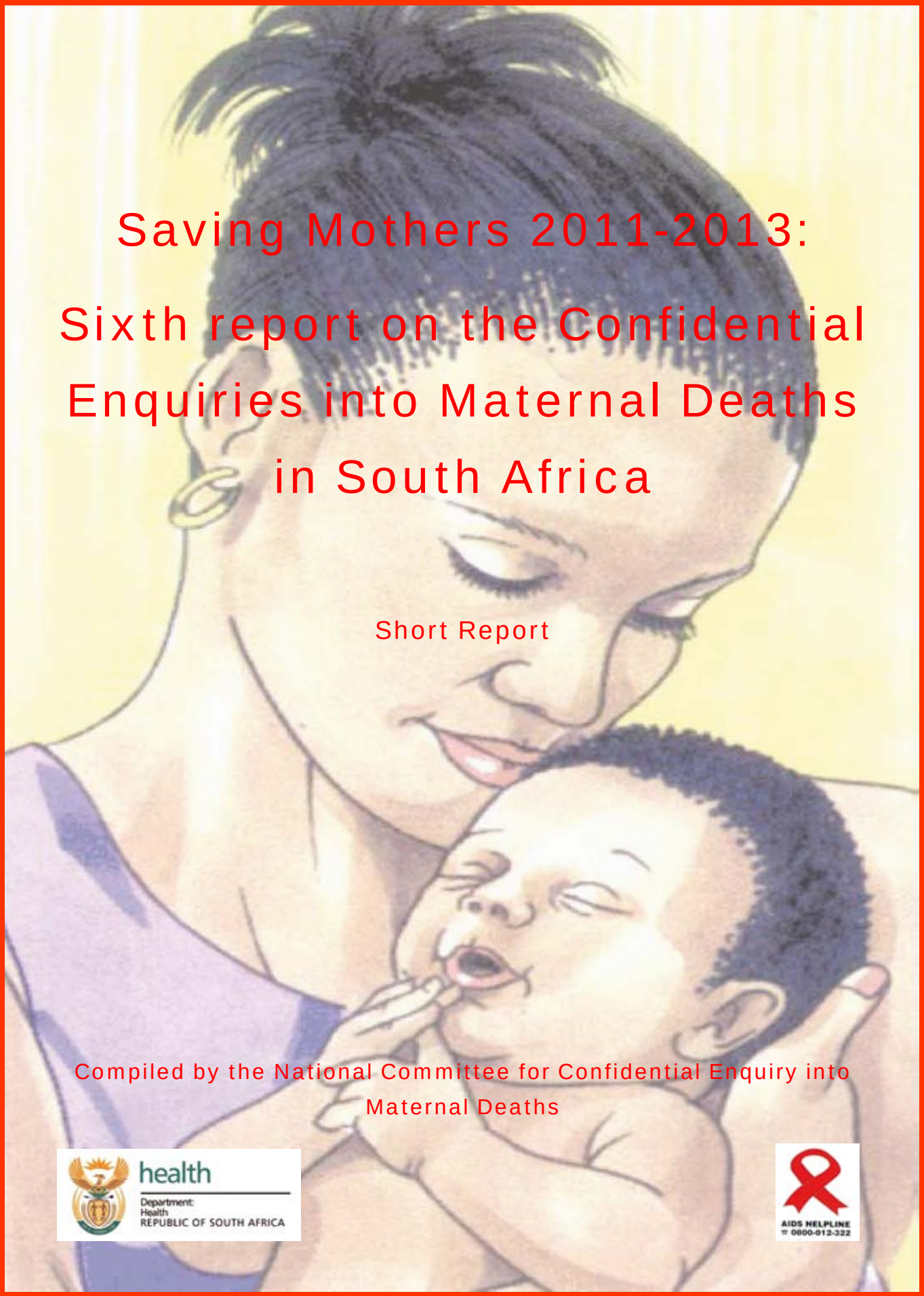


Saving Mothers 2011-2013:

Sixth report on the Confidential Enquiries into Maternal Deaths in South Africa

Short Report

Compiled by the National Committee for Confidential Enquiry into Maternal Deaths

health
Department:
Health
REPUBLIC OF SOUTH AFRICA

AIDS HELPLINE
0800-012-322

Saving Mothers 2011-2013: Sixth report on confidential enquiries into maternal deaths in South Africa

Short report

"A Nation thrives when mothers survive; we must strive to keep them alive'

Ellen Johnson Sirleaf

Contents

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

Acknowledgements

The NCCEMD would like to thank all the provincial assessors and the MCWH coordinators of all provinces and the National Department of Health's MCWH Youth and Nutrition cluster for their hard work and cooperation in collecting and entering the data on maternal deaths

Foreword

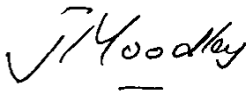
There is still much to be done! The current Short Report of Saving Mothers 2011-2013 shows that there is a decreasing trend of maternal deaths. This is due mainly, to a decrease in deaths from non-pregnancy related infections, and there are indications that there will be a further decrease in deaths 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 CD_4 count to 350 cells/µml.

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 basic building blocks 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

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 short 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 2012[1].

As the targeted date for millennium goals draw to a close, it is clear that the millennium goals will not easily 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 women[2] 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 NCCEMD decided to continue with the **5 Hs** recommendations. However, the NCCEMD 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

- **H**IV
- **H**aemorrhage
- **H**ypertension

[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

- **H**ealth professional training and
- **H**ealth 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:

- **C**are: Commitment to Quality
- **C**overage
- **C**aesarean section safety
- **C**ontraception
- **C**ommunity involvement

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

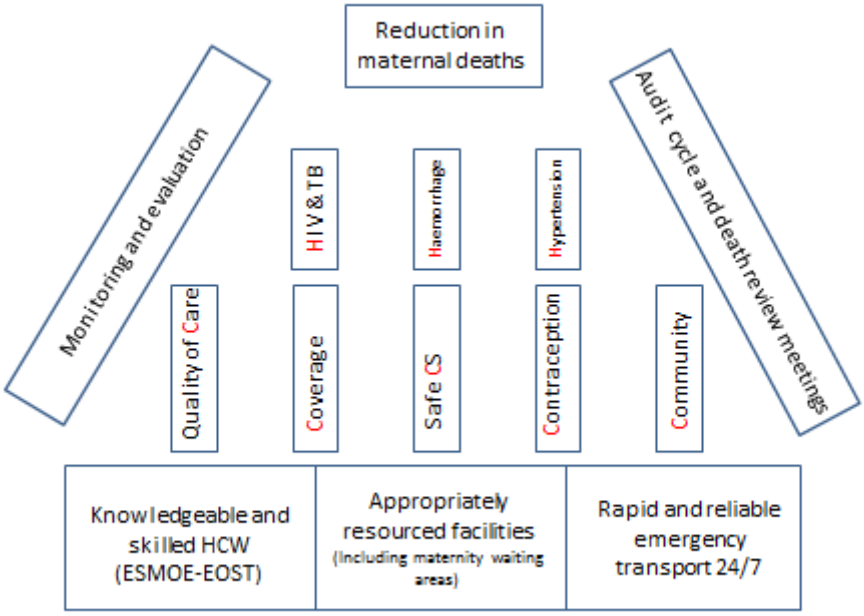
How	Who
Care: Commitment to quality	• DCSTs and clinical heads of department to improve clinical governance, clinical supervision, response to local audit findings, and leadership functions • HCPs to make themselves available for training, to participate in drills and to behave in professional manner • Managers to ensure emergency drills performed regularly • Managers need to evaluate and accredit HCWs to ensure they have appropriate skills
Coverage	• 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	• 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	• 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	• 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 Basic Building Blocks for the Health system**	
Improve Health worker training	- 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	- 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	- Promote preventive measures - Health care workers(HCP) actively screen for HIV co-infections and treat especially TB
Reduce deaths due to Haemorrhage	- Promote preventive interventions: - HCP involved in EOST exercises on haemorrhage
Reduce deaths due to Hypertension	- 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.[i]

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.

[1]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

Section 1.

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.

Section 2

2.1 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 2.1 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 2.1 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.

2.2 Distribution of deaths

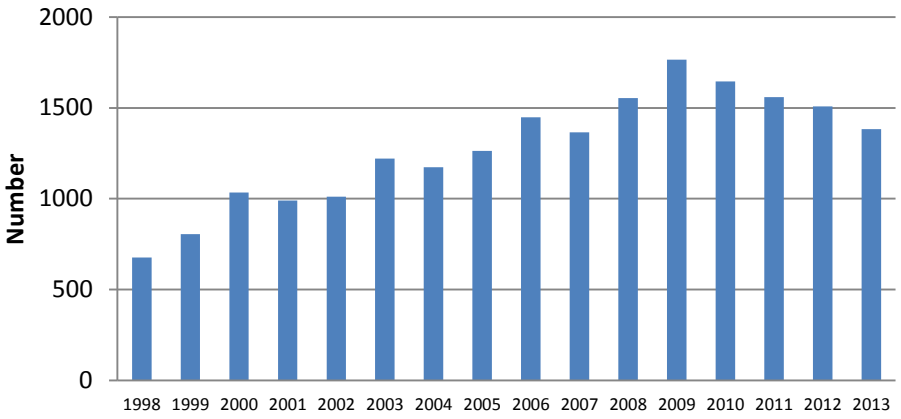
Table 2.2 give the deaths entered on the database since the start of the CEMD.

