time period.

Table 11.8.7. Comparison of anaesthesia between 2008-2010 and 2011-2013

Level	2008-2010			2011-2013		
	N	% of anaesthetic performed	% of total deaths occurring at this level	N	% of anaesthetic performed	% of total deaths occurring at this level
Health care centre	0			1	4.5	11.1
Level 1	12	36.4	17.1	10	45.5	27.0
Level 2	16	48.5	25.8	5	22.7	22.7
Level 3	0	0	0	3	13.6	12
Private	5	15.2	45.4	3	13.6	100

The single anaesthetic performed at a CHC was done at a Level 1 Hospital which was subsequently reclassified as CHC

Primary cause of death and final and contributory causes of death

Table 11.8.8. A comparison of primary obstetric causes of death between 2008-2010 and 2011-2013

Primary Obstetric Cause	2008-2010		2011-2013	
	N	%	N	%
DIRECT	60	36.4	44	40
Hypertension	17	10.3	14	12.7
• Proteinuric hypertension			7	6.4
• Eclampsia			5	4.5
• HELLP			2	1.8
Obstetric haemorrhage	13	7.9	13	11.8
PPH	11	6.7	10	9.0
• Retained placenta			1	0.9
• Bleeding after Caesarean Section			7	6.4
• Other PPH not specified			2	1.8
APH	2	1.2	3	2.7
• Abruptio with hypertension			2	1.8
• Abruptio without hypertension			1	0.9
Hyperemesis Gravidarum			0	
Ectopic pregnancy	6	3.6	1	0.9
Miscarriage	4	2.4	1	0.9
Pregnancy Related Sepsis	3	1.8	5	4.5
• Puerperal sepsis after NVD			3	2.7
• Puerperal sepsis after C/S			2	1.8
Anaesthetic related	2	1.2	0	
Embolism	9	5.4	9	8.2
• Pulmonary embolism			8	7.3
• Amniotic fluid embolism			1	0.9
Acute collapse	6	3.6	1	0.9
INDIRECT	82	49.7	66	60
Non-pregnancy related infections	59	35.8	33	30.0
• PCP Pneumonia			2	1.8
• Other pneumonia			7	6.4
• TB			13	11.8
• Other meningitis			2	1.8
• Hepatitis			1	3.9
• Gastro enteritis			2	1.8
• Complications of ARV			2	1.8
• Other			4	3.6
Medical and Surgical disorders	23	13.9	14	12.7
• Cardiac disease			6	5.5
• Endocrine			2	1.8
• CNS			1	0.9
• Respiratory			2	1.8
• Haematological			1	0.9
• Other			2	1.8
Unknown	13	7.9	6	5.5
• Death at home or outside health services			5	4.5
• No primary cause found			1	0.9
Coincidental	10	6.0	13	11.8
• MVA			8	7.3
• Assaults			1	0.9
• Herbal medicine			1	0.9
• Other			3	2.7
	105	63.6	57	51
Total	165	100	110	

The numbers are small, which makes it difficult to identify true trends in the data presented above. The most notable change, though, is the decrease in the actual number, as well as percentage of total deaths, of the women who died due to non-pregnancy related infections. The actual number of women who died due to post-partum haemorrhage unfortunately remained unchanged; the fact that 7 of the 13 women in this group died due to haemorrhage after caesarean section highlights a serious issue. Another concern is the number of women who died due to puerperal sepsis; an increase in actual number and percentage of all deaths compared to the previous triennium.

Avoidable factors, missed opportunities and substandard care

Table 11.8.9. Avoidable factors, missed opportunities and substandard care for all cases

Category	% of assessable cases where avoidable factors were identified	
	2008-2010	2011-2013
Patient orientated	45.9	46.7
Administrative factors	27.1	28.4
Health worker related emergency management problems	46.3	
- Primary level	46.2	48.1
- Secondary level	19.7	5.5
- Tertiary level	5.8	4.6
Resuscitation		17.4

There has been a notable decrease in the percentage of deaths at secondary level where health worker related avoidable factors were identified. The majority of health worker related avoidable factors are still identified at primary level.

Table 11.8.10. Avoidable factors, missed opportunities and substandard care with respect to Patient orientated problems for all cases

Description	% of assessable cases where avoidable factors were identified	
	2008-2010 (n=159)	2011-2013 (n=106)
No avoidable factors	54.1	53.8
No antenatal care	15.1	16.0
Infrequent antenatal care	2.5	0
Delay in seeking medical help	30.8	38.7
Declined medical/ surgery/advice	3.1	3.8
Family problem		0.9
Community problem	0.6	0
Unsafe abortion*	*50.0	0
Other	10.7	8.5

* Denominator is women who died due to abortions, not all maternal deaths

Delay of the community seeking help remains a problem within the province and probably reflects the deep rural nature of the province. The group of women where “other” avoidable factors were identified included three women who defaulted on their anti-retroviral treatment, one who defaulted on other treatment and two who refused hospitalisation.

Table 11.8.11. Avoidable factors, missed opportunities and substandard care with respect to administrative problems for all cases

Description	% of all deaths	
	2008-2010 (n=162)	2011-2013 (n=110)
Lack of information		0.9
No avoidable factor	72.8	70.9
Transport problem home to institution	1.9	2.7
Transport problem between institutions	13.8	7.3
Lack of accessibility /Barriers to entry	3.1	0.9
Lack of accessibility/other	0.6	0
Delay in initiating critical care (overburdened services)	5.6	10.0
Lack of health care facilities: ICU	6.8	1.8
Lack of health care facility : blood / blood products	15.8	0.9
Lack of health care facility: other	0.6	1.8
Lack of appropriately trained staff: Doctors		0.9
Lack of appropriately trained staff: nurses	0.6	1.8
Communication problems: technical	0	0
Communication problems: interpersonal	1.9	1.8
Other	9.3	10.9

In a large province like the Northern Cape, the provision of adequate emergency transport will always be a challenge. In 10% of maternal deaths insufficient emergency transport was identified as a contributing factor. Patient education to organise their own transport to maternity facilities and the establishment of maternity waiting homes may alleviate the pressure on the emergency transport service. Unfortunately, five of the twelve “other” avoidable factors identified refer to the absence of basic equipment, i.e. haemoglobin meters and essential medication.

Table 11.7.12. Resuscitation Problems in all cases

Description	% of assessable deaths with avoidable factors		% of assessable deaths with avoidable factors	
	2008- 2010	% of all deaths	2011-2013	% of all deaths
Lack of information			1	0.9
No avoidable factor	134	83.8	90	81.8
Airway problem	3	10.0	3	2.7
Breathing problem	5	16.7	2	1.8
Circulation problem	5	16.7	1	0.9
Drug problem	0	0.0	0	
Investigation problems	0	0.0	3	2.7
Monitoring problem	2	6.7	2	1.8
Resuscitation not attempted	20	12.1	10.0	9.1

Although the percentage of cases where problems with resuscitation were identified remained fairly constant (16.2% vs 17.3%), it seems that fewer avoidable factors were identified per case in the deaths where problems did exist.

Table 11.8.13. Health Worker orientated problems per level of care

2011 – 2013	Medical management problems							
	Primary level		Secondary level		Tertiary level		Any level	
	N	%	N	%	N	%	N	%
Lack of information	5	4.5	0		1	0.9	6	5.5
No avoidable factors	56	50.9	104	94.5	104	94.5		
Initial assessment	21	19.1	0		1	0.9	22	20.0
Problem with recognition / diagnosis	31	28.2	2	1.8	3	2.7	34	30.9
Delay in referring patient	43	39.1	2	1.8	0		45	40.9
Managed at inappropriate level	41	37.3	1	0.9	0		42	38.2
Incorrect management (Incorrect diagnosis)	21	19.1	2	1.8	0		23	20.9
Substandard management (Correct diagnosis)	30	27.3	3	2.7	1	0.9	34	30.9
Not monitored / Infrequently monitored	20	18.2	0		1	0.9	21	19.1
Prolonged abnormal monitoring without action	15	13.6	2	1.8	0		17	15.5

This table again indicates the fact that health worker related avoidable factors seem to be common at primary care level, with problems identified at this level in 44.6% of all cases. Delay in referring patients and management at an inappropriate level were the most common problems, but problems with assessment, management and monitoring were also common.

Recommendations

1. Policy

- Establish at least 1 facility adequately resourced to manage the obstetric emergencies in the district
- Develop a policy on inter-facility transport to prevent delays between facilities
- Enforce emergency obstetric simulation training and BANC

2. Health care promotion

- Provide all facilities with Information, Education and Communication (IEC) material on:
 - Risk factors during pregnancy and after delivery
 - Value of early booking
 - Delivery with skilled birth attendants
 - Importance of knowing HIV status and the value of PMTCT and ART during pregnancy
 - Value of family spacing / contraception
- Monthly radio skots on maternal and child health issues
- Involvement of WBOTs in defaulter tracing and dissemination of health promotion messages during antenatal and postnatal care, and registration of pregnant women on MomConnect.

3. Communication with the community

- Establish specific campaigns to inform the local communities of maternity related issues

4. Access to care by the community (includes ensuring that patients have access to specialist advice or care)

- All patients to have access to basic antenatal care at clinic close to home
- Effective transport system to ensure access to appropriately skilled maternal care site
- Collaboration with private sector on maternal and child care issues

5. Appropriate allocation of resources to health system

- Implement policy on accreditation of delivery sites and caesarean section sites

- Reorganization of health services by closing down maternity units that deliver few patients with limited number of staff that are made to rotate to other areas in the facility and having a shortage of essential equipment

6. Knowledge and skills of health care provider

- Establish ESMOE maintenance training schedules
- Implement privileging of obstetric surgery and delivery services
- Improve supervision of interns through optimal service design
- Prioritise provider initiated contraception
- Establish physicians with expertise in medical disease in pregnancy

7. Develop skills to enable implementation of the signal functions of basic and comprehensive emergency obstetric sites

8. Consultation skills

- Clinical outreach and in-reach for training
- Sterilisations to be conducted in all level 1 hospitals.
- Improve open communication with specialists at specialist hospitals and DCSTs

9. Monitoring and evaluation

- Interrogate data submitted by hospitals, CHCs and clinics to DHIS at district level to identify areas that are problematic
- Routine audit of files at all levels of care for compliance with protocols
- Scheduled Maternal Mortality meetings to be audited including morbidity discussions
- Improve quality control of the maternal deaths notification and assessment process

Chapter 11.9: Western Cape

Key recommendations

1. Reduce delay between pregnancy confirmation and antenatal booking or TOP
2. Promote diversity of FP methods and integration of FP services at all levels of care
3. Promote medical TOP and roll out of MTOP to more CHCs
4. Continue widespread HAART initiation and improve TB detection rates
5. ESMOE/EOST for all MOU/CHC/districts providing maternity care
6. Establish combined medical /obstetric clinics at regional and tertiary level
7. Implement postnatal care policy to enable earlier detection of postnatal infective and medical problems
8. Community drives to increase early booking (especially in the Metro)

The Western Cape population is estimated at 6 016 900 people, or 11.4% of the total South African population (according to the 2013 mid-year population estimate by Statistics South Africa). This is a similar number of people to the Eastern Cape, with only Gauteng and KwaZulu Natal having larger populations. The Western Cape, together with Gauteng, was the only provinces who had an increase in population over the past 10 years. As the number of deliveries in the Western Cape has stayed relatively constant over the past few years, the growth is mostly due to migration; according to the 2011 census, only 71% of people living in the Western Cape were born there. The municipal districts with the fastest growth (>100% over the past 10 years) are Overstrand (with a single district hospital in Hermanus) and Bitou (closest district hospital is in Knysna); both along the N2 highway running from East London to Cape Town.

Within the Western Cape, there is a well-developed four-tiered system of maternity care with most deliveries taking place in district health facilities (district hospitals and midwife obstetric units). A package of care for the different levels (refined from existing national documents) as well as the skills needed to render the service and the equipment needed for each level of care was developed as a provincial policy document. In rural areas, the district hospitals do all deliveries and refer their specialist referrals to one of the three rural regional hospitals situated in Paarl, Worcester or George. All three of these hospitals have well developed outreach programs with monthly visits to all the district hospitals (38 in total in the Western Cape) that include morbidity and mortality meetings (PPIP), high risk and gynaecology clinics and ESMOE training. In addition, roving ultrasonographers visit most of the rural areas at least once a month for routine scanning and supervise local ultrasound providers. The province has an official policy for routine ultrasound for all pregnant women to increase booking at antenatal clinics and to refer complicated twins, anomalies and other

severe problems in time to one of the two tertiary fetal medicine units. The province has adopted a health indicator for antenatal booking before 14 weeks' gestation.

