Saving Mothers 2014-2016: Seventh triennial report on confidential enquiries into maternal deaths in South Africa:

Short report

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List of abbreviations

Abbreviation	Meaning
AA	Anaesthetic related death
AC	Acute collapse
AIDS	Acquired Immune Deficiency Syndrome
AF	Avoidable Factors
APH	Antepartum haemorrhage
ARV	Antiretroviral drugs
BLDACD	Bleeding associated with 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. he	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

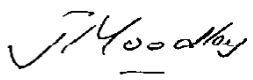
The NCCEMD would like to thank all the provincial assessors and the MCWH coordinators of all provinces and the National Department of Health's MCWH Youth and Nutrition cluster for their hard work and cooperation in collecting and entering the data on maternal deaths

Foreword

The Saving Mother's Reports (SMR's) as many would know are an analysis of data collected on each institutional maternal death provided by health facilities in South Africa. The SMRs are published triennially and disseminated to all hospitals, academic institutions and relevant professional bodies within the country. The analysis is done by members of the National Committee on Confidential Inquiries into Maternal Deaths; this is a Ministerial Committee consisting of experts in obstetrics, midwifery and anaesthesia with at least one representative from each of the 9 provinces in the country. The SMRs are disseminated every 3 years and takes a tremendous effort by all members of NCCEMD. Therefore all members need to be thanked for their efforts in writing the various chapters in the report.

The latest SMR (2014-2016) shows a continued fall in both the numbers and mortality ratios of institutional maternal deaths since the peak in the numbers of deaths in 2009. The reduction in maternal deaths is in the main due to changes the treatment programmes for HIV positive pregnant women. Changes in antiretroviral drug (ARVs) regimen has seen a decrease of almost 47% in the numbers of deaths due to non-pregnancy related infections (mainly HIV deaths) from the numbers in 2011. More specifically changes in drug regimen has seen a fall in deaths from adverse ARV drug events from130 (2011-2014) to 27 (2014-2016). Furthermore, the NCCEMD's recommendations to focus on reducing deaths in specific categories such as Obstetric Haemorrhage has resulted in a 22% reduction of deaths in this category.

Major challenges, however still remain and in the main these relate to quality of care, inter-facility transport, and knowledge and skills of health professionals; the quality of care is slowly improving but knowledge and skills is sometimes lacking. More effort needs to be put into respectful care and having a sense of being mindful. For the first time the NCCEMD has obtained more reliable information on "Home Deaths" and it appears that our post-partum care needs to be strengthened. Many of the women who died at home or those who return post- delivery in extremis may have been discharged too early. Finally, despite all the challenges faced by the NDOH, the minister of health needs to be thanked for making WOMENS HEALTH a priority issue.



J MOODLEY

Chair
National Committee on the Confidential Enquiries into Maternal Deaths

January 2018

Section 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 sixth comprehensive reports covered the trienniums 1999-2001, 2002-2004, 2005-2007, 2008-2010 and 2011-2013. 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 gives the key findings of the 2014-2016 triennium and new information on maternal deaths occurring outside of health facilities. There is an interesting discussion on the role of midwives in preventing maternal deaths. There have been unacceptable delays in publishing the Comprehensive report of 2011-2013 and the NCCEMD has decided that the chapter heads will write articles for journals instead of chapters for the report. In this way we hope to have the finding disseminated much quicker than previously. However, to ensure that the data is still available to those that want or need it, the tables that would be used in the chapters are given in the appendix at the end of this report.

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

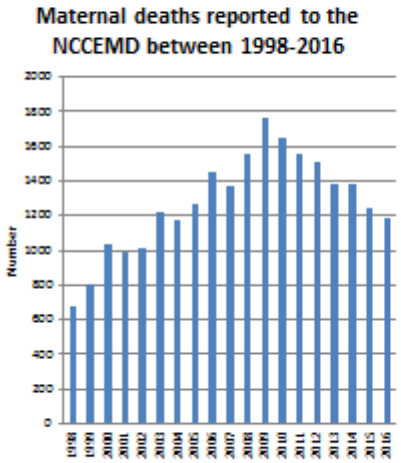
Data used in this report consist of the maternal deaths that occurred and were reported to the National Committee for Confidential Enquiries into Maternal Deaths (NCCEMD) secretariat and were entered on the MaMMAS database before 15th May 2017. This cut-off date was selected to try and ensure most deaths were reported and entered into the MaMMAS Database but still allow for a fairly rapid analysis of the data.

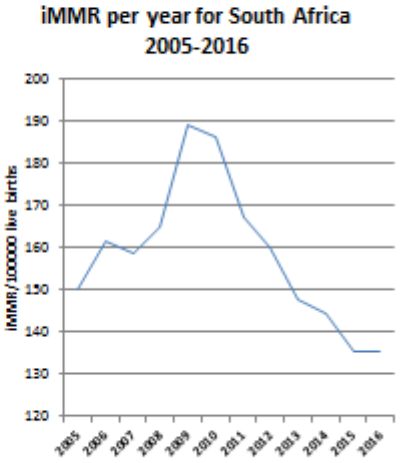
Section 2.1 Key Findings

1. Reduction in mortality

- The number of maternal deaths continues to fall each triennium by 12.8% from 2008-2010 to 2011-2013 and 12.5% from 2011-2013 to 2014-2016, and an overall reduction of 24% from the peak in 2008-2010, an overall reduction of 1152 from 2008-2010 to 2014-2016.
- 339 fewer deaths in 2016 than 2011 and 580 fewer maternal deaths than at the peak in 2009.

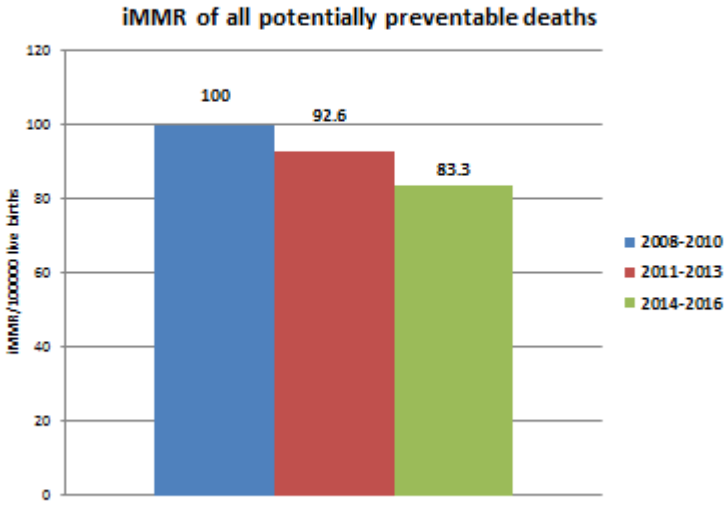
Changes in mortality over time





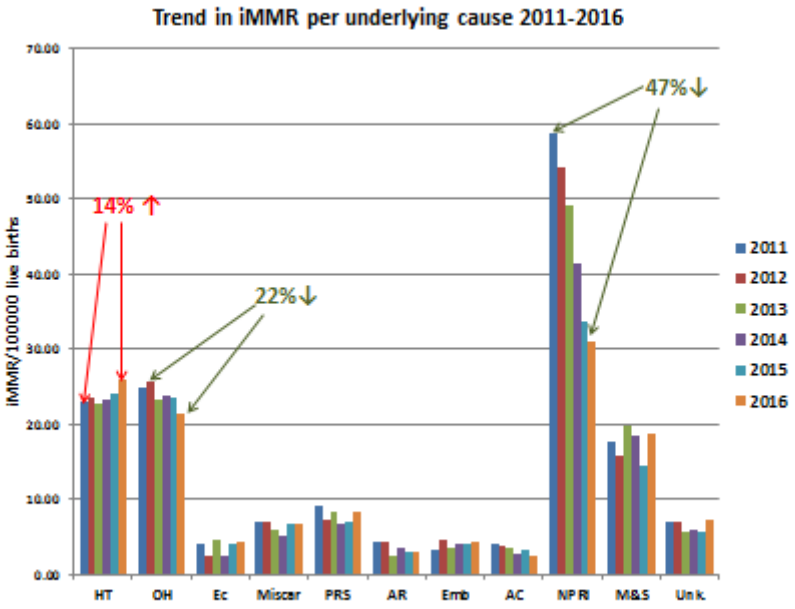
2. There has been a slight improvement in quality of care

- Potentially preventable deaths are defined as those assessed by the assessors as being possibly or probably preventable at the end of their assessment of the case.
- The iMMR for potentially preventable deaths decreased from 100.0 per 100000 live births in 2008-2010, to 92.6 and then to 83.3 in 2011 in 2011-2013 and 2014-2016 resepectively. This indicates a slow but steady decline in the number of potentially preventable deaths.



3. There has been a reduction in deaths related to HIV infection and obstetric haemorrhage but no change in deaths due to hypertensive diseases in pregnancy

- There has been a 47% reduction in NPRI and 22% reduction OH and from 2011 to 2016
- Increase of 14% in same time in deaths due to hypertensive diseases in pregnancy



4. Provincial tertiary hospitals have the highest iMMR

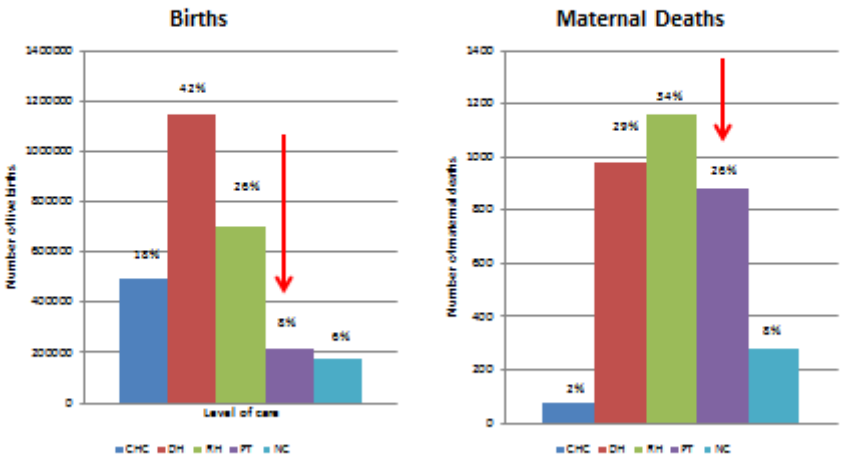
- The iMMR in provincial tertiary hospitals is 160% higher than regional and national central hospitals. There are 16 provincial tertiary hospitals that perform deliveries. Lower Umfolozi War Memorial Hospital (now Queen Nandi Hospital) is included as a provincial tertiary hospital as Ngwelezane Hospital in the same area does not have a maternity section and is a provincial tertiary hospital.

Provincial Tertiary Hospitals

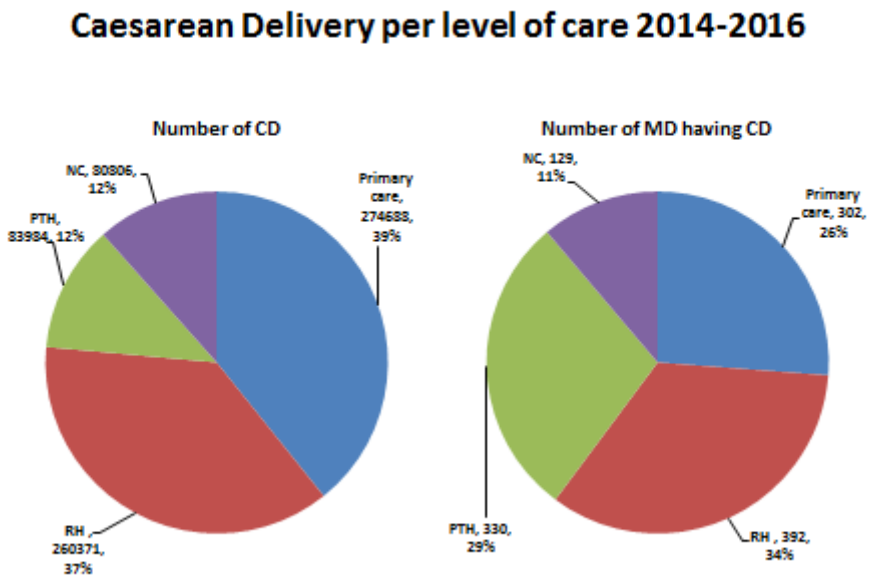
Province	District/Metro	Facility
Eastern Cape	Buffalo City MM	ec Frere Hospital
Eastern Cape	N Mandela Bay MM	ec Dora Nginza Hospital
Eastern Cape	O Tambo DM	ec Nelson Mandela Academic Hospital
Free State	Mangaung MM	fs Pelonomi Hospital
Gauteng	Ekurhuleni MM	gp Tembisa Hospital
Gauteng	Tshwane MM	gp Kalafong Hospital
KwaZulu-Natal	eThekwini MM	kz King Edward VIII Hospital
KwaZulu-Natal	uMgungundlovu DM	kz Grey's Hospital
KwaZulu-Natal	Uthungulu DM	kz Lower Umfolozi War Memorial Hospital
Limpopo	Capricorn DM	lp Mankweng Hospital
Limpopo	Capricorn DM	lp Pietersburg Hospital
Mpumalanga	Ehlanzeni DM	mp Rob Ferreira Hospital
Mpumalanga	Nkangala DM	mp Witbank Hospital
North West	Bojanala Platinum DM	nw Job Shimankana Tabane Hospital
North West	Dr K Kaunda DM	nw Klerksdorp-Tshepong Tertiary Hospital
Northern Cape	Frances Baard DM	nc Kimberley Hospital

Provincial tertiary hospitals conduct only 8% of births in the country but have 28% of the maternal deaths.

Births and deaths per level of care



Further they perform only 12% of the caesarean deliveries in the country but have 29% of the maternal deaths associated with a caesarean delivery. It is important to note that District hospitals perform 39% of the caesarean deliveries in the country but have 26% of the maternal deaths associated with caesarean delivery.



Overall there were 880 maternal deaths in provincial tertiary hospitals of which 382 (43%) were seen in CHCs, 436 (50%) in district hospitals and 218 (25%) in regional hospitals before dying in provincial tertiary hospitals.

There were 35% of cases in the CHCs, 57% in district hospitals, 44% in regional hospitals and 42% in provincial tertiary hospitals where there was health care professionals avoidable factors recorded in the deaths at the provincial tertiary hospitals.

Provincial tertiary hospitals see a lot of cases from lower levels of care that die in their facilities and often the care prior to admission to the provincial tertiary hospital has been substandard. However, there is also a high proportion of deaths in the provincial tertiary hospital that also has substandard care in the provincial tertiary hospitals.

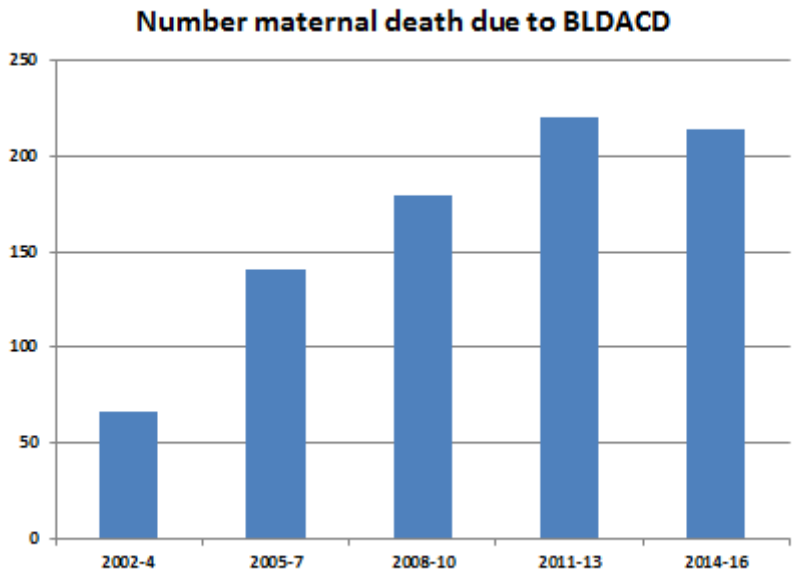
The high mortality in provincial tertiary hospitals is probably due to a combination of cases referred in a poor condition from lower levels of care and poor quality of care in hospitals themselves.

A committee has been appointed by the Minister of Health to further investigate the high mortality in the provincial tertiary hospitals.

5. There is still a way to go before Safe CD is available to all who need it

- In women who delivered a baby of more than 24 weeks gestation there were 1184 delivered were by CD and 1083 delivered vaginally; the iMMR for CD was 165 versus 53/100000 live births for vaginal delivery. The iMMR for CD was three time higher than for vaginal birth; however at primary level the iMMR per CD was 110 versus 25/100000 live births for vaginal deliveries (more than 4 times higher). This iMMR for CD at District hospitals would be much higher if the number of women having CD at district hospitals who developed complications and were referred to higher levels of care were counted. Thus safe CD at district hospitals must still be attained.
- Fortunately maternal deaths due to bleeding during or after CD (BLDACD) have stabilised but this category still represents 30% of all women who die due to OH.
- The following features were recorded in those cases dying due to BLDACD:
    a. Lack of skilled doctors in 33% cases
    b. Lack skilled nurse in 20% of case after CD; 14 of 50 cases in district hospitals
    c. In the 50 maternal deaths in DH, a lack skilled doctor was recorded in 25 cases; 14/43 cases in RH and 21/47 in PTHs.
    d. In 7 of 16 cases that died due to bleeding during CD in DHs there was a lack of skilled doctors.
    e. Only 32% of women who died from BLDACD had a hysterectomy. All should have had a hysterectomy and this indicates a skills gap.
- Fifty-six percent of anaesthetic related deaths occurred at DHs and the final cause of death in over half these cases was due to failure to protect the airway during the anaesthesia. It appears clinicians are giving spinal anaesthesia without the ability to give a general anaesthesia and protect the airway.

Full implementation of the safe CD programme will prevent a number of these deaths.



6. Referral problems have been identified as a major contributor to maternal deaths

- There was delay in referring and inter-facility transport problems in 32.5%, 55.2% and 79.9% in referrals from CHCs, district hospitals and regional hospitals respectively of women that subsequently died.
- Delay in inter-facility transport was thought to have contributed to the maternal death in 31% of ectopic pregnancies, 24% of obstetric haemorrhage, 19% of hypertensive disease, 20% of anaesthetic related and 18% of acute collapse cases requiring emergency transport between facilities.

7. Postnatal care, especially too early discharge of and lack of follow-up of patients was found to be a major problem, over looked in the past

- Bradshaw et al., (see next chapter) has shown that approximately 20% of maternal deaths (according to Stats SA birth certificate data) occur outside of health care facilities. The causes of these deaths are similar to the causes of maternal deaths in facilities. Ninety-six percent of women in SA deliver in health care facilities (SADHS 2016), so most of the women who died outside of the facilities were either discharged too soon or developed complications later.
- In M&S conditions more than 36% of deaths occurred in the postpartum period. A considerable proportion of women who died were discharged home after delivery with abnormal vital signs. Assessors believed that 226 (48.4%) of deaths were potentially preventable.
- A mechanism must be found to ensure all women postpartum are visited; this should be done in conjunction with the Ward Based Outreach Teams.

8. General lack of knowledge and skills

- Lack of skilled doctors was recorded in 51% of women who died due to ectopic pregnancies, 33% due to miscarriages, 46% due to pregnancy related sepsis, 48% due to obstetric haemorrhage, 34% due to hypertension and 71% due to anaesthetic related cases
- Overall in 39% of all maternal deaths with avoidable factors, lack of knowledge and skills of doctors was thought to have been contributory.
- Overall in 25% of all maternal deaths with avoidable factors, lack of skilled nurses was thought to be contributory.

The ESMOE-EOST programme in priority districts has shown a significant reduction in iMMR overall of 29.3% and for direct causes of maternal death a 17.5% reduction and should be implemented widely.

9. Only the Eastern Cape managed to achieve the target set of a 20% reduction in maternal deaths from 2014 to 2016

- During the assessors meeting in 2015 the target was set of reducing maternal deaths by 20% for all maternal deaths and specifically for deaths due to non-pregnancy related infections, obstetric haemorrhage and complications of hypertensive disease in pregnancy from 2014 to 2016. The Eastern Cape achieved all for targets, KwaZulu-Natal 3 of the four; the Free

State and North West provinces 2 of the four; and Gauteng and Limpopo provinces 1 of the four.

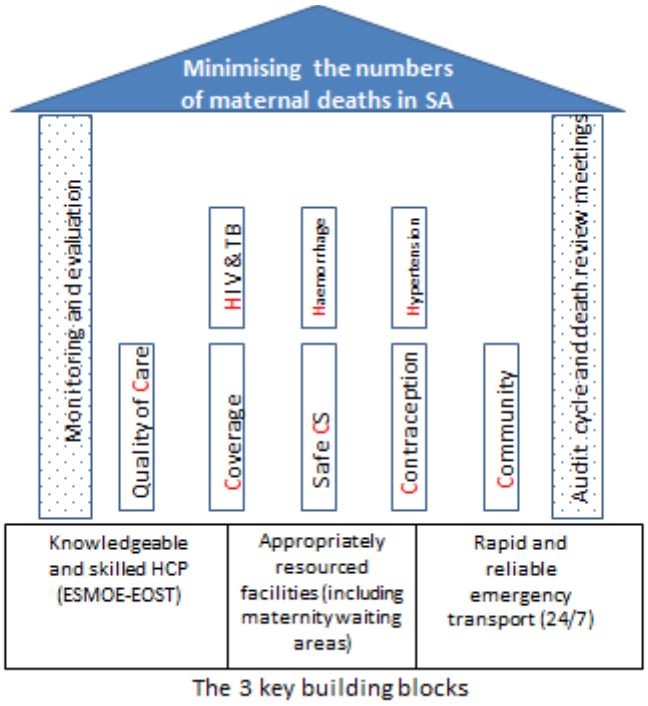
- Between triennia (2011-2013 and 2014-2016) all provinces showed a reduction in the iMMR overall except North West Province; two provinces KwaZulu-Natal and Mpumalanga had a greater than 20% reduction in iMMR overall. Every province showed a reduction in iMMR due to non-pregnancy related infections; but the Eastern Cape, Free State and Western Cape showed an increase in iMMR due to obstetric haemorrhage and 5 provinces (Gauteng, KwaZulu-Natal, Limpopo, North West and the Northern Cape) showed an increase in deaths due to hypertensive disease of pregnancy.
- There was a wide variation in mortality between provinces as shown by the comparison of maternal deaths with respect to the national average iMMR for the condition and overall. Green indicates more that 15% **below** the national average, yellow indicates **between** less than 15% and greater than 15% and red indicates more than 15 % **above** the national average.

Comparison between national average and provinces: 2014-2016

	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC
M&S	23.77	21.64	14.65	16.56	16.77	9.66	17.65	10.69	15.76
NPRI	42.94	47.91	28.45	39.20	36.75	33.16	53.47	32.65	16.11
Ec	1.61	3.66	3.90	3.55	4.65	4.05	4.70	0.00	2.10
Misca	5.95	6.95	6.62	4.77	9.25	4.95	7.64	1.56	1.40
PRS	7.56	10.05	8.76	6.56	10.07	4.46	7.05	1.56	4.55
OH	25.40	27.62	21.95	15.19	33.47	32.26	28.79	26.01	7.56
HT	26.42	31.65	26.16	16.54	27.75	26.25	30.56	26.45	9.11
AR	5.95	2.52	1.65	3.55	6.55	5.14	4.11	0.00	1.40
Emb	5.14	4.64	5.04	2.12	4.90	2.24	2.94	6.22	4.55
AC	1.51	6.15	5.74	5.00	1.90	2.24	2.94	4.67	1.40
iMMR	148.47	174.63	128.78	127.14	165.16	132.19	172.17	121.37	68.30

Highest
>15%
Between 15% above and below
<15%
Lowest

Section 2.2 Strategies for reducing maternal deaths



The 3 key building blocks

Reduction of maternal deaths can be achieved quickest by taking action to reduce deaths associated with HIV infection and those due obstetric haemorrhage and hypertensive disease of pregnancy (the 3 Hs) by involving all levels of the health care system from policy makers to health care professionals to the community.

The strategies needed to achieve these reductions include clinicians being committed to providing quality care to all pregnant women (in all areas), safe caesarean deliveries, preventing unwanted pregnancies and engaging the community to ensure the women know what to do when (5 C's). This is built upon a health system that has knowledgeable and skilled health care professionals, facilities that have the appropriate resources and an effective emergency service to rapidly transport patients to the appropriate level of care. To ensure continued functioning of these strategies the service must continually be monitored and evaluated and where appropriate remedial action taken where appropriate.

The 5 Cs

Safe caesarean delivery

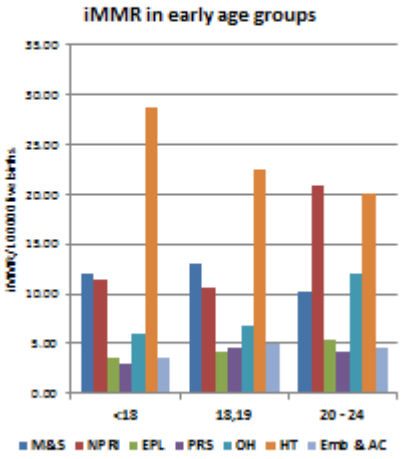
- A safe caesarean delivery (CD) service means having adequate resources including adequate numbers of **knowledgeable and skilled** staff who can manage surgical and anaesthetic

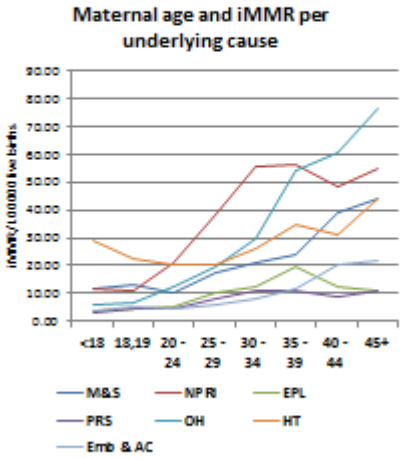
complications of CD. Criteria for accreditation of CD sites have been developed to ensure that hospitals provide a safe CD service. These need to be implemented, although this may result in the CD service being closed in some facilities and consolidation of health care professionals into viable working units, it will provide a safer service.

Contraception

- Our aim must be to prevent unwanted pregnancies.
- The post miscarriage and postnatal provide a captive audience for contraceptive counselling because 97% of women deliver in health facilities and 96% of women attend antenatal care. Counselling is particularly important at this time because if delivery of a subsequent baby is delayed till 24 months after the previous birth then there is a reduction in iMMR by 30% and perinatal deaths by 10% (PRICELESS).
- Long Acting Reversible Contraceptives (LARCs) are the most effective means of providing contraception for 15 months continuously.
- The best option for contraception in women on antiretroviral treatment is the IUCD
- Women with medical conditions often need special counselling for contraceptive use, but this is often forgotten by the physicians looking after the woman. Specialised contraception clinics need to be established in regional and tertiary hospitals to cater for these women.
- Community engagement about contraception is essential if unwanted pregnancies are to be prevented.
- The relationship between maternal age and underlying cause of death is discussed in section 2.5. The diagram below illustrates the high mortality in teenagers due to hypertensive disorders in pregnancy and stress the need for contraception in the teenager.

Maternal age and iMMR per underlying cause of maternal death





Commitment to quality of care (Professionalism and Creating a Culture of Caring)

- The assessors have regularly commented on the lack of professionalism shown by health care professionals. This problem is often under-reported.

- 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.
- Respectful care training programmes are available in the ESMOE programme.

Continuum of care

- The health system should ensure that no matter where the patient enters the system, she is followed-up appropriately, especially postnatally and antenatally. This has been illustrated by the number of deaths occurring outside of the health facilities.
- A system needs to be developed to ensure postnatal follow-up at home of all women by WBOTs
- Alleviating congestion can be achieved by down referral of patients; referral should be a two way street, one cannot just refer up there must be system to down refer.
- Checklists on discharge can ensure cases with problems are not discharged without solving the problems

Key Building Blocks

Referral system

- Our health care system is a primary health care system. This means we request women to enter the health system at the primary level of care and **we (health care system) undertake to ensure they will be seen and treated at the appropriate level of care** i.e. the transfer of patient's in the system is **our responsibility**. Data shown above indicates that this is lacking in a significant number of cases and this must be addressed.
- To improve our referral system we need:
  - Appropriate referral criteria
  - Stabilisation of the woman or baby before leaving and criteria when a professional nurse must accompany a patient.
  - To continue care in the ambulance, i.e. provide a continuum of care from facility to facility. The scope of practice of current EMS personnel is not sufficient to continue care of a pregnant woman in the ambulance as it does not include essential aspects like administration of oxytocin, antihypertensive drugs and magnesium sulphate.
  - The referring facility should have access to communicate directly with the receiving consultant to advise on treatment
  - The EMS management should audit and report on deaths in transit

Competencies

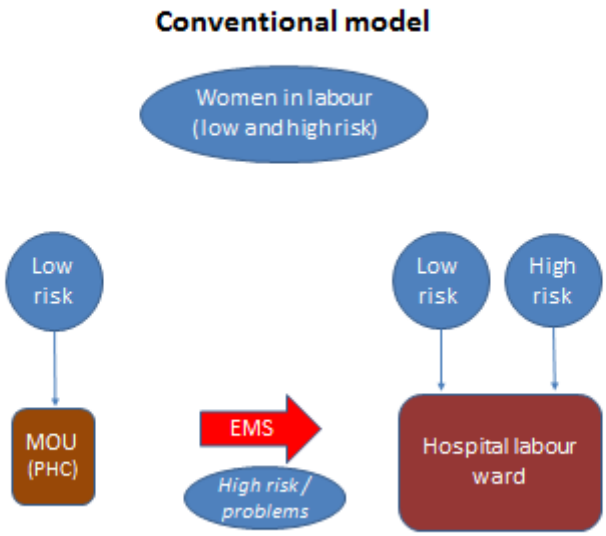
- A clear gap in the competencies of doctors and nurses has been demonstrated. This must start from undergraduate training but also persist in internship and beyond. Discussion with the various undergraduate bodies and HPCSA need to be conducted to rectify this.
- However, at present to ensure safe services some services, especially caesarean delivery, will have to be consolidated so that the knowledge and skills come together in a critical mass

to enable the safe service to be delivered. This will mean reducing access to some people. Thus a balance is needed between safety and accessibility and the community needs to understand this. EMS is essential in ensuring that patients are in the institutions that provide the appropriate level of care, so emergency inter-facility transport is vital.