Table 2.2 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 2.1 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 2.1) and the iMMR has also shown a similar decline since 2009 (Figure 2.2). 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 2012[3] 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.

[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 2.2 iMMR from 2005 to 2013

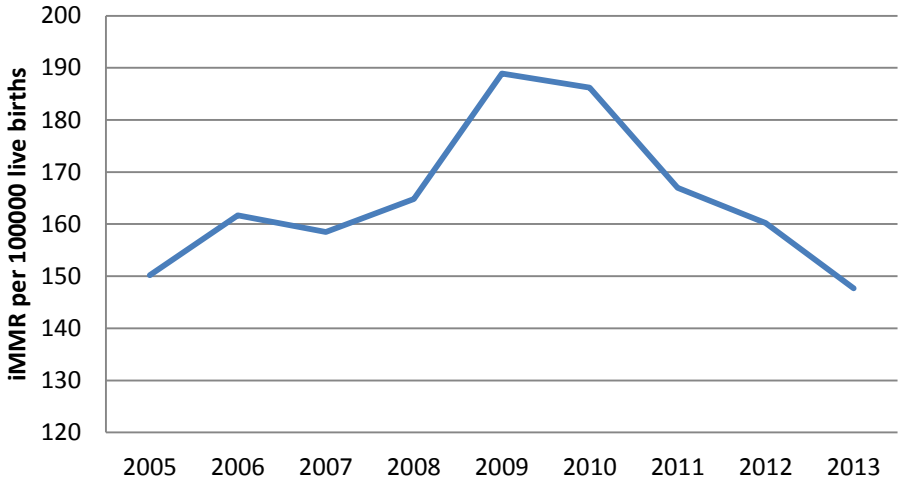


Figure 2.3 illustrated the provincial distribution of reported maternal deaths for 2011-2013. The most populous provinces have the most deaths, with the exception of the Western Cape where it reported the second lowest number of deaths, but is the third most populous province.

Figure 2.3 Distribution maternal deaths per province 2011-2013

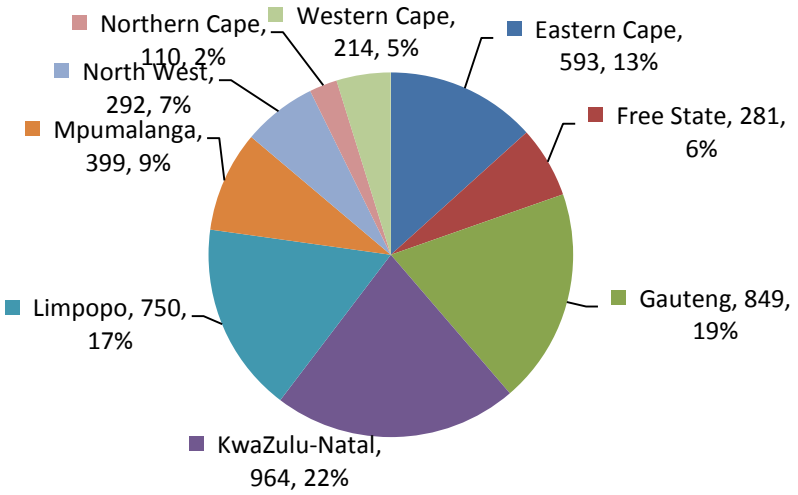


Figure 2.4 illustrates the trends in iMMR per province since 2005. The Free State and Northern Cape provinces have shown the biggest declines in mortality. All provinces except Limpopo province have shown a decline in recent years.

Figure 2.4 Trends in iMMR per province since 2005

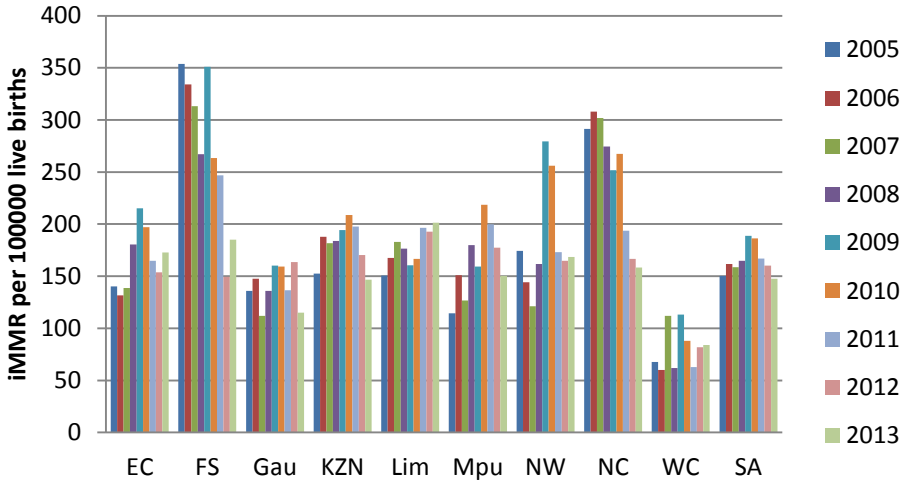


Table 2.3 give the maternal deaths, facility live births and iMMR per province for 2011-2013.

Table 2.3 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

2.3 Underlying obstetric causes of maternal death

Table 2.3 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 2.3. 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 2.4 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 2.4 Comparison of iMMR per underlying cause from 2002-2012

Disease category Institutional MMR /100000 live births	2002-2004	2005-2007	2008-2010	2011-2013
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

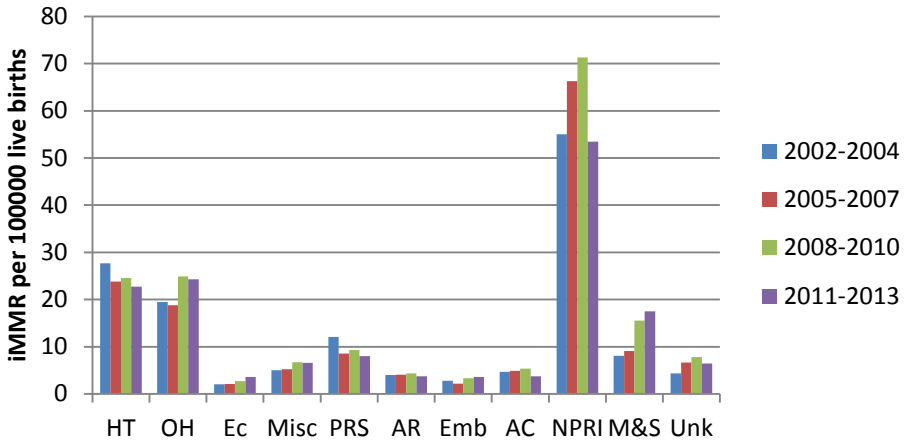
Table 2.5 illustrates the trends of iMMR per disease category for the years 2011, 2012 and 2013. The declining trend is seen clearly for non-pregnancy related infections and overall.

Table 2.5 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 2. Comparison of iMMR per disease category for four triennia



Indirect maternal deaths

Table 2.6 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 2.6 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 2.7 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 2.7 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 2.8. Cardiovascular disease remains the largest contributor, but respiratory infections are becoming increasingly more important.

Table 2.8 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 2.9 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 2.9 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

Table 2.9 Direct underlying causes of deaths 2011-2013 (Cont.)