In the metropolitan Cape Town, where two thirds of all the province's deliveries take place, 35% of all deliveries take place in midwife-only supported units (MOUs). The metro has four large district hospitals that provide maternity care (Karl Bremer, Helderberg, Khayelitsha and the newly opened Mitchell's Plain Hospitals), which manage complicated pregnancies that do not require specialist care; these are mainly referrals for poor progress or suspected fetal distress from their respective MOUs. A further 40% of deliveries take place at this level of care.

The metro has three specialist hospitals (Mowbray, Somerset, and Tygerberg) which manage a further 20% of all deliveries at general specialist level and the remaining 5% of pregnancies with severe complications are referred to the tertiary/highly specialised units within the two central hospitals, Groote Schuur and Tygerberg. These hospitals are linked to two academic institutions (the Universities of Cape Town and Stellenbosch). Due to a lack of district hospitals in the metro west area, Somerset and Mowbray also manage district level referrals from their MOUs.

There are 6 health districts in the Western Cape (Cape Town metro, West Coast, Cape Winelands, Overberg, Eden and Central Karoo), but Cape Winelands has two regional hospitals on both sides of the Limietberg mountains and the geographical area of drainage therefore differs from the district boundaries. Paarl Hospital Geographical Service Delivery Area (GSA) drains the West Coast and Winelands West (GSA) and Worcester hospital GSA the Winelands East and Overberg areas. Saldanha Bay local municipality, although part of the West Coast sub-district, drain to Somerset hospital in the metro. For planning purposes there are five GSAs (George, Paarl, Worcester, Metro East, Metro West), each with a regional referral hospital and a clinical specialist as Head of General Specialist Services who is based at the regional hospital but provides clinical governance oversight, outreach and support for the whole GSA.

Each of the five geographical service delivery areas in the province work towards planning the maternity service and in the metro two technical teams (one in the GSH drainage/Metro West and one in the TBH drainage/Metro East) plan and implement the district health maternal and neonatal service (now also working on women's and child health) and address issues in service delivery.

Clinical governance for maternity and neonatal care is governed by a Provincial Coordinating Committee comprised of the two Academic heads of department, the five provincial heads of general specialist services (three rural and two metropolitan, one of which chairs the meeting on a rotational basis), the NCCEMD facilitator, Maternal-Fetal, Reproductive Medicine and Oncology sub-specialists, a family physician and nursing representative, the MCWH deputy director and a senior manager that serves as link with the executive committee of the department of health.

Five district specialist obstetricians have been appointed but as yet there are no functioning DCST teams. Saturation training for ESMOE/EOST is in process and needs to be sustained.

Table 11.9.1: Deliveries and Caesarean Sections over the last two triennia (public sector only)

	2008	2009	2010	2011	2012	2013
Total deliveries	91 922	97 793	96 955	95288	94142	94270
Caesarean sections	19741	19082	20544	23604	24440	26784
CS rates	21.1%	19.5%	21.2%	24.7%	25.9%	28.4%

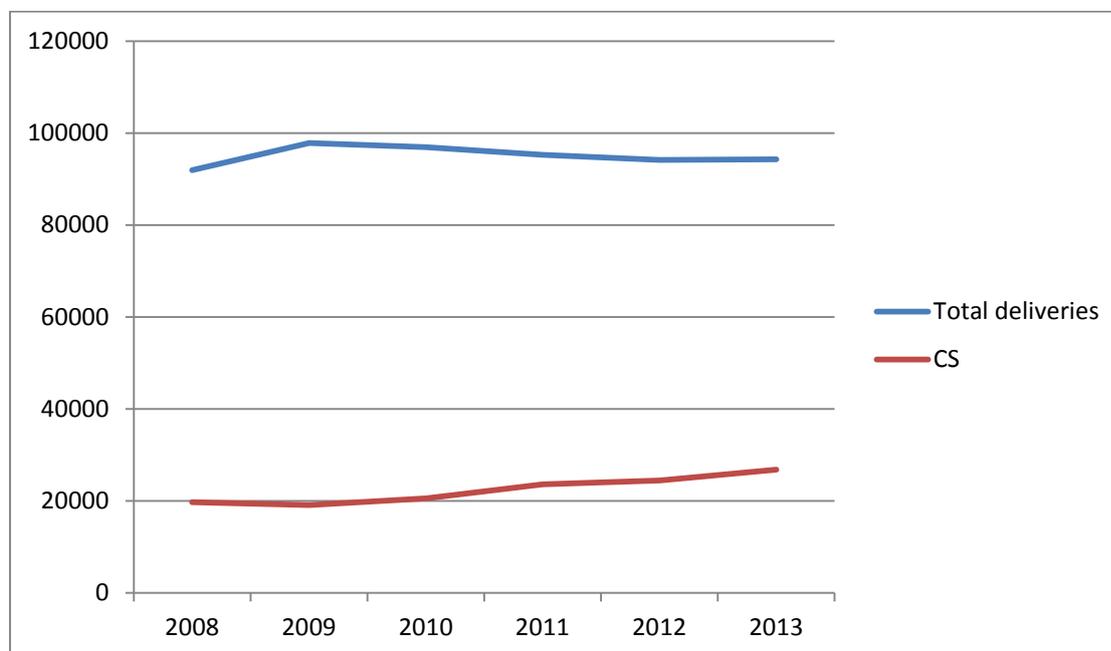


Figure 11.9.1. Graphic presentation of deliveries and Caesarean sections over the two recent triennia.

During 2011-2013, the total number of maternal deaths reported in the Western Cape was 214. The number of institutional deaths was 193; 21 deaths occurred outside of public sector health facilities and only four deaths were reported from private hospitals. These deaths accounted for 4.8% of all maternal deaths in South Africa

Table 11.9.1. Cases reported per year and percent of deaths in SA

Year	Number reported	% of deaths in SA
1998	34	5.0
1999	34	4.2
2000	50	4.8
2001	42	4.2
2002	60	5.9
2003	67	5.5
2004	80	6.8
2005	61	4.8
2006	53	3.7
2007	73	5.3
2008	60	3.9
2009	110	6.2
2010	82	5.0
2011	60	3.8
2012	75	4.9
2013	79	5.7

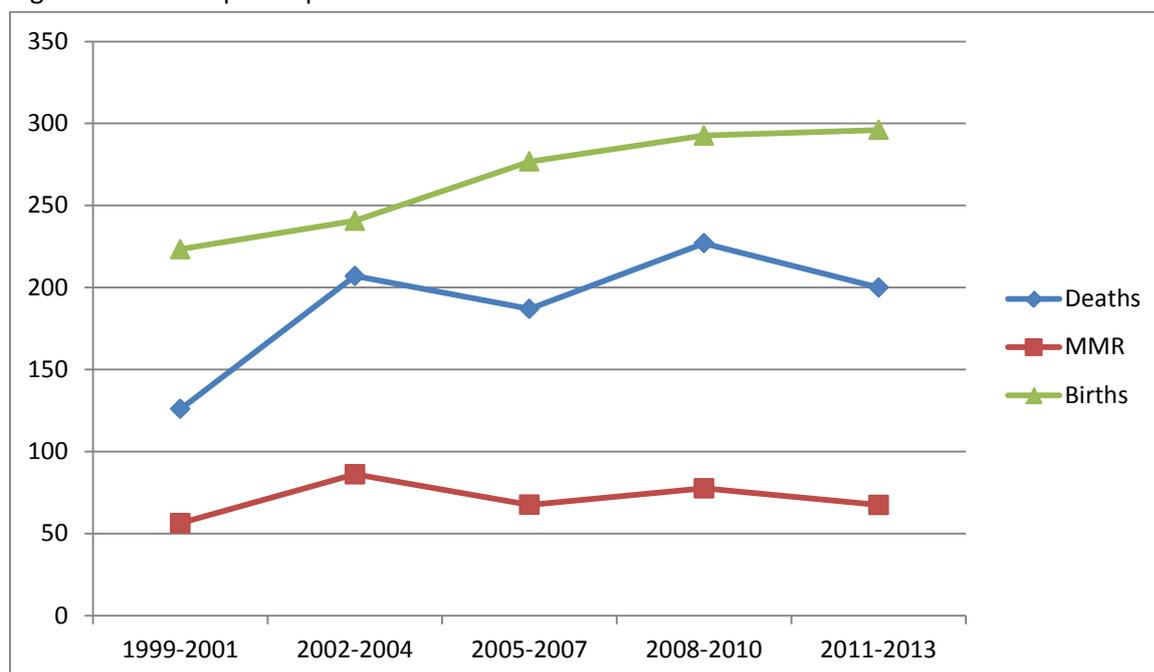
Since numbers are small, it is more valuable to compare triennia. There were 187 maternal deaths during 2005-2007, 207 during 2002-2004 and 126 during 1999-2001.

Table 11.9.2. Institutional Maternal mortality ratio: comparison of triennial

TRIENNIA	Number of maternal deaths	Number of live births	Maternal mortality ratio
1999-2001	126	223 420	56.4
2002-2004	207	240 651	86.2
2005-2007	187	276 808	67.6
2008-2010	227	292 632	77.6
2011-2013	200*	296 066	67.55

(*214 total deaths minus the 14 co-incidental deaths occurring outside of hospital)

Figure 11.9.2. Graphic representation of data in table 11.9.2.



Births is total number x 1000

It can be seen that, similar to national MMR, the Western Cape MMR has declined in the 2011-2013 triennium.

Table 11.9.3 shows the number of maternal deaths per district by residence of the mother; from 2001.

Table 11.9.3. Number of public sector maternal deaths in each district, by maternal residence. 2001-2013

DISTRICT	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Metro	28	40	39	45	33	35	51	39	70	48	46	59	62
Cape Winelands	5	4	5	8	10	2	6	4	11	11	6	5	7
Overberg	2	3	1	3	3	3	1	1	6	3	0	0	2
West Coast	1	3	3	3	2	4	7	4	4	3	1	5	4
Central Karoo	1	0	4	1	3	1	0	0	2	5	0	0	0
Eden	4	9	9	10	6	8	8	10	12	9	7	6	4
Total W. Cape	41	59	61	70	57	53	73	58	105	79	60	75	79

Fourty-four of the women residing in the Cape Town metropolitan district who died in the 2011-2013 triennium demised outside of a central (Tygerberg and Groote Schuur) or regional (Somerset and Mowbray Maternity) hospital; this number was 34 in the previous triennium. Of these, 17 died in a district hospital (including Karl Bremer 2, Helderberg 5 and Khayelitsha 7) and the rest in district hospitals that do not have a maternity service (GF Jooste 2 and Victoria 1), 9 in a midwife obstetric unit (MOU) or CHC (down from 15 in the previous 3 years), and 18 outside the institution.

It may be useful to scrutinise the seven deaths (41% of the district hospital deaths) that took place in the new hospital that opened its doors during 2012 (Khayelitsha); five of these deaths were not due to direct obstetric causes- NPRI (3), suicide (1) and unknown (1). The remaining two were due to cardiac disease with acute decompensation; and amniotic fluid embolism. Six of the 9 (66.6%) of the MOU/CHC deaths took place in the other half of Cape Town (metro west) where there was no large stand-alone district hospital with a maternity service yet.

All midwife obstetric units and district hospitals in the metro are in close proximity to a regional or central hospital (furthest is Wesfleur at 51 kilometres) and it could be expected that complicated cases could be referred in a reasonable time. It is therefore not surprising to see that the reasons for death at district level were mostly non-pregnancy related problems (NPR infection (8), suicide, assault) or acute conditions: cardiac disease (3); acute collapse (2); morbidly adherent placenta (1), pre-eclampsia/eclampsia (5), sepsis (2); amniotic fluid embolism (1), PPH (2).

Although George Hospital can refer their tertiary cases to Groote Schuur hospital, the distance involved makes it impractical and only one death from a mother residing in Eden or Central Karoo was recorded at Groote Schuur (Steven Johnson syndrome). George Hospital, a regional hospital with three permanent O&G consultants, recorded only six maternal deaths; down from 20 in the previous triennium. There were seven deaths at the two other regional rural hospitals -Paarl (3) and Worcester (4). These last two hospitals drain their tertiary care to Tygerberg, but only 9 of the 55 deaths recorded at Tygerberg were from patients residing within the rural drainage of Paarl and Worcester.

The forensic pathologists in the Western Cape are well aware of the confidential enquiry and complete a maternal death notification form and report all outside deaths in pregnant or postpartum women to the provincial office; these patients are then traced to their respective hospital (if they were recently discharged) to look for avoidable factors. It can be presumed that a number of cases would be missed, and a survey currently underway, looking at death certificates and relating it to laboratory results, indicate a number of demised women who had a recent Rh screen (as proxy of a possible booking for pregnancy). Nevertheless, of the 19 women who died outside of an institution while pregnant or postpartum, the majority were incidental (assault, murder, train and automobile accidents, burns); only 5 cases were pregnancy related, 4 due to complications of pre-eclampsia and one to post-partum sepsis. These 5 cases are included in the calculation of the iMMR.