- Emergency drills have been shown to decrease mortality and must be enforced in all maternity units.

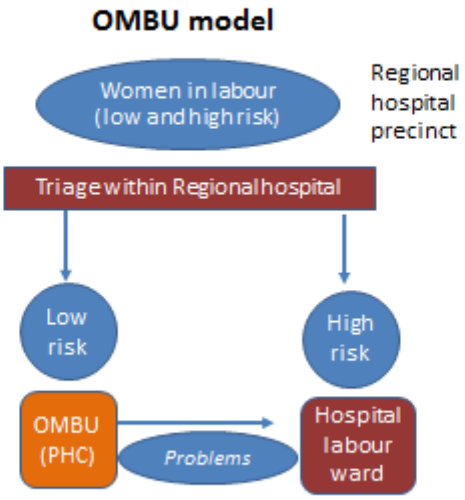
On-site Midwife-run Birthing Unit (OMBU) or Midwife Obstetric Unit on-site

- Many large regional and provincial tertiary hospitals are inundated with women in labour that are at low risk. The women chose to go to these hospitals for various reasons and the hospitals are often not in a position to transfer the women to other low risk units and must manage them. This puts strain on them and results in the sick women not getting enough attention.
- Below is a diagram of conventional obstetric care which results in the overloading of the large regional and tertiary hospitals



In the conventional model, in theory, low risk women in labour go straight to the local clinic with delivery facilities. In reality, many low risk women arrive at the hospital in labour and are either turned away and redirected to the clinic, or if this is not possible are admitted inappropriately to the hospital labour ward. Sometimes women contrive to achieve this by arriving very late in labour, with the attendant risks of this strategy. The net result is that too many women give birth in the overcrowded hospital labour wards. One in three women redirected to the clinic end up with a sometimes disastrous trip back to the hospital in advanced labour.

- Below is a diagram of the OMBU model.



- In the On-site Midwife birth Unit model, the primary care unit is located in the hospital, as close as possible to the labour ward. All women arriving at the hospital in labour are triaged to the correct level of care. The one in three who develops complications in the on-site Midwife Birth Unit are immediately transferred to the hospital labour ward. No emergency services personnel or ambulances are involved. Overall, more women give birth at the appropriate level of care, and the tragedies of delayed transfer are avoided.
- This OMBU model was accepted by the National Health Council on 24th November 2016 as a practical way of alleviating the major problems in overcrowding that the Provincial Tertiary Hospitals and Large Regional Hospitals are experiencing. Examples of the effect of these units are seen on Frere Hospital in East London and Dora Ngenza Hospital in Port Elizabeth. The WHO supports this concept, and it is now the preferred model for all obstetric units in developed countries.
- OMBUs need to be established in large regional and provincial tertiary hospitals.

Key topic specific messages to improve care (3 Hs)

HIV and TB

- TB is the most common cause of death in the Non-Pregnancy Related Infections group. All pregnant women (irrespective of HIV status) should be screened for TB. Pregnant HIV positive woman should be screened for TB at each health interaction during pregnancy and the postnatal period and given prophylaxis with Isoniazid or fast tracked for treatment if TB is demonstrated.
- Viral loads of HIV infected women must be available in all pregnant women to enable appropriate management

Haemorrhage

- Prevent anaemia by providing iron and folate supplementation to all pregnant women
- Ensure safe use of uterotonics in labour.
- New protocols for management of PPH, and the use of tranexamic acid, non-pneumatic anti-shock garment (NASG) and the locally manufactured balloon tamponade need to be introduced.
- The Safe CD programme needs to be implemented
- Practice emergency drills for haemorrhage; with a focus on problem recognition, resuscitation and practical procedures e.g. manual removal of the placenta, uterine compression sutures
- Ensure safe and adequate supplies of blood and blood products

Hypertension

- Have clear referral criteria for hypertensive disorders of pregnancy
- Screen all antenatal patients for hypertension and refer according to criteria (BANC Plus)
    - Note: With the increase in antenatal visits there has been a 60% increase in detection of women with hypertension.
- All pregnant women should be given calcium supplementation
- Practice emergency drills in complications of hypertension

Priority actions

The priority actions for 2018 are:

- Establishment of OMBUs
- Introduction of the new PPH protocols including NASG, balloon tamponade and tranexamic acid
- Reduce deaths due to hypertensive diseases of pregnancy by ensuring BANC Plus is fully implemented, and the all the women detected with hypertension are managed according to the appropriate protocols.
- Ensuring Safe CD for all women
- Ensuring safe, rapid inter-facility transport of women with obstetric emergencies
- Maintaining and extending ARV coverage and effective TB treatment of pregnant women

2.3 Assessment of provincial progress in reducing maternal mortality

At the assessors meeting in 2015 targets were set for the maximum number of maternal deaths and the key conditions (NPRI, obstetric haemorrhage and hypertension) per province for the year 2016. During the assessors meeting all the provinces had already implemented their plans for reducing maternal deaths; thus it was expected that there should be a significant decrease (20%) in maternal deaths or at least a modest decrease (12.5%) in 2016 compared with 2014.

In every year there is a delay in reporting all the deaths, so in 2017 some deaths were still being reported from 2015. There were 4 provinces where the data for 2015 reported in 2016 was different to the data for 2015 for 2017. To deal with this lag a correction factor was used for these 4 provinces based on the difference between 2015 and 2017 data. This should mitigate against under-reporting of the 2016 data. The detailed data is given in the Appendix.

Below is an assessment of the achievements.

Table 2.3.1 Target reduction of numbers of deaths for 2016 for each province

20% reduction Difference from 2014	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA
Non-pregnancy-related infections	-13	-5	-15	-18	-11	-5	-8	-1	-3	-79
Obstetric haemorrhage	-8	-2	-10	-8	-7	-5	-3	-1	-1	-45
Hypertension	-7	-3	-10	-6	-7	-4	-4	-1	-1	-44
Total MD	-40	-17	-55	-54	-43	-18	-23	-5	-12	-268

12.5% reduction difference from 2014	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA
Non-pregnancy-related infections	-8	-3	-10	-11	-7	-3	-5	-1	-2	-49
Obstetric haemorrhage	-5	-1	-6	-5	-4	-3	-2	-1	0	-28
Hypertension	-4	-2	-6	-4	-4	-3	-2	-1	-1	-28
Total MD	-25	-11	-35	-34	-27	-12	-14	-3	-8	-168

Table 2.3.2 Actual difference in maternal deaths between 2014 and 2016 (unadjusted)

	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA
Non-pregnancy-related infections	-23	-9	-36	-26	-18	0	-20	0	0	-132
Obstetric haemorrhage	-16	3	-14	-23	7	-3	-1	-1	4	-44
Hypertension	-8	-2	6	4	-4	-2	-1	1	3	-3
Total MD	-61	-18	-34	-55	-22	12	-32	-2	14	-198

Key

20% reduction or more

12.5% reduction or more

Less than 12.5% reduction

Table 2.3.3 Percentage difference in maternal deaths between 2014 and 2016 (unadjusted)

	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA
Non-pregnancy-related infections	-35.9	-34.6	-46.8	-29.2	-34.0	0.0	-50.0	0.0	0.0	-33.4
Obstetric haemorrhage	-41.0	30.0	-27.5	-57.5	20.0	-12.0	-6.7	-14.3	133.0	-19.6
Hypertension	-22.9	-11.8	12.0	12.5	11.4	-9.1	-5.3	20.0	50.0	-1.4
Total MD	-30.0	-20.7	-12.3	-20.3	-10.3	13.0	-27.8	-8.3	23.3	-14.8

The adjusted data is shown below. This is a more accurate description as the slowness in reporting is taken into consideration.

Table 2.3.4 Actual difference in maternal deaths between 2014 and 2016 (adjusted)

	EC	FS	cGau	KZN	cLim	Mpu	cNW	cNC	WC	cSA
Non-pregnancy-related infections	-23	-9	-31	-26	-17	0	-18	1	0	-123
Obstetric haemorrhage	-16	3	-9	-23	8	-3	0	0	4	-36
Hypertension	-8	-2	13	4	-3	-2	0	2	3	7
Total MD	-61	-18	-34	-55	-22	12	-25	0	14	-152

Key

20% reduction or more

12.5% reduction or more

Less than 12.5% reduction

Table 2.3.5 Percentage difference in maternal deaths between 2014 and 2016 (adjusted)

	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA
Non-pregnancy-related infections	-35.9	-34.6	-40.0	-29.2	-31.7	0.0	-46.6	9.4	0.0	-31.3
Obstetric haemorrhage	-41.0	30.0	-18.3	-57.5	24.2	-12.0	0.0	-6.2	133.0	-16.1
Hypertension	-22.9	-11.8	26.1	12.5	-8.3	-9.1	0.0	31.3	50.0	3.2
Total MD	-30.0	-20.7	-1.3	-20.3	-7.2	13.0	-22.1	0.0	23.3	-11.3

Figure 1-4 illustrate the percent change in maternal deaths in the adjusted data.

Figure 1. Estimated percentage reduction in maternal deaths between 2014 and 2016: Non-pregnancy related infections

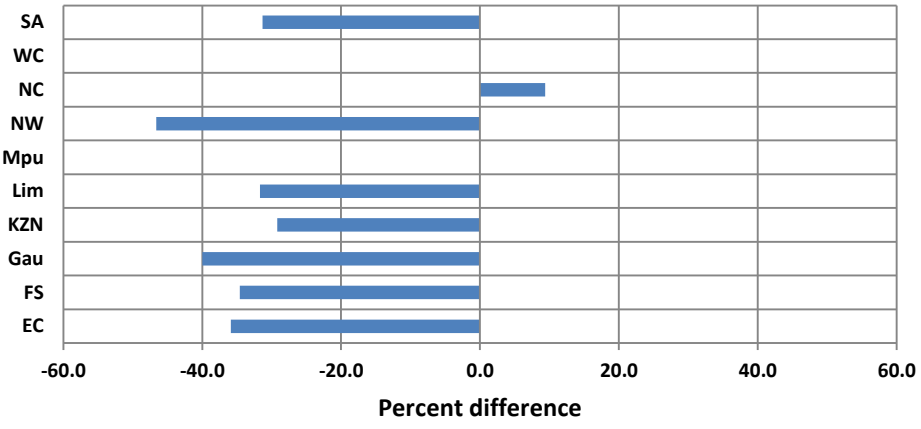


Figure 2. Estimated percentage reduction in maternal deaths between 2014 and 2016: Obstetric haemorrhage

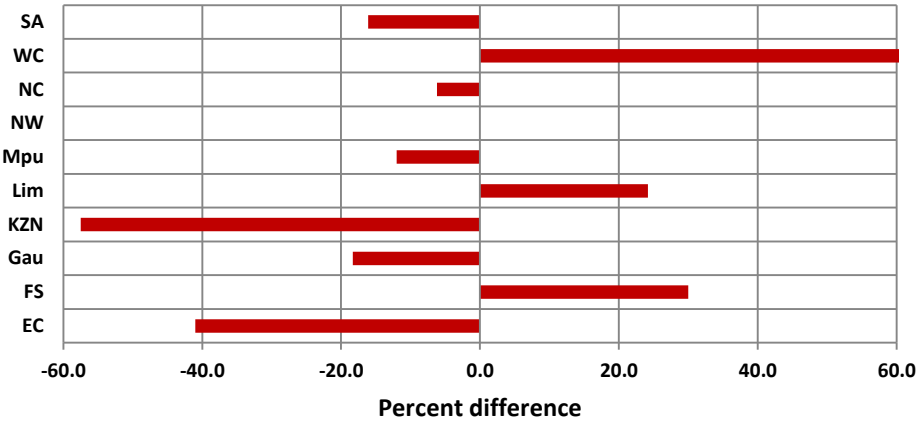


Figure 3. Estimated percentage reduction in maternal death between 2014 and 2016: Hypertension

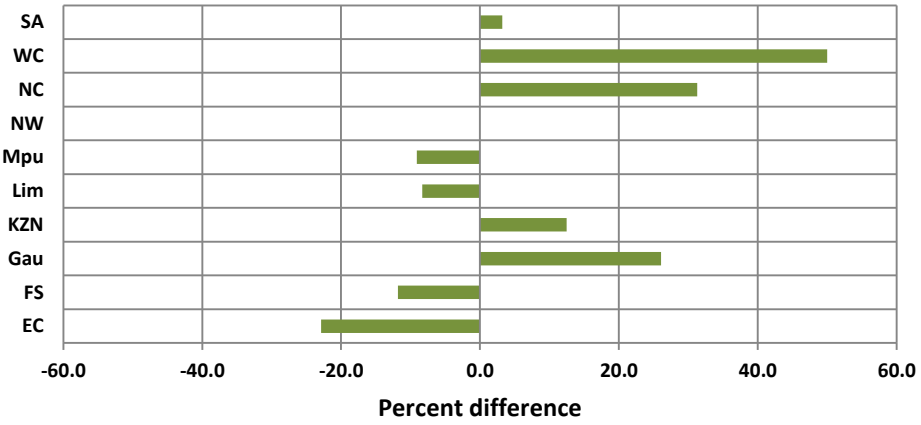
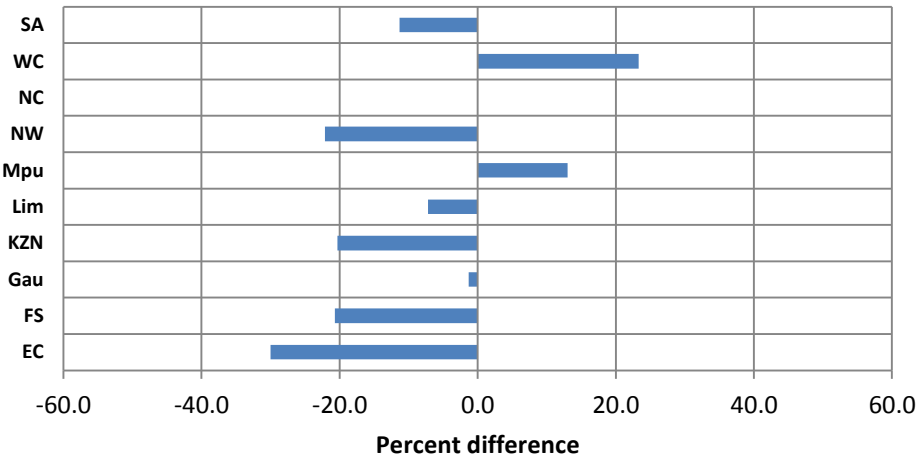


Figure 4. Estimated percentage reduction between 2014-2016

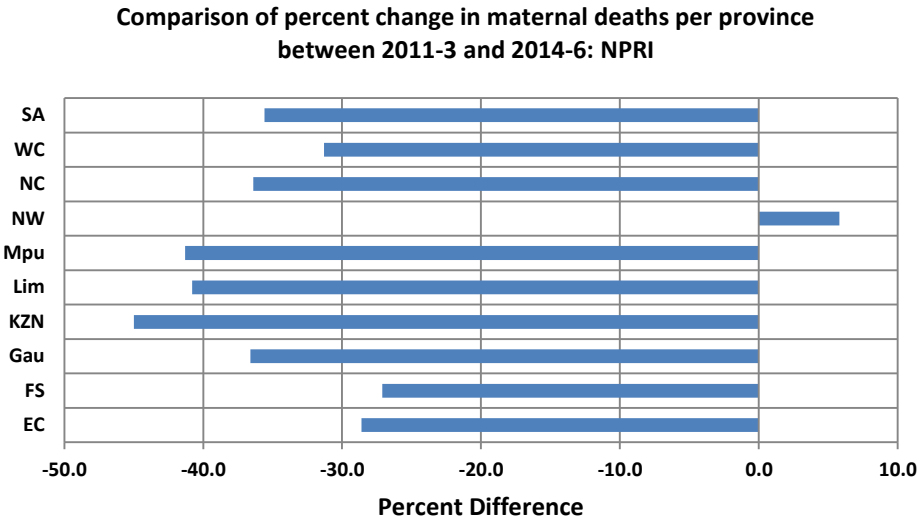


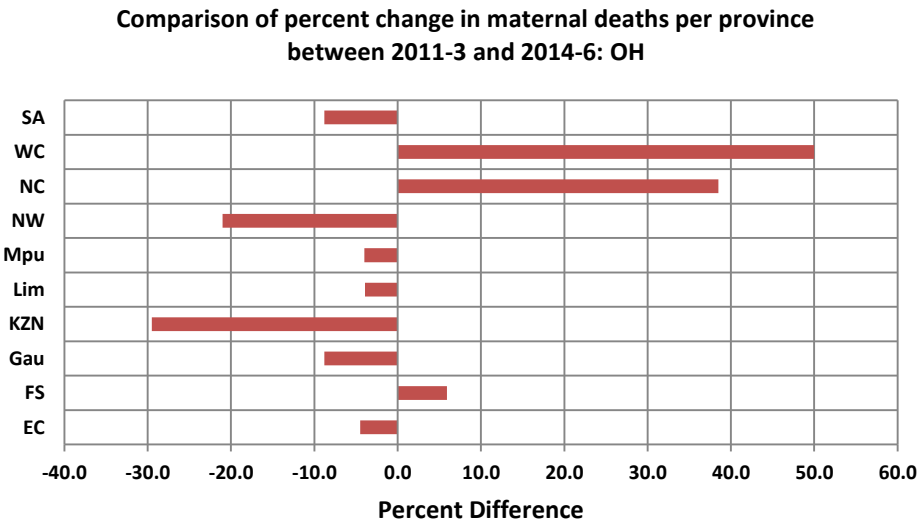
There is no bar for Mpumalanga and the Western Cape as there was no change 25 and 15 deaths in each year respectively.

Comparison 2011-3 and 2014-6

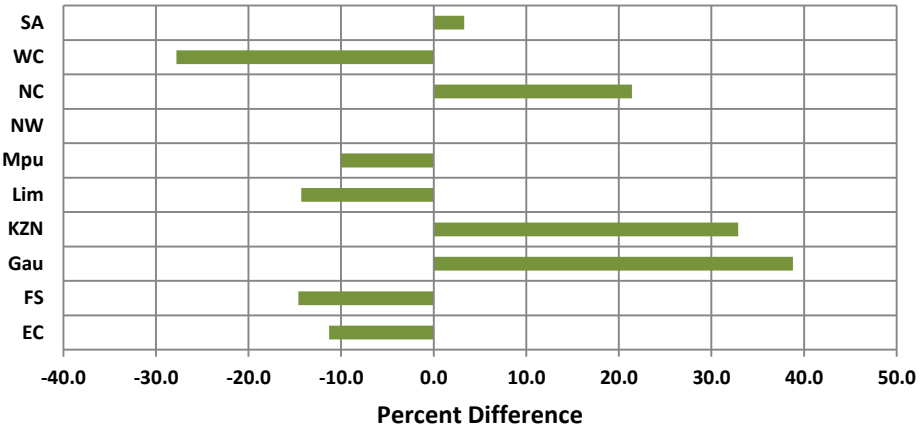
Table 2.3.6 Comparison between the percent difference in maternal deaths per province for the key conditions for 2011-3 and 2014-6

	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA
Non-pregnancy-related infections	-28.6	-27.1	-36.6	-45.0	-40.8	-41.3	5.8	-36.4	-31.3	-35.6
Obstetric haemorrhage	-4.5	5.9	-8.8	-29.5	-3.9	-4.0	-21.0	38.5	50.0	-8.8
Hypertension	-11.3	-14.6	38.8	32.9	-14.3	-10.0	0.0	21.4	-27.8	3.3
Total MD	-15.1	-16.0	-4.6	-24.2	-16.6	-24.9	1.7	-19.6	-2.5	-14.7

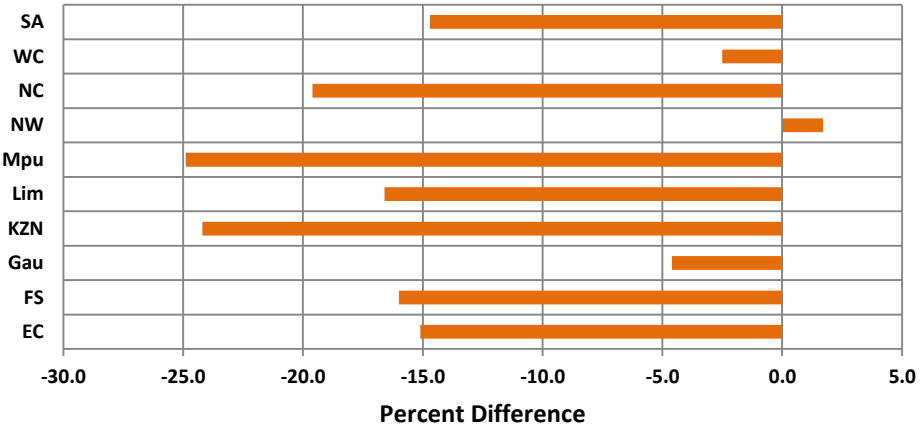




Comparison of percent change in maternal deaths per province between 2011-3 and 2014-6: HT



Comparison of percent change in maternal deaths per province between 2011-3 and 2014-6: Total



Change in iMMR in percent from 2011-3 & 2014-6

	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA
NPRI	-21.8	-18.6	-36.7	-45.3	-38.6	-40.2	7.6	-36.9	-32.3	-34.2
OH	4.6	18.1	-9	-29.9	-0.4	-2.2	-19.6	37.4	48	-6.8
HT	-2.9	-4.4	38.5	32.2	11.1	-8.3	1.7	20.5	-28.7	5.6
Tot.	-6.9	-6.3	-4.8	-24.6	-13.6	-23.5	3.4	-2.2	-3.8	-12.8

Key

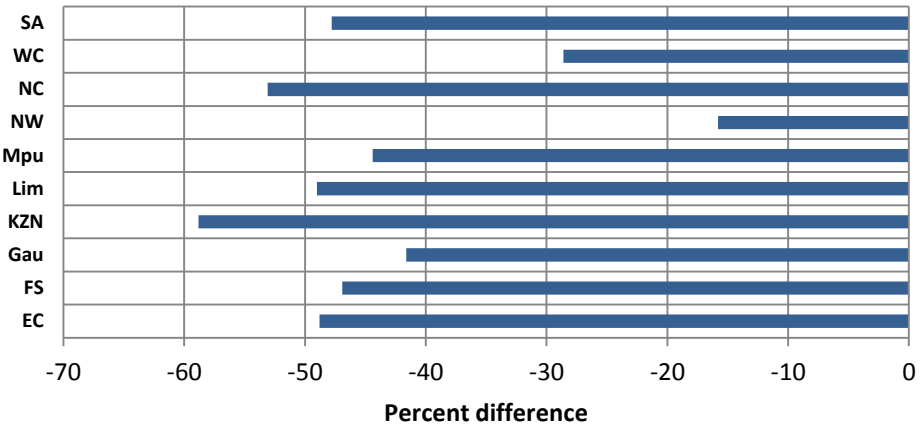
- >20% reduction
- 10%-20% reduction
- <10% reduction
- Increase

Comparison between 2011 and 2016

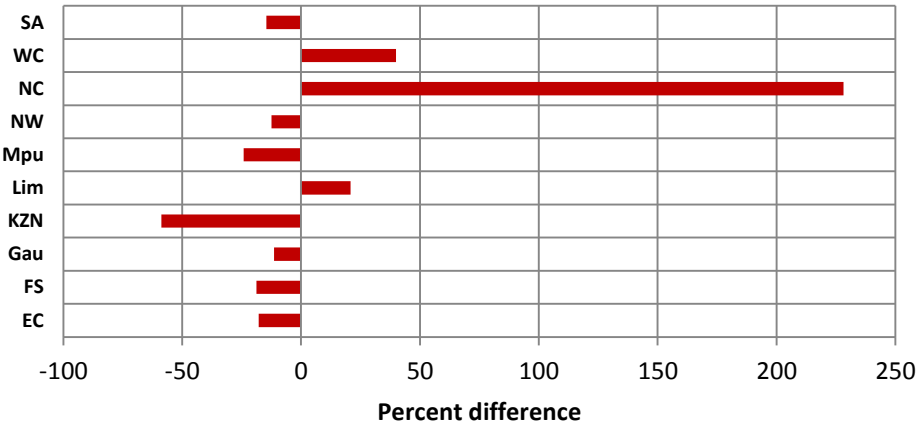
Table 2.3.7 Comparison between the number of maternal deaths per province for the key conditions and 2011 and 2016 expressed as a percentage difference

	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA
Non-pregnancy-related infections	-48.8	-46.9	-41.6	-58.8	-49.0	-44.4	-15.8	-53.1	-28.6	-47.8
Obstetric haemorrhage	-17.9	-18.8	-11.4	-58.8	20.8	-24.1	-12.5	228.2	40.0	-14.6
Hypertension	-10	-21.1	70.4	9.1	10.6	-25.9	22.8	118.8	12.5	13.5
Total MD	-30.7	-38.4	7.3	-37.0	-2.6	-28.3	7.3	-27.1	29.8	-17.2

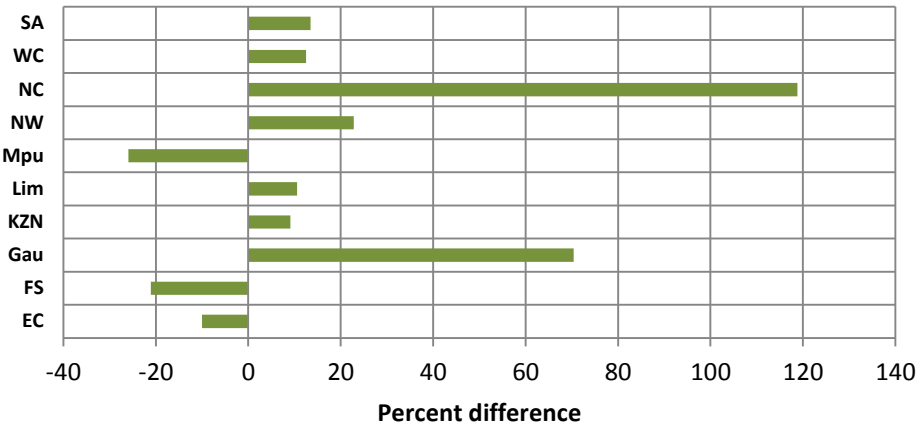
Comparison of maternal deaths per province between 2011 and 2016: NPRI



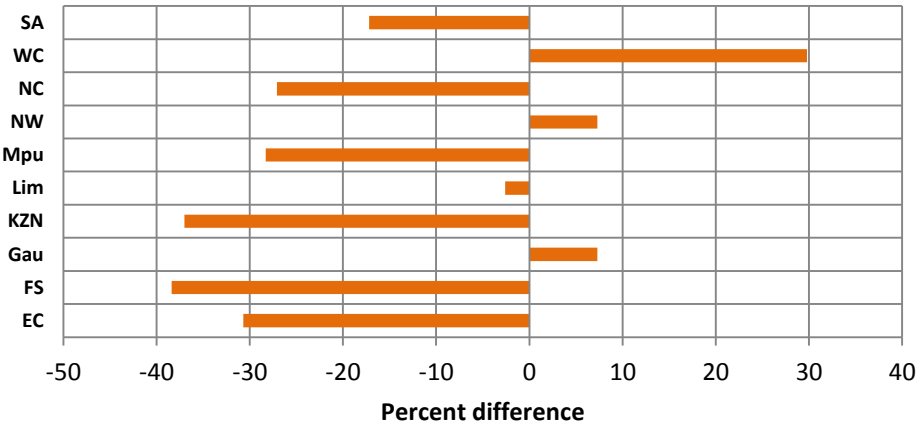
Comparison of maternal deaths per province between 2011 and 2016: OH



Comparison of maternal deaths per province between 2011 and 2016: HT



Comparison of maternal deaths per province between 2011 and 2016: All



The detailed data is shown in Appendix 1.

Observations:

Note:

Caution must be used when interpreting this data. The provinces which started the triennium with lower numbers of deaths and ratios will show larger percentage changes which can be misleading. The numbers, iMMR and percentage change all need to be viewed in context.

For comparisons between 2016 from 2014

1. Eastern Cape is the only province to achieve targets.
2. Mpumalanga and Western Cape had an increase in number of maternal deaths
3. Gauteng, KwaZulu-Natal, Northern Cape and Western Cape had an increase in maternal deaths due to hypertension
4. Free State, Limpopo and Western Cape had an increase in obstetric haemorrhage deaths

5. Northern Cape was the only province to have an increase in deaths due to non-pregnancy related infections
6. Additionally there was a net increase in the number of maternal deaths due ectopic pregnancy (61.3% biggest increase KwaZulu-Natal), miscarriage (23.2%, biggest increase Gauteng), and pregnancy related sepsis (14.4%, biggest increase in Gauteng)

For comparison between triennia 2011-3 and 2014-6:

1. North West is the only province where there was an increase in number of maternal deaths; overall there was a net decrease in maternal deaths by about 15%.
2. Gauteng, KwaZulu-Natal and North West had an increase in maternal deaths due to hypertension, and overall there was a net increase in of maternal deaths due to hypertension
3. Free State, Northern Cape and Western Cape had an increase in maternal deaths due to obstetric haemorrhage, but overall there was a decrease in maternal deaths for this condition
4. North West was the only province to have an increase in maternal deaths due to non-pregnancy related infections, but overall there was a 36% decrease.
5. Additionally there was an increase in embolism overall of 9%, most coming from Limpopo.

For comparison between 2011 and 2016

1. Overall there was a 17% reduction in the number of maternal deaths in South Africa, a 48% reduction in non-pregnancy related infections; a 15% reduction in obstetric haemorrhage; but a 14% **increase** in deaths due to hypertension.
2. All provinces showed a decrease in deaths due to non-pregnancy related infections
3. Limpopo, Northern Cape and Western Cape had an increase in maternal deaths due to obstetric haemorrhage
4. Gauteng, KwaZulu-Natal, Limpopo North West, Northern Cape and the Western Cape all had an increase in the number of maternal deaths due to hypertension
5. Gauteng, North West and Western Cape had an increase in the number of maternal deaths overall.
6. Additionally there was an increase of 5% in medical and surgical conditions (most in North West), ectopic pregnancy (most in KwaZulu-Natal) and embolism (40%, most in Gauteng).

Comments

Each province has examined the changes in their numbers and ratios and explanations are given in their provincial chapters and dissemination meetings.