Underlying cause	Number	Sub-category %
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**	

2.4 Maternal age and underlying cause of death

Table 2.10 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 2.5 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 2.10 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 2.5 Estimated iMMR per age group category

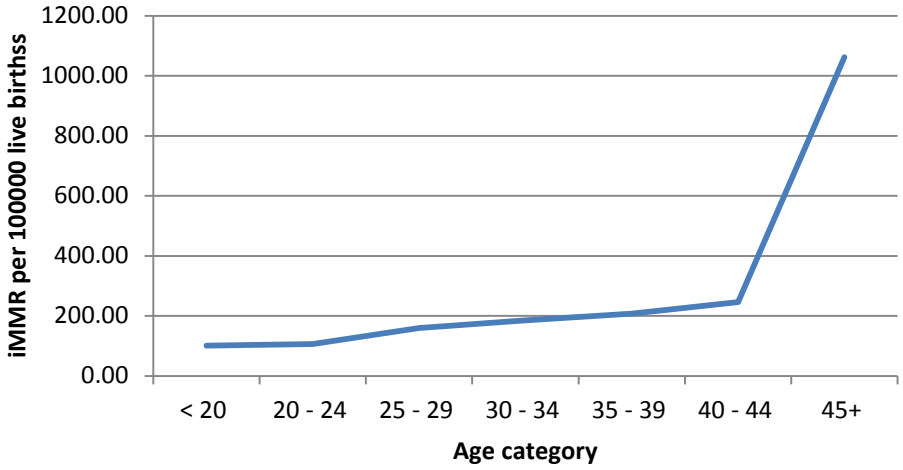


Table 2.11 demonstrates the priority conditions with respect to age. Hypertension in teenagers, non-pregnancy related infections in women between 20-39 years and obstetric haemorrhage in women 40 years and over were the top ranked conditions in their respect age groups.

Table 2.11. 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	100.0	100.0	100.0	100.0	100.0	100.0

xxxxx Top priority
xxxxx Second priority
xxxxx Third priority

2.5 Parity and underlying cause of death

Tables 2.12 and 2.13 demonstrate the relationship between parity and maternal death.

Table 2.12. 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 2.13. 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

2.6 Underlying Cause of Death and Levels of Care

Figure 2.6 and table 2.14 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 2.6 Comparison of iMMR and level of care for the three triennia

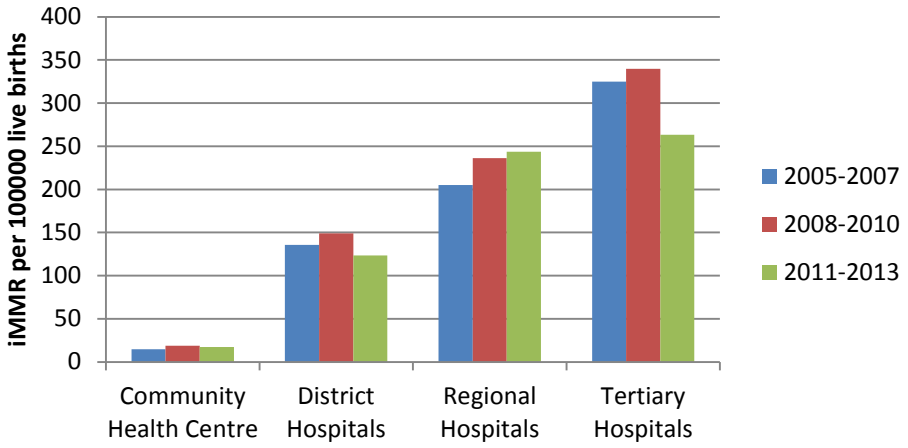


Table 2.14 Comparison of the iMMR per level of care for the three triennia

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 2.15 shows the distribution of the cause of death within each level of care, and Table 2.26 shows the distribution of causes of deaths across the levels of care for each condition.

Table 2.15 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 2.16 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

2.7 Distribution of underlying causes of death within Provinces

The distribution of the underlying causes of maternal death per province is shown in tables 2.17 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 2.18 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 2.19 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 2.17 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 2.18 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 2.19 Comparison between 2011-2013 and 2008-2010 of the iMMR per province

Institutional MMR /100000 live births	Eastern Cape		Free State		Gauteng*		KwaZulu-Natal		Limpopo	
Disease category	**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	Mpumalanga		North West		Northern Cape		Western Cape		South Africa	
Disease category	**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**

2.8 Contributory conditions and maternal deaths 2011-2013

2.8.1 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 2.20).

Table 2.20 HIV testing 2008-2010 and 2011-2013

	2008-2010			2011-2013		
HIV Status	**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 2.21 and 2.22 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 2.21 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/mm^3, 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 2.22 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 2.23 gives the final causes of maternal death in relation to their HIV status at the time of death.

Table 2.23 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.

2.8.2 Prolonged labour and maternal deaths

Table 2.24 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 2.24 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
- Abruption with hypertension	38	4	42	9.5
- Abruption 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

2.8.3 Anaemia and maternal deaths

The level of haemoglobin in the women who died was known in 72.2% of patients. Table 2.25 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 2.25 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**

2.9 Final/immediate and contributory causes of maternal death

The final and contributory causes of death are shown in Table 2.26. 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 2.26 Final and contributory causes of maternal death 2008-2010

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%

2.10. Avoidable factors, missed opportunities and substandard care

Tables 2.27 to 2.31 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 2.27 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 2.28 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 2.29 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 2.30 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 2.31 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 2.32 shows the impact of suboptimal care on maternal deaths.

Table 2.32. 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 2.7 Distribution of possibly and probably avoidable deaths per disease category

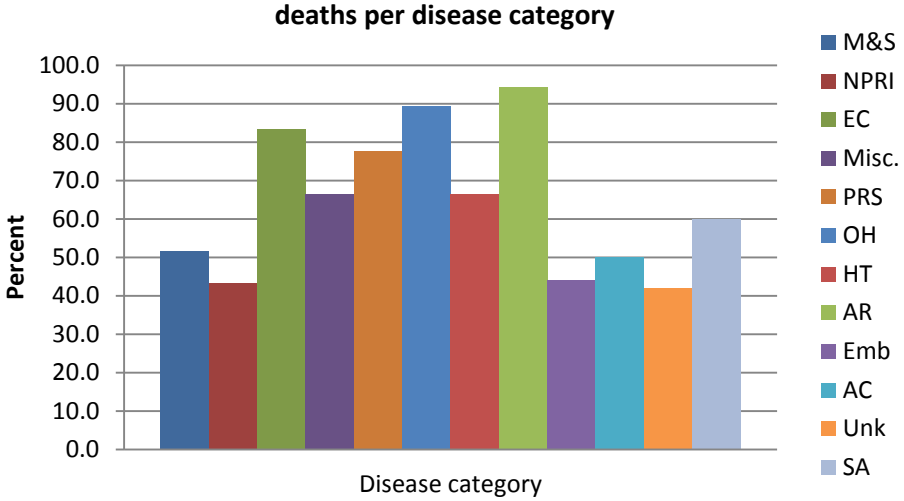
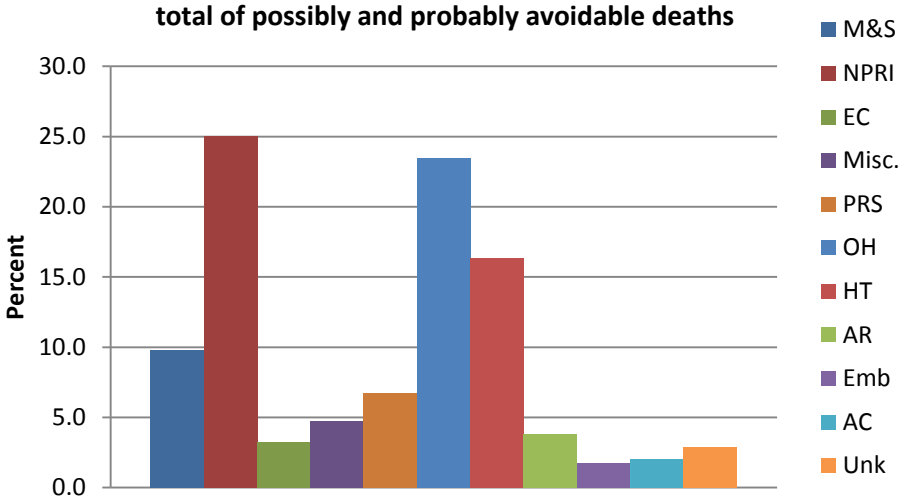


Figure 2.8 Distribution of the disease categories within the total of possibly and probably avoidable deaths



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 2.7 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 or reducing maternal deaths. Figure 2.8 illustrates the proportion each of the categories of disease play in the possibly and probably avoidable deaths. Three conditions standout, 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.