Maternal mortality ratio

There were 283700 live births in the public sector during 2011-2013. Using this denominator, the Maternal Mortality Ratio (MMR) for public sector institutional deliveries in the Western Cape in this triennium was 67.55 maternal deaths per 100,000 live births (214 deaths minus 14 outside). Since

there is data on the number of live births per district it is possible to calculate the MMR per district. However, since the number of deaths are very small in some districts, triennial comparisons could be misleading so it was decided to calculate the MMR per district and compare it with a longer time period, 2002-2007 and 2008-2010 (previous triennia).

Table 11.9.4 Maternal Mortality Rates (MMR) Per district 2008-2010 compared with 2002-2007, according to residence of Mother (private hospital deaths excluded)

<u>DISTRICT</u>	<u>No.</u> <u>Maternal deaths</u> <u>2011-2013</u>	<u>No.</u> <u>Live births</u> <u>2011-2013</u>	<u>MMR 2002-2007</u> <u>Deaths per</u> <u>100,000 live</u> <u>births</u> <u>within the</u> <u>drainage</u>	<u>MMR 2008-2010</u> <u>Deaths per</u> <u>100,000 live</u> <u>births</u> <u>within the</u> <u>drainage</u>	<u>MMR 2011-2013</u> <u>Deaths per</u> <u>100,000 live</u> <u>births within the</u> <u>drainage</u>
Metro	150	192 974	72.82	80.8	77.73
Eden	14	29 580	92.36	106.7	47.3
Cape Winelands	16	43 809	46.4	65.2	36.5
West Coast	9	16 456	77.67	68.2	54.7
Central Karoo	0	3 536	140.45	192.3	0
Overberg	2	9 711	84.38	105.6	20.6

The MMR has declined in every district; of note is the remarkable decline in Eden district, which had the highest district MMR for the W Cape in the previous triennium ; and has had a very active outreach programme including ESMOE training from George to district hospitals.

Since the geographical service delivery areas (GSA) are different, a comparison was also made for the GSA drainage (table 11.9.5):

Table 11.9.5. Maternal deaths according to the GSA

<u>Geographic Service Area</u>	<u>NO.</u> <u>Maternal</u> <u>deaths</u> <u>occurring in the</u> <u>GSA (previous</u> <u>triennium in</u> <u>brackets)</u>	<u>No.</u> <u>Live births</u> <u>(previous</u> <u>triennium in</u> <u>brackets)</u>	<u>MMR 2008-2010</u> <u>Deaths per 100,000</u> <u>live births within</u> <u>the hospital</u> <u>drainage</u>	<u>MMR 2011-2013</u> <u>Deaths per</u> <u>100,000 live births</u> <u>within the hospital</u> <u>drainage</u>
Metro West (Groote Schuur Hospital metro drainage)	74 (93)	108 554 (119 423)	77.8	68.16
Metro East (Tygerberg Hospital metro drainage)	72 (79)	89 942 (83 546)	94.5	80
Worcester Hospital drainage	13 (19)	30 535 (29 184)	65.1	42.56
Paarl Hospital drainage	16 (11)	33 919 (29 717)	37	47
George Hospital drainage	17 (39)	33 116 (32 702)	119	51.3

Births are all live births in public facilities only, as recorded by the facilities. Deaths are maternal deaths per hospital where it took place- for example a women living in Stellenbosch (Paarl Hospital drainage for secondary level care, Tygerberg drainage for tertiary level care) but referred to and

dying in Tygerberg Hospital will be recorded in the TBH drainage. Private deaths and deaths occurring outside of the institution were excluded.

The two central hospitals have a clinical governance function for their respective provincial drainage and they manage tertiary referrals from this drainage. When comparing the two central hospital GSAs by including their complete tertiary rural and clinical governance drainage areas, the Tygerberg drainage MMR would be 65.41 and the GSH MMR 64.2.

The opening of the Khayelitsha hospital and the concomitant shift of referrals to Tygerberg hospital as its regional and tertiary referral hospital explains the decrease in deliveries on the metro west side and the increase in the metro east side. As this shift happened midway (May 2012) through the triennium, the impact as calculated from then on equates to a 13.4% shift in workload from Groote Schuur to Tygerberg Hospital.

Demographic data

Table 11.9.6. Comparison of death by age and parity in the two triennia 2008-2010 and 2011-2013

Age	2008-	2008-	2011-	2011-	Parity	2008-	2008-	2011-	2011-
	2010	2010	2013	2013		2010	2010	2013	2013
	Numbe	%	Numbe	%		Numbe	%	Numbe	%
	r		r			r		r	
<20	16	6.3	10	4.7	0	87	34.5	58	27.1
20-24	49	19.4	43	20.1	1	87	34.5	64	29.9
25-29	81	32.1	76	35.5	2	44	17.5	48	22.4
30-34	49	19.4	44	20.6	3	14	5.6	15	7
35-39	49	19.4	30	14	4	7	2.8	7	3.3
40-44	6	2.4	11	5.1	5	2	0.8	4	1.9
45+	2	0.8	0	0	6+	0	0	1	0.5
Unknown	0	0	0	0	Unknown	11	4.4	17	7.9

Compared to the previous triennium, there was little change in this demographic.

Table 11.9.7. Comparison of levels of care where maternal death occurred between 2005-2007, 2008-2010 and 2011-2013

Level	2005-2007		2008-2010		2011-2013	
	N	%	N	%	N	%
Home	12	6.4	12	4.8	19	8.9
CHC or MOU	5	2.7	15	6	9	4.2
Level 1 (district)	29	15.5	45	17.8	36	16.8
Level 2 (regional)	40	21.4	46	18.2	34	15.9
Level 3 (Central)	98	52.4	124	49.2	112	52.3
Private	3	1.6	10	4	4	1.9

The percentage of women dying outside of the institution or at home has increased over the past 9 years, and the number of deaths at CHC/MOU level has increased slightly, but as already discussed, the former are mostly fortuitous deaths. The percentage of women dying in district hospitals did not change over the last 9 years, but remain low. The percentage of deaths in regional hospitals appears to have declined

The majority of deaths (52.3%) continue to occur at the central hospitals. This reflects an effective referral system for complicated cases. The relatively high number of deaths at district level needs to be put into perspective, as most (almost 75%) of deliveries occur at this level (MMR for institutional MOU and district hospital deliveries was 21.1 per 100 000).

Table 11.9.8. Comparison of HIV status between 2005-2007, 2008-2010 and 2011-2013

HIV Status	2005-2007		2008-2010		2011-2013	
	N	%	N	%	N	%
Positive	82	43.9	103	40.9	86	40.2
Negative	63	33.7	106	42.1	96	44.9
Unknown	42	22.5	43	17.1	32	15

The percentage of deaths with unknown HIV status has steadily decreased due to wider availability of HIV testing. There is a continued decrease in the number of HIV positive deaths.

The proportion of maternal deaths known to be HIV positive is still more than double (40.1%) the antenatal HIV prevalence for the general Western Cape obstetric population, which was 18.2% in 2011. The number of women with AIDS not on HAART has come down from 34 to 19 (8.9%) and is probably a reflection of the increased efforts to encourage earlier booking and the fast tracking of all HIV positive women onto HAART.

Table 11.9.9. Antenatal care attendance from 2005-2013

ANC	2005-2007		2008-2010		2011-2013	
	N	%	N	%	N	%
Attended	106	64.6	188	74.6	145	67.8
Not Attended	32	19.5	34	13.5	42	19.6
Unknown	26	15.9	30	12.0	27	13.0

The percentage of unbooked mothers at time of death has increased again to the numbers in the 2005-2007 triennium.

Table 11.9.10. Comparison of route of delivery of maternal deaths from 2005-2013

Route of delivery	2005-2007		2008-2010		2011-2013	
	N	%	N	%	N	%
Vaginal	76	40.6	87	37.2	57	28.3
Assisted	2	1.1	7	2.9	2	1
Caesarean sections	56	29.9	79	33.8	73	36.3
Undelivered	53	28.3	61	26.1	69	34.4

During 2011-2013, in 13 cases, the route of delivery was not regarded as applicable; percentages shown are for applicable cases only.

The increase in CS rate over the past years is reflected in the increase in number of women who died who had a CS as the route of delivery. The CS rate for maternal deaths (in those patients that did deliver) was 55%.

Table 11.9.11. Comparison of anaesthesia between 2008-2010 and 2011-2013

Level	2008-2010			2011-2013		
	N	% of anaesthetic performed	% of total deaths occurring at this level	N	% of anaesthetic performed	% of total deaths occurring at this level
Level 1	18	17.8	40	19	20.4	52.7
Level 2	22	21.8	47.8	23	24.7	67.6
Level 3	41	40.6	33	42	45.2	36.8
Private	7	6.9	70	3	3.2	75

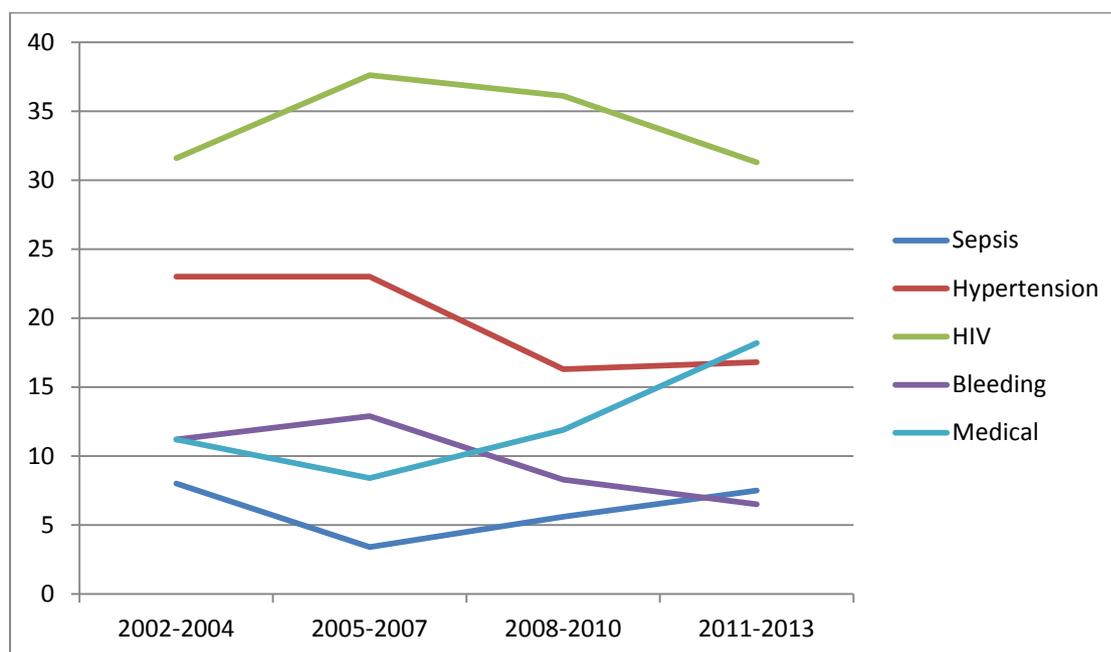
In 2011-2013, anaesthesia was administered in 87 of women who had maternal deaths. There was only 1 death attributed to anaesthetic complications. Table Xa.11 shows the level of care at which the anaesthetics were given, the majority (69.9%) occurring at specialist hospitals and only 20% at level one. At level one hospitals, anaesthesia was provided in 52.7% of the total deaths at this level, more than in the previous triennium (40%). In fact, overall the percentage of deaths where an anaesthetic was administered has increased yet the number of deaths attributable to the anaesthetic has decreased, which may be a reflection of the increased exposure to anaesthetics during internship training and the number of DA qualified medical officers working in the regional and district hospital anaesthetic service.

Table 11.9.12. A comparison of primary obstetric causes of death from 2005-2013

	2005-2007		2008-2010		2011-2013	
	N	%	N	%	N	%
Direct	90	50.6	117	46.5	90	42.8
Hypertension	41	23.0	41	16.3	36	16.8
Haemorrhage	23	12.9	21	8.3	14	6.5
Ectopic pregnancy	5	2.8	4	1.6	1	0.5
Miscarriage	1	0.6	5	2.0	5	2.3
Preg. Related Sepsis	6	3.4	14	5.6	16	7.5
Anaesthetic related	3	1.7	3	1.2	1	0.5
Embolism	2	1.1	14	5.6	10	4.7
Acute collapse	9	5.1	15	6.0	7	3.3
Indirect	82	46.1	121	48	106	50.7
Non pregnancy-related Infection	67	37.6	91	36.1	67	31.3
Pre-existing Medical Disease	15	8.4	30	11.9	39	18.2
Unknown/co-incidental	6	3.4	14	5.4	14	6.5
Total	178	100	252	100	210	100

Table 11.9.12 shows the primary causes of maternal death in the Western Cape in 2011-2013. The proportion of direct maternal deaths (42.8%) has steadily decreased in the Western Cape since 2002 and the proportion of indirect deaths and co-incidental has increased. This is represented graphically in Figure 2.