2.4 The necessity of providing Safe CD

Evidence

Maternal deaths are strongly associated with CD.

Table 2.4.1 Risk of caesarean delivery

Primary obstetric problems	All Delivered	Vaginal delivery	Number CD	% CD	CFR/100000 CD	CFR/100000 vaginal deliveries	Risk
Medical and surgical disorders	262	125	137	52.3	19.35	6.12	3.2
Non-pregnancy-related infections	511	387	124	24.3	17.51	18.93	0.9
Ectopic pregnancy	2	1	1	50.0	0.14	0.05	2.9
Miscarriage	4	4	0	0.0	0.00	0.20	0.0
Pregnancy-related sepsis	184	84	100	54.3	14.12	4.11	3.4
Obstetric haemorrhage	552	207	345	62.5	48.73	10.13	4.8
Hypertension	446	149	297	66.6	41.95	7.29	5.8
Anaesthetic complications	67	3	64	95.5	9.04	0.15	61.6
Adverse drug reactions	27	18	9	33.3	1.27	0.88	1.4
Embolism	76	33	43	56.6	6.07	1.61	3.8
Acute collapse - cause unknown	46	23	23	50.0	3.25	1.13	2.9
Miscellaneous	7	4	3	42.9	0.42	0.20	2.2
Unknown	83	45	38	45.8	5.37	2.20	2.4
Total	**2267**	**1083**	**1184**	**45.8**	**167.23**	**52.98**	**3.2**

The above table demonstrates the association between MDs and CD. It is important to recognise that for some MDs, e.g. from eclampsia, the final cause of death (eclampsia) may have been un-related to the CD which was done as part of the management of this serious condition. However for other obstetric conditions the CD is more likely to have been contributory to the death, notably Haemorrhage, Anaesthesia, CD associated sepsis and Thromboembolism.

Table 2.4.2 Comparison of CD rates

	2014-2016 CD rate	2011-2013 CD rate
KwaZulu-Natal	30.5	31.6
Western Cape	29.2	28.6
Eastern Cape	27.6	27.6
Gauteng	27.1	27.1
South Africa	25.7	25.4
Free State	25.3	26.3
North West	21.4	17.5
Northern Cape	20.9	20.5
Mpumalanga	18.9	18.3
Limpopo	18.8	16.9

There is a variable rate of CD, mostly rural provinces have the lowest rates e.g. Limpopo and Mpumalanga but KZN has the highest rate.

Table 2.4.3 Comparisons of CD iMMR and number of deaths per province

	CD iMMR		CD MD	
Provinces	**2014-2016**	**2011-2013**	**2014-2016**	**2011-2013**
North West	49.36	44.65	84	71
Gauteng	49.10	44.39	302	253
Eastern Cape	46.57	53.87	154	174
Limpopo	45.71	53.85	168	188
Mpumalanga	45.71	55.92	102	117
South Africa	43.64	48.26	1201	1243
Free State	43.27	57.15	56	74
KwaZulu-Natal	41.67	52.03	236	273
Northern Cape	38.90	34.04	25	20
Western Cape	25.92	28.91	74	73

North West and Gauteng had the highest iMMR and were the only two provinces where the iMMR and number of maternal deaths associated with CD increased. Gauteng deaths increased by 49 cases. The Western Cape had the lowest iMMR but the biggest change came in KZN where the number of deaths decreased by 37 deaths.

Table 2.4.4 Comparison case fatality rate (CFR) and number of deaths per province

	CFR/100000 CD		Number MD CD	
Provinces	2014-2016	2011-2013	2014-2016	2011-2013
Limpopo	242.90	319.20	168	188
Mpumalanga	242.42	305.32	102	117
North West	230.21	254.48	84	71
Northern Cape	185.93	165.78	25	20
Gauteng	180.94	163.91	302	253
Free State	170.84	216.95	56	74
South Africa	169.63	190.35	1201	1243
Eastern Cape	168.75	195.21	154	174
KwaZulu-Natal	136.77	164.49	236	273
Western Cape	88.78	101.03	74	73

There has been a general reduction in CD case fatality rate (CFR) except for Gauteng. The CFR for CD is highest in Limpopo and Mpumalanga (2-3 times higher than the lowest provinces). The rural provinces had again highest CFRs except for KZN.

Table 2.4.5 Comparison of anaesthetic related deaths

	AR iMMR 2014-2016	**No. AR Deaths 2014-2016**	**AR iMMR 2011-2013**	**No. AR MD 2011-2013**
Limpopo	6.53	24	9.74	34
North West	4.11	7	1.89	3
Eastern Cape	3.93	13	4.64	15
KwaZulu-Natal	3.35	19	4.00	21
South Africa	3.16	87	4.08	105
Mpumalanga	3.14	7	8.60	18
Free State	2.32	3	3.09	4
Gauteng	1.63	10	1.58	9
Western Cape	1.40	4	0.40	1
Northern Cape	0.00	0	0.00	0

The Anaesthetic related iMMR was highest in rural provinces; North West had a big increase, but the numbers were small. However, in Limpopo there is clearly still a big problem.

Table 2.4.6 Case fatality rate of anaesthetic related deaths

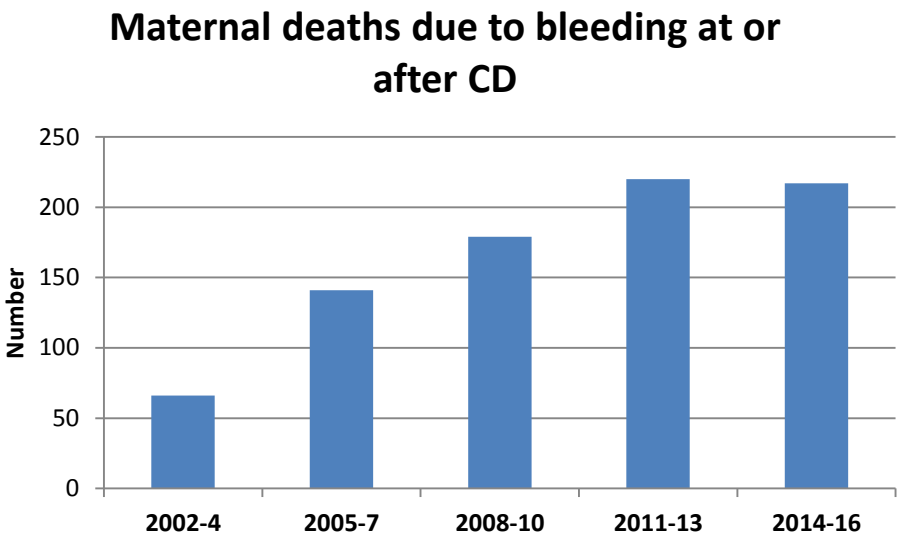
Provinces	AR CFR 2014-2016	No. AR Deaths 2014-2016	AR CFR 2011-2013	No. AR MD 2011-2013
Limpopo	34.70	24	57.73	34
North West	19.18	7	10.75	3
Mpumalanga	16.64	7	46.97	18
Eastern Cape	14.24	13	16.83	15
South Africa	12.29	87	16.08	105
KwaZulu-Natal	11.01	19	12.65	21
Free State	9.15	3	11.73	4
Gauteng	5.99	10	5.83	9
Western Cape	4.80	4	1.38	1
Northern Cape	0.00	0	0.00	0

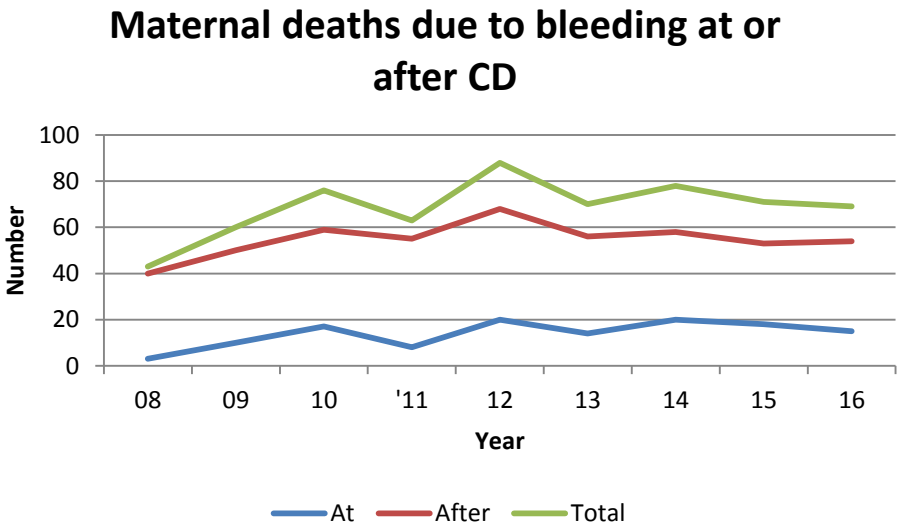
The anaesthetic related CFR was highest in Limpopo. There was a striking decrease in the CFR Mpumalanga, more than halving the number of anaesthetic deaths. Perhaps this is an effect of the DCST anaesthetist.

Quality of care

There are two very good measures of quality of care of CD; Bleeding during or after CD (BLDACD) and Anaesthetic related deaths. Using these measures the problem areas stand out. However, CD associated sepsis and venous thrombo-embolus (VTE) are also areas where quality of care is important; for CD sepsis better management of labour, general infection control measures and antibiotic prophylaxis; and for VTE thromboprophylaxis

- Of women who delivered a baby at more than 24 weeks gestation there were 1184 delivered by CD and 1083 delivered vaginally, the iMMR for CD was 165 versus 53/100000 live births for vaginal delivery, i.e. three times higher; however at primary level the iMMR per CD was 110 versus 25/100000 live births for vaginal deliveries (more than 4 times higher)
- Maternal deaths due to bleeding during or after CD (BLDACD) have stabilised but still represent 30% of all women who die due to OH.
- For all BLDACD deaths lack of skilled doctors was an avoidable factor in 33% cases, and lack skilled of nurses in 20% of cases. Fifty maternal deaths occurred after CD in District Hospitals (DH) in which 25 cases lacked a skilled doctor; similarly 14 of 43 cases in Regional Hospitals (RH), and 21 of 47 cases in Provincial Tertiary Hospitals (PTH). Lack of skilled nurses was also recorded in 14 of 50cases at DH. Only 32% of women who died from BLDACD had a hysterectomy. Given the severity of the bleeding all women should have had a hysterectomy. This is a further illustration of the skills gap.
- 56% of anaesthetic deaths occurred at DH and the final cause of death in over half the cases was due to failure to protect the airway during the anaesthesia. It appears clinicians are giving spinal anaesthesia without the ability to convert to or provide a general anaesthesia and protect the airway.
- Full implementation of the safe CD programme will prevent a number of these deaths.


Maternal deaths due to bleeding at or after CD
250
200
150
100
50
0
Number
2002-4
2005-7
2008-10
2011-13
2014-16


Maternal deaths due to bleeding at or after CD
100
80
60
40
20
0
Number
08
09
10
'11
12
13
14
15
16
Year
At
After
Total

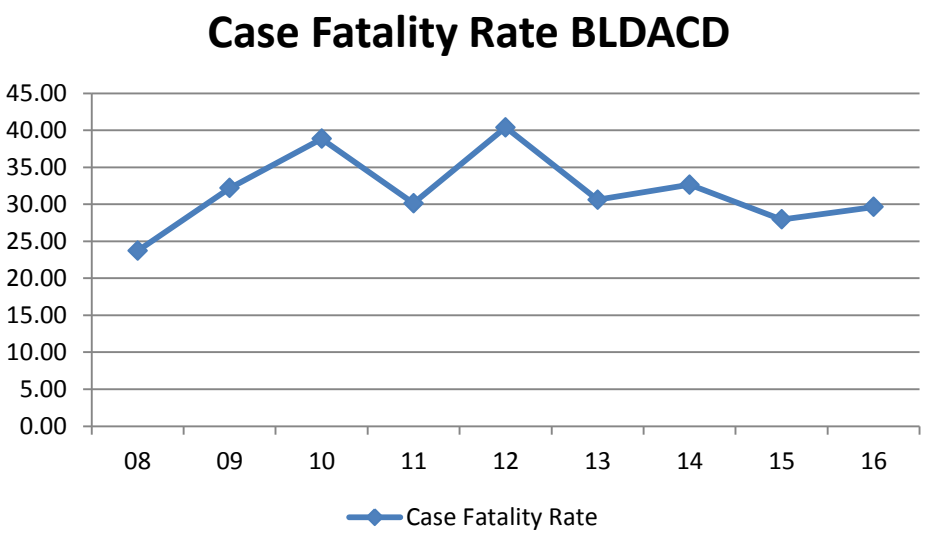


Table 2.4.7 Comparison of case fatality rate of BLDACD and number of deaths per province

	CFR BLDACD		Number MD BLDACD	
Provinces	**2014-2016**	**2011-2013**	**2014-2016**	**2011-2013**
Mpumalanga	76.05	73.07	32	28
Limpopo	70.85	59.43	49	35
Northern Cape	44.62	58.02	6	7
North West	38.37	64.52	14	18
South Africa	30.65	33.08	217	216
Eastern Cape	25.20	29.17	23	26
Gauteng	24.56	25.91	41	40
Free State	21.36	26.39	7	9
KwaZulu-Natal	18.55	28.32	32	47
Western Cape	15.60	8.30	13	6

Limpopo and Mpumalanga had the highest CFR for BLDACD; the biggest reduction was in KZN

Table 2.4.8 Comparison of number of deaths and iMMR BLDACD between the two triennia

	2014-2016	**2011-2013**	**2014-2016 iMMR**	**2011-2013 iMMR**
Mpumalanga	32	28	14.34	13.38
Limpopo	49	35	13.33	10.03
Northern Cape	6	7	9.34	11.91
North West	14	18	8.23	11.32
South Africa	217	216	7.88	8.39
Eastern Cape	23	26	6.95	8.05
Gauteng	41	40	6.67	7.02
KwaZulu-Natal	32	47	5.65	8.96
Free State	7	9	5.41	6.95
Western Cape	13	6	4.55	2.38

KZN has a high number of maternal deaths due to BLDACD, but the iMMR is low due to the number of deliveries in KZN. This high number must not be overlooked. Both Mpumalanga and Limpopo had the highest iMMR due to BLDACD.

Summary

- The provinces which clearly have problems are Limpopo (surgery and anaesthesia) and Mpumalanga (surgery). The Safe CD programme should concentrate on these provinces
- KwaZulu-Natal has had the biggest improvement in the quality of care around CD. Perhaps other provinces can learn from KZN and imitate what they did to improve the quality of their care.

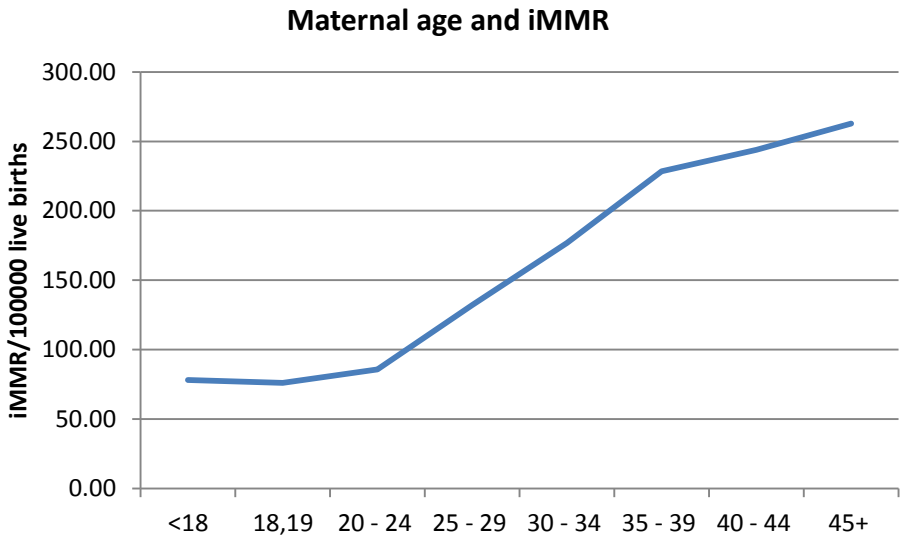
2.5 Maternal age and iMMR per underlying cause

Analysing maternal age with respect to the underlying cause of maternal death has led to some important findings

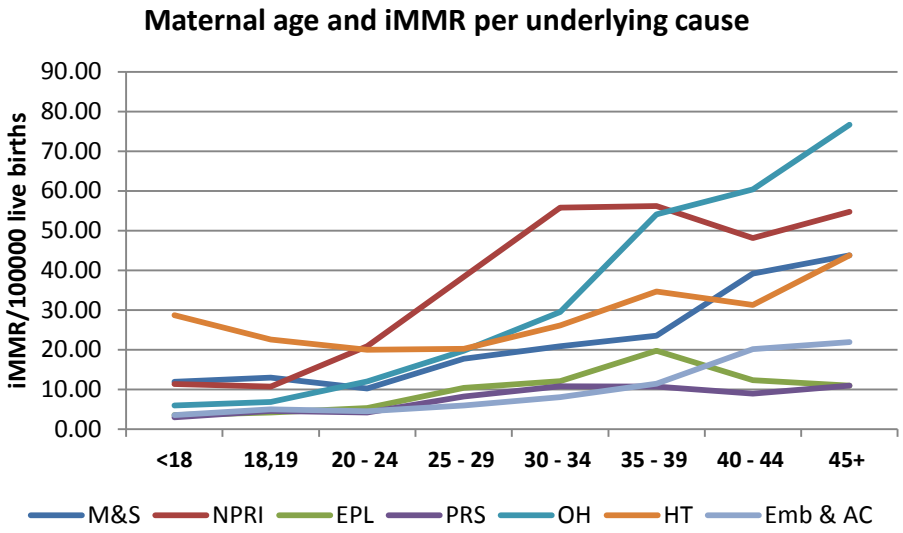
Primary obstetric problem	<18	18,19	< 20	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45+	Total
Medical and surgical disorders	11.95	12.99	12.58	10.22	17.71	20.90	23.58	39.14	43.79	16.97
Non-pregnancy-related infections	11.35	10.70	10.95	20.85	38.35	55.80	56.17	48.09	54.74	35.17
Ectopic pregnancy	1.79	1.53	1.63	2.24	3.95	3.92	6.59	5.59	0.00	3.45
Miscarriage	1.79	2.67	2.33	3.08	6.44	8.21	13.18	6.71	10.95	6.00
Pregnancy-related sepsis	2.99	4.58	3.96	4.20	8.20	10.82	10.75	8.95	10.95	7.30
Obstetric haemorrhage	5.98	6.88	6.52	12.03	19.76	29.48	54.09	60.39	76.64	22.67
Hypertension	28.69	22.54	24.92	20.01	20.20	26.13	34.67	31.31	43.79	24.02
Anaesthetic complications	5.38	2.29	3.49	2.10	3.07	3.55	5.20	2.24	0.00	3.16
Adverse drug reactions	0.00	2.29	1.40	1.68	1.32	3.17	3.12	1.12	0.00	1.96
Embolism	2.39	2.29	2.33	2.94	3.95	4.67	5.89	11.18	10.95	4.03
Acute collapse - cause unknown	1.20	2.67	2.10	1.54	2.05	3.36	5.55	8.95	10.95	2.80
Miscellaneous	0.60	0.38	0.47	0.42	0.73	0.56	1.04	2.24	0.00	0.65
Unknown	4.18	4.20	4.19	4.48	6.29	6.34	8.67	17.89	0.00	6.14
Total iMMR	78.29	76.03	76.87	85.78	132.04	176.91	228.49	243.81	262.76	134.33

Distribution of maternal age in categories from recorded live births from Stats SA. Split proportions for <20 from PPIP.

The women less than 18 years have a very high mortality due to hypertensive disorders in pregnancy (HDP). The figure below gives the overall mortality per age category which hides the impact of HDP.



However, when the iMMR per age category is plotted per underlying cause the differences in risk become obvious. (See below).



In this graph Ectopic and Miscarriage are EPL, and Emb. and acute collapse are joined.

The problems of HDP mortality below 18 years is clearly illustrated above. Also as age progresses the mortality risk increases. This is most marked in women dying due to obstetric haemorrhage.

The importance of providing contraception for teenagers and women over 34 years is clearly demonstrated by the increased risk of maternal deaths that the women face in these age groups.

Section 3

3.1. A focus on non-facility deaths during pregnancy, childbirth and puerperium in South Africa using vital registration data from 1999-2014

D. Bradshaw, R.Laubscher, S.Fawcus, R.Pattinson

Background

South Africa is one of many countries aiming to reduce the maternal mortality ratio (MMR) which is high in comparison to similar middle-income countries[1]. The National Committee for Confidential Enquiry into Maternal Deaths (NCCEMD) was set up in 1998 to measure and analyse maternal deaths so that targeted strategies could be recommended to reduce mortalities[2,3]. The enquiry is predominantly facility based and the MMR estimates, known as iMMR (institutional MMR), has consistently been lower than WHO country estimates[1]or the estimates from the Rapid Mortality Surveillance, using the methodology recommended by the Health Data Advisory and Coordinating Committee [4]. This discrepancy is in part likely to be accounted for by home or non-facility deaths.

Data on home/non-facility maternal deaths is amongst the data collected in the Health and Demographic Surveillance Sites at the Africa Centre[5] and Agincourt[6]; and the vital statistics reported by Statistics South Africa (Stats SA) based on information from death notifications.

Aim The aim of this paper is to measure and analyse the contribution of non-facility deaths during pregnancy, childbirth and the puerperium (DDPCP) to the overall DDPCP and identify the causes of DDPCP and maternal death that occur outside of facilities.

Specific Objectives

1. To measure the proportion of non-facility DDPCP and maternal deaths over a given time period
2. To further analyse non-facility DDPCD and maternal deaths by cause of death, age, province and to compare these patterns with facility deaths
3. To evaluate trends in DDPCP and maternal deaths in different settings over time
4. To compare findings from the Death Certificate (vital registration) data with that of the NCCEMD

Methods

Terminology

When comparing data sources, the terminology and definitions used for maternal mortality becomes very important. The WHO guide on the application of ICD-10 to deaths during pregnancy, childbirth and puerperium of 2012 provides a timely framework for terminology[7]. The definitions outlined in the ICD-MM guide are:

- ***Death occurring during pregnancy, childbirth and the puerperium (DDPCP)*** is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death (obstetric and non-obstetric).

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

- Maternal deaths are subdivided into two groups:
    - ***direct obstetric deaths***: direct obstetric deaths are those resulting from obstetric complications of the pregnancy state (pregnancy, labour and the puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above.
    - ***indirect obstetric deaths***: indirect obstetric deaths are those resulting from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by physiologic effects of pregnancy.

- A ***late maternal death*** is the death of a woman from direct or indirect causes more than 42 days but less than one year after termination of pregnancy.

Study design

This is a retrospective descriptive study of DDPCP and maternal deaths from 1999-2014, based on the secondary analysis.

Data sources

The source of DDPCD data is the routinely completed death notifications. All deaths must be registered with the Department of Home Affairs based on a death certificate / notification form (DHA-1663) completed by a medical doctor, with details about the immediate cause of death and the conditions leading to the death. In areas where no doctors are available to certify the death, it is possible for a traditional leader to notify the death (DHA-1680),

providing an affidavit that the death was not due to external causes which would require that the deceased be sent for Forensic assessment on the cause. The Department of Home Affairs submits the death notification forms to Stats SA for statistical processing. At Stats SA, the causes of death reported on the death notification form are coded using ICD-10 and the underlying cause of death is identified from the sequence of causes using an automated application of the ICD rules for selection of underlying cause. Information from traditional leaders might reflect details about the cause of death provided by the family of the deceased. Alternatively, it might merely reflect that it was a natural cause, in which case the underlying cause will be coded to ill-defined natural cause. The forms are mostly completed by health professionals in facilities or mortuaries and for home deaths.

The death notification includes fields for age, location and other details and on the last page the details for ascertaining the underlying cause of death as well as a tick-box question on pregnancy status of a deceased female. The tick-box reflects whether a female deceased was pregnant or had been pregnant within 42 days prior to the death. Since 2014, the last page of the death notification has become self-sealing and should be forwarded by the Department of Home Affairs to Stats SA for collation. In some rural areas, the notification may be done by traditional leaders. These forms have a field to report the cause of death based on information from the informant, but no specific question about pregnancy status.

Unit record data, classified by ICD-10 code, are obtained by the SAMRC Burden of Disease Research Unit on an annual basis, and a consolidated data set compiled. For this analysis, DDPCD deaths were identified from the pregnancy question on the death certificate (irrespective of the underlying cause) or the underlying cause having ICD-10 code O00-O99 which reflects 'maternal' causation (irrespective of reported pregnancy status). The data set also has data on age, residence and setting of death (hospital / home etc).

A collaboration with the NCCEMD enabled the DDPCP to be grouped into the causal groupings used by the NCCEMD (Appendix 1). The NCCEMD classification of causes of death into direct, indirect and coincidental cause is adapted from the WHO ICD-10 classification, with the latter being excluded in the calculation of the maternal mortality ratio[7,8]. Data were analysed by setting, cause of death, age, province and over the years 1999 -2014.

Results

Of the 31,505 deaths during pregnancy, childbirth and puerperium during the 15 year from 1999 to 2014, the majority, 22071 (70%) occurred in a hospital setting (Hospital, Inpatient, Outpatient, Emergency Room); 5516 (18%) occurred in a home/other setting (DOA, Home, Nursing home, Other-specified) and for 3918 (12%) the location was unknown (none of the relevant boxes on the death certificate were ticked). This unknown group is a problem in that it hinders accurate determination of the proportion of non-facility deaths, which could be much higher than the 18% if most of the unkown location group occurred outside a facility.

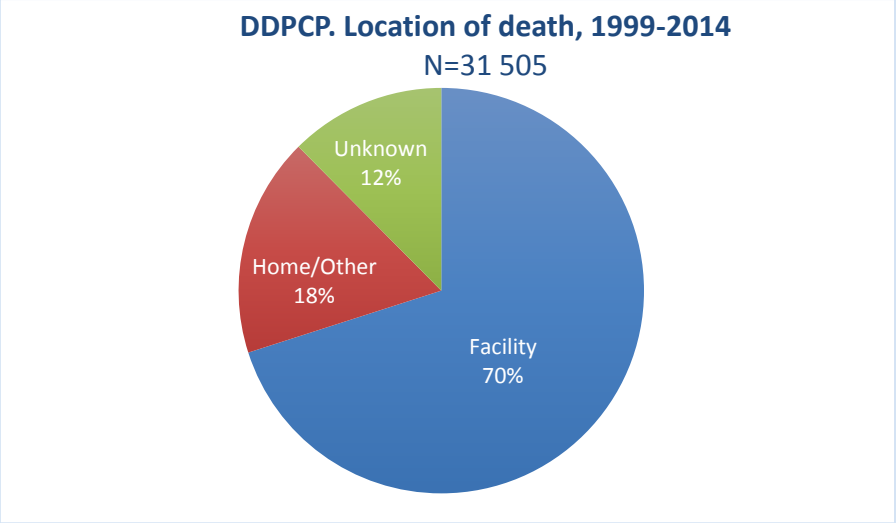


Figure 1: Location of deaths during pregnancy, childbirth and puerperium, 1999-2014.

Of the 31,505 DDPCP, there were 1600 (5%) with no obstetric cause; thus there were 29,905 maternal deaths. If only maternal deaths are considered the distribution by location was: Facility (72.2%), Home/other (16.2%) and Unknown (11.6%)

The proportion of deaths in setting per province are shown in Table 1 and Figure 2. KwaZulu- Natal has the highest proportion of facility deaths (76%) whereas Northern Cape (27%), Free State (25%), North West (23%) and Mpumulanga (26%) have the highest percentage of non –facility deaths.

Table 1. Number (%) of deaths during pregnancy, childbirth and puerperium by setting and by province, 1997-2014

Province	Facility	Home/Other	Unknown	Total
Western Cape	1060 (64.4)	299 (18.2)	288 (17.5)	1647 (100.0)
Eastern Cape	3063 (70.4)	749 (17.2)	541 (12.4)	4353 (100.0)
Northern Cape	368 (61.5)	159 (26.6)	71 (11.9)	598 (100.0)
Free State	1803 (69.3)	642 (24.7)	158 (6.1)	2603 (100.0)
KwaZulu Natal	5623 (75.9)	1143 (15.4)	640 (8.6)	7406 (100.0)
North West	1484 (58.2)	579 (22.7)	487 (19.1)	2550 (100.0)
Gauteng	4631 (72.0)	690 (10.7)	1111 (17.3)	6432 (100.0)
Mpumalanga	1927 (66.3)	741 (25.5)	237 (8.2)	2905 (100.0)
Limpopo	2085 (70.4)	503 (17.0)	374 (12.6)	2962 (100.0)
Outside RSA	9 (69.2)	1 (7.7)	3 (23.1)	13 (100.0)
Unspecified	18 (50.0)	10 (27.8)	8 (22.2)	36 (100.0)
Total	**22071 (70.1)**	**5516 (17.5)**	**3918 (12.4)**	**31505 (100.0)**

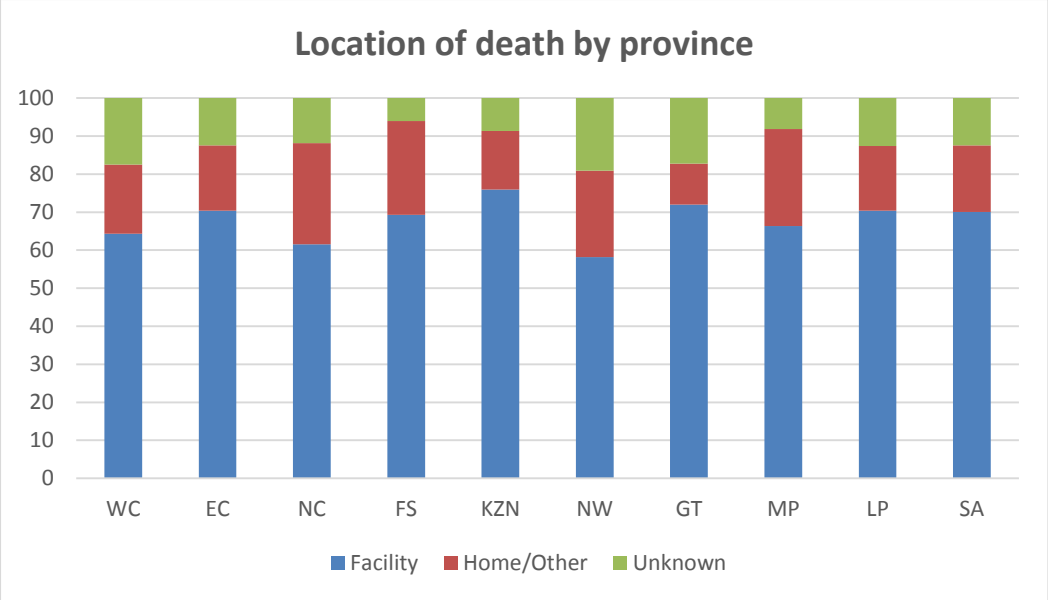


Figure 2: Percentage distribution of location of DDPCP by province, 1999-2014

Table 2 and Figure 3 show trends in DDPCP over time. It can be seen that facility deaths increased steadily from 1026 in 1999 to 1888 in 2006 and then declined to 890 in 2014. This trend is similar to that of the NCCEMD iMMR statistics but the peak is in 2006 whereas it was 2009 in the NCCEMD data.