Section 3

3.1 Accelerating the reduction of HIV and TB maternal mortality

Dr R Burton for the NCCEMD

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/mm^3 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/mm^3 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 /mm^3 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/mm^3. When the CD4 threshold for HAART for pregnant women was raised to 350cells/mm^3, 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/mm^3. 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/mm^3. 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

3.2 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 one. Case fatality rate for CS deliveries compared with vaginal delivery rate

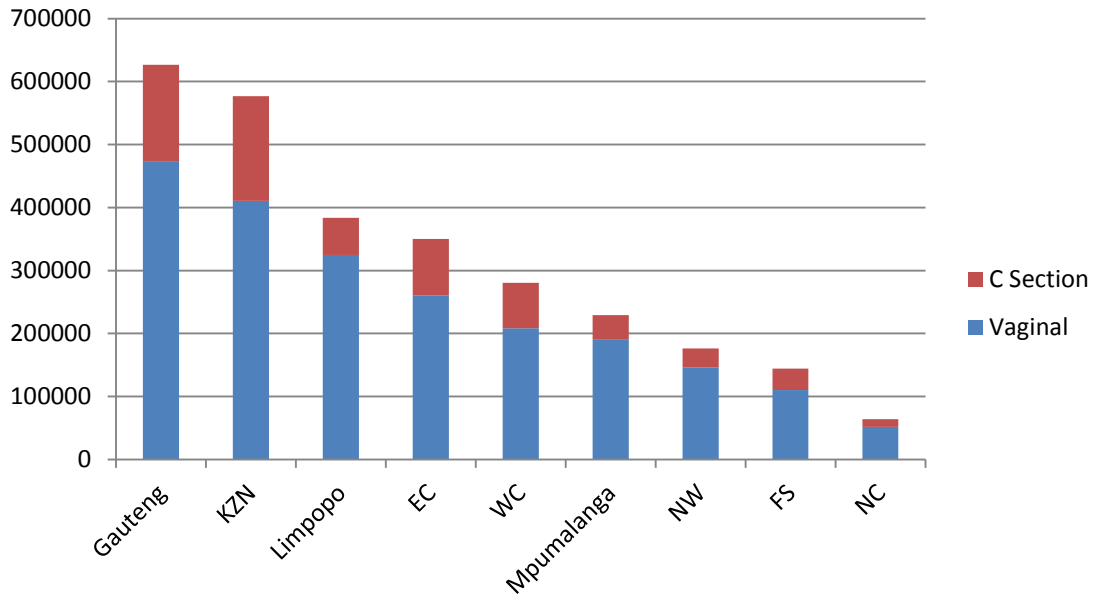
Type of delivery	Total number	Total number of deaths	Case Fatality Rate (per 10 000)	Relative risk	95% confidence interval
Vaginal delivery	2 175 380	1471	6,7	1	
Caesarean section	655 686	1243	18.9	2.8	2.5-3

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.

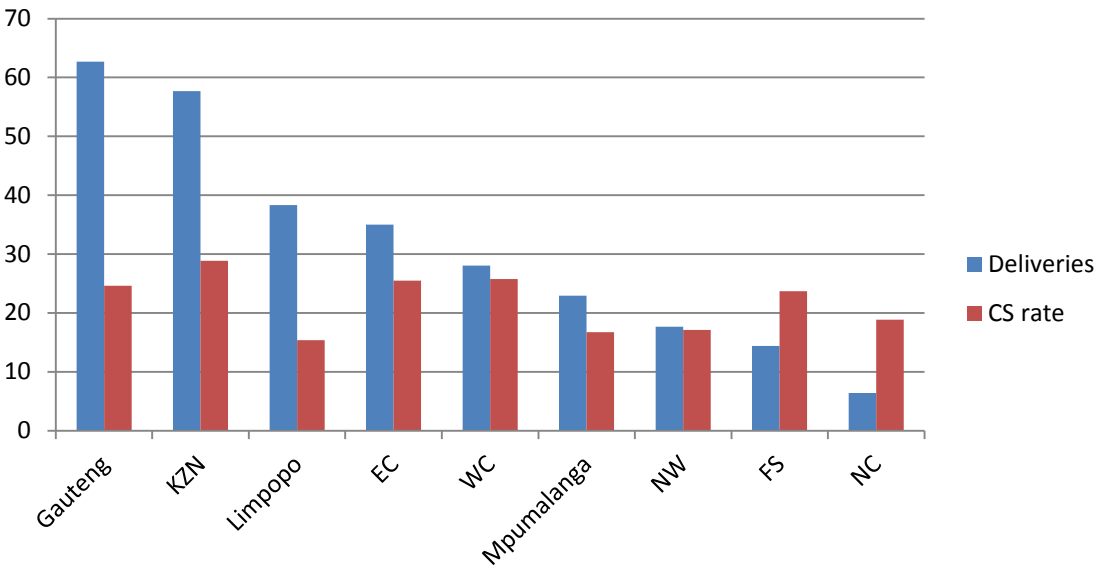
This chart shows the number of deliveries in each province, including the number of CS in decreasing order of delivery number; with most deliveries taking place in Gauteng, and most CS (in terms of actual numbers) done in KZN.

Figure 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. Caesarean rates per province 2011-2013*



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

Table 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:

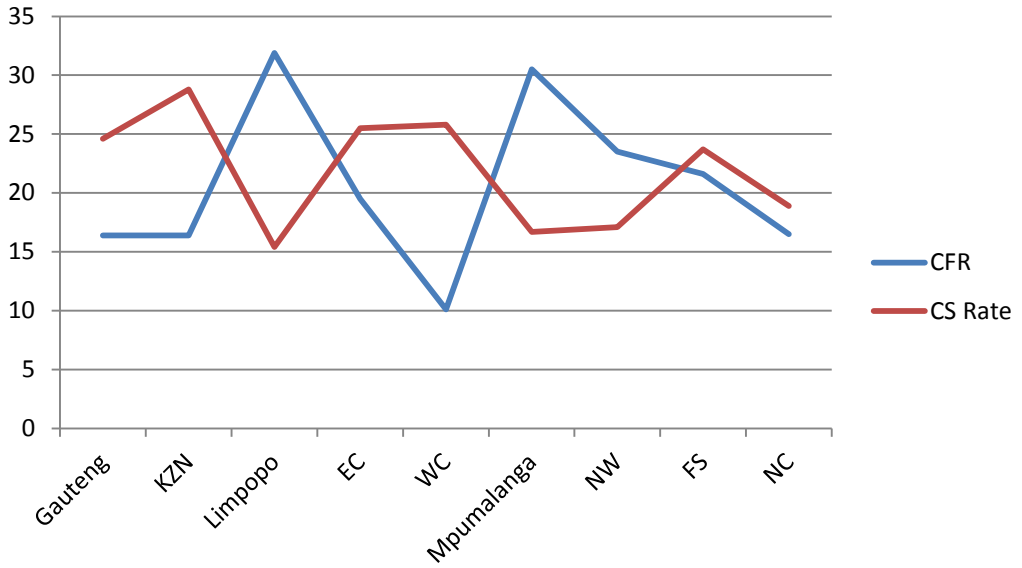
Numbers of deliveries and Caesarean sections						Caesarean section rate (%)				CS deaths
		2011	2012	2013	Total	2011	2012	2013	Total	
Eastern Cape	CS	28851	30097	30188	89136	24,8	25,4	26,2	25,5	174
	Deliveries	116414	118414	115095	349923					
Free State	CS	10495	11817	11798	34110	21,8	24,1	25,1	23,7	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 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

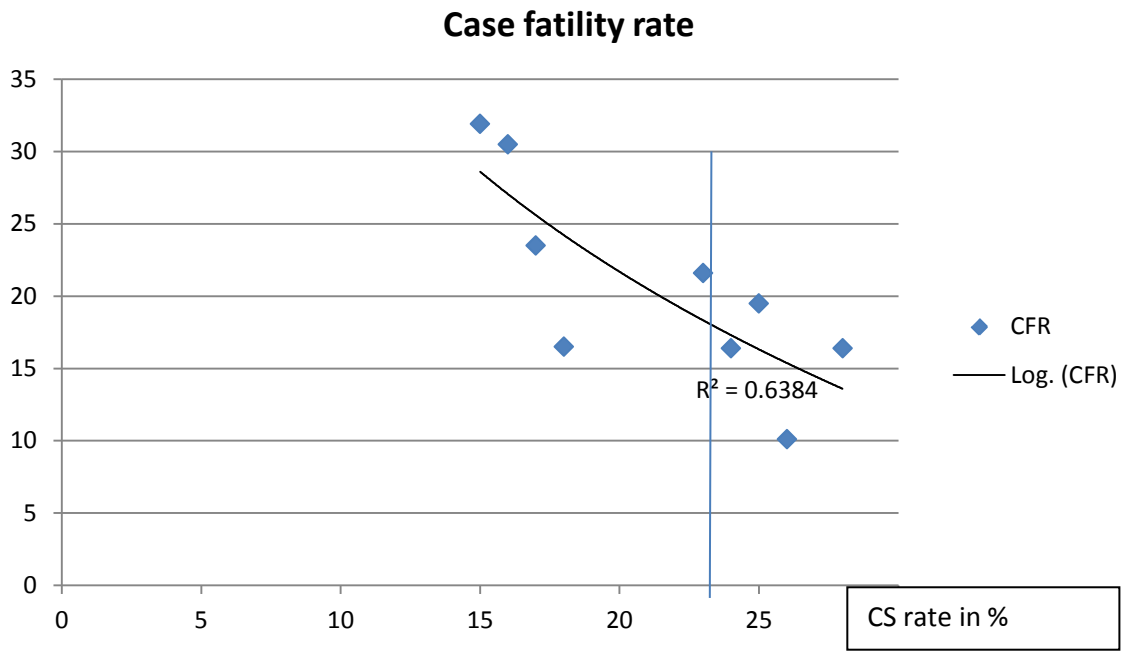
When the CS rate for each province is compared to its CFR from CS, it is quite striking that more mothers die from CS in the provinces where there is a low overall CS rate. The provinces with a CS rate >23% all had a CS CFR below 20; and those with a CS rate of <17% had the worst CFR.