Figure 11.9.3. Graphic representation of primary cause of death.



Considering individual causes of death; the leading cause of maternal death in 2011-2013 was still Non Pregnancy Related Infections, which accounted for 67 maternal deaths; yet the percentage of cases has steadily decreased over the years; a reflection of the very active Western Cape HIV programme. There is a steady increase in deaths relating to pre-existing medical disorders and this has now surpassed hypertensive deaths as the second most common cause of death. (It was 4th leading cause of death in the 2005-2007 triennium and 3rd most common on the 2008-2010 triennium). It may be a reflection of the perceived increase in pathology seen in the maternity services in the Western Cape, possibly due to patients with known disease accessing the service in this province. There were 9 deaths attributed to cancer and 14 to pre-existing cardiac disease amongst this group.

Hypertensive disorders accounted for 36 maternal deaths, percentage-wise remarkably similar to the previous triennia, but lower in actual numbers than previously; it is now the third most common cause of death. The fourth most common cause is now sepsis, which is steadily increasing; not necessarily related to the increase in CS rate (7 cases of sepsis post CS, but also two deaths attributed to sepsis after bowel injury during CS). Obstetric haemorrhage (fifth most common cause of death) continues to decrease and now only accounted for 14 maternal deaths, of which 6 were directly related to a CS (3 bleeding during and 3 bleeding after the CS). Acute collapse and death due to embolism decrease slightly but is still the sixth most common cause of death.

In the NPRI infection group there were 19 mothers (down from 34) who died from complications of tuberculosis; still more than those dying from sepsis or bleeding, but much less than the last triennium. Whether this is already an effect of the increased vigilance towards TB screening in pregnancy (advocated as a recommendation on the previous Western Cape report) may be too soon to tell.

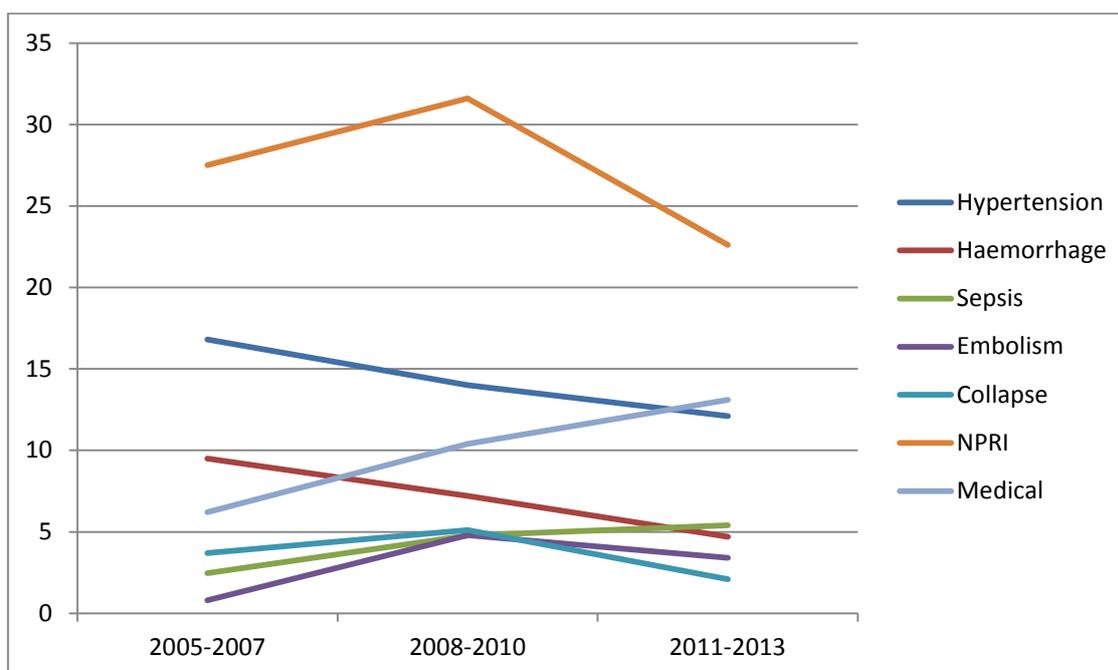
In order to compare trends in causes of death with the 2005-2007 and 2008-2011 triennia, it is more helpful to focus on specific cause related MMRs rather than proportions. This is shown in Table Xa.10 and in figure Xa.4.

Table 11.9.13. A comparison of cause specific MMRs from 2005-2013 (deaths outside of institutions included)

YEAR	2005-2007		2008-2010		2011-2013	
	N	MMR	N	MMR	N	MMR
TOTAL NUMBER of Live Births	276808		292632		296066	
DIRECT	90	36.97	117	40.0	90	30.4
Hypertension	41	16.84	41	14.0	36	12.1
Haemorrhage	23	9.45	21	7.17	14	4.7
Ectopic Pregnancy	5	2.05	4	1.36	1	0.3
Miscarriage	1	0.41	5	1.70	5	1.7
Pregnancy Related Sepsis	6	2.46	14	4.78	16	5.4
Anaesthetic Related	3	1.23	3	1.0	1	0.3
Embolism	3	0.82	14	4.78	10	3.4
Acute Collapse	8	3.7	15	5.12	7	2.1
INDIRECT	82	33.68	121	41.34	106	35.8
Non Pregnant Infection	67	27.52	91	31.65	67	22.6
Medical and surgical disorders	15	6.16	30	10.43	39	13.1
Unknown	6	2.46	6	2.09	14	4.72
TOTAL	178	73.12	252	84.87	210	70.9

This shows again reducing MMRs due to HIV, hypertension and haemorrhage but increases related to pregnancy related sepsis, and medical and surgical disorders. The data is represented graphically in Figure 11.9.4.

Figure 11.9.4 A comparison of Cause specific MMRs over the last three triennia



Avoidable factors, missed opportunities and substandard care

Table 11.9.14. Avoidable factors, missed opportunities and substandard care for all assessable cases

Category	Percentage of avoidable factors in assessable cases		
	2005-2007	2008-2010	2011-2013
Patient orientated	36.8	29	31.8
Administrative factors	22.5	22.5	15.4
Health worker related emergency management problems			
- Primary level	44.3	38.4	29.0
- Secondary level	35.1	25.6	14.5
- Tertiary level	30,2	33.3	15.4
Resuscitation	15.7	38.7	36.9

There are still a large number of resuscitation-related factors deemed avoidable by the assessors; this may possibly relate to the deaths at the CHC/MOUs where resuscitation protocols and procedures are not optimal. Health worker related avoidable factors have decreased at all levels of care, most likely due to the very active ESMOE training programme.

Table 11.7.15. Classification of level of substandard care/avoidability

	Number	Percentage of deaths
No suboptimal care	105	49.1
Suboptimal care, different management would have made no difference to the outcome	19	8.9
Suboptimal care, different management might have made a difference to the outcome	40	18.7
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	50	23.4

Table 11.9.16. Avoidable factors, missed opportunities and substandard care with respect to patient orientated problems for all assessable cases

Major Problems	Percentage of assessable deaths with avoidable factors		
	2005-2007 (n=163)	2008-2010 (n=215)	2011-2013 (n=214)
No avoidable factors	66.3	71.1	53.7
No antenatal care	17.8	9.3	14.5
Infrequent antenatal care	3.1	3.2	2.8
Delay in seeking medical help	11.7	11.6	15
Unsafe abortion	0.0	0	0
Other	9.2	7.9	0.9

No or infrequent uptake of antenatal care was still a problem in 14.5% of deaths. To increase booking at antenatal clinics, Basic Antenatal Care (BANC) was rolled out to all rural district hospitals and clinics. A provincial policy of routine ultrasound was also introduced with the same aim (amongst others). The province also revised the termination of pregnancy policy following an assessment of current services and rolled out medical Termination of Pregnancy (MTOP) during 2010. There was no death due to unsafe abortion and none related to the TOP programme.

The limiting antenatal care factor in the metro is still the discrepancy between MOUs and Community Health centres (which are mostly provincially governed clinics), and City Health clinics, which are managed by the local municipality. Traditionally all antenatal care at district level took place within an MOU, but with the growth and overcrowding in the service patients are often turned away with a return date for a first visit several weeks later. The City clinics have been slow to offer BANC and then at the rate of about 5 clients per week. It must be a provincial initiative to ensure that BANC can take place at every clinic within the province. The aim is immediate booking or referral for TOP on the day that the pregnancy is confirmed.

Although routine ultrasound (apart from encouraging early booking and picking up undiagnosed ectopic pregnancies) will probably not prevent a large number of maternal deaths, it does help in the timely referral of complicated or multiple pregnancies and may improve referral to the correct level of care for both mother and neonate. A limiting factor is the small number of ultrasonographers trained per year. The Western Cape must ensure that adequate numbers of sonographers are trained and vacant posts filled as a priority to assist with this policy.

The metro has launched an initiative called Patient Centred Maternity care which aims to reduce disrespect and abuse of women in labour through a multi-faceted approach based on a code of good conduct. Promoting better quality of care and women's experience of care could indirectly enhance health seeking behaviour of pregnant women and reduce delays in seeking care.

Administrative avoidable factors

Intensive care is a tertiary resource shared with the surgical and medical disciplines. Apart from a 4 bed critical care unit at Tygerberg hospital (no ventilation, single organ support) and a 4 bed maternal critical care unit at Groote Schuur Hospital that provides more intensive maternity care, including ventilating about 10 patients per month, maternity cases in need of intensive care have to compete with all the other patients in the province for a very scarce resource. An increase in the number of high care/ICU beds for maternity care was a recommendation in the previous triennium but no great strides have been made in this case. There were 8 cases where admission to an ICU bed (if it was available) may have made a difference in the outcome. The obstetrical critical care units are constantly full (admitting about 3000 patients per year) reflecting the severity of disease in the pregnant Western Cape population but also the effectiveness of the referral system within the province. The exception is George Hospital, which due to the vast distance to the nearest tertiary centre, often has to manage ICU patients at secondary level.

Lack of blood availability has decreased as a problem, whereas 'lack of appropriately trained doctors' has increased as an avoidable factor. The role out of ESMOE/EOST training to multidisciplinary teams at district level is critical to address this problem.

It seems as if large number of avoidable factors occur at primary level, but this is where 75% of all deliveries takes place. Timely recognition of severe disease, sub-standard management and delay in urgent referral are all factors that need to be emphasised in rural outreach. The problem in this triennium specifically was smaller hospitals staffed with general practitioners who only attend emergencies when identified by the nursing personnel. The placement of community service or permanent medical officers at these hospitals must remain a priority.

Table 11.9.17. Health Worker orientated problems per level of care

Medical management problems	Level 1 Number	Level 2 Number	Level 3 Number	Any level Number
Lack of information	76	141	95	194
No avoidable factor	76	42	86	142
Initial assessment	6	4	4	14
Problem with recognition / diagnosis	24	13	9	44
Delay in referring the patient	22	4	0	24
Managed at inappropriate level	22	6	0	27
Incorrect management (Incorrect diagnosis)	5	3	3	11
Sub-standard management (Correct diagnosis)	24	15	24	56
Not monitored / Infrequently monitored	8	3	2	12
Prolonged abnormal monitoring with no action taken	13	5	9	26

It is also interesting to note that sub-standard management of cases where the diagnosis was correct was identified by the assessors in a large number of cases at tertiary level. Even at this academic level of care improvement in basic management needs to be addressed. Rotations of registrars through the obstetrical critical care units are now part of the training at both GSH and TBH and the introduction of critical care aspects into the postgraduate FCOG syllabus may further improve management.

Table 11.9.18. Health care provider problems with resuscitation in 2008-2010 compared with 2011-2013

Description	% of assessable deaths	Distribution of complications in resuscitation	
		2008-2010	2011-2013
Resuscitation	32.5		
Airway not secured		7	8
Circulation not corrected		15	7
Inappropriate drugs given		3	3
Incompletely investigated		0	0
Not appropriately monitored		4	4

This potential avoidable factor is very complex to analyse and it is very difficult to evaluate notes from a prolonged resuscitation attempt where the detail may get lost in a retrospective summary made at the end of an exhaustive and emotionally draining unsuccessful resuscitation. Continuous training in basic resuscitation and regular fire drills need to be part of a labour ward management plan. It seems as if a delay in starting a resuscitation (resuscitation not attempted) was the main avoidable factor identified here (61 cases), but it may have been extreme cases where resuscitation would in any case have been futile.