Table 2. Number (%) of deaths during pregnancy childbirth and puerperium by location by year

Year	Facility	Home/Other	Unknown	Total
1999	1026 (66.9)	361 (23.5)	147 (9.6)	1534 (100.0)
2000	1133 (69.3)	344 (21.0)	159 (9.7)	1636 (100.0)
2001	1156 (66.9)	379 (21.9)	193 (11.2)	1728 (100.0)
2002	1154 (66.1)	338 (19.4)	253 (14.5)	1745 (100.0)
2003	1356 (67.4)	413 (20.5)	242 (12.0)	2011 (100.0)
2004	1677 (72.2)	443 (19.1)	203 (8.7)	2323 (100.0)
2005	1734 (70.6)	481 (19.6)	242 (9.8)	2457 (100.0)
2006	1888 (71.9)	455 (17.3)	283 (10.8)	2626 (100.0)
2007	1802 (72.3)	451 (18.1)	240 (9.6)	2493 (100.0)
2008	1710 (73.4)	383 (16.4)	236 (10.1)	2329 (100.0)
2009	1796 (74.1)	366 (15.1)	262 (10.8)	2424 (100.0)
2010	1531 (72.4)	327 (15.5)	258 (12.2)	2116 (100.0)
2011	1237 (69.1)	227 (12.7)	326 (18.2)	1790 (100.0)
2012	1058 (67.0)	203 (12.8)	319 (20.2)	1580 (100.0)
2013	923 (67.1)	171 (12.4)	281 (20.4)	1375 (100.0)
2014	890 (66.5)	174 (13.0)	274 (20.5)	1338 (100.0)
Total	**22071 (70.1)**	**5516 (17.5)**	**3918 (12.4)**	**31505 (100.0)**

Home/other deaths showed a similar trend to the total DDPCP increasing from 361 in 1999 to 481 in 2005 and then declining to 174 in 2014. The deaths with unknown location tended to increase but are difficult to interpret since they may represent mixed locations.

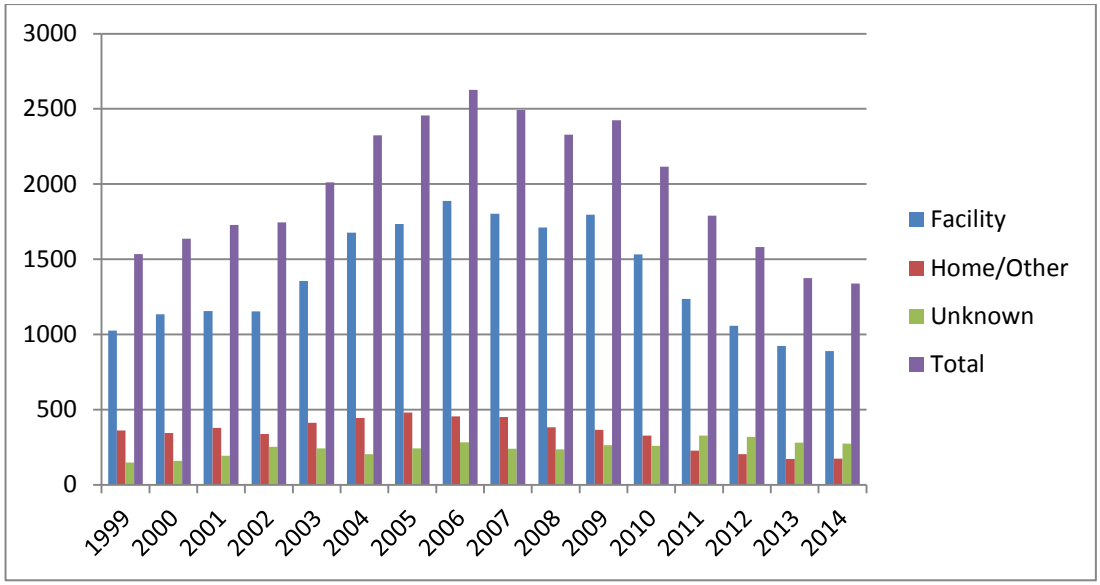


Figure 3: Trends in deaths during pregnancy, childbirth and puerperium by location, 1999-2014

The proportion of facility deaths has remained similar from 1999 to 2014, ranging from 67% in 1999 to 74% in 2009 and then down to 67% in 2014. (Figure 4). The percentage of home deaths steadily declined from 24% in 1999 to 13% in 2014 whereas the percentage of unknown location increased from 10% in 1999 to 20 % in 2014. The significance of this is unclear and may merely reflect decreasing completeness of the death certificate over time which is concerning given that there has been training on the new version of the certificate.

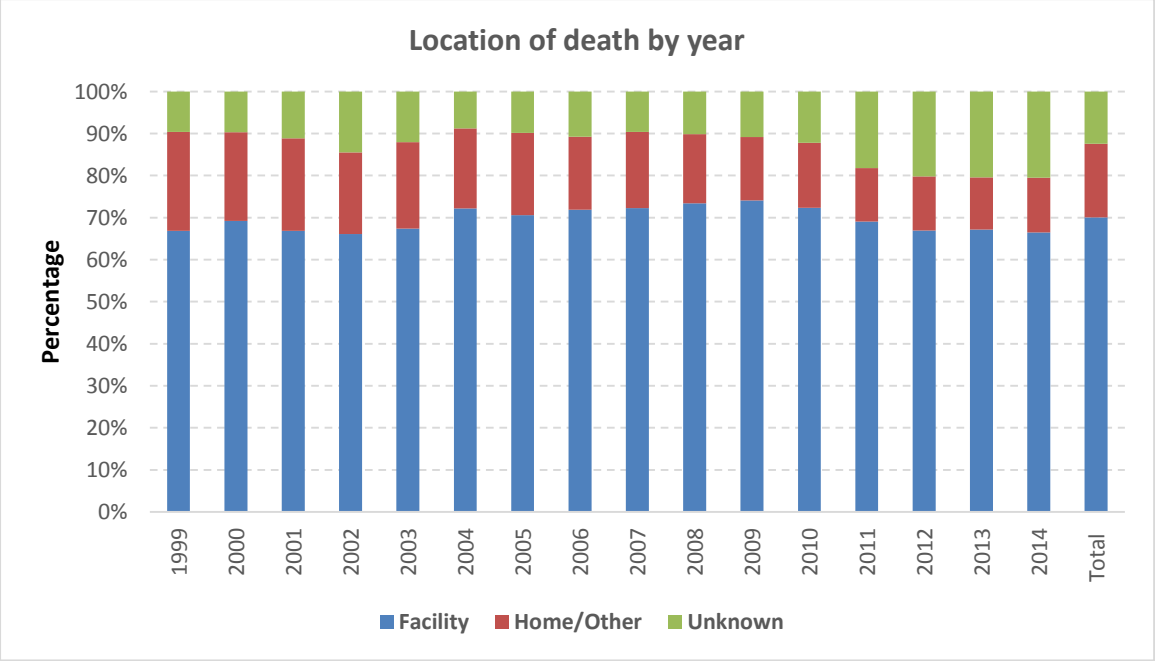


Figure 4: Percentage distribution of location of death by year, 1999-2014

Figure 5 shows the age distribution of the deaths during pregnancy, childbirth and puerperium. This analysis was done to confirm the veracity of case ascertainment. As expected, the majority of deaths fall within the reproductive age group 18 to 44 years.

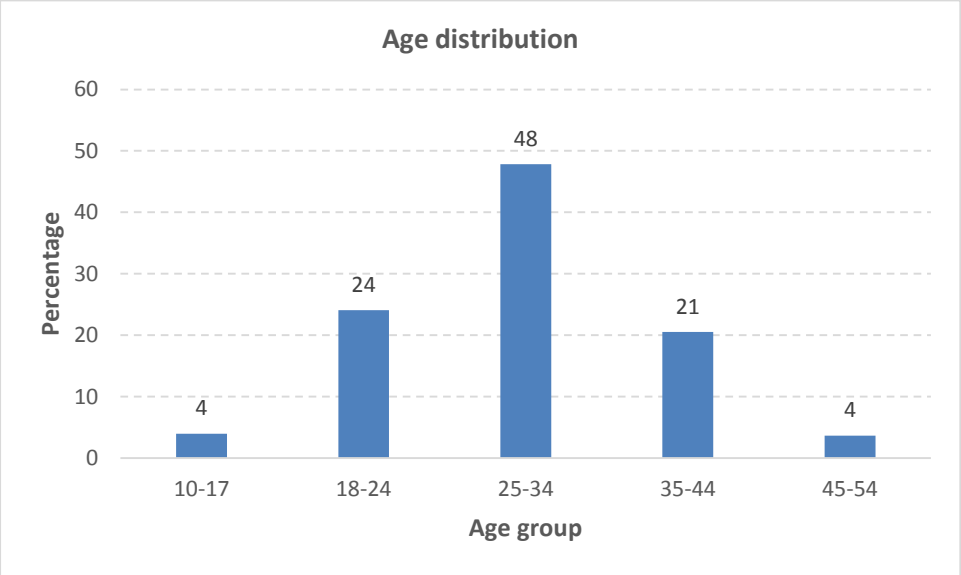


Figure 5: Percentage distribution of deaths during pregnancy, childbirth and puerperium by age group, 1999-2014

Causes of DDPCP, grouped according to NCCEMD subcategories, are shown in Figure 6.

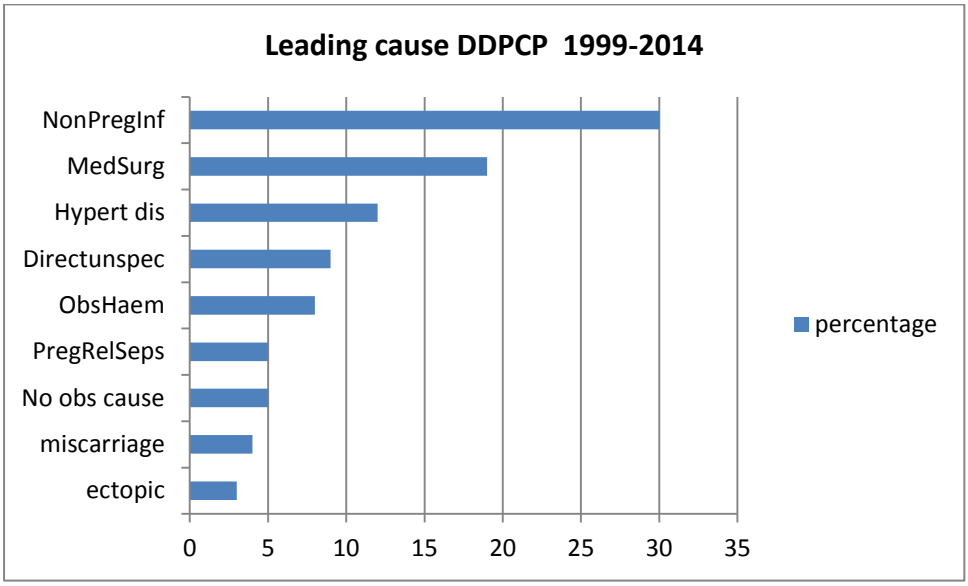


Figure 6: Leading causes of deaths during pregnancy, childbirth and puerperium, 1999-2014

There were some difficulties in correlating the causes of death as indicted by the ICD 10 code with the causal subcategories used by the NCCEMD. For example, some deaths had unclear underlying causes reported in death certificates such as preterm labour, occipito-posterior presentation, induction of labour etc where it appeared that the person completing the death certificate had described obstetric events rather than a causal sequence of conditions leading to death. Such cases, considered to reflect poor quality

cause assignment, were assigned to the Direct-unspecified group. In addition, the code 099 "Other maternal diseases classifiable elsewhere but complicating pregnancy, childbirth and the puerperium" was assigned to the Medical /Surgical disorder group which made it the second most common group.

The totals column in Table 3 gives the breakdown of all causes of DDPCP and Figure 6 gives the leading causes.
For the DDPCP in all locations, non-pregnancy related infections (NPRI) was the most frequent cause of death followed by Medical / surgical disorders, Hypertension, Direct unspecified and then Haemorrhage. Of note deaths with no obstetric causes accounted for 1600 deaths or 5% of the total. With these excluded, leading causes of maternal death were as followed: Non pregnancy related infections (31%), Medical/surgical disorders (20.5%), Hypertensive disorder (13.1%), Direct unspecified (9%), Haemorrhage (8.2%), Pregnancy related sepsis (5.5%), Miscarriage (4.5%), Ectopic (3.1%). This vital registration data on causes is similar to the NCCEMD findings in that NPRI is the most common cause, but differs in the subsequent ranking of causes with Medical and Surgical disorders being the second most common cause and having a group of Unspecified Direct causes.

The distribution of cause of DDPCP by setting is shown in Table 3 and Figure 7.

Table 3: Number (%) of deaths during pregnancy, childbirth and puerperium by cause for each setting, 1999-2014

Cause group	Facility	Home/Other	Unknown	Total
NonPregInf	7389 (33.5)	1198 (21.7)	785 (20.0)	9372 (29.7)
MedSurgDisord	4385(19.9)	1128(20.4)	609 (15.6)	6122 (19.5)
HypertDisord	2881 (13.1)	525 (9.5)	519 (13.2)	3925 (12.5)
DirectUnspec	1861 (8.4)	419 (7.6)	421 (10.7)	2701 (8.6)
ObsHaem	1666 (7.5)	426 (7.7)	368 (9.4)	2460 (7.8)
PregRelSepsis	1181 (5.4)	305 (5.5)	160 (4.1)	1646 (5.2)
NoOBScause	484 (2.2)	671 (12.2)	445 (11.4)	1600 (5.1)
Miscarriage	1005 (4.6)	172 (3.1)	169 (4.3)	1346 (4.3)
Ectopic	516 (2.3)	222 (4.0)	198 (5.1)	936 (3.0)
Embolism	281 (1.3)	77 (1.4)	54 (1.4)	412 (1.3)
AdvDrugReact	101 (0.5)	5 (0.1)	16 (0.4)	122 (0.4)
NewbornDiagn	54 (0.2)	10 (0.2)	11 (0.3)	75 (0.2)
Anaesthetic	44 (0.2)	11 (0.2)	10 (0.3)	65 (0.2)
Miscellaneous	25 (0.1)	12 (0.2)	5 (0.1)	42 (0.1)
Late Deaths	1 (0)	2 (0)	3 (0.1)	6 (0)
Missing/Unknown	197 (0.9)	333 (6.0)	145 (3.7)	675 (2.1)
Total	**22071 (100.0)**	**5516 (100.0)**	**3918 (100.0)**	**31505 (100.0)**

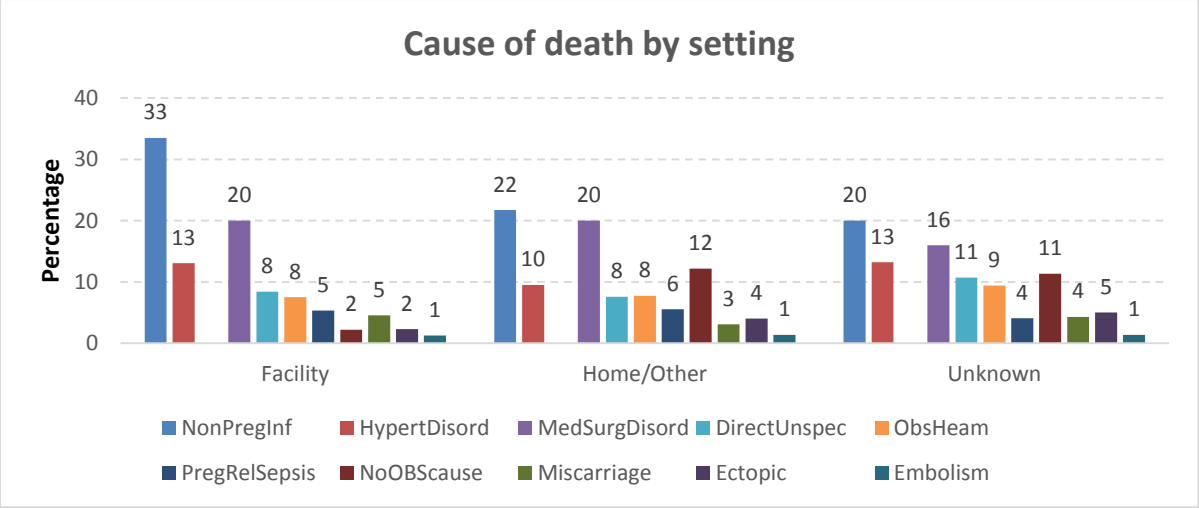


Figure 7: Leading causes of deaths during pregnancy, childbirth and puerperium by setting, 1999-2014

Table 3 and Figure 7 show a different pattern of cause when comparing facility and non-facility deaths. Non-pregnancy related infections were the most common cause in all settings, but the ranking after this differs for different settings. For both facility and non-facility settings, the medical and surgical disorders groups, hypertension, direct unspecified and haemorrhage were the next most common causes. For the home/other setting, Indirect deaths from medical /surgical conditions (11%) and deaths with no obstetric cause (12%) such as from assault or accidents (coincidental) formed a larger proportion than for the facility deaths. Of note, there were direct maternal deaths from hypertensive disorders (10%), haemorrhage (8%) and sepsis (6%) that occurred in the home /other setting (Figure 7), but in lower proportions than for facility deaths.

Figure 8 shows trends in most common causes of deaths during pregnancy, childbirth and puerperium including the unspecified groups from 1999 to 2014. The main condition contributing to the trends in DDPCP over the time period studied is the non-pregnancy related infections (NonPregInf) which showed an increase from 424 deaths in 1999 to 906 in 2006 and declined to 281 in 2014. In contrast, the Medical /Surgical disorders were stable from 1999, increased from 2008 to 2010 and then subsequently started to decline .

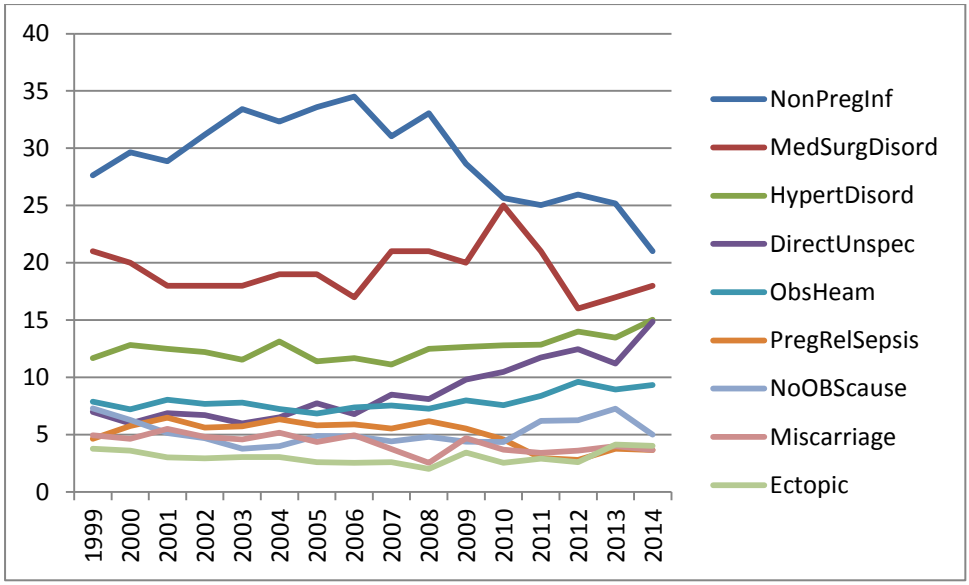


Figure 8: Trend in number of deaths during pregnancy, childbirth and puerperium by cause group, 1999-2014

Figure 9 shows that Hypertension and Non-obstetric cause group accounted for the highest proportion of deaths in the 10-17 year age group and medical and surgical disorders were the highest proportion of the oldest group. For the other age groups non-pregnancy related infections (NPRI) was most frequent followed by hypertension.

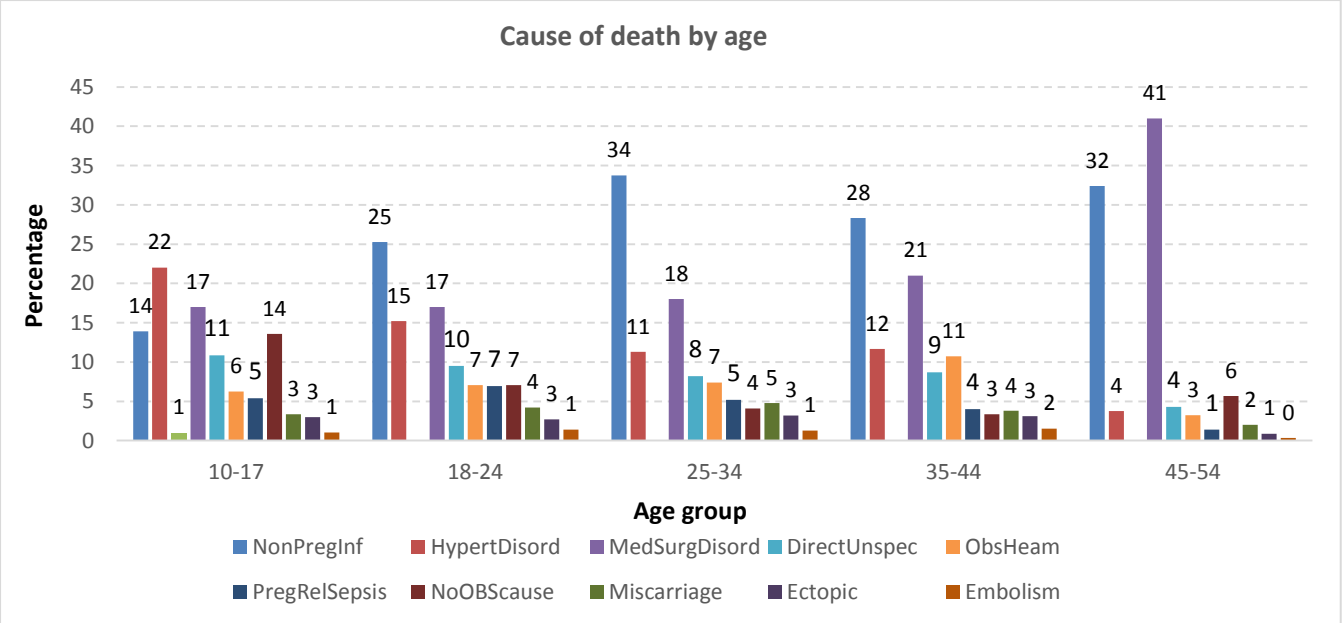


Figure 9: Leading causes of DDPCP by age group, 1999-2014

In South Africa pathology services, including forensic pathology, are limited resources so it is not possible for post-mortems to be performed on all deaths during pregnancy, childbirth and puerperium. Moreover, for some there is a clinically obvious cause of death. Among the DDPCP, a post-mortem was performed for 15%. The highest number of autopsies were done

for those with no obstetric cause and most in the home/other setting. This would be expected given that deaths outside facilities require forensic post-mortems and it is likely that a clinical diagnosis would have been unlikely to have been made prior to death.

Table 4: Number (%) of deaths with autopsy by cause group and location

Cause group	Hospital	Home/Other	Unknown	Total
NoOBScause	311 (14.5)	585 (42.8)	354 (29.4)	1250 (26.5)
ObsHeam	308 (14.3)	143 (10.5)	163 (13.5)	614 (13.0)
HypertDisord	306 (14.2)	111 (8.1)	133 (11.0)	550 (11.6)
DirectUnspec	259 (12.0)	85 (6.2)	126 (10.4)	470 (9.9)
Ectopic	131 (6.1)	102 (7.5)	113 (9.4)	346 (7.3)
NonPregInf	207 (9.6)	56 (4.1)	65 (5.4)	328 (6.9)
MedSurgDisord	346 (16.1)	170 (12.5)	122 (10.1)	638 (13.5)
Miscarriage	91 (4.2)	42 (3.1)	36 (3.0)	169 (3.6)
Unknown	56 (2.6)	29 (2.1)	46 (3.8)	131 (2.8)
PregRelSepsis	45 (2.1)	19 (1.4)	16 (1.3)	80 (1.7)
Embolism	38 (1.8)	16 (1.2)	16 (1.3)	70 (1.5)
AdvDrugReact	41 (1.9)	2 (0.1)	10 (0.8)	53 (1.1)
Anaesthetic	6 (0.3)	3 (0.2)	3 (0.2)	12 (0.3)
NewbornDiagn	6 (0.3)	3 (0.2)	3 (0.2)	12 (0.3)
Miscellaneous	(0)	1 (0.1)	(0)	1 (0)
Total	**2151 (100.0)**	**1367 (100.0)**	**1206 (100.0)**	**4724 (100.0)**

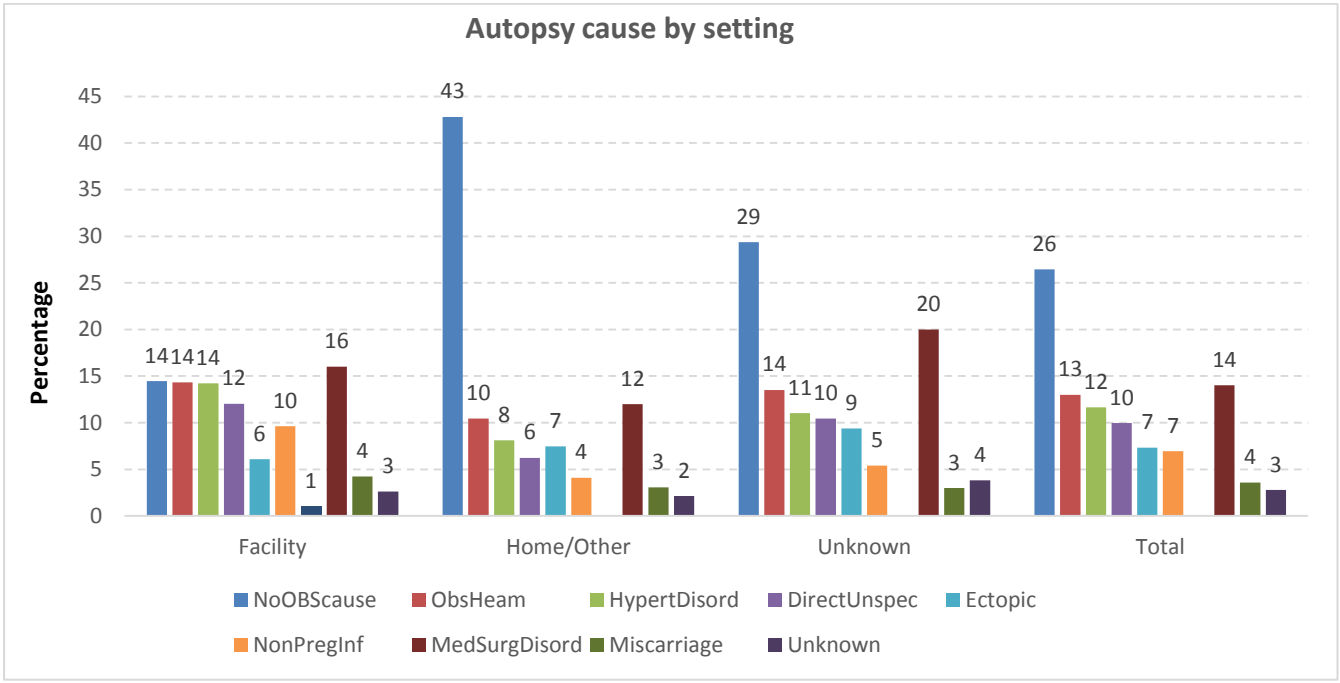


Figure 10: Percentage distribution of cause by setting for causes determined by autopsy, 1999-2014

Comparison of vital registration data with NCCEMD data

The NCCEMD data on maternal deaths are derived from notifications of mostly facility deaths; thus numbers would be expected to be less than the vital registration data from death certificates (VR) due to the limited notification of home deaths to the NCCEMD. Other potential differences between the two data sets could be that the DDPCP identified by the VR data includes not only maternal deaths (direct and indirect) but also coincidental deaths. It would be expected that the latter group are less likely to be notified to the NCCEMD but could appear on death certificates and be recorded in VR. In addition, indirect maternal deaths occurring in non-maternity wards such as medical wards or psychiatric hospitals may not be notified as maternal deaths to the NCCEMD but would appear in facility VR data.

Trends in DDPCP and maternal deaths over time

Both the VR data and the NCCEMD DDPCP data show an initial rise from 1999 and a later decline to lowest numbers in 2014. However the timing of the peaks differ; 2006 for VR data and 2009 for NCCEMD data. (Table 5 and Figure 11)

In addition, Table 5 and Figure 11 show that, from 1999 to 2011 deaths during pregnancy, childbirth and puerperium reported by the VR exceeded the numbers reported by the NCCEMD, but from 2011 to 2014 the numbers were similar.