Figure 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 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 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 4b. Relationship between <u>final</u> 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.

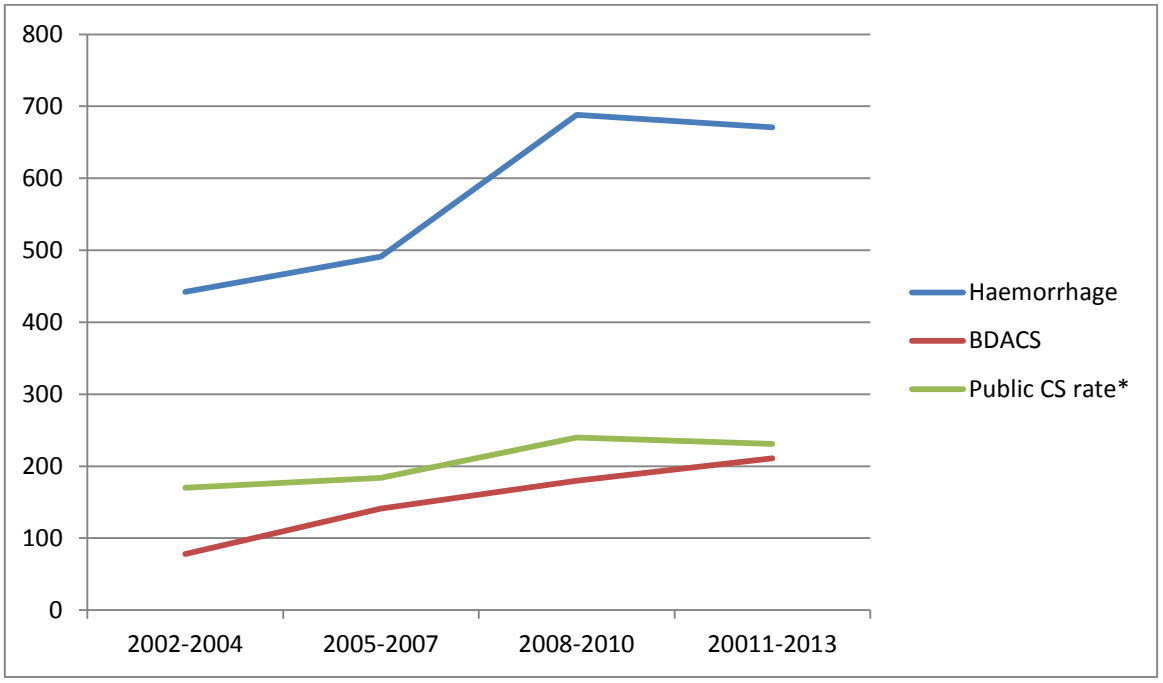
- **Bleeding during and after CS**

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.

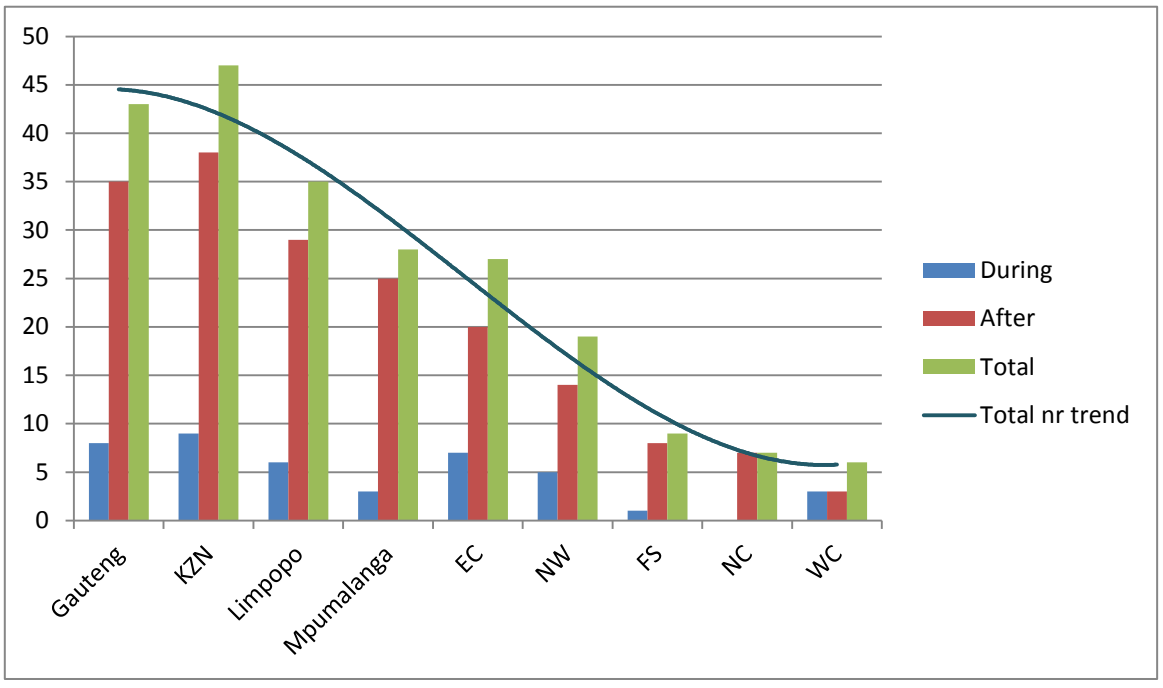
It is of great concern that in the majority of cases, no attempt was made to go back to theatre to stop the bleeding, or the decision was taken too late. It was either not part of the plan, or no assistant was available, or the patient was referred but died waiting for an ambulance or en route to the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

Figure 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 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 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 abstract

- **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 $x10^9$/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 $MgS0_4$.
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 50kg/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 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	
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/m^2
- Anticipate difficult surgery (two or more previous CS, BMI >40kg/m^2, 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.

3.3 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 1 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 1. 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 1 below:

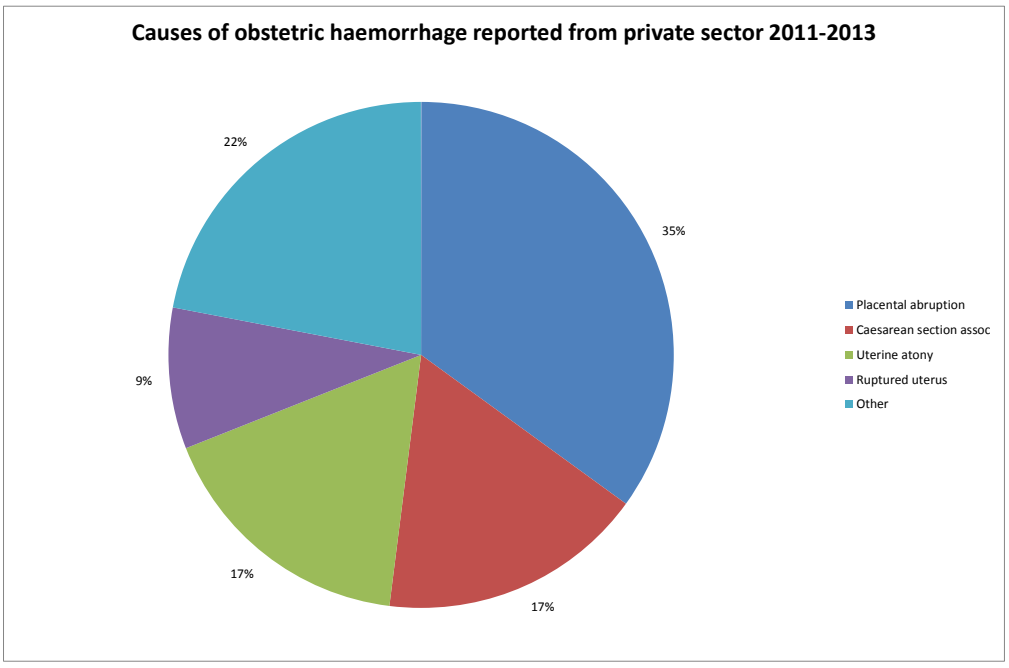


Figure 1

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 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.