Appendix 1

Suggested actions for health care managers, providers and the community to implement the 5H's and 5C's to reduce maternal deaths

The actions requested below were developed by going through the process described in Saving Mothers 2008-2010 Fifth report on confidential enquiries into maternal deaths. They are structured so that actions requested are focused at each level health system. The process will need to be facilitated by the Maternal Child and Women's Health cluster, the chairperson of the NCCEMD, and the new district clinical specialist and ward primary care teams.

Actions requested from the Policy makers (Minister of Health and Provincial MECs)

- Provide widespread advocacy to achieve MDG5 goal. Prioritise managing HIV and TB in pregnancy, preventing and managing obstetric haemorrhage and hypertension.
- Insist on every maternity unit conducting emergency obstetric and neonatal care drills (EOST exercises) at a minimum of once a month.
- Actively support
 - Current HIV and AIDS strategy
 - Strategies to prevent and manage obstetric haemorrhage and hypertension (detailed below in each section) but include prevention by iron, folate and calcium supplementation, taking the blood pressure and measuring the haemoglobin at antenatal care, provide emergency care training and protocols for emergencies in obstetric haemorrhage and hypertension using the ESMOE programme and by provide facilities appropriately equipped and staffed for basic (CHCs) and comprehensive emergency obstetric care (District hospitals and above).
- Prioritise districts with most severe problems and target those districts
- Continue to promote District clinical specialist teams
- Continue to promote contraceptive services being available at every contact with health service i.e. integrated into the health system.
- Continue to ensure that standard basic educational maternal health messages are developed and available (as in MomConnect)
- Continue developing maternity waiting areas
- Consider the use of motor-bike ambulances in remote areas with community health workers as "ambulance" drivers
- Fast track the development of national and provincial staffing and equipment norms for maternity units and caesarean section theatres
- Continue to promote morbidity and mortality reviews and the local use of the data
- Consider making Institutional MMR due to Obstetric Haemorrhage and Hypertension as indices and suggest monitoring progress in provinces and districts 6 monthly
- Consider introducing an accreditation system for hospitals for caesarean sections

Actions requested from the National and the Province Director Generals

- Actively support the policy's given above
- Provide support for the training of doctors and midwives in ESMOE, by instructing CEOs to give time for the doctors and midwives to have the training and insist on emergency obstetric simulation training exercises taking place at least monthly in their institutions
- Ensure Emergency Obstetric Simulation Training exercises are preformed routinely at every institution conducting births
- Ensure the key activities become part of the key performance areas of the appropriate managers.

- Ensure staffing and equipment norms are established for each level and for every health institution concerned with the care of pregnant women.
- Ensure the standard basic educational messages are circulated (MomConnect)
- Ensure emergency transport facilities must be available for all pregnant women in need (at any site)
- Ensure transport issues are addressed with communities
- Continue introducing Maternity Waiting areas
- Ensure transport from L1/CHC to higher levels be continuously available and preferably on site; in remote areas consider the use of motor bike ambulances stationed at clinics and with a CHW as "ambulance" driver
- Ensure criteria for referral and referral routes must be established and utilized appropriately in all provinces.
- Ensure all CHC can provide **basic emergency obstetric care**, namely ability to give magnesium sulphate, oxytocics, antibiotics, manual removal of the placenta, manual vacuum aspiration of incomplete miscarriage, assisted delivery, bag and mask ventilation of newborns and HIV testing and antiretroviral treatment if indicated.
- Ensure all district hospitals can provide **comprehensive emergency obstetric care**, namely basic antenatal care (listed above) and the ability to give a blood transfusion and perform a caesarean section.
- Ensure adequate staffing levels for 24 hour acute care in labour and postpartum; but also for maternity theatres and monitoring post-delivery and post CS. Until norms are provided use the WHO labour ward norm of one midwife in labour ward per 175 deliveries per year.
- Ensure Blood for transfusion must be available at every institution where caesarean sections are performed
- Ensure the supply chain for essential drugs; iron, folate oxytocin, ergometrine, magnesium sulphate, antihypertensives (nifedipine & alpha-methyl dopa), antiretroviral drugs to be seen as essential drugs and never in short supply
- Ensure basic monitoring equipment especially baumanometers, pulse oxymeters, haemoglobinmeters, on-site HIV testing kits are available at all institutions conducting births
- Introduce a national standardised birth register to be the major source of data for DHIS and audit programmes
- Ensure review meeting occur where maternal death notification forms are completed and minutes are kept of the meeting
- Consider making Institutional MMR due to Obstetric Haemorrhage and Hypertension as indices and monitor progress in districts and provinces 6 monthly
- Consider instituting Maternal Near miss and death data sheet at every site with deliveries
- Consider Introducing an accreditation system for hospitals for caesarean sections
- Have six monthly reports on proportion of women testing for HIV, proportion found positive, proportion started on ARVS and on dual therapy, proportion HIV infected mothers and infants seen within 6 days of discharge and at 6 weeks, proportion of HIV exposed infants that have a PCR at 6weeks and proportion of HIV infected mothers that have a CD4 count at 6 weeks

Actions requested from the provincial MCWH managers and the District Managers

- Provide support for the training of doctors and midwives in ESMOE, by instructing CEOs to give time for the doctors and midwives to have the training and insist on emergency obstetric simulation training exercises taking place at least monthly in their institutions
- Ensure midwives and MOs in CHCs, District Hospitals and above undergo ESMOE training
- Ensure Health Care Institutions performing deliveries perform and score Emergency Obstetric Simulation Training exercises at least monthly and involve all their maternity staff. (A roster of those attending and the score must be passed onto the CEO of the institution)

- Ensure these key activities become part of the key performance areas of the appropriate managers.
- Ensure staffing and equipment norms are established for each level and for every health institution concerned with the care of pregnant women and form part of accreditation criteria for maternal services.
- Ensure the standard basic maternal health educational messages are spread using MomConnect
- Ensure emergency transport facilities must be available for all pregnant women in need (at any site)
- Address transport issues with communities;
- Plan for introducing Maternity Waiting Areas where appropriate
- Ensure transport from L1/CHC to higher levels be continuously available and preferably on site especially in remote areas. Consider the use of motor bike ambulances stationed at clinics and with a CHW as "ambulance" driver
- Ensure criteria for referral and referral routes are established and utilized appropriately in all provinces.
- Ensure all CHC can provide **basic emergency obstetric care**, namely ability to give magnesium sulphate, oxytocics, antibiotics, manual removal of the placenta, manual vacuum aspiration of incomplete miscarriage, assisted delivery, bag and mask ventilation of newborns and HIV testing and antiretroviral treatment if indicated.
- Ensure all district hospitals can provide **comprehensive emergency obstetric care**, namely basic antenatal care (listed above) and the ability to give a blood transfusion and perform a caesarean section.
- Ensure dedicated telephonic linkages for consultation for emergencies between referring and referral site are available. (SBAR charts)
- Ensure adequate staffing levels for 24 hour acute care in labour and postpartum; but also for maternity theatres and monitoring post-delivery and post CS. Until norms are provided use the WHO labour ward norm of one midwife in labour ward per 175 deliveries per year.
- Ensure Blood for transfusion must be available at every institution where caesarean sections are performed
- Ensure the supply chain for essential drugs; iron, folate, oxytocin, ergometrine, magnesium sulphate, antihypertensives (nifedipine & alpha-methyl dopa), antiretroviral drugs to be seen as essential drugs and never in short supply
- Ensure **basic monitoring equipment** such as baumanometers, pulse oximeters, haemoglobinmeters, on-site HIV testing kits are available at all institutions conducting births
- Introduce **practical skills training** and training for caesarean section
- Introduce **Early Warning Charts**
- Postoperative and postpartum monitoring must occur, be audited and enabled with appropriate equipment and early warning monitoring charts.
- **Protocols** on the management of important conditions (especially HIV/AIDS, obstetric Haemorrhage and hypertension) causing maternal deaths must be available and utilised appropriately in all institutions (including facilities which only provide antenatal and postnatal services) where women deliver. All midwives and doctors must be trained on the use of these protocols.
- An **eclampsia box** must be on the resuscitation trolley of all institutions conducting births and must include a checklist of action for managing eclampsia
- An **obstetric haemorrhage box** must be on the resuscitation trolley of all institutions conducting births and must include a checklist of action for managing obstetric haemorrhage
- Training should be provided for all health professional working in maternity units in practical obstetrical and surgical skills. Skills should be provided in anaesthesia, especially in level 1 institutions

- Ensure the introduction of the **national standardised birth register** to be the major source of data for DHIS and audit programmes
- Check data submitted by institution to DHIS
- Ensure review meeting occur where maternal death notification forms are completed and minutes are kept of the meeting
- Consider making Institutional MMR due to Obstetric Haemorrhage and Hypertension as indices and monitor progress in districts and provinces 6 monthly
- Consider instituting Maternal Near miss and death data sheet at every site with deliveries
- Consider completing process monitoring sheet for every maternal death related to obstetric haemorrhage and hypertension
- Consider Introducing **an accreditation system for hospitals for caesarean sections**
- Have six monthly reports on proportion of women testing for HIV, proportion found positive, proportion started on ARVS and on dual therapy, proportion HIV infected mothers and infants seen within 6 days of discharge and at 6 weeks, proportion of HIV exposed infants that have a PCR at 6weeks and proportion of HIV infected mothers that have a CD4 count at 6 weeks

Actions requested from the CEO's of institutions

- Provide support for the training of doctors and midwives in ESMOE, by instructing area managers to give time for the doctors and midwives to have the training and insist on emergency obstetric simulation training exercises taking place at least monthly in their institutions
- Ensure midwives and MOs undergo ESMOE training
- Ensure Health Care Institutions performing deliveries perform and score Emergency Obstetric Simulation Training exercises at least monthly and involve all their maternity staff. (A roster of those attending and the score must be passed onto the CEO of the institution)
- Ensure emergency transport facilities are available for all pregnant women in need (at any site)
- Transport issues to be addressed with communities;
- Ensure criteria for referral and referral routes are established and utilized appropriately
- If a CEO of a CHC: Ensure CHC can provide **basic emergency care**, namely ability to give magnesium sulphate, oxytocics, antibiotics, manual removal of the placenta, manual vacuum aspiration of incomplete miscarriage, assisted delivery, bag and mask ventilation of newborns and HIV testing and antiretroviral treatment if indicated.
- If a CEO of a District Hospital: Ensure the hospital can provide **comprehensive emergency obstetric care**, namely basic antenatal care (listed above) and the ability to give a blood transfusion and perform a caesarean section.
- Make available dedicated telephonic linkages for consultation for emergencies between referring and referral site. (SBAR charts)
- Ensure adequate staffing levels for 24 hour acute care in labour and postpartum; but also for maternity theatres and monitoring post-delivery and post CS. Until norms are provided use the WHO labour ward norm of **one midwife in labour ward per 175 deliveries per year**.
- For CEOs of District Hospitals and higher: Ensure Blood for transfusion must be available at every institution where caesarean sections are performed
- Ensure the supply chain for essential drugs; iron, folate oxytocin, ergometrine, magnesium sulphate, antihypertensives (nifedipine & alpha-methyl dopa), antiretroviral drugs to be seen as essential drugs and **never in short supply**
- Ensure basic monitoring equipment such as baumanometers, pulse oxymeters, **Doptones**, heamoglobinmeters, on-site HIV testing kits are available at all institutions conducting births
- In District Hospitals and above Introduce practical skills training and training for caesarean section
- Ensure postoperative and postpartum monitoring must occur, be audited and enabled with appropriate equipment and using the **early warning monitoring charts**.