Table 5: Number of deaths during pregnancy, childbirth and puerperium from vital registration and NCCEMD, 1999-2014

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Vital reg	1534	1636	1728	1745	2011	2323	2457	2626	2493	2329	2424	2116	1790	1580	1375	1338
NCCEMD	805	1035	990	1012	1221	1173	1263	1448	1366	1554	1766	1646	1560	1508	1384	1378

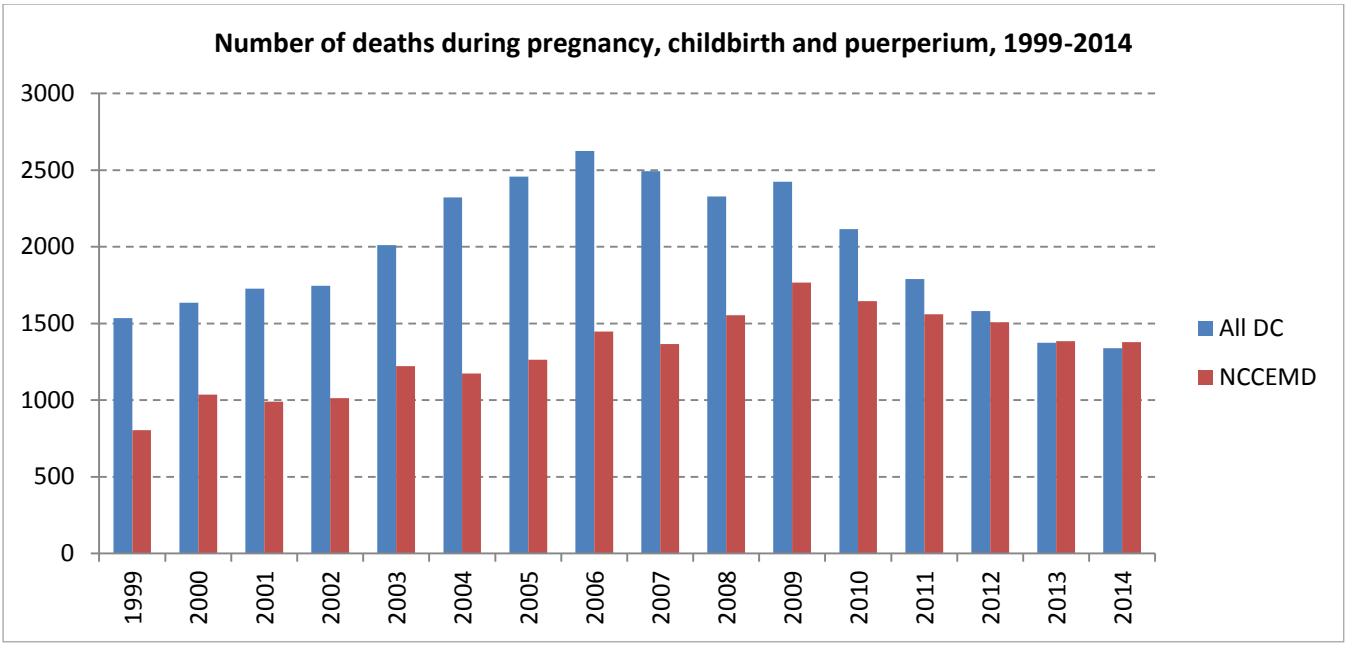


Figure 11: Numbers of deaths during pregnancy, childbirth and puerperium from vital registration/deathk.njm certificates and NCCEMD, 1999-2014

Since the NCCEMD is predominantly institutional, it is more appropriate to compare NCCEMD death data with the deaths during pregnancy, childbirth and puerperium deaths recorded in vital registration data that occurred in the facility setting. This will enable a more reasonable correlation of the two different sources of data (Table 6 and Figure 12).

Table 6: Number of facility based deaths during pregnancy, childbirth and puerperium from vital registration and all NCCEMD, 1999-2014

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hosp. VR	1026	1133	1156	1154	1356	1677	1734	1888	1802	1710	1796	1531	1237	1058	923	890
NCCEMD	805	1035	990	1012	1221	1173	1263	1448	1366	1554	1766	1646	1560	1508	1384	1378

From 1999 to 2008, there were more VR deaths in facility settings than numbers reported to the NCCEMD, but from 2009 the NCCEMD reported more deaths than VR data. The differences between NCCEMD and VR data are very difficult to interpret. The fall-off in the number of maternal deaths in the VR data from 2009 when compared to the NCCEMD raises questions about the robustness of VR data, as it was expected that the number in VR would be higher than the number in NCCEMD.

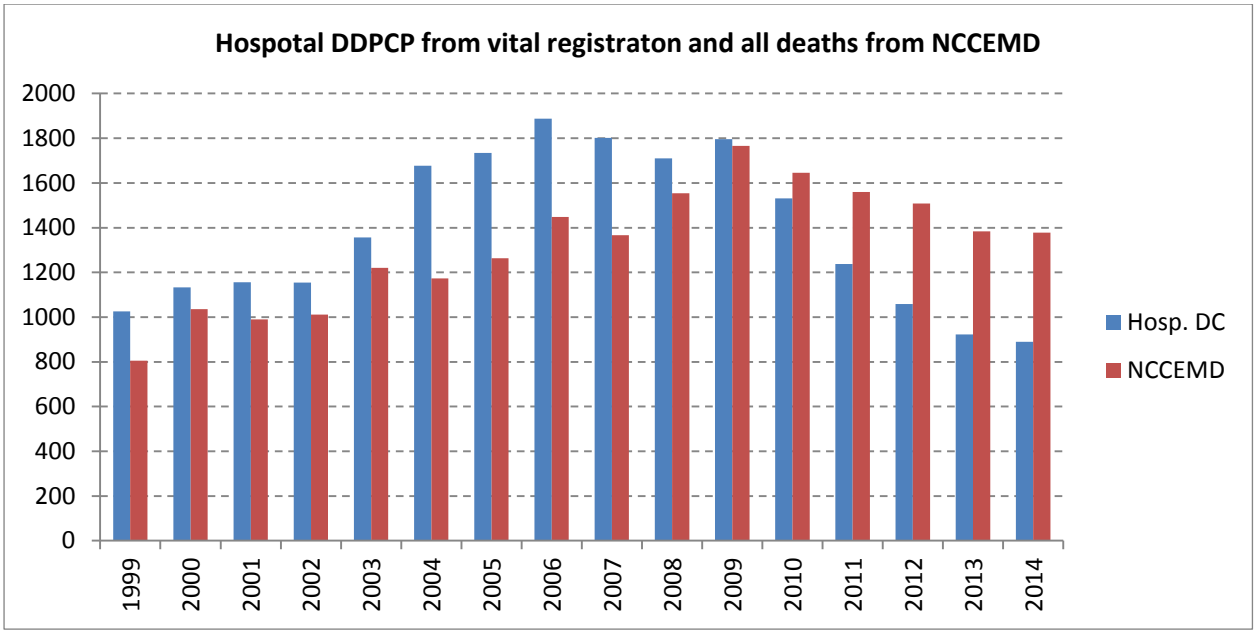


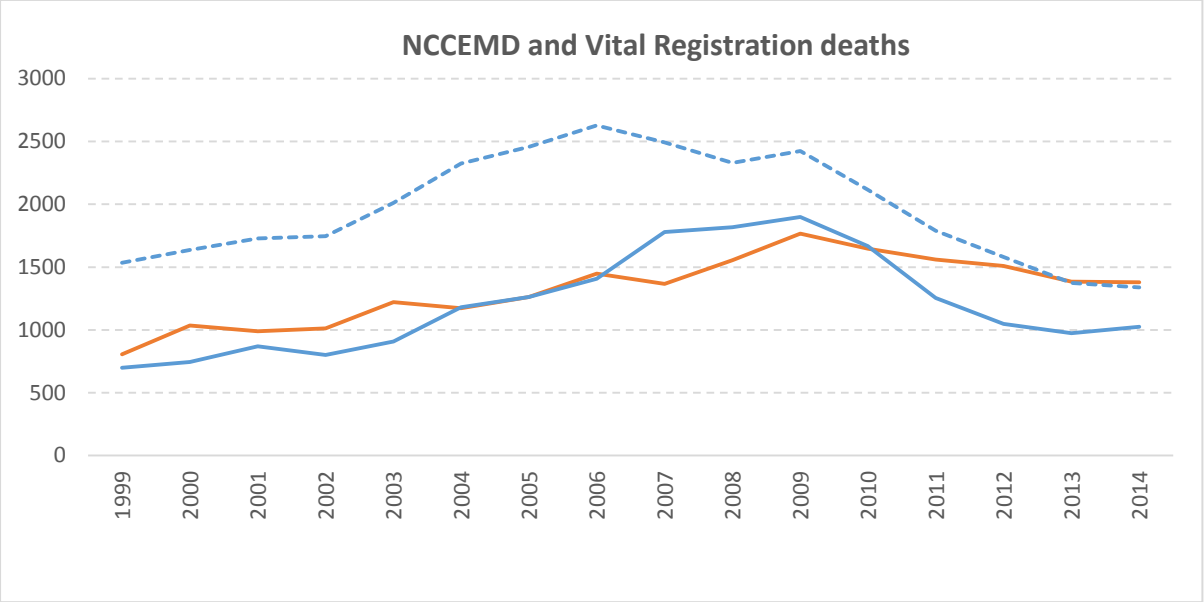
Figure 12: Numbers of hospital deaths during pregnancy, childbirth and puerperium in hospital from vital registration and all NCCEMD deaths, 1999-2014

To assist explain the inconsistencies in the above VR and NCCEMD data, it is important to recognise that the two data sources are not truly comparable both due to differences in proportion of non-facility deaths and coincidental deaths but also because of the ways in which the VR data DDPCP deaths are identified. As described in the methods section, the VR data come from two sources; (a) those with an ICD 10 code 0 00 to 0 99 and (b) those that are identified as DDPCP only because the pregnancy box is ticked irrespective of the cause given. Group (a) includes all the direct cause of maternal death but also two codes which reflect indirect deaths; O98 (infections complicating pregnancy) and 099 (other medical disorders complicating pregnancy). Group (b) would all be indirect maternal deaths and it is possible that some could be coincidental.

Therefore, a further analysis has been performed using the group (a) sub-category of the DDPCP in the VR data. Table 7 and Figure 13 show the trend in the number of deaths from NCCEMD compared with the VR data derived from the ICD 10 O-00 to O-99. When the VR data for the ICD10 codes 00-099 only are analysed, the trend of deaths over times is more similar to the NCCEMD data.

Table 7: Number of maternal deaths from vital registration and all NCCEMD, 1999-2014

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
VR Maternal (ICD 10 0 00-99 codes) *	698	744	869	802	908	1180	1261	1406	1780	1816	1900	1667	1255	1048	974	1024
All VR group *	1422	1533	1639	1663	1935	2230	2337	2498	2383	2217	2318	2024	1679	1481	1275	1271
NCCEMD	805	1035	990	1012	1221	1173	1263	1448	1366	1554	1766	1646	1560	1508	1384	1378
***coincidental causes have been excluded)**																



___ NCCEMD; ___ VR (ICD 10 code O 00-99): _ _ _ _ All VR

Figure 13: Comparison of NCCEMD deaths with VR maternal deaths and VR maternal and coincidental deaths, 1999-2014

Table 8 and Figure 14 compare VR maternal deaths (direct and indirect) and VR maternal and coincidental deaths for facility settings only with the NCCEMD data. This shows similar trends to Table 7 and Figure 13, with trends in VR direct maternal deaths mirroring trends in NCCEMD data. However, from 2009 onwards, the NCCEMD reported more maternal deaths than hospital maternal deaths from VR. Possible explanations are that the VR data is not robust and quality has deteriorated over time, or the NCCEMD increased its reporting of deaths due to changes in its classification of maternal deaths in 2008 in which the medical disorders sub category was expanded.

Table 8: Number of Hospital maternal deaths from VR and NCCEMD deaths, 1999-2014

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Facility Maternal VR (1CD 10 code O 00-99) *	474	527	601	549	629	878	917	1041	1362	1417	1484	1270	920	757	703	723
Facility All VR*	1001	1112	1139	1144	1355	1679	1731	1878	1794	1727	1801	1539	1238	1062	930	900
NCCEMD	805	1035	990	1012	1221	1173	1263	1448	1366	1554	1766	1646	1560	1508	1384	1378
***coincidental causes have been excluded)**																

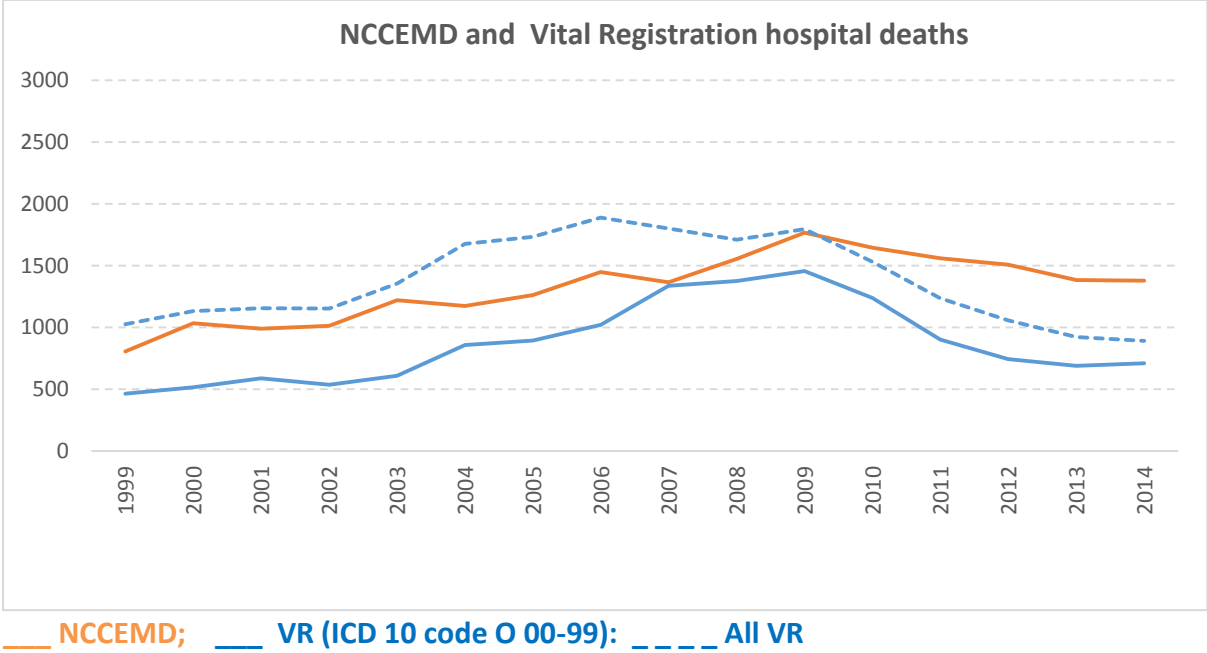


Figure 14: Comparison NCCEMD deaths with VR hospital maternal and VR hospital maternal and coincidental deaths, 1999-2014

Discussion

The VR data confirms that the NCCEMD is under-reporting deaths occurring at home. The finding of 18% deaths occurring at home/outside facilities in the VR data, is much greater than the 1.8% of non-facility deaths reported to the NCCEMD in its sixth Saving Mothers report [2]. The proportion of home deaths reported to the NCCEMD has remained less than 3% in all Saving Mothers reports and shown little fluctuation. This partly explains why global and RAMOS estimates of SA's MMR are higher than those from NCCEMD. Over the period, the proportion of deaths occurring at home/outside facilities has decreased. However, that has been also been accompanied by little change in the proportion of deaths occurring in facilities and an increase in the proportion of deaths without a record of the setting. This is a disturbing sign about the completeness of information provided on death notification forms.

The pattern of cause for Home/Outside deaths has similarities with that found by the NCCEMD in that non-pregnancy related infections are the most common cause in all settings, with hypertension and haemorrhage being the most common direct causes. However non-obstetric causes are proportionately greater in the Home/outside deaths. This is not surprising given that many accidental/ trauma related deaths occur outside of health facilities. These are not actually maternal deaths, thus reducing slightly the proportion of non-facility home maternal deaths.

In addition, Indirect maternal deaths due to medical and surgical disorders in pregnancy are proportionately greater in the VR data compared to NCCEMD data and this may reflect non-reporting of this group of deaths to the NCCEMD when they occur in non- maternity wards. It is possible that some of the indirect deaths grouped under medical and surgical disorders could also have been coincidental, but the VR data is derived from death certificates and automated coding and thus cannot be verified.

Also it is possible that the NCCEMD identified more indirect maternal deaths from medical and surgical disorders from 2008 when the new classification system broadened the inclusion criteria for deaths from medical, psychiatric and surgical disorders occurring in pregnancy.

The inclusion of this broad group of Indirect maternal deaths, including the non-pregnancy related infections, into maternal death measurement has been questioned by Garenne et al in the Agincourt HDSS survey who suggest that many of these deaths can be seen as "pregnancy related coincidental " and are not true maternal deaths[9,10] . This view is echoed by the MRC Burden of Disease Unit. The NCCEMD however, has justified its broad definition of Indirect maternal deaths because these conditions occur while the women are pregnant under the care of maternal health care providers who thus have the responsibility to manage these conditions and prevent deaths.

The importance of identifying home deaths is not only to get a better estimate of MMR and the pattern of causes, but also to identify modifiable or avoidable factors occurring outside of facilities at community level and involving access or barriers to care. Such factors may be important for both facility and non- facility deaths. Women dying in facilities may have had had social, transport or economic problems hindering their ability to access care; and many women dying at home may have had facility care. However, the VR data does not provide this information.

The Verbal Autopsy approach [11] used by the DHS sites of Agincourt and Hlabisa identifies such factors through direct questions with household members and narrative summaries of their accounts of circumstances around the death. The community based study conducted in Zimbabwe in 1989 also used a verbal autopsy technique and in so doing was able to identify important community based factors contributing to maternal deaths such as transport, financial and social support problems[12]. Similar studies in India have identified the multitude of community or access problems occurring in women who died, emphasising that a biological/clinical analysis of maternal deaths may miss the root causes[13,14].

The NCCEMD enables a detailed enquiry of facility factors but not of non-facility avoidable factors. Possible extending the remit of the NCCEMD to investigating near misses may allow such non-facility modifiable factors to be better investigated

This review of VR data has revealed problems with the way death certificates are completed in SA. Unlikely causes are written e.g. "newborn diagnosis' and the large number of causes that had to grouped as direct and indirect unspecified showed lack of precision in allocating the cause. Also, there was incomplete data with the location of death not being

ticked. This reiterates the need for more widespread training of doctors and possible auditing of death certificates might improve this allowing for more robust data to be obtained from the VR source.[15],[16]

Two surprising observations were made when comparing VR data and NCCEMD data. In the first instance, both data sources show an initial increase in maternal deaths from 1999, and then a decline but with different timing of the peaks. The cause information of the VR data indicates that the peak was associated with non-pregnancy related infections which followed the same time trend as AIDS mortality among the general female population ie peaking in 2006 as the roll-out of ARTs was effected. The majority of the DDPCP deaths from non-pregnancy related infections were reported in the VR data in two ways; firstly as code O 98 (Infections classifiable elsewhere but complicating pregnancy) and secondly infectious cause given together with pregnancy question box in the death certificate being ticked. As mentioned earlier, the NCCEMD also has broad inclusion criteria for Indirect maternal deaths. Both data sources could therefore overestimate the proportion of Indirect deaths which might, by applying strict ICD-10 coding rules, be considered coincidental deaths, rather than an indirect maternal death aggravated by the physiologic effects of pregnancy. However, given the concerns about the quality of medical certification of the cause of death in South Africa, some uncertainty remains.

The second surprise was the observation that from 2010 onwards, the NCCEMD numbers are very close or exceed the number of deaths from VR when it was expected that the VR number would be somewhat higher based on the inclusion of non-facility deaths. This observation raises questions about the VR system in the past few years. Since 2012, the time lag in reporting the cause-of-death statistics has become shorter, but it is not clear whether the completeness of registration has changed. The RMS report has expressed concerns about the number of deaths on the national population register being higher than the number of deaths from VR, raising questions about whether all the forms submitted to the Department of Home Affairs have been transferred to Stats SA for processing.

In conclusion, both the VR data and the NCCEMD data, have limitations. Efforts are needed to improve medical certification of deaths and ensure that all deaths are registered. The question of distinguishing indirect maternal deaths from coincidental deaths needs to be interrogated further. The VR data confirms that maternal deaths are occurring outside facilities and explains why the NCCEMD iMMR is lower than other global and SA estimates. Neither the NCCEMD or VR data provide information about community factors involved in the pathway to maternal death; this requires a verbal autopsy methodology.

Appendix 1: Grouping based on underlying cause of death and pregnancy status

Category	ICD-10 codes	Pregnant within 42 days of death
NO OBSTETRIC CAUSE	V03-Y38; Y67-Y68; Y87	√
NON-PREGNANCY RELATED INFECTIONS	A00-B99; D84; G00-G09; H60-H66; I88-J42; J85-J86; O23; O98	√ √
MEDICAL AND SURGICAL DISORDERS	C002–D83; E05-F53; G20-H18; I00 - I86; J43 – J84; J90-N94; O24-025; O99 (*INDIRECT UNSPECIFIED);* R02; U51	√ √ √
HYPERTENSIVE DISORDERS	O10 – O16	
OBSTETRIC HAEMORRHAGE	O43-O46; O67; O71-O73; R58	 √
PREGNANCY RELATED SEPSIS	O85-O86; O91	
MISCARRIAGE	O01-O07; O20	
ECTOPIC	O00	
EMBOLISM	O22; O87-O88	
ANAESTHETIC	O29; O74; O89	
ADVERSE DRUG REACTIONS	Y41-Y57; Y83-Y84; Y88	√
MISCELLANEOUS	O21	
DIRECT – UNSPECIFIED	O26; O28; 030-042; O47-O61; O62-066; O68-O70; O75; O90; O92	
LATE DEATHS	O96	
UNKNOWN	O95; R05-R57; R63-R87; R96; R98; R99	 √

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3.2. The role of midwives in reducing maternal mortality.

Elgonda Bekker

Internationally the role of the midwife as key role-player in saving lives of mothers and babies is well described. The 2014 State of the World Midwifery report (SoWMR) which reviewed 73 of the 75 low-and- middle-income countries including South Africa (SA) reports that more than 92% of the world's maternal and newborn mortalities occur in these 73 countries. However, only 42% of the world's medical, midwifery and nursing personnel are available to provide care in these countries (UNFPA, 2014).

According to the 2017 State of the World Midwifery report that is focused on the East and Southern African Region, estimated that in 2015 in SA, of an estimated total population of 54.5 million, and 14.7 million (27%) were women in the reproductive age with a total fertility rate of 2.3. By 2030, the population is projected to increase by 10% to 60.0 million. To achieve universal access to sexual, reproductive, maternal, newborn and adolescent (SRMNAH) care, health services must be ready to take care of 1.4 million pregnancies per year by 2030. The estimation is that there would be at least 91.0 million antenatal visits, 16.7 million births and 65.5 million postnatal visits between 2015 and 2030 (UNFPA, 2017).

Globally the aim is to end all preventable maternal mortality by 2030. In the past triennium from 2014 -2016, there is clearly a reduction in the maternal deaths occurring in SA, see Table 1. At this stage the focus should be to look at those elements within the reach of each healthcare worker in sexual, reproductive, maternal and newborn and adolescent health (SRMNAH) care to ensure that we do reach the goal of elimination of preventable maternal mortality in our life-time.

Table 1Number of Maternal deaths per category per year.

Underlying cause	2011	2012	2013	2014	2015	2016
Direct	**745**	**738**	**672**	**689**	**702**	**648**
Hypertension	214	221	205	221	222	218
Obstetric haemorrhage	233	242	209	226	217	181
Ectopic pregnancy	38	22	42	23	36	36
Miscarriage	66	65	54	48	61	56
Pregnancy-related sepsis	84	68	74	65	65	71
Anaesthetic complications	41	41	23	34	28	25
Embolism	29	42	31	38	37	36
Acute collapse - cause unknown	38	36	32	26	31	20
Miscellaneous	2	1	2	8	5	5
Indirect	**715**	**658**	**624**	**571**	**442**	**422**
Non-pregnancy-related infections	550	509	445	395	310	263
Medical and surgical disorders	165	149	179	176	132	159
Unknown	64	65	52	57	51	61
Total maternal deaths	1524	1461	1348	1342	1212	1143*

* - Under-reporting, estimate 1185

The global challenge to end preventable maternal mortality would need a targeted response from countries based on the needs of the country. One element that contribute to maternal mortality is

poor quality of care. Poor quality care can also contribute to lives affected negatively if the severe morbidity has negative effects on the psychosocial well-being and ability to earn a living.

Poor quality care is not only looking at under resourced systems but there is also an issue of overuse of interventions (Renfrew *et al.*, 2014).

The guiding principles formulated by the World Health Organization to end preventable maternal mortality are:

• Empower women, girls and communities.
• Protect and support the mother–baby dyad.
• Ensure country ownership, leadership and supportive legal, regulatory and financial frameworks.
• Apply a human rights framework to ensure that high-quality reproductive, maternal and newborn health care is available, accessible and acceptable to all who need it (World Health Organisation, 2015).

This resonates with the central theme of the State of the World Midwifery Report of 2014 (SoWMR) that identifies four major healthcare elements to address as **availability, accessibility, acceptability and quality**. The elements are at the core of enabling the care that women and childbearing families need and impact also on maternal mortality (UNFPA, 2014).

Availability: This need for services, in each country, can be converted into the need for the midwifery workforce. Midwives should be educated based on the essential competencies and regulated to international standards. If this is reached, they should have the competencies to render 87% of the need for families seeking sexual, reproductive, maternal and newborn health (SRMNAH) care (UNFPA, 2014). However, midwives are not easy to identify in South Africa. Midwifery as an autonomous profession is regarded as the basic care provider for families seeking SRMNAH care. This is the case for SA as well where primary SRMNAH is given by nurse-midwives. There is however not a clear role or identity for the nurses/midwives in SA. In the SoWMR there is no accurate count for midwives, nor nurse-midwives but only a count given for nurses (124 045) and 39 541 General Physicians (UNFPA, 2014). The latest SoWMR for East and Southern Africa states that SA has only 1284 midwives, 124 045 nurses Non-physician clinical associates 581 (spending 50% of their time in SRMNAH. There are 43 277 doctors and 1247 obstetrician specialists (UNFPA, 2017).

From many sources it is clear that an essential step in improving quality of care and maternal health there need to be educated, trained, motivated, and respected registered midwives. They should be working effectively with other colleagues in SRMNAH (Renfrew *et al.*, 2014).

The inability of SA to quantify and identify amongst the large numbers the midwives, can be attributed to the fact that the current qualifications of registered professionals at either diploma of graduate level leads to professional registration in four areas being, general nurse, midwife, community health nurse and psychiatric nurse. The need for a multi-skilled professional took preference to ensuring a proper skill mix of staff within an enabling environment (Schoon & Motlolometsi, 2012). In comparison with other low and middle income countries, SA did not adapt to respond to the healthcare needs by adding cadres like direct entry midwifery as was done in countries like Nepal, Ghana and Malawi where maternal health showed marked improvement (UNFPA, 2014).

To define a midwife is important as a package of care is needed to identify the important aspects of this care and to provide a structure for the education and registration of midwives and the evaluation of the quality of midwifery care (Renfrew *et al.*, 2014). The midwifery curriculum is not standardized for midwifery hence it is difficult to ascertain if all qualified as midwives indeed meet the definition of the midwife of the International Confederation of Midwives (ICM). This defines a midwife as:

ICM International Definition of the Midwife

A midwife is a person who has successfully completed a midwifery education programme that is duly recognized in the country where it is located and that is based on the ICM Essential Competencies for Basic Midwifery Practice and the framework of the ICM Global Standards for Midwifery Education; who has acquired the requisite qualifications to be registered and/or legally licensed to practice midwifery and use the title 'midwife'; and who demonstrates competency in the practice of midwifery.

Scope of Practice

The midwife is recognised as a responsible and accountable professional who works in partnership with women to give the necessary support, care and advice during pregnancy, labour and the postpartum period, to conduct births on the midwife's own responsibility and to provide care for the newborn and the infant. This care includes preventative measures, the promotion of normal birth, the detection of complications in mother and child, the accessing of medical care or other appropriate assistance and the carrying out of emergency measures.

The midwife has an important task in health counselling and education, not only for the woman, but also within the family and the community. This work should involve antenatal education and preparation for parenthood and may extend to women's health, sexual or reproductive health and child care.

A midwife may practise in any setting including the home, community, hospitals, clinics or health units.

(International Confederation of Midwives, 2011a)

The need to align our national programmes with international standards is also emphasized by the proposed definition that is currently reviewed by the World Health Organisation (WHO) for the competent health care professional in maternal and newborn health, formerly called the skilled birth attendant.

This states that: "*Quality maternal and newborn health care (QMNHC) is the provision of quality care for women of reproductive age, their newborns and families, before and during pregnancy, birth, and the postnatal period and beyond. This care is provided by competent qualified maternal and newborn health care professionals (QMNHCP) who are educated and regulated as per international and national standards and who work as a team within an enabling and supportive environment*"(World Health Organisation, 2017)

So if we consider that with the current stage where in SA midwifery and nursing education is revisited, the lack of alignment to international standards contribute to inconsistencies in competencies of healthcare workers. One could argue that this is a contributory factor to the fact that resuscitation problems occurred in a number of the reviewed maternal deaths. It was regarded as shown in Table 2 below that problems with the resuscitation led to the issue alerted as an avoidable factor.

Table 2 Problems with resuscitation

RESUSCITATION PROBLEMS

	All
Number	**3697**
- Avoidable factors identified	1762
- No avoidable factors	1782
- Lack of information	288
Accessible cases	3409
Percent avoidable factors	51.7

It was also found in 3438 cases that there was a lack of appropriately trained staff of which 608 were within the category of medical doctors and 388 for nurse/midwife.

Accessibility: Improving accessibility requires that barriers to care like lack of transportation, essential medicines and health-care workers, are removed. Administrative factors were identified as indicated in Table 3 below.

Table 3 Administrative factors contributing to maternal deaths

	All
Number	**3697**
- Avoidable factors identified	1632
- No avoidable factors	1964
- Lack of information	271
Accessible cases	3426
Percent avoidable factors	47.6

There was a total of 45 women where reports of problems with transport from the home to the institution was mentioned. This is not the major transportation related issue but the majority of cases were either with institution to institution referrals (225) or cases referred between facilities (1824). Often the problematic factors of inter-facility transport and the availability of emergency medical services for the community and referral of a woman complicating with obstetric risks might not be related to the actual transport but rather to the way emergencies are communicated within teams and between facilities. The lack of inter-professional collaboration and communication negatively impact on how a woman is cared for. Communication failure due to technical issues were found in 111 of 3438 cases but interpersonal communication failure were identified in 253 of the 3438 cases.