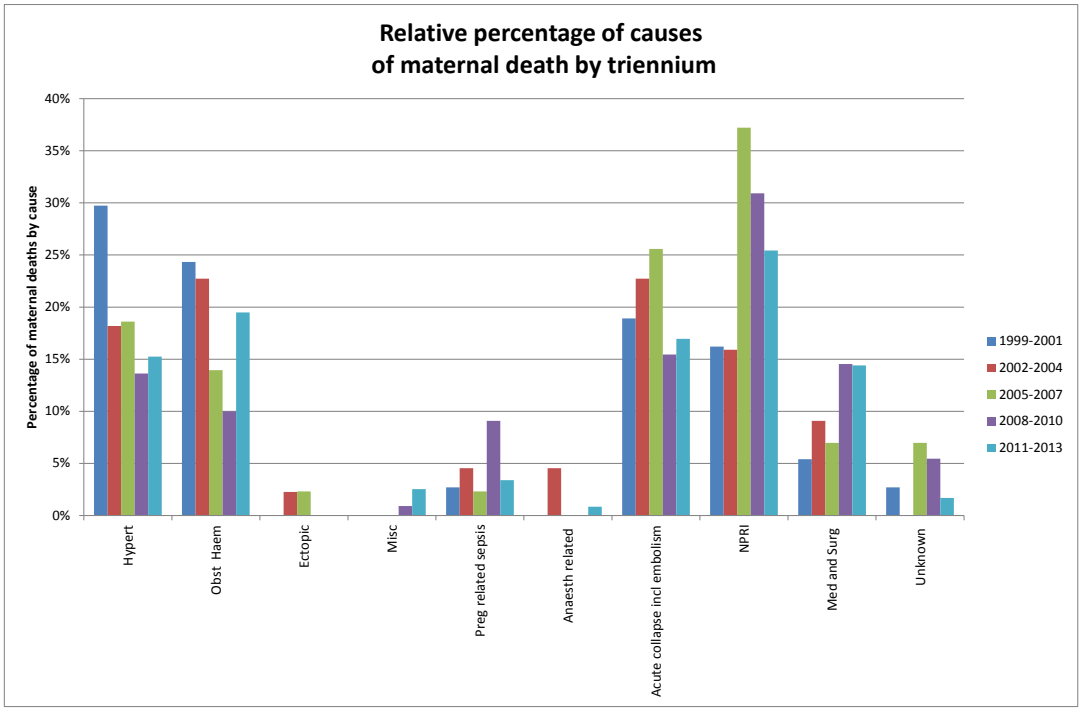


Figure 2

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 Apri2014, https://www.aon.co.za/index.php/en/news-articles/302-soaring-medical-malpractice-claims-demand-statutory-intervention).

Section 4

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 NCCEMD to guide practice. The NCCEMD 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 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 2012[4].

As the targeted date for millennium goals draw to a close, it is clear that the millennium goals will not easily 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

[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

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 women[5] 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 NCCEMD decided to continue with the **5 Hs** recommendations. However, the NCCEMD 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

- **H**IV
- **H**aemorrhage
- **H**ypertension
- **H**ealth worker training and
- **H**ealth 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:

- **C**are: Commitment to Quality
- **C**overage
- **C**aesarean section safety
- **C**ontraception
- **C**ommunity involvement

[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

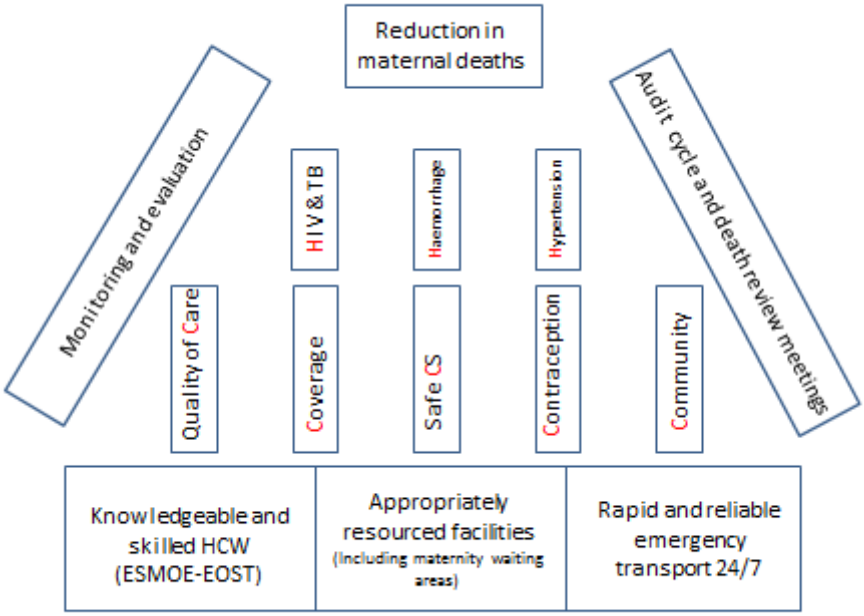
The **5Cs** are shown in the table below.

How	Who
Care: Commitment to quality	• 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	• 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	• 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	• 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	• 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 Basic Building Blocks for the Health system**	
Improve Health worker training	- 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	- 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	- Promote preventive measures - Health care workers(HCP) actively screen for HIV co-infections and treat especially TB
Reduce deaths due to Haemorrhage	- Promote preventive interventions: - HCP involved in EOST exercises on haemorrhage
Reduce deaths due to Hypertension	- 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 feedin gd 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

Appendix 1: Abstracts

Medical and Surgical disorders

Deaths due to medical and surgical disorders were the 4th most common cause of maternal deaths during this triennium. There were 4493 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 11.3% 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 17.53 per 100 000 live births. The most common causes of death were cardiac (34.3%, 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 identified 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.

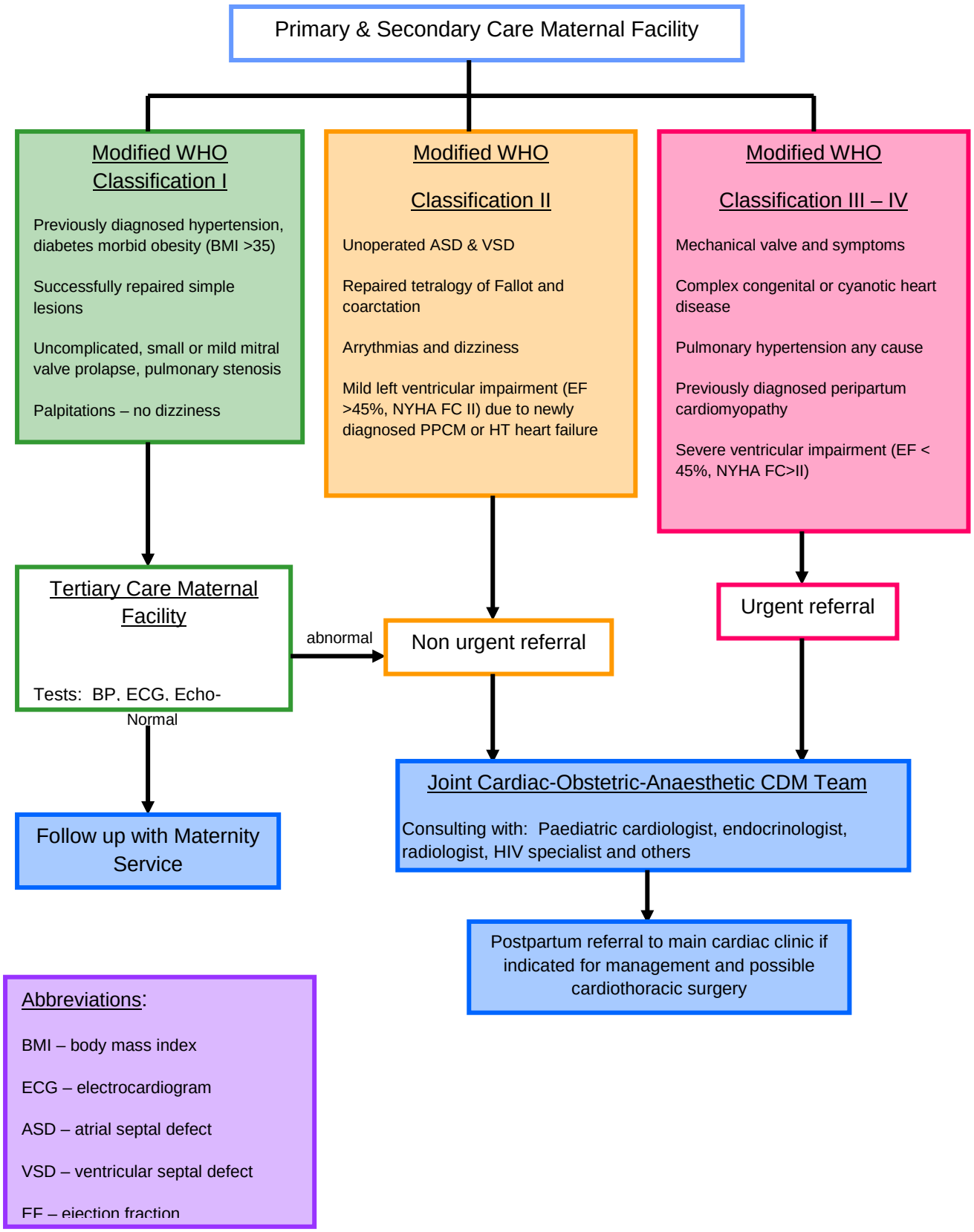
There has been a steady increase in the institutional maternal mortality rate for cardiac disease over the last 3 triennia. The iMMR for 2005-2007 was 3.73 and this has increased to 5.64 during 2008-2010 and to 5.78 per 100 000 in this triennium. Cardiac disease is therefore, after non-pregnancy related 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