- Protocols on the management of important conditions (especially HIV/AIDS, obstetric Haemorrhage and hypertension) causing maternal deaths must be available and utilised appropriately in all institutions (including facilities which only provide antenatal and postnatal services) where women deliver. All midwives and doctors must be trained on the use of these protocols.
- An **eclampsia box** must be on the resuscitation trolley of all institutions conducting births and must include a checklist of action for managing eclampsia
- An **obstetric haemorrhage box** must be on the resuscitation trolley of all institutions conducting births and must include a checklist of action for managing obstetric haemorrhage
- Training should be provided for all health professional working in maternity units in practical obstetrical and surgical skills. Skills should be provided in anaesthesia, especially in level 1 institutions
- Introduce the **national standardised birth register** to be the major source of data for DHIS and audit programmes
- Check data submitted by institution to DHIS
- Ensure review meeting occur where maternal death notification forms are completed and minutes are received monthly
- Consider completing process monitoring sheet for every maternal death related to obstetric haemorrhage and hypertension

Actions requested from district clinical specialist teams

- **Monitor Emergency Obstetric Simulation Training exercises and ensure they involve all their maternity staff and are performed and scored at least monthly. (A roster of those attending and the score must be passed onto the CEO of the institution)**
- **Introduce practical skills training and training for caesarean section in District Hospitals and above**
- Monitor and where necessary support the appropriate health manager to ensure that emergency transport facilities are available for all pregnant women in need (at any site)
- Monitor and where necessary support the appropriate health manager to ensure transport issues are address with communities;
- Monitor and where necessary ensure criteria for referral and referral routes are established and utilized appropriately to functional emergency maternity facilities.
- Monitor and where necessary support the appropriate health manager to ensure the CHC can provide **basic emergency obstetric care**, namely ability to give magnesium sulphate, oxytocics, antibiotics, manual removal of the placenta, manual vacuum aspiration of incomplete miscarriage, assisted delivery, bag and mask ventilation of newborns and HIV testing and antiretroviral treatment if indicated.
- Monitor and where necessary support the appropriate health manager to ensure the district hospitals can provide **comprehensive emergency obstetric care**, namely basic antenatal care (listed above) and the ability to give a blood transfusion and perform a caesarean section.
- Train midwives and MOs in CHCs, District Hospitals in ESMOE
- Ensure protocols on the management of important conditions (especially HIV and TB, obstetric Haemorrhage and hypertension) causing maternal deaths are available and utilised appropriately in all institutions (including facilities which only provide antenatal and postnatal services) where women deliver. All midwives and doctors must be trained on the use of these protocols.
- Monitor and where necessary support the appropriate health manager to ensure dedicated telephonic linkages for consultation for emergencies between referring and referral site are available. (SBAR charts)
- Train maternity staff in the use of early warning monitoring charts and SBAR chart use.

- Monitor and where necessary provide health care manages support to ensure adequate staffing levels for 24 hour acute care in labour and postpartum; but also for maternity theatres and monitoring post-delivery and post CS. Until norms are provided use the WHO labour ward norm of one midwife in labour ward per 175 deliveries per year.
- Monitor and where necessary support the appropriate health manager to ensure availability of blood for transfusion at institution where caesarean sections are performed
- Monitor and where necessary support the appropriate health manager to ensure the supply chain for essential drugs; iron, folate oxytocin, ergometrine, magnesium sulphate, antihypertensives (nifedipine & alpha-methyl dopa), antiretroviral drugs to be seen as essential drugs and never be in short supply
- Monitor and where necessary support the appropriate health manager to ensure that basic monitoring equipment such as baumanometers, pulse oxymeters, heamoglobinmeters, on-site HIV testing kits are available at all institutions conducting births
- Monitor and where necessary ensure postoperative and postpartum care, and ensure it is audited and enabled with appropriate equipment and using the early warning monitoring charts.
- Monitor and where necessary support the appropriate health manager to ensure that an eclampsia box is on the resuscitation trolley of all institutions conducting births and must include a checklist of action for managing eclampsia
- Monitor and where necessary support the appropriate health manager to ensure that an obstetric haemorrhage box is on the resuscitation trolley of all institutions conducting births and must include a checklist of action for managing obstetric haemorrhage
- Train appropriate MOs in obstetric anaesthesia, especially in level 1 institutions
- Monitor and where necessary support the appropriate health manager to ensure that the national standardised birth register is introduced and used as the major source of data for DHIS and audit programmes
- Check data submitted by hospitals to DHIS
- Ensure review meeting occur and attend these meetings where maternal death notification forms are completed and ensure minutes are kept of the meeting
- Encourage labour wards, theatres and OPDs to monitor and chart own progress as way of getting buy in to make changes, e.g. theatres to have chart for numbers of PPH after caesarean section to be entered monthly on notice board in theatre to monitor progress and to provide incentives to improve
- Make Institutional MMR due to Obstetric Haemorrhage and Hypertension as indices and monitor progress in district 6 monthly
- Consider introducing Institute Maternal Near Miss data collection and analysis to every site with deliveries. This can take the form of severe adverse event reporting
- Complete process monitoring sheet for every maternal death related to obstetric haemorrhage and hypertension
- Monitor and where necessary support the appropriate health manager to ensure that the maternity theatres are of the appropriate standard
- Review six monthly reports on proportion of women testing for HIV, proportion found positive, proportion started on ARVS and on dual therapy, proportion HIV infected mothers and infants seen within 6 days of discharge and at 6 weeks, proportion of HIV exposed infants that have a PCR at 6weeks and proportion of HIV infected mothers that have a CD4 count at 6 weeks
- Ensure that an adequate system is in place to provide accessible advanced antenatal care

Actions requested from ward primary care team

- Ensure that standard basic educational maternal health messages are promoted in the community
- Encourage everyone to know their HIV status

- Encourage pregnant women to start antenatal care in the first trimester
- Encourage the community to plan their families
- Ensure mother and infant in the postnatal period are seen and examined within 6 days of delivery (3 days of discharge) and at 6 weeks
- Address transport issues with communities;
- Ensure contraceptive use is discussed and where appropriate prescribed.

Actions requested from all doctors involved in care of pregnant women

- **Ensure they promote professional attitudes and ethical behaviour**
- **Ensure a non-judgemental approach to people infected with HIV**
- **Ensure they undergo ESMOE training**
- **Ensure they participate in Emergency obstetric simulation training (EOST) exercises**
- Where applicable be trained in practical obstetrical and surgical skills. Skills should include anaesthesia, especially in level 1 institutions
- Ensure they offer all pregnant women information on, screening for and appropriate management of non-pregnancy related infections (especially HIV and TB) and common medical disorders
- Ensure contraceptive use is discussed and where appropriate prescribed.
- Ensure that standard basic educational maternal health messages are promoted in the community

Actions requested from the midwives and all nurses involved in the care of pregnant women

- **Ensure they promote professional attitudes and ethical behaviour**
- **Ensure a non-judgemental approach to people infected with HIV**
- **Ensure they undergo ESMOE training**
- **Ensure they participate in Emergency obstetric simulation training exercises**
- Ensure they offer all pregnant women information on, screening for and appropriate management of non-pregnancy related infections (especially HIV and TB) and common medical disorders
- Ensure contraceptive use is discussed and where appropriate prescribed.
- Ensure that standard basic educational maternal health messages are promoted in the community

Actions requested from Nursing Colleges and Nursing Departments in universities

- **Provide training and monitoring of professional attitudes and ethical behaviour**
- **Ensure that standard basic educational maternal health messages are taught**
- **Ensure the contents of the ESMOE course are included in their curriculum**
- Ensure training in the early warning charts and SBAR referral system is provided
- Ensure managing pregnant women and their babies with HIV infection, hypertension in pregnancy and obstetric haemorrhage are priorities in the training
- Ensure morbidity and mortality auditing is taught and becomes part of the ethos of nurses
- Discuss with medical schools to standardise midwifery training

Actions requested from Medical Schools

- **Provide training and monitoring of professional attitudes and ethical behaviour**
- **Ensure morbidity and mortality auditing is taught and becomes part of the ethos of doctors**
- **Ensure the contents of the ESMOE course are included in their curriculum**
- Ensure training in the early warning charts and SBAR referral system is provided
- Ensure managing pregnant women and their babies with HIV infection, hypertension in pregnancy and obstetric haemorrhage are priorities in the training

- Ensure that standard basic educational maternal health messages are taught
- Discuss with nursing schools to standardise midwifery training for doctors

Actions requested from HPCSA

- **Make successful completion of the ESMOE course a requirement for registration as a community service doctor**

Actions requested from the Community

- Adhere to the basic maternal health care messages
- Accept responsibility for their health and live a healthy life style

Appendix 2: Fact Sheets

Table 1. Deaths during pregnancy and puerperium, facility live births and iMMR per district, per year

	Deaths during pregnancy and puerperium				Facility live births (DHIS)				iMMR			
	2011	2012	2013	2011-2013	2011	2012	2013	2011-2013	2011	2012	2013	2011-2013
A Nzo (DC44)	16	5	15	36	22614	12724	12732	48070	70.75	39.30	117.81	74.89
Amathole combined*	45	42	42	129	26681	26884	26769	80334	168.66	156.23	156.90	160.58
C Hani (DC13)	18	21	22	61	13422	13168	12561	39151	134.11	159.48	175.15	155.81
Cacadu (DC10)	6	10	9	25	6308	6440	6424	19172	95.12	155.28	140.10	130.40
N Mandela (NMM)	27	25	25	77	21202	21095	20052	62349	127.35	118.51	124.68	123.50
O Tambo (DC15)	90	72	77	239	31521	32996	31547	96064	285.52	218.21	244.08	248.79
Joe Qabi - Ukhahlamba (DC14)	8	8	10	26	5724	5749	5700	17173	139.76	139.15	175.44	151.40
Eastern Cape	210	183	200	593	127472	119056	115785	362313	164.74	153.71	172.73	163.67
Fezile Dabi (DC20)	21	7	16	44	8245	8023	7694	23962	254.70	87.25	207.95	183.62
Lejweleputswa (DC18)	33	18	26	77	11239	10632	10022	31893	293.62	169.30	259.43	241.43
Mangaung - Motheo (DC17)	35	27	23	85	14556	14633	14319	43508	240.45	184.51	160.63	195.37
T Mofutsanyane (DC19)	34	20	20	74	14801	13885	12947	41633	229.71	144.04	154.48	177.74
Xhariep (DC16)	1	0	0	1	1393	1039	945	3377	71.79	0.00	0.00	29.61
Free State	124	72	85	281	50234	48212	45927	144373	246.84	149.34	185.08	194.63
Ekurhuleni	86	140	97	323	53132	59183	61327	173642	161.86	236.55	158.17	186.01
Johannesburg	84	70	54	208	67552	66803	65921	200276	124.35	104.79	81.92	103.86
Sedibeng (DC42)	19	42	24	85	14123	14927	14773	43823	134.53	281.37	162.46	193.96
Tshwane	59	74	50	183	47125	49615	50539	147279	125.20	149.15	98.93	124.25
West Rand (CBDC8)	22	13	15	50	15953	16602	16150	48705	137.91	78.30	92.88	102.66
Gauteng	270	339	240	849	197885	207130	208710	613725	136.44	163.67	114.99	138.34

* - Amathole district was split into Buffalo Bay Metropolitan area and Amathole district during the triennium. The database could not be changed during the triennium to accommodate this and Amathole is presented as both districts in this Facts Sheet.

	Deaths during pregnancy and puerperium				Facility live births (DHIS)				iMMR			
	2011	2012	2013	2011-2013	2011	2012	2013	2011-2013	2011	2012	2013	2011-2013
Amajuba (DC25)	14	7	11	32	8395	8874	9023	26292	166.77	78.88	121.91	121.71
eThekweni (Durban)	124	114	103	341	57242	58103	57220	172565	216.62	196.20	180.01	197.61
iLembe (DC29)	12	11	20	43	10265	10633	10553	31451	116.90	103.45	189.52	136.72
Sisonke (DC43)	13	14	11	38	8493	8583	8385	25461	153.07	163.11	131.19	149.25
Ugu (DC21)	22	20	23	65	11206	13423	13573	38202	196.32	149.00	169.45	170.15
uMgungundlovu (DC22)	49	59	29	137	16596	17031	16280	49907	295.25	346.43	178.13	274.51
Umkhanyakude (DC27)	10	10	3	23	13733	14430	14847	43010	72.82	69.30	20.21	53.48
Umqhinyathi (DC24)	12	7	7	26	11262	11566	11209	34037	106.55	60.52	62.45	76.39
Uthukela (DC23)	17	23	16	56	12579	12583	12323	37485	135.15	182.79	129.84	149.39
Uthungulu (DC28)	58	53	33	144	18068	19949	20129	58146	321.01	265.68	163.94	247.65
Zululand (DC26)	29	8	22	59	14345	16377	16168	46890	202.16	48.85	136.07	125.83
KwaZulu-Natal	360	326	278	964	182184	191552	189710	563446	197.60	170.19	146.54	171.09
Capricorn (DC35)	98	75	116	289	27685	27867	27715	83267	353.98	269.14	418.55	347.08
Gr Sekhukhune (CBDC3)	42	47	40	129	27308	24909	25978	78195	153.80	188.69	153.98	164.97
Mopani (DC33)	40	50	35	125	24926	26792	26030	77748	160.48	186.62	134.46	160.78
Vhembe (DC34)	42	44	43	129	32221	32682	32777	97680	130.35	134.63	131.19	132.06
Waterberg (DC36)	27	29	22	78	14645	14766	14733	44144	184.36	196.40	149.32	176.69
Limpopo	249	245	256	750	126785	127016	127233	381034	196.40	192.89	201.21	196.83
Ehlanzeni DC32)	65	52	40	157	37143	38574	38537	114254	175.00	134.81	103.80	137.41
G Sibande (DC30)	43	37	30	110	17339	18045	17684	53068	248.00	205.04	169.64	207.28
Nkangala (DC31)	40	47	45	132	19619	20049	20317	59985	203.88	234.43	221.49	220.06
Mpumalanga	148	136	115	399	74098	76668	76538	227304	199.74	177.39	150.25	175.54
Bojanala Platinum (DC37)	38	42	33	113	19805	20462	21264	61531	191.87	205.26	155.19	183.65
K Kaunda Southern (DC40)	16	10	30	56	11905	12181	11764	35850	134.40	82.10	255.02	156.21
NM Molema Central (DC38)	34	31	26	91	16540	16257	15732	48529	205.56	190.69	165.27	187.52
R S Mompoti Bophirima (DC39)	11	13	8	32	8959	9353	8815	27127	122.78	138.99	90.75	117.96
North West	99	96	97	292	57209	58253	57575	173037	173.05	164.80	168.48	168.75