One element to consider is in the continuum of maternal health care, two extreme cases are found: too little, too late (TLTL) and too much, too soon (TMTS). TLTL describes care with inadequate resources, below evidence-based standards, or care withheld or unavailable until too late to help. TMTS is found where unnecessary intervention and over medicalization of normal birth is found (Miller *et al.*, 2016). In SA with the disparity in healthcare between the public and private sector, this is true for many facilities. The access to care is mostly negatively influenced by TLTL.

Acceptability: Ensuring that women indeed feel able to access SRMNAH is of the utmost importance. That would ensure that contraceptive use can increase, also that the services are responsive to the social and cultural needs of the community. The patient rights charter and Batho Pele principles have been displayed on the walls of institutions for a long time but anecdotal reports and newspaper reports testify that women delay in seeking care due to the perception that services and providers of care are not treating women well.

Workshops held in 2014 to complete the SoWMR had several reports that the unacceptability is strongly linked to discrimination and the status of women which are embedded in the elements of empowerment of women and girls and their communities. The impact of a lack of application of a human rights based approach in SRMNAH care is evident if we consider what the possible causes is for delay in seeking medical care.

Table 4 gives the detail of some of the patient related avoidable factors. These factors like attending antenatal care or how well a woman was attending antenatal care might reflect not only of the acceptability of the care but also accessibility of care where distance, available hours and resources available to render care should be considered. The status of women in society as well as the role of human rights in SRMNAH care could also indicate that women are not empowered enough or respected enough to seek or use reproductive health services like contraception and safe termination of pregnancy. Unsafe abortion was still an avoidable factor in 24.8% or 41 of 165 death due to miscarriage. With the focus on ensuring that every pregnancy is a planned pregnancy as one of the key recommendations from previous Saving Mothers reports, the mere fact that of the cases reviewed so many despite services and an act that allows safe termination of pregnancy opted for unsafe abortion is a warning that women are not having accessible and acceptable safe options.

Table 4 Patient related avoidable factors

% distribution of avoidable factors	
No antenatal care	18.7
Infrequent antenatal care	6.4
Delay in accessing medical help	26.9
Declined medication/surgery/advice	8.7
Family problem	1.4
Community problem	0.6
Unsafe abortion	1.2
Other	5.7

If we consider that since 2011 there was a decline in maternal deaths each year, it could mostly be attributed to the decline in Non-pregnancy-related infection that decreased due to the implementation of a new policy for the management and prevention of HIV in SA. Every life saved is indeed celebrated but the concern is that avoidable factors reviewed in each of the maternal deaths were found in 52.9% of the cases, classified as patient related factors.

Table 5 Patient related avoidable factors-general

	All
Number	**3697**
- Avoidable factors identified	1756
- No avoidable factors	1762
- Lack of information	376
Accessible cases	3321
Percent avoidable factors	52.9

However, if we consider that some of the patient related factors might be explained by the hesitation of women to seek care, the accessibility and acceptability of services need to be considered.

Quality of care could best be evaluated against the background of the health care professional avoidable factors. In the past triennium again there were many reports that women were inadequately assessed initially, or the diagnosis or problem recognition were not adequate. Then

also healthcare workers delayed in referring the patient with complications and some managed complications at an inappropriate level, mostly at district hospital level with 16.6%. The management of cases based on correct diagnosis and incorrect management or substandard care with a correct diagnosis were also most prevalent in district and regional hospitals. Monitoring that were either not done or infrequently done or done with abnormalities that were not acted upon also occurred. See Figure 1.

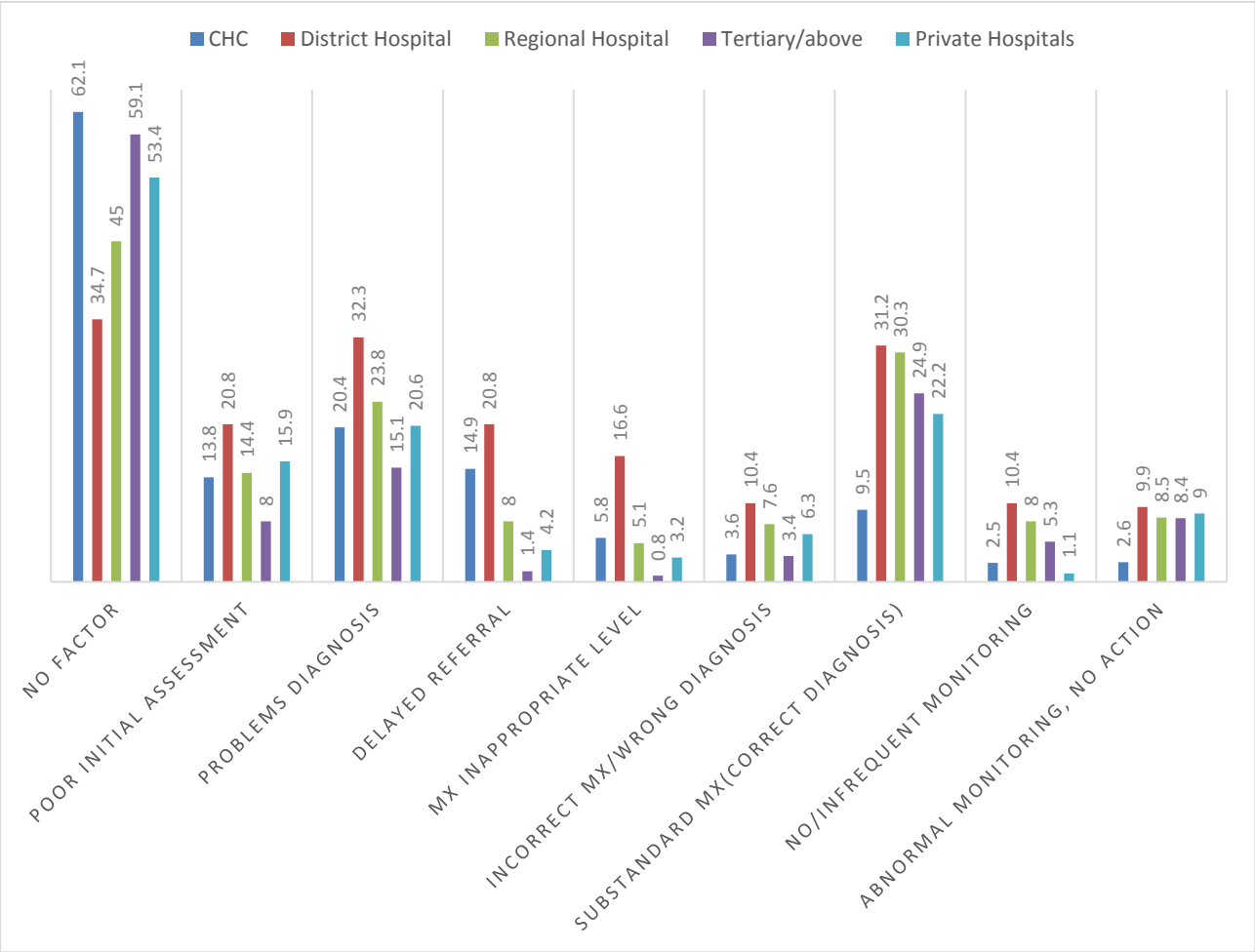

Figure 1. Healthcare worker related factors per facility type

If the focus on midwife led practice areas like community healthcare centres give apparently a more positive picture with less healthcare worker related factors identified. That should however also be balanced against the risk profile of this area which is lower than for higher levels of care. Disparities in elements of the enabling environment like staff ratios and stock availability which should not impact on the private hospitals but still there were alarming indicators of possible inadequate competencies. The private hospitals had the second highest occurrence of 9% with only district hospitals of the public health system.

The issues of communication between the inter-professional team cannot be excluded. The importance of the ability to work with other healthcare workers in SRMNAH is a key element to improve quality of care (Renfrew *et al.*, 2014).

Quality of both care and care providers can be increased by improving the quality of midwifery education, regulation and the role of professional associations according to the SoWMy 2014. Curricula in most countries that were evaluated are appropriate and up-to-date However, prevalent gaps remain in education of which it could be infrastructure, resources and systems, particularly for direct-entry midwifery programmes (UNFPA, 2014). In SA several colleges do not have internet access for lecturers. SA also does not have any direct entry programmes. Although the category does exist in the Nursing Act (No 33 of 2005) no education programmes are developed by the South African Nursing Council. The recommendations from the previous Saving Mothers reports that medical and midwifery programmes should work to collaborate their efforts have not yet yielded any fruits on a national level. Strengthening of education by regulation that complies with international standards would benefit SRMNAH care.

When the focus of the healthcare worker related issues is on the midwifery component the pre-service and continuing education mechanisms should be optimized. Quality of care would be further strengthened by licensing/re-licensing systems that require the midwifery workforce to demonstrate continuing professional development. In SA although captured in the Nursing Act, implementation is not yet finalized. In SA we need to redefine midwifery to comply with the newly coined definition of midwifery: "*Midwifery is the profession of midwives, only midwives practise midwifery. It has a unique body of knowledge, skills and professional attitudes drawn from disciplines shared by other health professions such as science and sociology, but practised by midwives within a professional framework of autonomy, partnership, ethics and accountability*" (International Confederation of Midwives, 2017).

Having midwives educated and regulated according to global standards can increase the autonomy of the profession that can enable midwives to reach those needing their evidence based, quality care based in a human based rights approach (International Confederation of Midwives, 2011b).

In summary, the following key recommendations might ensure that the availability, accessibility, acceptability and quality of SRMN care in SA could be strengthened to reduce maternal and also neonatal mortality and morbidity.

- Availability of SRMNAH services would be improved if sufficient midwives are available. The education programmes should comply with ICM global standards for education and subsequently regulated by regulations complying with ICM global standards for regulation (International Confederation of Midwives, 2011c).
- The addition of cadres like direct entry midwives should be initiated.
- Education (pre-service and continuing) of healthcare providers for SRMNAH should be standardised and cross inter-professional boundaries to ensure inter-professional collaboration. It should be based on global competencies (Schoon & Motlolometsi, 2012).
- Care should be taken to balance the SRMNAH in SA to avoid the two major pitfalls, Too much too soon or too little too late
- Professional associations, regulatory bodies and employers should strengthen and enforce a human rights based approach to SRMNAH.

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Section 4 Abstracts and key recommendations on each common cause of maternal death

Non-pregnancy related sepsis

Summary of findings

Non pregnancy related infections remain the leading cause of maternal mortality in South Africa and in all provinces. The last triennium (2011-2013) has shown a decrease of 25% compared to 2008-2010. The latest report shows a significant drop in the maternal deaths by 52% from 2011 to 2016.

There has been a highly significant drop by 29% from 2011-2013 (968 vs 1374).The highest number of provincial maternal deaths were in KZN (222) followed by Gauteng (175) and EC (142).

HIV status and NPRI:

In total 88.8% of cases were HIV positive , 8.8% were negative and 2.27% had an unknown HIV status. Overall 60.02% of women were on ART (FDC or HAART) compared to 49% in 2011-2013.

Levels of care

Deaths were 34.2% in regional hospital , 24.6% in tertiary hospitals , 30.2% were at district hospital and only 6.8% in national central hospital.

Distribution of maternal deaths per age and parity

Non pregnancy related infections were highest between 25-39yrs (unchanged from 2011-2013) and the deaths were highest from p1 to p3.

Cause of death

Primary obstetric problem :

The major cause of death remains respiratory infections with TB , PCP pneumonia and other pneumonias responsible for 69.4% of deaths. TB is still the major contributor even though there is a decrease of 15% from 2011-2013. Other pneumonia causes have decreased by 48% from 2011-2013.

Other HIV related causes also showed a decrease this triennium namely other meningitis (52% reduction), cryptococcal meningitis (21% reduction) and Kaposi sarcoma(26% reduction). However there were 15 deaths from malaria, an increase by 25%.

Final cause of death :

Overall 68.3% of maternal deaths were due to respiratory failure followed by immune system failure at 62.8% and septic shock at 14.6%.

Avoidable factors

Patient oriented related factors were identified in 66% of deaths. The most common factor was delayed access to medical help, followed by no antenatal care. This is unchanged from the last report.

Administrative problems were identified in 32.7% of deaths. This is due to lack of appropriately trained staff (nurses and doctors), lack of ICU facilities and delay in initiating critical care due to overburdened service. This has been noted in the last report. Resuscitation problems were identified in 52.7% of deaths.

Healthcare provider factors ranged from 33% in tertiary hospitals to 53.7% in district hospitals. Most deaths happened in the postpartum period and early antenatal (less than 20wks). This was mainly due to problems with recognition/diagnosis and substandard management (correct diagnosis). This is similar to the last triennium (2011-2013).

Recommendations

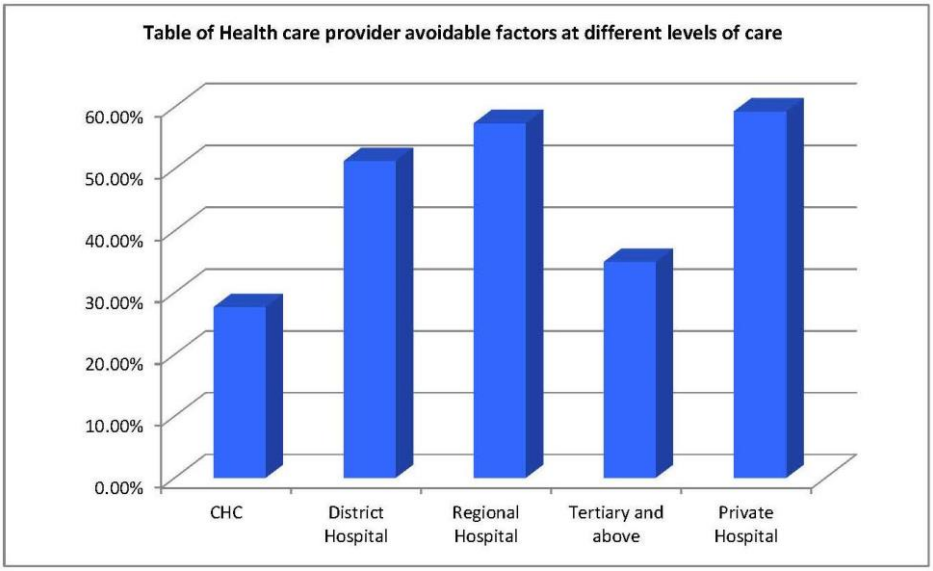
1. Prevention of HIV infection
    a. Continuing education of the community is paramount including encouragement of routine HIV testing outside the pregnancy.
    b. Routine HIV testing at family planning clinics particularly at youth friendly services
2. Promotion of contraception particularly long term contraception.
3. Patients who are eligible for HAART should be on treatment and adherence to treatment promoted
4. Monitor viral load in pregnancy
5. Screening for TB and chest infections needs to strengthened
6. Pregnant women who are unwell needs proper investigation, diagnosis and management of opportunistic infections and involvement of internal medicine and infectious specialists early
    a. Referral pathways are needed for patients requiring tertiary hospitals and ICU care.
7. Training of staff members on proper diagnosis and management of respiratory infections
8. Up scaling of obstetric critical services. Creation of obstetric critical units in tertiary and national central hospitals
9. Recognition of malaria and proper management
    a. provision of artenusate particularly in malaria endemic areas

Deaths due to medical and surgical disease in pregnancy including suicides

Summary of findings

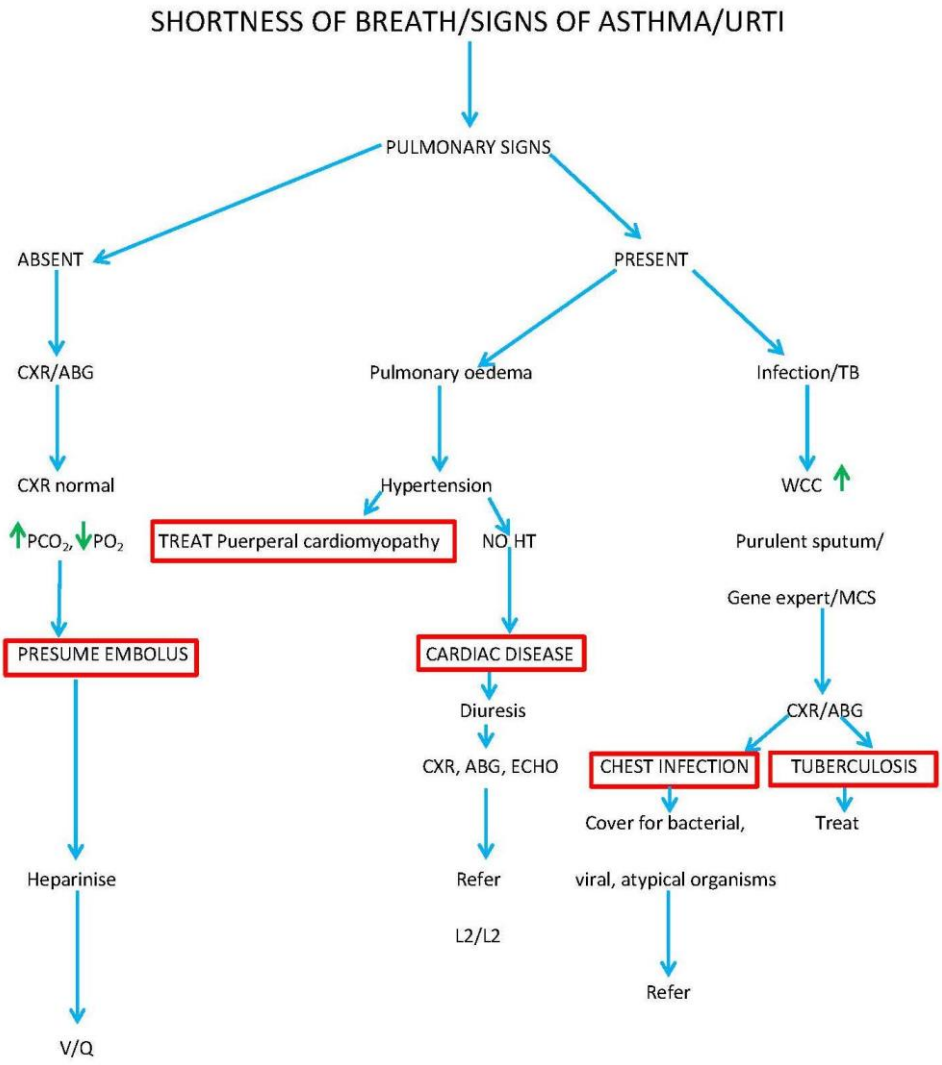
Deaths due to medical and surgical disorders have remained the 4th most common cause of maternal death for the triennium 2014-2016. There were 467 deaths reported for this category and this made up 12.6% of total maternal deaths. There were 26 fewer deaths reported and this is reflected in the slight decrease in the iMMR of 17.53 for 2011-2013 to 16.97 per 100 000 live births for this triennium. The most common causes of death in this category were cardiac (35.3%, n= 165), respiratory (12.4%, n=58), gastro-intestinal disease (9.6%, n=45), central nervous system disorders (8.8%, n=41) and neoplasm (8.4%, n=39). There were 7 more oncological deaths in this triennium compared to 2011-2013. There were 5 deaths due to psychiatric conditions and all the deaths were in women < 24 years of age. Twenty-two deaths occurred in private health facilities. Deaths due to cardiac and respiratory conditions formed 50% of medical and surgical deaths in private institutions.

One hundred and eleven (24.9%) deaths occurred at district level or lower. There is marked difference (> 50%) in the distribution of deaths between provinces with the Northern and Western Cape reporting the lowest number of deaths while the highest reported from KZN and Gauteng. More than 36% of deaths occurred in the postpartum period. A considerable proportion of women who died were discharged home after delivery with abnormal vital signs. Problem recognition and diagnosis was an important avoidable factor. Assessors believed that 226 (48.4%) of deaths were potentially preventable. Administrative related avoidable factors were present in 42.1% of maternal deaths while in 39.7% of cases avoidable factors related to resuscitation were identified. This highlights the need to refer patients timeously to the appropriate level of care and for multidisciplinary care where appropriate. Table 1 illustrates the percentage avoidable factors identified at the different levels of care. Majority of deaths occurred on women with undiagnosed medical conditions or in women with known medical disease who presented with acute organ failure/distress. Obstetric medical personnel were often not adequately trained to diagnose and treat acute medical emergencies in pregnancy.



Recommendations

1. Following delivery all patients should be assessed for fitness for discharge according to a standard tick sheet (showing a presumptive diagnosis, pulse rate < 100bpm, systolic BP > 100 mmHg and below 160 mmHg and a respiratory rate < 20 bpm). All patients with chronic disease should have a follow-up plan (designated) within 1 month of discharge.
2. Patients admitted to an institution for reasons other than the onset of labour must have a diagnosis made. All patients with certain diagnoses (cardiac disease, neoplasm, thrombo-embolism, infectious morbidity) must be referred to a designated hospital, depending on referral pattern for the area.
3. Doctors in District hospitals should be trained in advanced critical life support and ventilation. ICU care should be part of O&G registrar training.
4. The management of patients with acute medical disease in pregnancy should be improved. The triaging system within hospitals must be improved. Below is an algorithm for patients presenting with shortness of breath in pregnancy.



Deaths due to suicide

In the period 2014-2016, 5 deaths due to suicide were reported (1.1%). This figure has decreased from 11 deaths (2.2%) reported for the period 2011-2013. Two of the five case files were available for review. In both cases, the women were young primigravidas, (both 19). Both were unbooked, with their first presentation to health services being at the time of the suicide attempt. Both suicides were in response to conflict with the fathers of their unborn children. Given the small sample size, it is impossible to draw any meaningful conclusions from this data.

Suicidal ideation is a common feature of postnatal depression. In South African women suicidal ideation rates of between 7.6% and 27.5% have been reported. It is therefore important to examine the contribution of suicide to maternal mortality. The number of completed suicides is small compared to the number of women expressing suicidal ideation. One possibility is that deaths due to suicide may have been missed. The peak presentation

for postnatal depression is at around 6 weeks, when collection of maternal mortality data ends, hence deaths due to suicide as a result of postpartum mental illness may not be captured. Furthermore, death due to suicide carries a huge social stigma, which may result in these deaths not being reported, or the cause of death being reported as an accident. Finally, of women who endorse suicidal ideation, a substantially smaller proportion is considered at high risk for completed suicide.

Oncological deaths

The most common malignancies reported were breast and cervical cancer. AIDS-related malignancies were lymphoma, leukaemia and primary liver. Most women presented with widely disseminated malignancy during pregnancy which was not potentially curable. Histologic diagnosis, assessment and staging were all major obstacles to a treatment plan and successful clinical management. Medical and/or radiation oncologists were very seldom involved in diagnosis and management plans and when they were, they usually recommended delaying assessment and therapy until post-partum. Significant or severe anaemia was the most common clinical finding. Anemia was, however, poorly investigated and treated unsuccessfully with multiple blood transfusions without assessment of urine output and kidney function.

Many women spent weeks in hospital without clear diagnosis or treatment plan. A small group of women dying from malignancy around pregnancy can potentially be salvaged, provided presentation is early and management can be instituted at an appropriate level of care. Ideally gynaecologic oncologists should take an interest in malignant disease during pregnancy and assist obstetric colleagues to lead the multi-disciplinary team. It is now widely accepted that oncological treatment should be initiated as soon as possible and should start during pregnancy. As an alternative, delivery should be expedited in order to improve prompt histologic diagnosis, staging and treatment.

Maternal deaths from Obstetric Haemorrhage

Summary of findings

Obstetric haemorrhage (OH) was the third most common cause of maternal death in South Africa for the triennium 2014 to 2016, accounting for 624 deaths or 16.9% of the total. This compares with 684 (15.8%) deaths in the 20011-2013 triennium. The OH related maternal mortality ratio (MMR) was 22.67 deaths per 100,000 live births, which is less than 24.32 in 2011-2013, but higher than the MMR of 18.8 in 2005-2007. There was considerable provincial variation with the MMR due to haemorrhage being highest in Limpopo (33.47) Mpumulanga (32.65) and North West (28.79); and lowest in Western Cape (7.36). Targets were set in 2014 to reduce MMR from OH by 20% in 2016. In 2014 there were 226 deaths (MMR 23.71), dropping to 181 (MMR 21.41) in 2016, representing a reduction of 19.9%. There was provincial variation in achieving this target as shown in the overview chapter. As in the previous triennium, maternal age over 35 years and delivery by Caesarean section (CD) were strongly associated with OH; 35% of the deaths were in women over 35 years of age; and 62.5% delivered by CD. Underlying factors for OH death were prolonged labour (18%), anaemia (27.6%), HIV positive (38.3%), and previous CD (33.4%). The major causes of death from haemorrhage were: bleeding associated with CD (34.9%), uterine rupture (15.1%) abruptio placentae (12.9%), uterine atony (9.5%) and retained placenta (6.9%). Of concern was the persisting high numbers of deaths due to bleeding after CD and lack of change in ruptured uterus deaths, but there was a 4% decrease in the proportion of abruptio placentae deaths. Emergency hysterectomy was performed in 26.8% of all OH deaths (35.6% of women dying from ruptured uterus and 31.7% of deaths from bleeding associated with CD). The majority of deaths (93.9%) occurred at public hospitals; 32.4% at district hospitals, 30.4% at regional hospitals and 27.3% at tertiary hospitals. This may not reflect the level of care where delivery occurred as many women were referred from district level with bleeding after delivery or CD to a regional or tertiary facility. Assessors judged the majority (87.8%) of the OH deaths to be possibly or probably avoidable; and 58.8% were thought to be probably avoidable. Patient related avoidable factors, mostly delay in seeking care, were present for 33.8%. Administrative factors occurred for 66.2%, highlighting major problems in health facility management and training. Administrative factors included lack of blood (11.7%) , delays in inter-institution transport (23.7%), delays initiating clinical care due to overburdened services (7.8%), and a worrying 50% due to lack of appropriately trained doctors (31%) or nurses (19%), especially at district hospitals. Health worker related avoidable factors occurred for 86.3% of assessable deaths at district hospitals, 68.5% at regional hospitals and 53.6% at tertiary hospitals. Analysis of avoidable factors indicates that focus needs to be addressed to improving the quality of medical care at district, regional and provincial tertiary hospitals particularly in the provinces with greatest numbers of haemorrhage deaths.

Review of a sample of folders shows serious delays in instituting second line measures such as additional uterotonic drugs or examination in theatre for PPH after vaginal delivery or caesarean delivery. Documentation of CD operative details was frequently inadequate with scanty detail even

when there was excessive blood loss. Abruptio placentae has poor outcome when managed at district hospitals and where CDs are performed with intrauterine fetal demise.

Of much concern is the poor outcomes in women who are transferred after bleeding and who are shocked; for example women having severe bleeding after CD performed at a district hospital and dying in transit or soon after arrival at regional or tertiary hospitals. The frequently cited avoidable factor "lack appropriately trained doctors" mostly reflects poor problem recognition especially of ruptured uterus, delays in treatment and insufficiently aggressive management. In some cases it reflects actual numerical lack of staff especially in the more under-resourced provinces. The NCCEMD algorithms for managing PPH have been amended and key recommendations for further reducing OH deaths are presented.

Key recommendations

1. Implementation of national protocols for (a) uterotonic drugs for induction of labour and (b) uterotonics and Tranexamic acid for prevention and management of PPH after vaginal delivery and at CS
2. Implementing the Safe Caesarean Delivery package of interventions
3. Where possible, ensure women with abruptio placentae plus fetal demise are referred to and deliver at regional or tertiary hospitals vaginally
4. Ensure continuous availability of blood products in hospitals and promote rational blood usage
5. Direct Telephonic links for 24 hour specialist support to district hospital doctors.
6. Ensuring earlier recourse to theatre for on-going bleeding after vaginal delivery as well as after CD.
7. DCSTS to ensure essential competencies available and EOST drills performed on PPH and Safe CD
8. Reduce deaths in transit and deaths shortly after arrival, by improving skills at District Hospitals (DHs) before transfer, ensuring emergency transport to be onsite for transfers from DHs, and optimising haemodynamic condition during transfer. The non–pneumatic anti-shock garment may assist if available and shown in the SA pilot to be beneficial.

Maternal deaths due to hypertensive disorders of pregnancy

Summary of findings

Hypertensive disorders of pregnancy (HDP) are currently the commonest direct cause of maternal deaths (triennium 2014-2016). There were a total of 661 deaths due to hypertensive deaths of pregnancy, an increase of 21 deaths compared to the 640 deaths in the triennium 2011-2013. This is of obvious concern since the data for the last triennium showed a slight decline and was probably due to a considerable decrease in the number of deaths in the KwaZulu-Natal province in 2013.

Deaths from HDP were reported from all provinces with Gauteng, KwaZulu-Natal and Limpopo having the highest number of deaths.

The final causes of death were respiratory failure (n =153), pulmonary oedema (n = 227), renal failure (n = 114) and intracranial haemorrhage (n = 191). In addition to deaths from intracranial haemorrhage, 80 deaths were due to unspecified cerebral problems and 37 were due to cerebral coning from cerebral oedema.

This illustrates the fact that pre-eclampsia has a major impact on the brain and detection of high blood pressure early and immediate judicious lowering of severe systolic and/or diastolic blood pressure must be instituted. Interrogation of the maternal death notification forms and patient records suggests that health professionals use $MgS0_4$ for the prevention of seizures in severe pre-eclampsia and for prevention of further seizures in eclampsia, but that these may be a delayed response in lowering severe hypertension and a lack of continuing intense observations. The lack of continuous monitoring also seems to occur, while the patient awaits transport from one health institution to another.

The increasing number of deaths from pulmonary oedema (n = 227 : 30%) as the final cause of deaths, this despite the fact that present clinical guidelines indicate that there is no place for fluid loading and that a standard fluid balance policy should be practiced.

Deaths from pulmonary oedema also occurred in a number of patients who were readmitted with signs of upper respiratory tract infections, asthma and hypertension.

Deaths from severe hypertension and pulmonary oedema suggest that clinical guidelines are not being followed and specialist / expert care not being obtained.