1. Health professionals at primary health care clinics should be trained to screen all pregnant patients for underlying medical or surgical conditions
2. All patients with cardiovascular disease need to be risk assessed based on algorithm 1.
3. Patients with other medical conditions need to be referred to an ante-natal high risk clinic at a regional or tertiary hospital. A follow up and delivery plan must be communicated back to the regional hospital.
4. 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.
5. 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.
6. Preconceptual risk assessment clinics for patients with underlying medical disease should be established at tertiary centres.
7. All women should receive appropriate counselling about contraception and future pregnancy risks after delivery.

Algorithm 1

Referral Algorithm for suspected and previously known Cardiovascular Disease in Maternity (CDM)



Abbreviations:

BMI – body mass index

ECG – electrocardiogram

ASD – atrial septal defect

VSD – ventricular septal defect

EF – ejection fraction

Non-pregnancy related infections

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 NPRI 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, 49.1% 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, 43.4% 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. The PMTCT programme has prioritised maternal health. HIV positive women of reproductive age have many points of contact with healthcare services other than HIV clinics. 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 health of women who may planning pregnancy, or at risk of unplanned pregnancy.

3. Contraceptive needs need to be addressed at every clinic consultation, and during all hospital admissions, and immediate steps taken to ensure contraception is provided. 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. These issues can be addressed by any healthcare worker, at any time HIV positive women of reproductive age have contact with the health service, for any reason.
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. Women with high CD4 counts who start HAART while pregnant or breastfeeding should be able to continue HAART at their request. The positive partner in discordant couples should be offered HAART irrespective of CD4 count; women who are the HIV negative partner will have a reduced risk of acquiring HIV.
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 and any changes, date of initiation of HAART was started, CD4 counts and viral loads. Viral load monitoring in pregnant women is essential both to reduce the risk of vertical transmission, and to detect poor adherence early, and prevent resistance.
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. HIV positive pregnant women requiring hospital admission for any medical illness should all be investigated for TB. Women with neurological symptoms need investigating for CNS opportunistic infections, including TB meningitis and cryptococcal meningitis.
10. Infectious diseases that are more severe in pregnant women need recognition, 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.

Obstetric Haemorrhage

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 deaths in the 2008-2010 triennium. The haemorrhage related maternal mortality ratio (MMR) was 24.3 deaths per 100,000 live births, which is a slight decrease from 24.9 in 2008-2010 but still higher than the MMR of 18.8 in 2005-2007. There was considerable provincial variation with the greatest numbers of haemorrhage deaths occurring in Gauteng (148 deaths). The MMR due to haemorrhage was highest in Limpopo (33.59/100000 live births and lowest in Western Cape (4.97/100000 live births). As in the previous triennium, maternal age over 35 years was a risk factor for deaths from obstetric haemorrhage, with 28.8% 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 CS and the continuing high numbers due to abruptio placentae and ruptured uterus. The majority of deaths (93.7%) 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 be 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 29.4%. Administrative factors occurred for 61.6%, highlighting major problems in health facility management and training. Administrative factors included 13.2% lack of blood, 12.2% delays in inter-institution transport, 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 51.3% of assessable deaths at district hospitals, 33.2% at regional hospitals and 10.1% 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 uterotonics 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.

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 uterotonics 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 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 providing surgery 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.

Hypertension

There were 640 deaths in the last triennium with a gradual decline in 2013, viz. 2011=214; 2012=221; 2013=203. The primary obstetric problems were eclampsia, severe hypertension, HELLP and liver rupture. Deaths were reported in all sub categories of hypertensive disorders of pregnancy(HDP). Eclampsia was the commonest subcategory of HDP to cause mortality.

Deaths from hypertension were reported from all provinces with Capricorn district in Limpopo reporting iMMR figures of approximately 73.26/100000 live births, while KwaZulu-Natal had a drop in mortality to a MMR of 14.02/100000 live births.

The overall iMMR for hypertension in South Africa was 22.75/100000 live births

Cerebral complications(n=357:58.2%) were the single most commonest final cause of hypertensive deaths and was related to failure to lower very high blood pressure timeously and judiciously. Pulmonary edema was the final cause of death in 155(25%).

Severe hypertensive disorders in a large proportion of cases were not regarded as a major alert.

A sizeable proportion of women died at home and some of these women were assessed to have avoidable factors such as the poor quality of antenatal care. Sixty-six percent of the deaths were assessed to have a significant avoidable factor (i.e. possibly or probably avoidable as assessed by the assessors).

Key Recommendations:

1. Aggressive lowering of high blood pressure in a high care setting (close, intensive monitoring of blood pressure) must be instituted using standard methods outlined in the Maternity Care Guidelines of South Africa.
2. Ensure frequent measuring of blood pressure, pulse rate, respiratory rate and urine output prior to and following delivery
3. Teenagers and primigravidae < 24 years are an age group at risk of pre-eclamptic mortality. Reproductive health services for this group must be promoted in schools, workplaces, families and through electronic and print media. Be given toThe district specialists teams must help in this endeavour
4. Health system strengthening in respect of improving the quality of antenatal care, ensuring regular fire drills to improve the management of HDP (antenatal, antepartum, intrapartum and postnatal), ensuring appropriate equipment for resuscitation and that pharmaceutical agents are available for rapid lowering of high blood pressure.
5. Strongly consider the establishment of district or one or more regional centres of excellence for hypertensive care and provision of advice on management of HDP.
6. Women with severe hypertension, HELLP and eclampsia should not be managed at a district hospital but have their high blood pressure lowered, magnesium sulphate given and transferred.
7. Strong consideration should be given to delivery of women with severe early onset of pre eclampsia in maternal interests and especially if the baby is greater than 1500 kgs. Expectant management in these circumstances has led to a number of deaths
8. Chronic hypertension, if detected at a clinic must be referred to the base hospital

Early pregnancy loss

There were 287 early pregnancy deaths in 2011-2013, an 8% increase compared to 2008-2010. One hundred and one deaths (102) were caused by ectopic pregnancy (35% increase), and 185 by complications of miscarriage, which was about the same number as in 2008-2010 (186). Sixty-four percent (64%) of ectopic pregnancy deaths and 35% of miscarriage deaths were assessed as being probably 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 cases (8%) were classified as extrauterine pregnancy beyond 20 weeks' gestation. Although the majority of women who died from ectopic pregnancy had unknown HIV status (55%), 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% followed legal termination of pregnancy, and 4% were classified as gestational trophoblastic disease. Although 40% of women who died from miscarriage had unknown HIV status, of those who were tested, 82% were HIV infected. The final cause of death was septic shock in 63% and hypovolaemic shock in 37%. The most frequent patient behaviour-related avoidable factors were delay in accessing medical help, no antenatal care, and unsafe miscarriage. 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. 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. 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
7. 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
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 of ectopic pregnancy and its management, particularly the need for immediate surgery if the patient is shocked.
10. 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.

Pregnancy-related sepsis following viable pregnancies

Deaths from pregnancy-related sepsis (PRS) are those caused by infections of the genital tract associated with 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 206 women, of whom 137 (67%) 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 cases of deaths following bowel injury in 2008-2010.

Forty-three 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.

Acute Collapse and Embolism

During the triennium a total 208 cases were classified as acute collapse and embolism, 4.8% of all maternal deaths, similar to that in previous Saving Mothers reports. A total of 83 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 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.

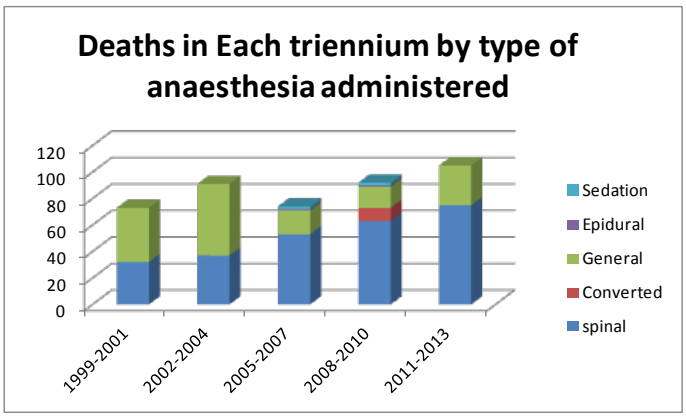
Key recommendations

1. Obesity should be more carefully documented and noted as a risk factor. Routine thrombo-prophylaxis 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).