	Deaths during pregnancy and puerperium				Facility live births (DHIS)				iMMR			
	2011	2012	2013	2011-2013	2011	2012	2013	2011-2013	2011	2012	2013	2011-2013
Frances Baard (DC9)	20	18	21	59	8020	8344	8083	24447	249.38	215.72	259.80	241.34
JT Gaetsewe Kgalagadi (CBDC1)	7	11	6	24	4704	4586	4877	14167	148.81	239.86	123.03	169.41
Namakwa (DC6)	0	1	0	1	1488	1557	1628	4673	0.00	64.23	0.00	21.40
Pixley ka Seme (DC7)	5	2	2	9	2866	3079	3023	8968	174.46	64.96	66.16	100.36
Siyanda (DC8)	8	4	5	17	3581	4052	3864	11497	223.40	98.72	129.40	147.86
Northern Cape	40	36	34	110	20659	21618	21475	63752	193.62	166.53	158.32	172.54
Cape Town	46	58	60	164	65040	62548	62671	190259	70.73	92.73	95.74	86.20
Cape Winelands (DC2)	6	5	9	20	12435	11848	13356	37639	48.25	42.20	67.39	53.14
Central Karoo (DC5)	0	0	0	0	1175	1095	1078	3348	0.00	0.00	0.00	0.00
Eden (DC4)	7	6	4	17	8892	8357	9113	26362	78.72	71.80	43.89	64.49
Overberg (DC3)	0	1	2	3	3039	2891	2991	8921	0.00	34.59	66.87	33.63
West Coast (DC1)	1	5	4	10	5200	4938	4935	15073	19.23	101.26	81.05	66.34
Western Cape	60	75	79	214	95781	91677	94144	281602	62.64	81.81	83.91	75.99
South Africa	1560	1508	1384	4452	934318	941182	937097	2812597	166.97	160.22	147.69	158.29

Table 2. Underlying causes of maternal deaths per district for 2011-2013 (expressed as iMMR per cause)

Underlying causes	M&S	NPRI	Ec	Misc	HG	PRS	OH	HT	AR	Emb	AC	Unk	Total iMMR
Eastern Cape	20.98	54.92	1.66	2.48	0.00	7.73	24.29	29.26	4.14	3.31	3.86	6.90	159.53
Alfred Nzo	6.24	35.37	2.08	0.00	0.00	2.08	10.40	6.24	4.16	0.00	4.16	2.08	72.81
Amathole combined*	22.41	53.53	2.49	2.49	0.00	7.47	12.45	41.08	2.49	3.73	4.98	6.22	159.33
C Hani	20.43	35.76	2.55	5.11	0.00	7.66	30.65	22.99	12.77	2.55	0.00	12.77	153.25
Cacadu	26.08	52.16	5.22	0.00	0.00	0.00	20.86	10.43	10.43	0.00	0.00	5.22	130.40
NM Metro	17.64	49.72	0.00	1.60	0.00	1.60	19.25	14.43	0.00	8.02	4.81	6.42	123.50
OR Tambo	31.23	80.15	1.04	4.16	0.00	16.66	39.56	47.88	3.12	2.08	3.12	7.29	236.30
Ukhahlamba/ Joe Qwabe	5.82	40.76	0.00	0.00	0.00	5.82	40.76	23.29	5.82	5.82	11.65	11.65	151.40
Free State	27.71	58.88	4.85	6.23	1.39	6.23	23.55	33.25	2.77	8.31	4.85	8.31	186.32
Fezile Dabe	33.39	37.56	8.35	8.35	4.17	8.35	20.87	25.04	4.17	12.52	0.00	8.35	171.10
Lejwelseputsjwa	28.22	81.52	9.41	3.14	0.00	6.27	34.49	40.76	3.14	12.54	6.27	6.27	232.03
Mangaung	34.48	73.55	0.00	11.49	2.30	0.00	6.90	43.67	2.30	2.30	6.90	2.30	186.17
T Mofutsanyane	19.22	43.23	4.80	2.40	0.00	12.01	36.03	24.02	2.40	9.61	4.80	14.41	172.94
Xhariep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.61	29.61
Gauteng	16.29	44.97	3.91	8.47	0.00	4.89	24.12	18.90	1.47	3.75	6.03	2.44	135.24
Ekhuruleni	12.67	70.84	8.06	18.43	0.00	7.49	28.22	19.00	1.73	2.88	7.49	2.30	179.10
Johannesburg	18.97	32.46	2.50	4.49	0.00	3.50	14.48	17.98	1.50	2.00	3.50	1.50	102.86
Sedibeng	15.97	70.74	0.00	6.85	0.00	11.41	47.92	18.26	0.00	6.85	13.69	2.28	193.96
Tshwane	21.05	29.20	2.72	4.07	0.00	2.72	23.09	22.41	1.36	6.79	4.07	4.75	122.22
West Rand	4.11	26.69	2.05	4.11	0.00	2.05	30.80	12.32	2.05	2.05	10.27	0.00	96.50

* - Amathole district was split into Buffalo Bay Metropolitan area and Amathole district during the triennium. The database could not be changed during the triennium to accommodate this and Amathole is presented as both districts in this Facts Sheet.

Underlying causes	M&S	NPRI	Ec	Misc	HG	PRS	OH	HT	AR	Emb	AC	Unk	Total iMMR
KwaZul-Natal	20.23	71.70	3.73	9.41	0.35	8.87	21.65	14.02	3.73	1.95	3.19	9.76	168.61
Amajuba	3.80	57.05	0.00	0.00	0.00	11.41	19.02	11.41	3.80	3.80	0.00	7.61	117.91
eThekweni	31.87	90.98	2.32	11.01	0.00	12.75	13.91	11.59	4.06	2.32	6.37	7.53	194.71
Ilembe	12.72	47.69	9.54	0.00	0.00	9.54	19.08	9.54	19.08	0.00	0.00	3.18	130.36
Sisonke	15.71	47.13	3.93	11.78	0.00	3.93	27.49	15.71	0.00	0.00	0.00	23.57	149.25
Ugu	13.09	60.21	2.62	7.85	2.62	10.47	20.94	26.18	5.24	0.00	5.24	13.09	167.53
UmGungunglovu	40.07	130.24	2.00	26.05	0.00	6.01	22.04	30.06	4.01	0.00	0.00	10.02	270.50
Umkanyakude	6.98	20.93	2.33	0.00	0.00	4.65	9.30	0.00	0.00	0.00	0.00	9.30	53.48
Umkhanyakude	2.94	35.26	0.00	2.94	0.00	0.00	8.81	5.88	2.94	5.88	0.00	11.75	76.39
Uthukela	18.67	53.35	0.00	5.34	0.00	10.67	29.35	10.67	0.00	2.67	2.67	13.34	146.73
Uthungulu	15.48	96.31	13.76	15.48	1.72	10.32	43.00	25.80	3.44	1.72	3.44	13.76	244.21
Zululand	10.66	42.65	4.27	6.40	0.00	4.27	38.39	6.40	0.00	4.27	4.27	4.27	125.83
Limpopo	17.32	59.84	6.30	8.40	0.26	10.24	33.59	31.23	8.92	2.10	2.89	9.97	191.06
Capricorn	38.43	97.28	4.80	16.81	0.00	21.62	63.65	73.26	7.21	1.20	3.60	8.41	336.27
Gr Sekekhune	12.79	48.60	6.39	5.12	0.00	7.67	26.86	26.86	10.23	1.28	3.84	12.79	162.41
Mopani	10.29	54.02	3.86	9.00	0.00	5.14	34.73	18.01	7.72	2.57	2.57	6.43	154.34
Vhembe	11.26	41.97	7.17	4.10	1.02	6.14	19.45	8.19	10.24	3.07	2.05	14.33	128.99
Waterberg	11.33	58.90	11.33	6.80	0.00	11.33	18.12	33.98	9.06	2.27	2.27	4.53	169.90
Mpumalanga	8.80	55.43	5.72	6.60	0.00	12.76	33.00	30.80	7.92	4.40	1.32	6.16	172.90
Ehlanzeni	5.25	43.76	1.75	7.00	0.00	14.88	23.63	24.51	7.00	4.38	0.00	5.25	137.41
G Sibande	11.31	75.37	11.31	1.88	0.00	9.42	37.69	26.38	7.54	7.54	1.88	13.19	203.51
Nkangala	13.34	60.02	8.34	10.00	0.00	11.67	46.68	46.68	10.00	1.67	3.33	1.67	213.39
North West	13.87	49.70	2.89	5.20	0.00	11.56	35.83	30.05	1.73	4.05	4.62	6.93	166.44
Bojanala Platinum (DC 37)	17.88	48.76	6.50	8.13	0.00	16.25	26.00	32.50	3.25	3.25	4.88	13.00	180.40
K Kaunda DC 40	5.58	41.84	0.00	11.16	0.00	16.74	44.63	27.89	0.00	2.79	2.79	0.00	153.42
NM Molema (DC38)	18.55	65.94	0.00	0.00	0.00	8.24	39.15	39.15	0.00	6.18	2.06	6.18	185.46
RS Mompoti (DC 39)	7.37	33.18	3.69	0.00	0.00	0.00	40.55	11.06	3.69	3.69	11.06	3.69	117.96

Underlying causes	M&S	NPRI	Ec	Misc	HG	PRS	OH	HT	AR	Emb	AC	Unk	Total iMMR
Northern Cape	21.96	51.76	1.57	1.57	0.00	7.84	20.39	21.96	0.00	14.12	1.57	9.41	152.15
Francis Baard	28.63	94.08	0.00	0.00	0.00	16.36	16.36	40.90	0.00	12.27	4.09	8.18	220.89
JT Gaetsewe Kgalagadi	28.23	28.23	7.06	7.06	0.00	0.00	35.29	0.00	0.00	21.18	0.00	14.12	141.17
Namakwa	0.00	0.00	0.00	0.00	0.00	0.00	21.40	0.00	0.00	0.00	0.00	0.00	21.40
Pixley ka Seme	0.00	33.45	0.00	0.00	0.00	0.00	11.15	22.30	0.00	11.15	0.00	0.00	78.06
Siyande	26.09	26.09	0.00	0.00	0.00	8.70	17.40	17.40	0.00	17.40	0.00	17.40	130.47
Western Cape	13.85	23.79	0.36	1.78	0.00	5.68	4.97	12.78	0.36	3.55	2.49	1.42	71.02
Cape Town	16.82	27.86	0.00	2.10	0.00	7.36	5.26	14.19	0.00	3.15	2.10	2.10	80.94
Cape Winelands	7.97	13.28	2.66	0.00	0.00	0.00	2.66	5.31	0.00	7.97	5.31	0.00	45.17
Central Karoo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eden	11.38	15.17	0.00	3.79	0.00	3.79	7.59	15.17	3.79	0.00	3.79	0.00	64.49
Overberg	0.00	11.21	0.00	0.00	0.00	0.00	0.00	22.42	0.00	0.00	0.00	0.00	33.63
West Coast	6.63	26.54	0.00	0.00	0.00	6.63	6.63	6.63	0.00	6.63	0.00	0.00	59.71
South Africa	17.53	53.47	3.63	6.58	0.18	8.04	24.32	22.75	3.73	3.63	3.77	6.44	154.06

M&S – pre-existing medical and surgical conditions; NPRI – non-pregnancy related infections; Ec – Ectopic pregnancies; Misc – miscarriage; HG – Hyperemesis gravidarum; PRS – pregnancy related sepsis; OH – Obstetric Haemorrhage; HT – Hypertension; AR – anaesthetic related complications; Emb – embolism; AC – acute collapse; Unk – unknown