Hypertension

There were 661 deaths in the last triennium (2014 – 2016) with an increase in the number of deaths of 21 (640 deaths in 2011-2013). The primary obstetric problems were eclampsia, severe hypertension, HELLP and liver rupture. Deaths were reported in all categories of 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 73.26/100,000 live births.

The overall iMMR for hypertension in South Africa was 24.01/100,000 live births compared to a rate of 22.75/100,000 live births in 2011-2013. Cerebral complications (n = 357 : 58.2%) were the single most common final cause of hypertensive deaths and was related to failure to lower very high blood pressure timeously and judiciously. Pulmonary oedema was the final cause of deaths in 227 (34.3%).

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 are an age group at risk of pre-eclamptic mortality. Reproductive health services for this group must be prompted in schools, workplaces, families and through electronic and print media.
4. Health system strengthening in respect to 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 to appropriate higher level healthcare facilities.
7. Women with severe pre-eclampsia and eclampsia must NOT be fluid loaded.
8. There may be a place for all cases of severe pre-eclampsia to have an echocardiography.

Early pregnancy loss

Summary of Findings

There were 260 early pregnancy deaths in 2014-2016, an 8% decrease compared to 2011-2013. Ninety-five deaths (95) were caused by ectopic pregnancy (7% decrease), and 165 by complications of miscarriage (9% decrease). Within the triennium, comparing 2016 data to 2014 data, there was a 56% increase in ectopic deaths (23 deaths in 2014 and 36 deaths in 2016), and a 17% increase in miscarriage deaths (48 deaths in 2014 and 56 deaths in 2016). This contrasts with an overall reduction in maternal deaths in South Africa of 15% between 2014 and 2016. Sixty-three percent (63%) of ectopic pregnancy deaths and 30% of miscarriage deaths were clearly avoidable within the health system during the 2014-16 triennium. The equivalent figures for the 2011-13 triennium were 64% for ectopic deaths and 35% for miscarriage deaths. In summary, despite a large proportion of early pregnancy deaths, and in particular ectopic pregnancy deaths, being clearly avoidable, the numbers of these deaths are not decreasing. This suggests that the recommendations made in the last Saving Mothers report (2011-13) for reducing early pregnancy deaths have been neglected. The recommendations in the current report remain similar. Greater efforts are now required to implement these recommendations.

Ectopic pregnancy

Deaths from ectopic pregnancy occurred most frequently at district hospitals (35%), followed by tertiary/central (32%) and regional (27%) hospitals. Five cases (6%) 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, 72% were HIV infected. The final cause of death was hypovolaemic shock in 83%. 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. With regard to management by health care providers, there were avoidable factors in over 80% of cases at both district hospital and at regional hospital level, but only in 38% of cases at tertiary level. 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. In 17% there was no resuscitation attempted. Anaesthesia was only administered in 44% of cases, suggesting missed opportunities for surgical intervention.

Miscarriage

Deaths from miscarriage occurred most frequently at regional hospitals (39%), followed by district (29%) and tertiary/central (27%) hospitals. Of the subcategories of miscarriage, 65% were classified as septic miscarriage, 20% as deaths from haemorrhage (non-traumatic), 5% as deaths from uterine trauma, 7% followed legal termination of pregnancy, and 3% were classified as gestational trophoblastic disease. Although 40% of women who died from miscarriage had unknown HIV status, of those who were tested, 77% were HIV infected. The final cause of death was septic shock in 54% and hypovolaemic shock in 32%. The most frequent patient behaviour-related avoidable factors were delay in accessing medical help, no antenatal care, and unsafe abortion. The latter was

documented in 25% of miscarriage deaths where avoidable factors were assessable. The most frequent administrative avoidable factors were lack of appropriately trained doctors and lack of blood or blood products. With regard to management by health care providers, there were avoidable factors in over 80% of cases at district hospital level, and in over 60% of cases at both regional hospital and at tertiary level. 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. In 19% there was no resuscitation attempted. At district hospital level specifically, delay in referral was an additional prominent avoidable factor. Anaesthesia was only administered in 40% of cases, suggesting missed opportunities for surgical intervention.

Key recommendations

1. Family planning and contraception 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

Summary of findings

The previous reports including Saving Mothers reports consistently, uses the term "pregnancy-related sepsis" and that deaths from pregnancy related sepsis (PRS) are those caused by infections in the genital tract or in tissues involved in the birth process in viable pregnancies. In an attempt to standardize maternal sepsis WHO defines as "life-threatening organ dysfunction resulting from infection during pregnancy, childbirth, post-abortion or postpartum". Deaths from septic miscarriage (though as part of new definition) are described elsewhere in this report.

Between 2014 and 2016, 201 women died as a result of PRS. The number of deaths decreased every year between 2011 (84 cases) until 2015 (65 cases) but shot up again in 2016 to 71 cases, higher than the 2012 level. That this is not merely due to fluctuations in number of pregnancies as shown by the institutional maternal mortality rate (iMMR 100,000 live births) which showed the same trend. PRS remains an important topic, representing about 10% of all direct obstetric deaths and 5.4% of overall maternal mortality, similar to 2011-2013.

Of these 201 deaths, 94 women had puerperal sepsis after vaginal delivery, 85 after caesarean section, 14 suffered bowel trauma during caesarean section and 8 deaths were caused by chorioamnionitis. The proportion of deaths after caesarean section increased from 43.8% (2011-2013) to 49.3% in this triennium. For less than 10% of the women their HIV status was unknown (9%, compared to 8% in 2011-2013) and an increasing percentage of 75.2% was on treatment with ARVs, versus 49% in 2011-2013 and only 20% in 2008-2010.

Almost all cases (97.5%) occurred in hospital, mainly in regional hospitals (37.3%) and tertiary facilities or above (37.8%). Limpopo and Free State have the highest iMMR due to PRS (10.07 and 10.05, respectively) whilst Mpumalanga saw a dramatic decrease of its iMMR from 12.8 to 4.48.

A worryingly large majority of deaths (79.6%) were potentially preventable. On the patient side, delay in accessing care is the most important contributor (35.5%). A lack of capacity in the health care system remains problematic, with no significant improvement compared to 2011-2013. Finally, as was already pointed out in the previous report, the severity of PRS is often underestimated by health care providers and its management inadequate. Avoidable factors associated with health care providers were present in 78.4% of cases in regional hospitals and 70% of cases in district hospitals.

While the rate of PRS deaths has shown a slow but steady decline in recent years, the high proportion of avoidable deaths is of concern. Failures in initial assessment and diagnosis,and continued monitoring of patients with abnormal findings without taking actions or even referring women to the higher/appropriate level of care in of great concern. and suggest possible lack of insight and communication breakdown. The recent sharp increase in deaths from bowel injury at caesarean section may indicate a trend of increasing numbers of difficult repeat caesarean sections.

Key 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.

Embolism and acute collapse (cause unknown)

Summary of findings

During the triennium 2014-2016 a total of 188 deaths were classified as acute collapse, 111 were listed as embolism and 77 as acute collapse cause unknown. Since previous reports, this represents a decline in the numbers of cases reported in this category. The number of cases with embolism have remained reasonably similar in the past 3 trienniums. The decline in the numbers is attributed to a decrease in the number of cases listed as acute collapse-cause unknown.

Table 1- trends in acute collapse

	.2008-10	2011-13	2014-16
Embolism	93	102	111
Acute collapse - cause unknown	148	106	77
total	241	208	188

The institutional maternal mortality for embolism have remained constantly between 3-4.5/100,000 live births since 2011, but have decreased from 4.3 to 2/100,000 live births for cases with acute collapse cause unknown. This could be attributed to a greater awareness and improved diagnostics in facilities.

The age distribution as previously recorded have a shift to the right of that for the general pregnant population highlighting the risk of increased maternal age for these conditions.

The HIV positive status for the embolism group was 27.2% and for the unknown group 31.2%. This is higher than the previous report, mainly due to a significant decrease in the HIV status unknown category.

The institutional mortality rates for the condition also varied between provinces. Embolism mortality varied between 2.12 (KZN) and 6.22 (Northern cape) and the unknown collapse group between 1.4 (WC) and 6.18 (FS). Reasons for these variances is at present unclear.

The proportion of deaths in each level of care attributed to acute collapse varied between 2.2% (at district hospitals) and 6.4% (Private hospitals) for embolism and 1.7% (Regional hospitals) and 8% (CHC) for unknown acute collapse. The bulk of deaths were however managed at district and regional hospitals (19.8% and 28.8% for embolism and 27.3% and 26% for cause unknown respectively).

Avoidable factors were identified in 24-46% of cases (Table1). Of concern is the number of cases that could not be assessed due to lack of information. The Patient related factors predominantly reflected no or poor attendance of antenatal care and delay in access to medical help.

Transport related factors were identified in 6.4% of cases with embolism and 18.2% of cases with acute collapse. Other admin related factors included lack of appropriately trained staff and lack of ICU facilities.

Table 2 Avoidable factors		
	Emb	AC
Patient related	29.6%	40.6%
Admin related	33.02%	25.8%
Health professional related		
CHC	18.6	25.9
District hospital	60	50
Regional hospital	44.7	60.9
Tertiary hospital	51.5	60
Private hospital	36.4	0*

Of concern is the health worker related factors contributing to avoidable deaths. The high levels at hospital level indicate lack of appropriate clinical governance. In the private sector there were only 2 cases with sufficient information to be assessed in the acute collapse cause unknown group hence no health worker avoidable factors identified. For both conditions problems with recognition or diagnosis were prevalent followed by substandard care and incorrect management.

The increase in the numbers of cases with health worker related factors is substantial as in the previous triennium the health worker avoidable factors were listed as 21.9% at PHC, 25% at secondary care and only 6.9% at tertiary care.

The case fatality rates for both conditions were substantially higher in the cases delivered by caesarean delivery (embolism 6.14 and cause unknown 3.29) than those with vaginal and assisted deliveries (embolism 1.62 and cause unknown 1.18)

In this triennium 39.6% of cases with embolism and 33.8% of collapse cause unknown had a post mortem performed. This is an improvement from the 2008-10 report.

Conclusions

Although the trends for embolism have not changed, there is a clear reduction in the number of acute collapse cause unknown. This is likely due to improved diagnostics and possibly implementation of the colour coded observation charts.

The older gravid women remain at risk and should be more carefully assessed for possible risk factors and a more aggressive thromboprophylactic program.

The increase in the number of cases classified as avoidable relating to health worker related factors is of concern and should receive more attention. This could reflect insufficient clinical governance or poor skills levels at the public health facilities.

Although there is an improvement in the number of post mortems performed, this should be improved, especially in the acute collapse, cause unknown group. The post-mortems could be responsible for the decrease in this group due to improved diagnosis.

Recommendations

1. Continue with previous programs of thrombo-embolism and implementation of the colour coded observation charts
2. More focus should be placed on improving clinical governance and supervision. This should include an intensive skills audit at all levels of care

Anaesthetic Related maternal deaths

Summary of findings

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 has decreased, although there are concerns about incomplete data collection and/or underreporting, in some provinces and in the private sector. (Table 1) The majority of procedures performed were caesarean deliveries.

Table 1

Anaesthetic complications	2014-2016 n=87 (100%)	2011-2013 n=105 (100%)
General anaesthetic	18 (20.7)	30 (28.6)
Spinal anaesthetic	68 (78.2)	75 (71.4)
Epidural anaesthetic	1 (1.1)	0

The rising proportion of cases due to spinal anaesthesia (78% in this triennium) is of special concern. The widespread adoption of spinal anaesthesia has occurred because of perceived safety. However, this has been accompanied by a lack or loss of skills commensurate with a cavalier approach to the performance of spinal anaesthesia, without the knowledge of how to deal with ensuing complications. **These maternal deaths are avoidable.**

2. There is a disproportionate representation of District Hospitals in Anaesthetic related deaths as is seen in Table 2.

Table 2

	DH	RH	TH	NCH	Pvt	Total
Anaesthetic death	49 (56%)	22 (25%)	14 (16%)	1	1	87
General	6	7	5	0	0	18
Spinal	43	15	9	1	0	68
Epidural	0	0	0	0	1	1

Note that 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 theatre cases. The vast majority of district hospital caesarean sections should be performed under spinal anaesthesia. However, as a result, this may lead to a loss of skills in airway management and acute resuscitation, both essential components in the management of the obstetric anaesthetic emergency.

3. The causes/mechanisms of death are of grave concern.

Eighty-one out of 87 (93%) were avoidable.

The main causes/mechanisms of death were:

- Respiratory failure (38/87)
- Pulmonary oedema (13/87)
- Brain death following a hypoxic event (23/87)
- Hypovolaemic shock (11/87)

The twenty-three deaths due to "brain death following hypoxic event/s" are of concern, and need to be analysed and addressed. There are numerous possible causes, one of which is the probable lack of skills in dealing with anaesthetic complications, such as a "high spinal". Likewise, the 38 cases out of 87 that were due to respiratory failure were mainly due to a lack of adequate airway management, which is an essential component of obstetric anaesthesia. In addition, there were numerous patients who suffered a cardiac arrest intraoperatively, and the baby was not delivered by caesarean section as part of the resuscitation. This is a basic component of cardiopulmonary resuscitation in theatre in a pregnant patient.

The breakdown per province is as follows:

Province	Total deaths	Brain death	Respiratory complications
Limpopo	24	8	16
Mpumalanga	7	5	2
Kwa Zulu Natal	19	5	6
Western Cape	4	2	2
Eastern Cape	13	1	5
Free State	3	1	2
North West	7	1	2
Gauteng	10	0	3
Northern Cape	0	0	0

Note the high number of cases in Limpopo.

There is a concern once again, of possible under-reporting, particularly in the Northern Cape.

Conclusion:

This interim analysis strongly suggests that improvements in the training of anaesthetists are urgently required, particularly in District Hospitals. A strong drive needs to be instituted with regard to implementation of nationally agreed upon standards and protocols, particularly those that have been drawn up for safe caesarean delivery. It is absolutely unacceptable and unethical that spinal anaesthesia is being administered to mothers by doctors who are unable to deal with the complications of the spinal, and who are also unable to either convert to, or administer safe general anaesthesia. Equally untenable and unethical, is the "single operator" for a caesarean delivery, where one doctor administers the anaesthetic AND performs the caesarean section.

Section 5 Conclusions and recommendations

Conclusions

There has been a significant reduction in maternal deaths from 2011-2016 and this reduction is mostly due to a decrease in deaths due to NPRI, but also a significant reduction on obstetric haemorrhage. Unfortunately death due to hypertensive disorders of pregnancy has marginally increased over this time period. Over the last three triennia there has been a significant improvement in the quality of care of pregnant women; however much more still needs to be done. Assessors classified sixty-one percent of maternal deaths to be potentially preventable indicating mostly poor quality of care during the antenatal, intrapartum and postnatal periods. Implementing the actions given below will greatly reduce potentially preventable maternal deaths.

Areas for action (Recommendations)

Policy-makers, service planners, Health Professions Council, Nursing Council and Professional Organisations

- ***Continue focus on HIV:*** Two-thirds of the maternal deaths were HIV positive; although a reduction from the previous year, attention must still be focussed on screening and treatment of HIV positive women
- ***Ensure safe caesarean section sites:*** The mortality rate of women having caesarean sections was three times higher than those having normal deliveries. More than half of the women dying of obstetric haemorrhage had caesarean sections. The Sfe CD programme must be implemented. This programme ensures that facilities performing caesarean sections can do so safely, and this requires adequate numbers of doctors with relevant accredited surgical and anaesthetic skills. Facilities which are unable to perform safe CD should not offer a CD service. Accreditation of facilities performing caesarean sections must be implemented.
- ***Improve intern training:*** Lack of appropriately trained doctors and nurses was thought to be a significant contributory factor in many maternal deaths. Lack of appropriately trained doctors was recorded as a significant factor in maternal deaths due to anaesthesia, obstetric haemorrhage, pregnancy related sepsis and complications of hypertension. The quality of intern training must be thoroughly examined and the hospitals training interns must be properly evaluated. All interns must complete the ESMOE course and its anaesthetic module before being registered as community service doctors. Before being allowed to manage maternity cases independently, a doctor's clinical competence, including competence in performing caesarean section, should be assessed and confirmed. Further training must be arranged for the doctor as required to attain competence.
- ***Emergency Medical Services must prioritise transfer of maternity emergencies.*** At least 1 in 10 maternal deaths were associated with transport delays.
- ***Engage the community.*** MomConnect is a successful example of this and provides the essential knowledge on when and where to go to receive the appropriate care.

- ***Explain to the community the balance between accessible services and safe services.*** Currently we do not have the staff and knowledge and skills to provide a readily accessible service to all; knowledge and skills need to be consolidated to provide a safe service, but this means a less accessible service. To obviate that the EMS and maternity waitng homes need to be improved.

Chief Executive Officers (CEOs), District Managers, Clinical Managers, Heads of Maternity

- ***Maternity units must have more than eighty percent of their staff trained in ESMOE:*** Sixty percent of the maternal deaths were thought to be possibly or probably avoidable. ESMOE has been shown to improve knowledge and skills of health care professionals and has been associated with a reduction in maternal and neonatal deaths.
- ***Obstetric and neonatal emergency drills (EOST exercises) must be conducted at least monthly:*** Maternal deaths due to obstetric haemorrhage and hypertension were thought to be possibly and probably preventable in 89% and 67% of cases respectively
- ***Contraceptives, including hormone tablets, barrier methods and long-acting reversible contraceptives must to be integrated into all relevant health contacts and through community engagement:*** Preventing unwanted pregnancies and pregnancies in teenagers and women over 34 years will reduce the number of maternal deaths. The use of LARC will substantially help this by providing efficient mechanisms of providing continuous contraception for at least 15 months. Considerations should be given to implementing the Leading Safe Choices programme.
- ***Ensure priority inter-facility emergency transport.*** Efficient transport between facilities essential.
- ***All hospitals must provide a safe caesarean section service:*** This might involve consolidation of services within the district. This includes a safe anaesthetic service.
- ***Attend maternal and perinatal death review meetings:*** Action plans for preventing recurrence of maternal and perinatal deaths should be made at these meetings and must be followed up at the next meeting.
- ***High risk antenatal clinics must be established and made accessible to all pregnant women requiring their services:*** This will require innovations; such as specialist outreach clinics or family practitioners/advanced midwife run high risk clinics in rural areas.
- ***Monitor implementation of the basic and comprehensive emergency obstetric and neonatal signal functions in their facilities:*** District managers have to ensure pregnant women have access to the signal functions in the district.

District clinical specialist teams should facilitate

- ***Maternity units having more than eighty percent of their staff trained in ESMOE:*** Sixty percent of the maternal deaths were thought to be possibly or probably avoidable. ESMOE has been shown to improve knowledge and skills of health care professionals and has been associated with a reduction in maternal and neonatal deaths.
- ***Obstetric and neonatal emergency drills (EOST exercises) are conducted at least monthly:*** Maternal deaths due to obstetric haemorrhage and hypertension were thought to be possibly and probably preventable in 89% and 67% of cases respectively

- ***Negotiate for priority inter-facility emergency transport for pregnant women.*** Efficient transport between facilities essential.
- ***The introduction of the safe caesarean section package:*** This might involve consolidation of services within the district. This includes a safe anaesthetic service.
- ***Maternal and perinatal death review meetings:*** Action plans for preventing recurrence of maternal and perinatal deaths should be made at these meetings and must be followed up at the next meeting.
- ***Establishment of high risk antenatal clinics that are accessible to all pregnant women requiring their services:*** This will require innovations; such as specialist outreach clinics or family practitioners/advanced midwife run high risk clinics in rural areas.
- ***The monitoring of the implementation of the basic and comprehensive emergency obstetric and neonatal signal functions in their facilities:*** District managers have to ensure pregnant women have access to the signal functions in the district.
- ***The establishment of On-site Midwife run Birthing Units*** at large regional and provincial tertiary hospitals.
- ***The implementation of the new PPH protocol (including non-pneumatic anti-shock garments, balloon tamponade and tranexamic acid***

Doctors, nurses and allied health workers who work in or cover maternity service

- ***Participate in obstetric and neonatal emergency drills***
- ***Improve knowledge and skills by attending ESMOE courses***
- ***Know and apply the latest HIV screening and treatment protocols***
- ***Discuss contraception with all men and women of reproductive age at all relevant health interactions***
- ***Engage in maternal and perinatal death review processes***

Appendices

Appendix 1

Appendix 1A. Comparison of number of maternal deaths for each underlying cause between 2014 and 2016 per province

Primary obstetric problems	Eastern Cape				Free State				Gauteng				KwaZulu-Natal				Limpopo			
	2014	2016	Diff	% diff	2014	2016	Diff.	%diff	2014	2016	Diff	% diff	2014	2016	Diff	% diff	2014	2016	diff	% diff
Medical and surgical disorders	26	22	-4	-15.4	11	8	-3	-27.3	35	34	-1	-2.9	43	36	-7	-16.3	24	24	0	0.0
Non-pregnancy-related infections	64	41	-23	-35.9	26	17	-9	-34.6	77	41	-36	-46.8	89	63	-26	-29.2	53	35	-18	-34.0
Ectopic pregnancy	1	1	0	0.0	0	4	4		9	7	-2	-22.2	2	12	10	500.0	5	6	1	20.0
Miscarriage	2	7	5	250.0	5	1	-4	-80.0	10	18	8	80.0	9	5	-4	-44.4	10	14	4	40.0
Pregnancy-related sepsis	9	9	0	0.0	5	4	-1	-20.0	10	20	10	100.0	17	8	-9	-52.9	13	15	2	15.4
Obstetric haemorrhage	39	23	-16	-41.0	10	13	3	30.0	51	37	-14	-27.5	40	17	-23	-57.5	35	42	7	20.0
Hypertension	35	27	-8	-22.9	17	15	-2	-11.8	50	56	6	12.0	32	36	4	12.5	35	31	-4	-11.4
Anaesthetic complications	7	3	-4	-57.1	2	1	-1	-50.0	3	2	-1	-33.3	3	8	5	166.7	12	4	-8	-66.7
Adverse drug reactions	4	0	-4	-100	2	0	-2	-100	4	1	-3	-75.0	6	4	-2	-33.3	3	4	1	33.3
Embolism	3	5	2	66.7	2	2	0	0.0	12	11	-1	-8.3	5	4	-1	-20.0	6	5	-1	-16.7
Acute collapse - cause unknown	3	1	-2	-66.7	1	1	0	0.0	8	5	-3	-37.5	6	4	-2	-33.3	5	2	-3	-60.0
Miscellaneous	0	1	1		0	0	0		2	0	-2	-100	2	1	-1	-50.0	4	0	-4	-100
Unknown	10	2	-8	-80.0	6	3	-3	-50.0	5	10	5	100.0	17	18	1	5.9	8	9	1	12.5
Total MD	203	142	-61	-30.0	87	69	-18	-20.7	276	242	-34	-12.3	271	216	-55	-20.3	213	191	-22	-10.3
Total DDPCP	205	147	-58	-28.3	92	70	-22	-23.9	282	253	-29	-10.3	281	220	-61	-21.7	216	200	-16	-7.4
Coincidental cause	2	5	3	150.0	5	1	-4	-80.0	6	11	5	83.3	10	4	-6	-60.0	3	9	6	200.0

Comparison of number of maternal deaths for each underlying cause between 2014 and 2016 per province (cont.)

Primary obstetric problems	Mpumalanga				North West				Northern Cape				Western Cape				South Africa			
	2014	2016	diff	% diff	2014	2016	diff	% diff	2014	2016	diff	% diff	2014	2016	diff	% diff	2014	2016	diff	% diff
Medical and surgical disorders	4	12	8	200.0	12	11	-1	-8.3	1	1	0	0.0	20	11	-9	-45.0	176	159	-17	-9.7
Non-pregnancy-related infections	25	25	0	0.0	40	20	-20	-50.0	6	6	0	0.0	15	15	0	0.0	395	263	-132	-33.4
Ectopic pregnancy	2	3	1	50.0	3	0	-3	-100	0	0	0		1	3	2	200.0	23	36	13	56.5
Miscarriage	2	5	3	150.0	6	5	-1	-16.7	1	0	-1	-100	3	1	-2	-66.7	48	56	8	16.7
Pregnancy-related sepsis	4	4	0	0.0	3	4	1	33.3	1	0	-1	-100	3	7	4	133.3	65	71	6	9.2
Obstetric haemorrhage	25	22	-3	-12.0	15	14	-1	-6.7	7	6	-1	-14.3	3	7	4	133.3	225	181	-44	-19.6
Hypertension	22	20	-2	-9.1	19	18	-1	-5.3	5	6	1	20.0	6	9	3	50.0	221	218	-3	-1.4
Anaesthetic complications	2	3	1	50.0	3	2	-1	-33.3	0	0	0		2	2	0	0.0	34	25	-9	-26.5
Adverse drug reactions	3	3	0	0.0	2	0	-2	-100.0	0	0	0		1	0	-1	-100	25	12	-13	-52.0
Embolism	2	1	-1	-50.0	2	2	0	0.0	2	0	-2	-100	4	6	2	50.0	38	36	-2	-5.3
Acute collapse	0	1	1		2	2	0	0.0	1	0	-1	-100	0	4	4		26	20	-6	-23.1
Miscellaneous	0	0	0		0	0	0		0	0	0		0	3	3		8	5	-3	-37.5
Unknown	1	5	4	400.0	8	5	-3	-37.5	0	3	3		2	6	4	200.0	57	61	4	7.0
Total MD	92	104	12	13.0	115	83	-32	-27.8	24	22	-2	-8.3	60	74	14	23.3	1341	1143	-198	-14.8
Total: DDPCP	93	106	13	14.0	116	84	-32	-27.6	27	23	-4	-14.8	65	83	18	27.7	1377	1186	-191	-13.9
Coincidental cause	1	2	1	100.0	1	1	0	0.0	3	1	-2	-66.7	5	9	4	80.0	36	43	7	19.4

Appendix 1B. Comparison of adjusted number of maternal deaths for each underlying cause between 2014 and 2016 per province

Primary obstetric problems	Eastern Cape			Free State			Adjusted Gauteng				KwaZulu-Natal			Adjusted Limpopo			
	2014	2016	Diff	2014	2016	Diff.	2014	c2016	Diff	% diff	2014	2016	Diff	2014	c2016	diff	% Diff
Medical and surgical disorders	26	22	-4	11	8	-3	35	38	3	9.4	43	36	-7	24	25	1	3.5
Non-pregnancy-related infections	64	41	-23	26	17	-9	77	46	-31	-40.0	89	63	-26	53	36	-17	-31.7
Ectopic pregnancy	1	1	0	0	4	4	9	8	-1	-12.4	2	12	10	5	6	1	24.2
Miscarriage	2	7	5	5	1	-4	10	20	10	102.7	9	5	-4	10	14	4	44.9
Pregnancy-related sepsis	9	9	0	5	4	-1	10	23	13	125.2	17	8	-9	13	16	3	19.4
Obstetric haemorrhage	39	23	-16	10	13	3	51	42	-9	-18.3	40	17	-23	35	43	8	24.2
Hypertension	35	27	-8	17	15	-2	50	63	13	26.1	32	36	4	35	32	-3	-8.3
Anaesthetic complications	7	3	-4	2	1	-1	3	2	-1	-24.9	3	8	5	12	4	-8	-65.5
Adverse drug reactions	4	0	-4	2	0	-2	4	1	-3	-71.9	6	4	-2	3	4	1	38.0
Embolism	3	5	2	2	2	0	12	12	0	3.2	5	4	-1	6	5	-1	-13.8
Acute collapse - cause unknown	3	1	-2	1	1	0	8	6	-2	-29.6	6	4	-2	5	2	-3	-58.6
Miscellaneous	0	1	1	0	0	0	2	0	-2	-100.0	2	1	-1	4	0	-4	-100.0
Unknown	10	2	-8	6	3	-3	5	11	6	125.2	17	18	1	8	9	1	16.4
Total MD	203	142	-61	87	69	-18	276	272	-4	-1.3	271	216	-55	213	198	-15	-7.2
Total:	205	147	-58	92	70	-22	282	285	3	1.0	281	220	-61	216	207	-9	-4.2
Coincidental cause	2	5	3	5	1	-4	6	12	6	106.4	10	4	-6	3	9	6	210.5

Comparison of adjusted number of maternal deaths for each underlying cause between 2014 and 2016 per province (cont.)