Anaesthetic related maternal deaths

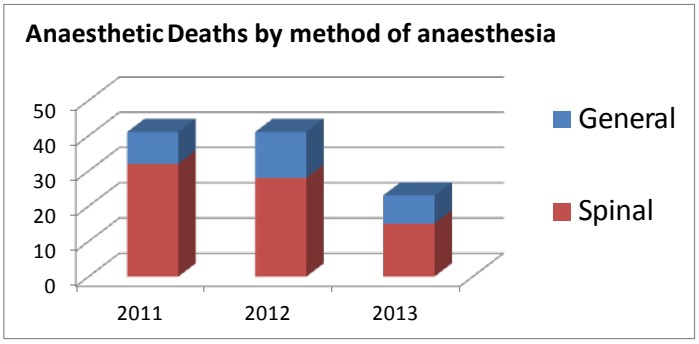
Disclaimer: This report is prepared mainly from data extracted from the obstetric database of the NCCEMD. Discrepancies may arise between this data and the full anaesthetic analysis from the original case files. The key findings of this review are:

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.

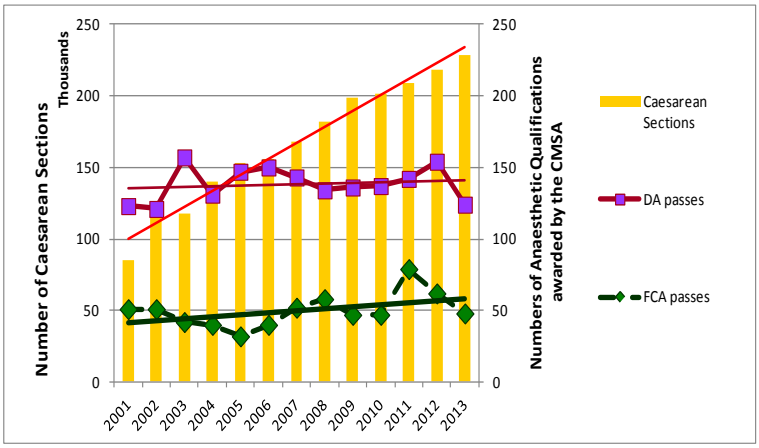
3: Potential understatement of the importance of anaesthesia contribution to Maternal Mortality

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 disproportionally 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.

Appendix 2

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 oxyimeters, heamoglobinmeters, 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 oxyimeters, heamoglobinmeters, 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 oxyimeters, **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 oxyimeters, 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 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
CHAIRPERSON:
Prof Jack Moodley

DEPUTY CHAIRPERSON:
Prof Susan Fawcus

EDITOR
Prof Robert Pattinson
MEMBERS
Prof Christopher Rout
Prof Nomafrench Mbombo
Dr Neil Francis Moran
Dr Zane Farina
Dr Gregory Zwelidumile Mbambisa
Dr Marthinus Schoon
Dr Seabe Joseph Seabe
Dr Ntandho Patrick Godi
Ms Nnana Elizabeth Molefe
Ms Dimpho Chweneyagae
Dr Busisiwe Kunene
Dr Nilda Delis-Jarrosay

C.PROVINCIAL ASSESSORS
EASTERN CAPE
Dr Gregory Zwelidumile Mbambisa
Ms Nomonde Dilinga
Dr Mana Lungisa Mdaka
Ms Lulama Sompeta
Mrs Ntombizanele Ngwabeni
Dr Andile Maliza
Ms Jacoba Snyman
Dr KAP Bhat
Ms Ntombizodwa Martha Phokontsi
Dr Mfundiso Samson Mabenge
Dr Natalia Novikova
Ms Naomi Mwesigye
Dr Pinky Selanto
Dr Sibongile Desiree Mandondo
Sr Cingiswa B Qwakanisa
Mrs Nomvula A Kwadjo
Dr Pila M Shweni
Mrs Nobulumko Gaba

FREE STATE
Mrs. Mafura Dineo Maggie
Mrs. Mbelekane Maselloane Mary
Mrs. Mohale Ntombizonke Tryphina
Mrs. Mphirime Sebakeng Aletta
Mrs. Nkhame Nokufa
Mrs. Leseli Mojabeng Sanna
Dr Akweyo Nancy
Dr Thando Nondabula
Dr Kelebigile Lorraine Finger-Motsepe
Dr Janine Lemmer-Malherbe
Dr Muzi D Mngomezulu
Dr Marthinus Schoon

GAUTENG
Mr Sikhonjiwe Masilela
Prof E. Buchmann
Dr S Chetty
Dr F. Molokoane
Sr. M Sekgabi
Dr. Soma Pillay
Sr. Horn
Dr. Mjoli
Sr. Rachael Raborife
Dr. Seabe
Sr. Ndubane
Sr. Notyilana
Prof. F Paruk
Sr. Nyembe
Dr. N Myamya
Dr. N Pirani
Dr. TJ Mashamba
Sr. N Madumo
Dr. Mwinyoglee
Ms. P Mashigo
Sr. M Ngwane
Sr. A Mazibu
Dr. Opai Tetteh
Dr JLY Bitumba

KWAZULU NATAL
Prof. J Moodley
Dr N Moran
Mat Razia Roopchand
Dr Z Farina
Dr G Kirsten
Mat. N Ngongoma
Dr B Hira
Sr BV Shabane
Dr J. Titus
Dr T Ibrahim
Dr K Tunkyi
Sr L Msweli
Dr M Naidoo
Mat. F Abdullah
Sr. Ayanda Ngema
Mat N Mtshali

Dr U. Wessels
Dr T Sebitloane
Ms. Pinky Phungula
Sr Scott Leigh
Mr Thami Shange
Dr U Singh
Dr S Bechan

LIMPOPO
Ms Elizabeth Matidze
Dr Raul Fuentes
Dr Edwin Maboya
Dr Johannes GvH Geldenhys
Ms Martha Maboho
Ms Elphina Maloko
Dr Roberto Varona
Dr Margaret Dagada
Ms Jane Maboa
Dr Frank Mayimele
Ms Dorcus Ragedi
Dr Venny Bopape
Ms Beauty Motsanane
Ms Ellence Mokaba

MPUMALANGA
Pansy Vadanile Mdhluli
Mantwana Leah Mokwena
Jorge Luis Perez Donato
Gerhardus Rossouw
Heyroon Victoria Mokoena
Marie Muller
Duduzile Ethelina Ngoma
Sesi Emelina Dhlamini
Zodwa Margaret Khoza
Mpho Gertrude Makuse
Thandi Goodness Simelane
Emeka Ferdinand Orie
Sam Alton Motswene
Genius Sunamisai Mpombwa
Donald Hilton Amu-druza Amoko
Millet Duduzile Mashua
Marthinus Stephanus Nel
Rafique Ismail
Dr E Mhlanga

NORTH WEST
George MohoboMothupi
Micheal Monde Mphatsoe
Diane Mavis Magadlela
Nnana Elizabeth Molefe
Tshinyama Kanku
Mokaiemang Eva Dintoe
Christina NtombiniModise
Baitshahatsi Virginia Baboile
Matsie Maria Molusi
Tshenolo Violet Batji
Basil Trench Lyngdoh
Virginia TshepoDitsele
Kegomoditswe MagdelineNtlolokwane
Jeniffer Elizabeth Griqua
Kesaobaka Monica Bolae
Oubunmi Isaiah Adejayan
Nthatane Salome Komane

NORTHERN CAPE
Ms Lindiwe ML Nyathi – Mokotso
Ms Mary Elsabe De Wee
Ms Makekana Magdeline Lekhoathi
Dr Jan van Soest
Ms Lydia Caroline Van Wyk
Ms Magriet Johanna Cordier
Ms Alleta Dipuo Thupane
Dr Phillip J Kenny
Dr Mukendi Ngalamulume
Ms Cindy Esme McKenzie
Ms Adelene Van Jaarsveld

WESTERN CAPE
Prof. Sue Fawcus
Ms. Hestelle Louw
Prof. Robert Dyer
Prof. David Hall
Dr. Leann Schoeman
Prof. John Anthony
Mrs Jawahir Harris
Dr. Jonathan Burke
Dr. J L Van Der Merwe
Dr. Gregory Petro
Ms. Pumla Mvunyiswa
Dr. Owen Porrill
Ms. Katrina Kruger
Dr. Linda Vollmer