Table 3. Distribution of districts and provinces with respect to iMMR for the underlying cause

District	NPRI	District	OH	District	HT	District	AR
UmGungunglovu	130.24	Capricorn	63.65	Capricorn	73.26	Ilembe	19.08
Capricorn	97.28	Sedibeng	47.92	OR Tambo	47.88	C Hani	12.77
Uthungulu	96.31	Nkangala	46.68	Nkangala	46.68	Cacadu	10.43
Francis Baard	94.08	K Kaunda DC 40	44.63	Mangaung	43.67	Vhembe	10.24
eThekweni	90.98	Uthungulu	43.00	Amathole	41.08	Gr Sekekhune	10.23
Lejwelseputsjwa	81.52	Ukhahlamba	40.76	Francis Baard	40.90	Nkangala	10.00
OR Tambo	80.15	RS Mompoti (DC 39)	40.55	Lejwelseputsjwa	40.76	Waterberg	9.06
G Sibande	75.37	OR Tambo	39.56	NM Molema (DC38)	39.15	iMMR Limpopo	8.92
Mangaung	73.55	NM Molema (DC38)	39.15	Waterberg	33.98	iMMR Mpumalanga	7.92
iMMR KZN	71.70	Zululand	38.39	iMMR Free State	33.25	Mopani	7.72
Ekhuruleni	70.84	G Sibande	37.69	Bojanala Platinum (DC 37)	32.50	G Sibande	7.54
Sedibeng	70.74	T Mofutsanyane	36.03	iMMR Limpopo	31.23	Capricorn	7.21
NM Molema (DC38)	65.94	iMMR North West	35.83	iMMR Mpumalanga	30.80	Ehlanzeni	7.00
Ugu	60.21	JT Gaetsewe Kgalagadi (CBDC1)	35.29	UmGungunglovu	30.06	Ukhahlamba	5.82
Nkangala	60.02	Mopani	34.73	iMMR North West	30.05	Ugu	5.24
iMMR Limpopo	59.84	Lejwelseputsjwa	34.49	iMMR Eastern Cape	29.26	Fezile Dabe	4.17
Waterberg	58.90	iMMR Limpopo	33.59	K Kaunda DC 40	27.89	Alfred Nzo	4.16
iMMR Free State	58.88	iMMR Mpumalanga	33.00	Gr Sekekhune	26.86	iMMR Eastern Cape	4.14
Amajuba	57.05	West Rand	30.80	G Sibande	26.38	eThekweni	4.06
iMMR Mpumalanga	55.43	C Hani	30.65	Ugu	26.18	UmGungunglovu	4.01
iMMR Eastern Cape	54.92	Uthukela	29.35	Uthungulu	25.80	Amajuba	3.80
Mopani	54.02	Ekhuruleni	28.22	Fezile Dabe	25.04	Eden	3.79
Amathole	53.53	Sisonke	27.49	Ehlanzeni	24.51	South Africa	3.73
South Africa	53.47	Gr Sekekhune	26.86	T Mofutsanyane	24.02	iMMR KwaZulu-Natal	3.73
Uthukela	53.35	Bojanala Platinum (DC 37)	26.00	Ukhahlamba	23.29	RS Mompoti (DC 39)	3.69
Cacadu	52.16	South Africa	24.32	C Hani	22.99	Uthungulu	3.44
iMMR Northern Cape	51.76	iMMR Eastern Cape	24.29	South Africa	22.75	Bojanala Platinum (DC 37)	3.25
NM Metro	49.72	iMMR Gauteng	24.12	Overberg	22.42	Lejwelseputsjwa	3.14
iMMR North West	49.70	Ehlanzeni	23.63	Tshwane	22.41	OR Tambo	3.12
Bojanala Platinum (DC 37)	48.76	iMMR Free State	23.55	Pixley ka Seme	22.30	Umzinyathi	2.94
Gr Sekekhune	48.60	Tshwane	23.09	iMMR Northern Cape	21.96	iMMR Free State	2.77
Ilembe	47.69	UmGungunglovu	22.04	Ekhuruleni	19.00	Amathole	2.49
Sisonke	47.13	iMMR KwaZulu-Natal	21.65	iMMR Gauteng	18.90	T Mofutsanyane	2.40
iMMR Gauteng	44.97	Namakwa	21.40	Sedibeng	18.26	Mangaung	2.30
Ehlanzeni	43.76	Ugu	20.94	Mopani	18.01	West Rand	2.05

District	NPRI	District	OH	District	HT	District	AR
T Mofutsanyane	43.23	Fezile Dabe	20.87	Johannesburg	17.98	iMMR North West	1.73
Zululand	42.65	Cacadu	20.86	Siyande	17.40	Ekhuruleni	1.73
Vhembe	41.97	iMMR Northern Cape	20.39	Sisonke	15.71	Johannesburg	1.50
K Kaunda DC 40	41.84	Vhembe	19.45	Eden	15.17	iMMR Gauteng	1.47
Ukhahlamba	40.76	NM Metro	19.25	NM Metro	14.43	Tshwane	1.36
Fezile Dabe	37.56	Ilembe	19.08	Cape Town	14.19	iMMR Western Cape	0.36
C Hani	35.76	Amajuba	19.02	iMMR KwaZulu-Natal	14.02	NM Metro	0.00
Alfred Nzo	35.37	Waterberg	18.12	iMMR Western Cape	12.78	Xhariep	0.00
Umzinyathi	35.26	Siyande	17.40	West Rand	12.32	Sedibeng	0.00
Pixley ka Seme	33.45	Francis Baard	16.36	eThekweni	11.59	Sisonke	0.00
RS Mompoti (DC 39)	33.18	Johannesburg	14.48	Amajuba	11.41	Umkanyakude	0.00
Johannesburg	32.46	eThekweni	13.91	RS Mompoti (DC 39)	11.06	Uthukela	0.00
Tshwane	29.20	Amathole	12.45	Uthukela	10.67	Zululand	0.00
JT Gaetsewe Kgalagadi (CBDC1)	28.23	Pixley ka Seme	11.15	Cacadu	10.43	K Kaunda DC 40	0.00
Cape Town	27.86	Alfred Nzo	10.40	Ilembe	9.54	NM Molema (DC38)	0.00
West Rand	26.69	Umkanyakude	9.30	Vhembe	8.19	iMMR Northern Cape	0.00
West Coast	26.54	Umzinyathi	8.81	West Coast	6.63	Francis Baard	0.00
Siyande	26.09	Eden	7.59	Zululand	6.40	JT Gaetsewe Kgalagadi (CBDC1)	0.00
iMMR Western Cape	23.79	Mangaung	6.90	Alfred Nzo	6.24	Namakwa	0.00
Umkanyakude	20.93	West Coast	6.63	Umzinyathi	5.88	Pixley ka Seme	0.00
Eden	15.17	Cape Town	5.26	Cape Winelands	5.31	Siyande	0.00
Cape Winelands	13.28	iMMR Western Cape	4.97	Xhariep	0.00	Cape Town	0.00
Overberg	11.21	Cape Winelands	2.66	Umkanyakude	0.00	Cape Winelands	0.00
Xhariep	0.00	Xhariep	0.00	JT Gaetsewe Kgalagadi (CBDC1)	0.00	Central Karoo	0.00
Namakwa	0.00	Central Karoo	0.00	Namakwa	0.00	Overberg	0.00
Central Karoo	0.00	Overberg	0.00	Central Karoo	0.00	West Coast	0.00

Table 4. Comparison of the iMMR per district between 2008-2010 and 2011-2013

Districts	2008-2010	Districts	2011-2013
Frances Baard DM	325.92	Capricorn	336.27
Lejweleputswa DM	314.64	UmGungunglovu	270.50
Bojanala Platinum DM	310.79	Uthungulu	244.21
T Mofutsanyane DM	301.18	OR Tambo	236.30
Ugu DM	299.45	Lejwelseputsjwa	232.03
Xhariep DM	284.02	Francis Baard	220.89
Fezile Dabi DM	282.79	Nkangala	213.39
Motheo DM	281.35	G Sibande	203.51
J T Gaetsewe DM	276.50	eThekwini	194.71
Capricorn DM	275.86	Sedibeng	193.96
O Tambo DM	272.77	Mangaung	186.17
Uthungulu DM	266.62	NM Molema (DC38)	185.46
Pixley ka Seme DM	260.22	Bojanala Platinum (DC 37)	180.40
uMgungundlovu DM	229.20	Ekhuruleni	179.10
G Sibande DM	223.82	T Mofutsanyane	172.94
Uthukela DM	221.58	Fezile Dabe	171.10
A Nzo DM	220.56	Waterberg	169.90
eThekwini MM	217.25	Ugu	167.53
Amathole DM	211.98	Gr Sekekhune	162.41
Siyanda DM	206.75	Amathole	159.33
Ngaka Modiri Molema DM	196.25	Mopani	154.34
Ekurhuleni MM	192.28	South Africa (2011-2013)	154.06
Waterberg DM	191.85	K Kaunda DC 40	153.42
Central Karoo DM	184.62	C Hani	153.25
Dr K Kaunda DM	184.16	Ukhahlamba	151.40
iLembe DM	180.91	Sisonke	149.25
South Africa (2008-2010)	179.47	Uthukela	146.73
Gr Sekhukhune DM	175.85	JT Gaetsewe Kgalagadi (CBDC1)	141.17
Ehlanzeni DM	174.15	Ehlanzeni	137.41
Nkangala DM	172.32	Siyande	130.47
N Mandela MM	162.91	Cacadu	130.40
Sedibeng DM	156.30	Ilembe	130.36
Ukhahlamba DM	155.84	Vhembe	128.99
Zululand DM	150.11	Zululand	125.83
Ruth Segomotsi Mompati DM	149.46	NM Metro	123.50
Mopani DM	147.89	Tshwane	122.22
Amajuba DM	139.85	RS Mompati (DC 39)	117.96
Johannesburg MM	136.01	Amajuba	117.91
Tshwane MM	133.70	Johannesburg	102.86
West Rand DM	125.40	West Rand	96.50
Umzinyathi DM	113.59	Cape Town	80.94
Eden DM	109.02	Pixley ka Seme	78.06
C Hani DM	101.90	Umzinyathi	76.39
Cape Town MM	95.01	Alfred Nzo	72.81
Umkhanyakude DM	91.30	Eden	64.49
Vhembe DM	71.84	West Coast	59.71
Namakwa DM	60.77	Umkanyakude	53.48
Cacadu DM	59.38	Cape Winelands	45.17
Overberg DM	53.74	Overberg	33.63
Cape Winelands DM	53.65	Xhariep	29.61
West Coast DM	51.56	Namakwa	21.40
Sisonke DM	40.73	Central Karoo	0.00

Table 5. Percent change between 2008-10 and 2011-13

District	% difference 2008-10 and 2011-13
Sisonke	266.4
Cacadu	119.6
Vhembe	79.6
C Hani	50.4
Sedibeng	24.1
Nkangala	23.8
Capricorn	21.9
UmGungunglovu	18.0
West Coast	15.8
Mopani	4.4
Ukhahlamba	-2.8
NM Molema (DC38)	-5.5
Ekhuruli	-6.9
Gr Sekekhune	-7.6
Uthungulu	-8.4
Tshwane	-8.6
G Sibande	-9.1
eThekweni	-10.4
Waterberg	-11.4
OR Tambo	-13.4
South Africa	-14.2
Cape Town	-14.8
Amajuba	-15.7
Cape Winelands	-15.8
Zululand	-16.2
K Kaunda DC 40	-16.7
RS Mompoti (DC 39)	-21.1
Ehlanzeni	-21.1
West Rand	-23.0
NM Metro	-24.2
Johannesburg	-24.4
Amathole	-24.8
Lejwelseputsjwa	-26.3
Ilembe	-27.9
Francis Baard	-32.2
Umzinyathi	-32.8
Uthukela	-33.8
Mangaung	-33.8
Siyande	-36.9
Overberg	-37.4
Fezile Dabe	-39.5
Eden	-40.9
Umkanyakude	-41.4
Bojanala Platinum (DC 37)	-42.0
T Mofutsanyane	-42.6
Ugu	-44.1
JT Gaetsewe Kgalagadi (CBDC1)	-48.9
Namakwa	-64.8
Alfred Nzo	-67.0
Pixley ka Seme	-70.0
Xhariep	-89.6
Central Karoo	-100.0

Appendix 3

Secretariat, NCCEMD members and Provincial Assessors for 2011-2013

A .SECRETARIAT

Dr P Holele
Dr N Khaole
Mr A Mafunisa
Ms T Mabale

B. National Committee on Confidential Enquiries into Maternal Deaths

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Prof Jack Moodley

DEPUTY CHAIRPERSON:

Prof Susan Fawcus

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Dr Marthinus Schoon

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