Primary obstetric problems	Mpumalanga			Adjusted North West				Adjusted Northern Cape				Western Cape			South Africa			
	2014	2016	diff	2014	c2016	diff	% diff	2014	c2016	diff	% diff	2014	2016	diff	2014	2016	diff	% diff
Medical and surgical disorders	4	12	8	12	12	0	-1.1	1	1	0	9.4	20	11	-9	176	165	-11	-6.2
Non-pregnancy-related infections	25	25	0	40	22	-18	-46.1	6	7	1	9.4	15	15	0	395	272	-123	-31.3
Ectopic pregnancy	2	3	1	3	0	-3	-100.0	0	0	0		1	3	2	23	37	14	61.3
Miscarriage	2	5	3	6	5	-1	-10.1	1	0	-1	-100.0	3	1	-2	48	59	11	23.2
Pregnancy-related sepsis	4	4	0	3	4	1	43.9	1	0	-1	-100.0	3	7	4	65	74	9	14.4
Obstetric haemorrhage	25	22	-3	15	15	0	0.7	7	7	0	-6.2	3	7	4	225	189	-36	-16.1
Hypertension	22	20	-2	19	19	0	2.2	5	7	2	31.3	6	9	3	221	228	7	3.2
Anaesthetic complications	2	3	1	3	2	-1	-28.1	0	0	0		2	2	0	34	26	-8	-24.9
Adverse drug reactions	3	3	0	2	0	-2	-100.0	0	0	0		1	0	-1	25	12	-13	-50.9
Embolism	2	1	-1	2	2	0	7.9	2	0	-2	-100.0	4	6	2	38	38	0	-0.7
Acute collapse	0	1	1	2	2	0	7.9	1	0	-1	-100.0	0	4	4	26	21	-5	-19.8
Miscellaneous	0	0	0	0	0	0		0	0	0		0	3	3	8	5	-3	-37.5
Unknown	1	5	4	8	5	-3	-32.6	0	3	3		2	6	4	57	63	6	11.0
Total MD	92	104	12	115	90	-25	-22.1	24	24	0	0.3	60	74	14	1341	1189	-152	-11.3
Total:	93	106	13	116	91	-25	-21.9	27	25	-2	-6.8	65	83	18	1377	1234	-143	-10.4
Coincidental cause	1	2	1	1	1	0	7.9	3	1	-2	-63.5	5	9	4	36	45	9	24.7

Appendix 1C. Comparison between underlying causes of maternal deaths per province between 2011-3 and 2014-6

	Eastern Cape				Free State				Gauteng				KwaZulu-Natal				Limpopo			
	2011-13	2014-16	Diff	% Diff	2011-13	2014-16	Diff	% Diff	2011-13	2014-16	Diff	% Diff	2011-13	2014-16	Diff	% Diff	2011-13	2014-16	Diff	% Diff
Medical and surgical disorders	76	72	-4	-5.3	40	28	-12	-30.0	100	90	-10	-10.0	114	104	-10	-8.8	66	69	3	4.5
Non-pregnancy-related infections	199	142	-57	-28.6	85	62	-23	-27.1	276	175	-101	-36.6	404	222	-182	-45.0	228	135	-93	-40.8
Ectopic pregnancy	6	6	0	0.0	7	5	-2	-28.6	24	24	0	0.0	21	20	-1	-4.8	24	17	-7	-29.2
Miscarriage	9	13	4	44.4	9	9	0	0.0	52	53	1	1.9	53	27	-26	-49.1	32	34	2	6.3
Pregnancy-related sepsis	28	25	-3	-10.7	9	13	4	44.4	30	54	24	80.0	50	36	-14	-28.0	39	37	-2	-5.1
Obstetric haemorrhage	88	84	-4	-4.5	34	36	2	5.9	148	135	-13	-8.8	122	86	-36	-29.5	128	123	-5	-3.9
Hypertension	106	94	-12	-11.3	48	41	-7	-14.6	116	161	45	38.8	79	105	26	32.9	119	102	-17	-14.3
Anaesthetic complications	15	13	-2	-13.3	4	3	-1	-25.0	9	10	1	11.1	21	19	-2	-9.5	34	24	-10	-29.4
Embolism	12	17	5	41.7	12	6	-6	-50.0	23	31	8	34.8	11	12	1	9.1	8	18	10	125.0
Acute collapse - cause unknown	14	5	-9	-64.3	7	8	1	14.3	37	23	-14	-37.8	18	17	-1	-5.6	11	7	-4	-36.4
Unknown	25	14	-11	-44.0	12	13	1	8.3	15	24	9	60.0	55	50	-5	-9.1	38	27	-11	-28.9
Total Maternal Deaths	578	491	-87	-15.1	269	226	-43	-16.0	830	792	-38	-4.6	950	720	-230	-24.2	728	607	-121	-16.6
Total: DDPCP	593	500	-93	-15.7	281	233	-48	-17.1	849	821	-28	-3.3	964	740	-224	-23.2	750	623	-127	-16.9
Coincidental cause	15	9	-6	-40.0	12	7	-5	-41.7	19	29	10	52.6	14	20	6	42.9	22	16	-6	-27.3

Comparison between underlying causes of maternal deaths per province between 2011-3 and 2014-6 (Cont.)

	Mpumalanga				North West				Northern Cape				Western Cape				South Africa			
	2011-13	2014-16	Diff	% Diff	2011-13	2014-16	Diff	% Diff	2011-13	2014-16	Diff	% Diff	2011-13	2014-16	Diff	% Diff	2011-13	2014-16	Diff	% Diff
Medical and surgical disorders	20	22	2	10.0	24	30	6	25.0	14	7	-7	-50.0	39	45	6	15.4	493	467	-26	-5.3
Non-pregnancy-related infections	126	74	-52	-41.3	86	91	5	5.8	33	21	-12	-36.4	67	46	-21	-31.3	1504	968	-536	-35.6
Ectopic pregnancy	13	9	-4	-30.8	5	8	3	60.0	1	0	-1	-100.0	1	6	5	500.0	102	95	-7	-6.9
Miscarriage	15	11	-4	-26.7	9	13	4	44.4	1	1	0	0.0	5	4	-1	-20.0	185	165	-20	-10.8
Pregnancy-related sepsis	29	10	-19	-65.5	20	12	-8	-40.0	5	1	-4	-80.0	16	13	-3	-18.8	226	201	-25	-11.1
Obstetric haemorrhage	75	72	-3	-4.0	62	49	-13	-21.0	13	18	5	38.5	14	21	7	50.0	684	624	-60	-8.8
Hypertension	70	63	-7	-10.0	52	52	0	0.0	14	17	3	21.4	36	26	-10	-27.8	640	661	21	3.3
Anaesthetic complications	18	7	-11	-61.1	3	7	4	133.3	0	0	0		1	4	3	300.0	105	87	-18	-17.1
Embolism	10	5	-5	-50.0	7	5	-2	-28.6	9	4	-5	-55.6	10	13	3	30.0	102	111	9	8.8
Acute collapse - cause unknown	3	5	2	66.7	8	5	-3	-37.5	1	3	2	200.0	7	4	-3	-42.9	106	77	-29	-27.4
Unknown	14	9	-5	-35.7	12	19	7	58.3	6	5	-1	-16.7	4	8	4	100.0	181	169	-12	-6.6
Total Maternal Deaths	393	295	-98	-24.9	288	293	5	1.7	97	78	-19	-19.6	200	195	-5	-2.5	4333	3697	-636	-14.7
Total: DDPCP	399	300	-99	-24.8	292	296	4	1.4	110	85	-25	-22.7	214	216	2	0.9	4452	3814	-638	-14.3
Coincidental cause	6	5	-1	-16.7	4	3	-1	-25.0	13	7	-6	-46.2	14	21	7	50.0	119	117	-2	-1.7

Appendix 4. Comparison between underlying causes of maternal deaths per province between 2011 and 2016

Primary obstetric problems	Eastern Cape				Free State				Gauteng				KwaZulu-Natal				Limpopo			
	2011	2016	Diff	% Diff	2011	2016	Diff.	Diff%	2011	c2016	Diff	% diff	2011	2016	Diff	Diff %	2011	c2016	diff	% Diff
Medical and surgical disorders	29	22	-7	-24.1	16	8	-8	-50.0	34	38	4	12.6	32	36	4	12.5	19	25	6	30.7
Non-pregnancy-related infections	80	41	-39	-48.8	32	17	-15	-46.9	79	46	-33	-41.6	153	63	-90	-58.8	71	36	-35	-49.0
Ectopic pregnancy	2	1	-1	-50.0	2	4	2	100.0	8	8	0	-1.5	8	12	4	50.0	8	6	-2	-22.4
Miscarriage	5	7	2	40.0	4	1	-3	-75.0	16	20	4	26.7	24	5	-19	-79.2	9	14	5	61.0
Pregnancy-related sepsis	11	9	-2	-18.2	4	4	0	0.0	10	23	13	125.2	19	8	-11	-57.9	8	16	8	94.1
Obstetric haemorrhage	28	23	-5	-17.9	16	13	-3	-18.8	47	42	-5	-11.4	41	17	-24	-58.5	36	43	7	20.8
Hypertension	30	27	-3	-10.0	19	15	-4	-21.1	37	63	26	70.4	33	36	3	9.1	29	32	3	10.6
Anaesthetic complications	6	3	-3	-50.0	1	1	0	0.0	3	2	-1	-24.9	9	8	-1	-11.1	9	4	-5	-54.0
Embolism	1	5	4	400.0	6	2	-4	-66.7	4	12	8	209.7	4	4	0	0.0	2	5	3	158.8
Acute collapse - cause unknown	7	1	-6	-85.7	1	1	0	0.0	12	6	-6	-53.1	5	4	-1	-20.0	2	2	0	3.5
Unknown	6	2	-4	-66.7	9	3	-6	-66.7	4	11	7	181.5	15	18	3	20.0	10	9	-1	-6.9
Total MD	**205**	**142**	**-63**	**-30.7**	**112**	**69**	**-43**	**-38.4**	**254**	**272**	**18**	**7.3**	**343**	**216**	**-127**	**-37.0**	**203**	**198**	**-5**	**-2.6**
Coincidental cause	5	5	0	0.0	3	1	-2	-66.7	3	12	9	312.9	5	4	-1	-20.0	7	9	2	33.1

Primary obstetric problems	Mpumalanga				North West				Northern Cape				Western Cape				South Africa			
	2011	2016	diff	% diff	2011	c2016	diff	% diff	2011	c2016	diff	% diff	2011	2016	diff	% diff	2011	2016	diff	% diff
Medical and surgical disorders	9	12	3	33.3	5	12	7	57.9	6	1	-5	-81.8	8	11	3	37.5	158	165	7	4.5
Non-pregnancy-related infections	45	25	-20	-44.4	25	22	-3	-15.8	14	7	-7	-53.1	21	15	-6	-28.6	520	272	-248	-47.8
Ectopic pregnancy	6	3	-3	-50.0	1	0	-1		0	0	0		0	3	3		35	37	2	6.0
Miscarriage	3	5	2	66.7	1	5	4	81.5	1	0	-1	-100	1	1	0	0.0	64	59	-5	-7.6
Pregnancy-related sepsis	9	4	-5	-55.6	10	4	-6	-131.7	3	0	-3	-100	5	7	2	40.0	79	74	-5	-5.9
Obstetric haemorrhage	29	22	-7	-24.1	17	15	-2	-12.5	2	7	5	228.2	5	7	2	40.0	221	189	-32	-14.6
Hypertension	27	20	-7	-25.9	15	19	4	22.8	3	7	4	118.8	8	9	1	12.5	201	228	27	13.5
Anaesthetic complications	7	3	-4	-57.1	1	2	1	53.7	0	0	0		0	2	2		36	26	-10	-29.0
Embolism	2	1	-1	-50.0	3	2	-1	-39.0	1	0	-1	-100	4	6	2	50.0	27	38	11	39.7
Acute collapse	1	1	0	0.0	3	2	-1	-39.0	1	0	-1	-100	5	4	-1	-20.0	37	21	-16	-43.6
Unknown	7	5	-2	-28.6	2	5	3	62.9	2	3	1	64.1	0	6	6		55	63	8	15.0
Total MD	**145**	**104**	**-41**	**-28.3**	**83**	**90**	**7**	**7.3**	**33**	**24**	**-9**	**-27.1**	**57**	**74**	**17**	**29.8**	**1435**	**1189**	**-246**	-17.2
Coincidental cause	1	2	1	100.0	1	1	0	7.3	3	1	-2	-63.5	3	9	6	200.0	31	45	14	44.8

Appendix 2.
Maternal deaths 2014-2016:
Fact Sheets for provinces and districts

Data from NCCEMD

Abbreviations

AC	Acute collapse - cause unknown
ADR	Adverse drug reactions
AR	Anaesthetic related
BLDACD	Bleeding during or after caesarean delivery
CD	Caesarean delivery
CFR	Case fatality rate
Ec	Ectopic pregnancy
Emb.	Embolism
HDP	Hypertensive disorders of pregnancy
iMMR	Institutional Maternal Mortality Ratio
M&S	Medical and surgical disorders
MD	Maternal death
Misc.	Miscellaneous
Miscar.	Miscarriage
NPRI	Non-pregnancy-related infections
OH	Obstetric haemorrhage
PRS	Pregnancy-related sepsis
Unk.	Unknown

Number of maternal deaths per district per underlying cause

Primary obstetric problems	M&S	NPRI	Ec	Miscar.	PRS	OH	HDP	AR	ADR	Emb.	AC	Misc.	Unk.	Total:
Alfred Nzo	3	6	0	1	0	6	3	3	0	1	0	0	1	24
Amatole/Buffalo City	19	34	0	5	2	13	21	3	2	5	1	0	4	109
C Hani	3	20	0	1	2	12	16	0	1	0	1	0	1	57
Sarah Baartman	4	6	0	1	0	6	1	0	0	0	0	0	1	19
NMM	8	22	2	1	3	8	16	0	1	4	2	1	3	71
OR Tambo	31	48	4	4	18	36	35	6	1	7	1	0	3	194
Joe Qwabe	4	6	0	0	0	3	2	1	0	0	0	0	1	17
Eastern Cape	**72**	**142**	**6**	**13**	**25**	**84**	**94**	**13**	**5**	**17**	**5**	**1**	**14**	**491**
Fezile Dabe	3	11	0	2	2	8	5	1	0	0	0	0	3	35
Lejwelesputwa	4	22	3	5	2	6	8	0	0	1	2	0	2	55
Mangaung	15	18	2	0	4	10	16	1	1	1	4	0	4	76
Thabo Mfutsanye	6	11	0	2	5	12	12	1	1	4	2	0	4	60
Xhariep	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Free State	**28**	**62**	**5**	**9**	**13**	**36**	**41**	**3**	**2**	**6**	**8**	**0**	**13**	**226**
Ekhuruleni	21	68	8	13	20	42	32	5	2	9	8	0	13	241
Johannesburg	32	51	10	15	11	42	62	2	1	4	6	2	2	240
Sedibeng	4	7	1	3	5	9	11	1	1	1	1	0	2	46
Tshwane	27	40	2	20	13	28	38	2	5	13	8	1	6	203
West Rand	6	9	3	2	5	13	18	0	0	4	0	0	1	61
Gauteng	**90**	**175**	**24**	**53**	**54**	**134**	**161**	**10**	**9**	**31**	**23**	**3**	**24**	**791**
Amajuba	6	14	0	1	2	4	7	3	2	1	0	0	0	40
Ethekweni	41	71	5	11	9	23	33	5	5	5	5	2	24	239
iLembe	4	8	1	0	4	3	3	0	1	0	2	0	4	30
Sisonke	5	10	0	1	2	2	1	0	0	1	0	0	4	26
Ugu	5	17	2	1	3	5	9	2	0	1	0	0	1	46
Umgungungluvu	22	32	5	4	6	7	10	1	2	2	0	1	6	98
uMkanyakude	2	8	1	1	1	8	1	1	1	1	0	0	1	26
Umzinyathi	2	4	0	0	0	5	6	0	0	0	1	0	1	19
Uthukela	5	20	2	4	2	10	10	1	3	0	2	1	2	62
Uthungulu (King Ceteswayo)	11	29	3	4	7	12	20	3	4	1	2	0	5	101
Zululand	1	9	1	0	0	7	5	3	0	0	5	0	2	33
KwaZulu-Natal	**104**	**222**	**20**	**27**	**36**	**86**	**105**	**19**	**18**	**12**	**17**	**4**	**50**	**720**

Primary obstetric problems	M&S	NPRI	Ec	Miscar.	PRS	OH	HDP	AR	ADR	Emb.	AC	Misc.	Unk.	Total:
Capricorn	36	59	6	11	20	54	53	7	6	8	1	3	7	271
Gr Sekekhune	13	24	4	10	8	15	16	1	0	3	2	1	15	112
Mopani	13	24	4	10	8	15	16	1	0	3	2	1	15	112
Vhembe	6	16	2	4	3	24	11	9	0	0	1	1	2	79
Waterberg	4	12	1	2	1	10	6	4	1	1	2	0	2	46
Limpopo	**72**	**135**	**17**	**37**	**40**	**118**	**102**	**22**	**7**	**15**	**8**	**6**	**41**	**620**
Ehlanzeni	14	39	6	6	5	37	21	1	5	1	4	0	3	145
Gert Sibande	2	14	1	2	0	15	14	0	0	3	0	0	4	56
Nkangala	6	21	2	3	5	20	28	6	3	1	1	0	2	99
Mpumalanga	**22**	**74**	**9**	**11**	**10**	**72**	**63**	**7**	**8**	**5**	**5**	**0**	**9**	**300**
Bojanala Platinum	6	30	2	5	4	16	17	4	1	1	2	0	6	94
K Kaunda DC 40 (Southern)	13	24	2	3	6	6	10	2	0	2	1	0	5	74
NM Molema DC 38 - Central)	8	28	3	4	1	16	16	1	0	1	0	0	6	84
RS Momati (DC 39)	3	9	1	1	1	11	9	0	1	1	2	0	2	41
North West	**30**	**91**	**8**	**13**	**12**	**49**	**52**	**7**	**2**	**5**	**5**	**0**	**19**	**293**
Francis Baard	3	8	0	0	1	7	10	0	1	1	0	0	2	35
John Taolo Gaetsewe (Kalagadi)	0	3	0	0	0	5	3	0	0	2	1	0	3	17
Namakwa	0	1	0	1	0	1	0	0	0	0	0	0	0	4
Pixley ka Seme	1	3	0	0	0	3	0	0	0	0	1	0	0	9
Zwelentlanga Fatman Mgcawu (Siyanda)	3	6	0	0	0	2	4	0	0	1	1	0	0	20
Northern Cape	**7**	**21**	**0**	**1**	**1**	**18**	**17**	**0**	**1**	**4**	**3**	**0**	**5**	**85**
Cape Town	31	32	5	3	10	14	17	3	0	10	3	3	6	137
Cape Winelands	6	4	0	0	0	3	4	0	0	2	0	1	0	20
Central Karoo	1	1	0	0	0	0	1	0	0	0	0	0	0	3
Eden	5	5	1	1	2	3	4	0	1	1	0	0	2	25
Overberg	0	1	0	0	0	0	0	1	0	0	0	0	0	2
West Coast	2	3	0	0	1	1	0	0	0	0	1	0	0	8
Western Cape	**45**	**46**	**6**	**4**	**13**	**21**	**26**	**4**	**1**	**13**	**4**	**4**	**8**	**195**

iMMR per district per underlying cause

Primary obstetric problems	M&S	NPRI	Ec	Miscar.	PRS	OH	HDP	AR	ADR	Emb.	AC	Misc.	Unk.	Total:
Alfred Nzo	8.05	16.10	0.00	2.68	0.00	16.10	8.05	8.05	0.00	2.68	0.00	0.00	2.68	64.41
Amatole/Buffalo City	25.40	45.46	0.00	6.69	2.67	17.38	28.08	4.01	2.67	6.69	1.34	0.00	5.35	145.74
C Hani	8.74	58.29	0.00	2.91	5.83	34.98	46.63	0.00	2.91	0.00	2.91	0.00	2.91	166.14
Sarah Baartman	21.71	32.56	0.00	5.43	0.00	32.56	5.43	0.00	0.00	0.00	0.00	0.00	5.43	103.12
NMM	13.78	37.89	3.44	1.72	5.17	13.78	27.56	0.00	1.72	6.89	3.44	1.72	5.17	122.29
OR Tambo	33.57	51.98	4.33	4.33	19.49	38.98	37.90	6.50	1.08	7.58	1.08	0.00	3.25	210.07
Joe Qwabe	25.80	38.70	0.00	0.00	0.00	19.35	12.90	6.45	0.00	0.00	0.00	0.00	6.45	109.66
Eastern Cape Province	**21.77**	**42.94**	**1.81**	**3.93**	**7.56**	**25.40**	**28.42**	**3.93**	**1.51**	**5.14**	**1.51**	**0.30**	**4.23**	**148.47**
Fezile Dabe	13.85	50.78	0.00	9.23	9.23	36.93	23.08	4.62	0.00	0.00	0.00	0.00	13.85	161.57
Lejwelesputwa	14.33	78.80	10.75	17.91	7.16	21.49	28.65	0.00	0.00	3.58	7.16	0.00	7.16	197.00
Mangaung	36.25	43.50	4.83	0.00	9.67	24.17	38.67	2.42	2.42	2.42	9.67	0.00	9.67	183.67
Thabo Mfutsanye	16.62	30.48	0.00	5.54	13.85	33.25	33.25	2.77	2.77	11.08	5.54	0.00	11.08	166.25
Xhariep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Free State Province	**21.64**	**47.91**	**3.86**	**6.95**	**10.05**	**27.82**	**31.68**	**2.32**	**1.55**	**4.64**	**6.18**	**0.00**	**10.05**	**174.63**
Ekhuruleni	11.50	37.24	4.38	7.12	10.95	23.00	17.52	2.74	1.10	4.93	4.38	0.00	7.12	131.98
Johannesburg	16.27	25.92	5.08	7.62	5.59	21.35	31.52	1.02	0.51	2.03	3.05	1.02	1.02	121.99
Sedibeng	9.39	16.43	2.35	7.04	11.74	21.13	25.83	2.35	2.35	2.35	2.35	0.00	4.70	108.00
Tshwane	18.22	27.00	1.35	13.50	8.77	18.90	25.65	1.35	3.37	8.77	5.40	0.67	4.05	137.01
West Rand	13.36	20.04	6.68	4.45	11.13	28.94	40.07	0.00	0.00	8.90	0.00	0.00	2.23	135.80
Gauteng Province	**14.63**	**28.45**	**3.90**	**8.62**	**8.78**	**21.79**	**26.18**	**1.63**	**1.46**	**5.04**	**3.74**	**0.49**	**3.90**	**128.62**
Amajuba	19.21	44.81	0.00	3.20	6.40	12.80	22.41	9.60	6.40	3.20	0.00	0.00	0.00	128.04
Ethekweni	24.11	41.76	2.94	6.47	5.29	13.53	19.41	2.94	2.94	2.94	2.94	1.18	14.12	140.57
iLembe	12.69	25.39	3.17	0.00	12.69	9.52	9.52	0.00	3.17	0.00	6.35	0.00	12.69	95.21
Sisonke	20.38	40.77	0.00	4.08	8.15	8.15	4.08	0.00	0.00	4.08	0.00	0.00	16.31	106.00
Ugu	12.53	42.60	5.01	2.51	7.52	12.53	22.55	5.01	0.00	2.51	0.00	0.00	2.51	115.28
Umgungungluvu	43.14	62.75	9.80	7.84	11.77	13.73	19.61	1.96	3.92	3.92	0.00	1.96	11.77	192.16
uMkanyakude	4.59	18.37	2.30	2.30	2.30	18.37	2.30	2.30	2.30	2.30	0.00	0.00	2.30	59.69
Umzinyathi	6.06	12.11	0.00	0.00	0.00	15.14	18.17	0.00	0.00	0.00	3.03	0.00	3.03	57.54
Uthukela	13.77	55.09	5.51	11.02	5.51	27.54	27.54	2.75	8.26	0.00	5.51	2.75	5.51	170.77
Uthungulu	18.90	49.84	5.16	6.87	12.03	20.62	34.37	5.16	6.87	1.72	3.44	0.00	8.59	173.57
Zululand	2.13	19.13	2.13	0.00	0.00	14.88	10.63	6.38	0.00	0.00	10.63	0.00	4.25	70.14
KwaZulu-Natal Province	**18.36**	**39.20**	**3.53**	**4.77**	**6.36**	**15.19**	**18.54**	**3.35**	**3.18**	**2.12**	**3.00**	**0.71**	**8.83**	**127.14**

Primary obstetric problems	M&S	NPRI	Ec	Miscar.	PRS	OH	HDP	AR	ADR	Emb.	AC	Misc.	Unk.	Total:
Capricorn	44.85	73.51	7.48	13.71	24.92	67.28	66.03	8.72	7.48	9.97	1.25	3.74	8.72	337.64
Gr Sekekhune	17.17	31.71	5.28	13.21	10.57	19.82	21.14	1.32	0.00	3.96	2.64	1.32	19.82	147.96
Mopani	17.10	31.58	5.26	13.16	10.53	19.74	21.05	1.32	0.00	3.95	2.63	1.32	19.74	147.36
Vhembe	6.54	17.43	2.18	4.36	3.27	26.14	11.98	9.80	0.00	0.00	1.09	1.09	2.18	86.06
Waterberg	9.14	27.42	2.28	4.57	2.28	22.85	13.71	9.14	2.28	2.28	4.57	0.00	4.57	105.10
Limpopo Province	**19.59**	**36.73**	**4.63**	**10.07**	**10.88**	**32.11**	**27.75**	**5.99**	**1.90**	**4.08**	**2.18**	**1.63**	**11.16**	**168.69**
Ehlanzeni	12.51	34.84	5.36	5.36	4.47	33.05	18.76	0.89	4.47	0.89	3.57	0.00	2.68	129.52
Gert Sibande	3.83	26.78	1.91	3.83	0.00	28.69	26.78	0.00	0.00	5.74	0.00	0.00	7.65	107.12
Nkangala	10.18	35.63	3.39	5.09	8.48	33.94	47.51	10.18	5.09	1.70	1.70	0.00	3.39	167.98
Mpumalanga Province	**9.86**	**33.16**	**4.03**	**4.93**	**4.48**	**32.26**	**28.23**	**3.14**	**3.58**	**2.24**	**2.24**	**0.00**	**4.03**	**134.43**
Bojanala Platinum	9.81	49.03	3.27	8.17	6.54	26.15	27.79	6.54	1.63	1.63	3.27	0.00	9.81	153.63
K Kaunda DC 40 (Southern)	35.82	66.13	5.51	8.27	16.53	16.53	27.55	5.51	0.00	5.51	2.76	0.00	13.78	203.90
NM Molema DC 38 - Central)	17.76	62.17	6.66	8.88	2.22	35.53	35.53	2.22	0.00	2.22	0.00	0.00	13.32	186.51
RS Momati (DC 39)	10.84	32.53	3.61	3.61	3.61	39.76	32.53	0.00	3.61	3.61	7.23	0.00	7.23	148.21
North West Province	**17.63**	**53.47**	**4.70**	**7.64**	**7.05**	**28.79**	**30.56**	**4.11**	**1.18**	**2.94**	**2.94**	**0.00**	**11.16**	**172.17**
Francis Baard	12.47	33.24	0.00	0.00	4.16	29.09	41.55	0.00	4.16	4.16	0.00	0.00	8.31	145.43
John Taolo Gaetsewe (Kalagadi)	0.00	20.35	0.00	0.00	0.00	33.92	20.35	0.00	0.00	13.57	6.78	0.00	20.35	115.32
Namakwa	0.00	22.01	0.00	22.01	0.00	22.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	88.05
Pixley ka Seme	11.38	34.14	0.00	0.00	0.00	34.14	0.00	0.00	0.00	0.00	11.38	0.00	0.00	102.42
Zwelentlanga Fatman Mgcawu (Siyanda)	24.73	49.46	0.00	0.00	0.00	16.49	32.98	0.00	0.00	8.24	8.24	0.00	0.00	164.88
Northern CapeProvince	**10.89**	**32.68**	**0.00**	**1.56**	**1.56**	**28.01**	**26.45**	**0.00**	**1.56**	**6.22**	**4.67**	**0.00**	**7.78**	**132.26**
Cape Town	16.57	17.10	2.67	1.60	5.34	7.48	9.08	1.60	0.00	5.34	1.60	1.60	3.21	73.21
Cape Winelands	14.24	9.49	0.00	0.00	0.00	7.12	9.49	0.00	0.00	4.75	0.00	2.37	0.00	47.47
Central Karoo	33.10	33.10	0.00	0.00	0.00	0.00	33.10	0.00	0.00	0.00	0.00	0.00	0.00	99.30
Eden	17.94	17.94	3.59	3.59	7.18	10.77	14.35	0.00	3.59	3.59	0.00	0.00	7.18	89.71
Overberg	0.00	10.13	0.00	0.00	0.00	0.00	0.00	10.13	0.00	0.00	0.00	0.00	0.00	20.26
West Coast	12.91	19.37	0.00	0.00	6.46	6.46	0.00	0.00	0.00	0.00	6.46	0.00	0.00	51.66
Western Cape Province	**15.76**	**16.11**	**2.10**	**1.40**	**4.55**	**7.36**	**9.11**	**1.40**	**0.35**	**4.55**	**1.40**	**1.40**	**2.80**	**68.30**

Ranking of district's iMMR

District	iMMR
Capricorn	337.64
OR Tambo	210.07
K Kaunda DC 40 (Southern)	203.90
Lejwelesputwa	197.00
Umgungungluvu	192.16
NM Molema DC 38 - Central)	186.51
Mangaung	183.67
Uthungulu	173.57
Uthukela	170.77
Nkangala	167.98
Thabo Mfutsanye	166.25
C Hani	166.14
Zwelentlanga Fatman Mgcawu (Siyanda)	164.88
Fezile Dabe	161.57
Bojanala Platinum	153.63
RS Momati (DC 39)	148.21
Gr Sekekhune	147.96
Mopani	147.36
Amatole/Buffalo City	145.74
Francis Baard	145.43
Ethekweni	140.57
Tshwane	137.01
West Rand	135.80
Northern Cape	132.26
Ekhuruleni	131.98
Ehlanzeni	129.52
Amajuba	128.04
NMM	122.29
Johannesburg	121.99
John Taolo Gaetsewe (Kalagadi)	115.32
Ugu	115.28
Joe Qwabe	109.66
Sedibeng	108.00
Gert Sibande	107.12
Sisonke	106.00
Waterberg	105.10
Sarah Baartman	103.12
Pixley ka Seme	102.42
Central Karoo	99.30
iLembe	95.21
Eden	89.71
Namakwa	88.05
Vhembe	86.06
Cape Town	73.21
Zululand	70.14
Alfred Nzo	64.41
uMkanyakude	59.69
Umzinyathi	57.54
West Coast	51.66
Cape Winelands	47.47
Overberg	20.26
Xhariep	0.00

Ranking of district's iMMR due to non-pregnancy related infections

District	Non-pregnancy-related infections
Lejwelesputwa	78.80
Capricorn	73.51
K Kaunda DC 40 (Southern)	66.13
Umgungungluvu	62.75
NM Molema DC 38 - Central)	62.17
C Hani	58.29
Uthukela	55.09
OR Tambo	51.98
Fezile Dabe	50.78
Uthungulu	49.84
Zwelentlanga Fatman Mgcawu (Siyanda)	49.46
Bojanala Platinum	49.03
Amatole/Buffalo City	45.46
Amajuba	44.81
Mangaung	43.50
Ugu	42.60
Ethekweni	41.76
Sisonke	40.77
Joe Qwabe	38.70
NMM	37.89
Ekhuruleni	37.24
Nkangala	35.63
Ehlanzeni	34.84
Pixley ka Seme	34.14
Francis Baard	33.24
Central Karoo	33.10
Sarah Baartman	32.56
RS Momati (DC 39)	32.53
Gr Sekekhune	31.71
Mopani	31.58
Thabo Mfutsanye	30.48
Gauteng Province	28.45
Waterberg	27.42
Tshwane	27.00
Gert Sibande	26.78
Johannesburg	25.92
iLembe	25.39
Namakwa	22.01
John Taolo Gaetsewe (Kalagadi)	20.35
West Rand	20.04
West Coast	19.37
Zululand	19.13
uMkanyakude	18.37
Eden	17.94
Vhembe	17.43
Cape Town	17.10
Sedibeng	16.43
Alfred Nzo	16.10
Umzinyathi	12.11
Overberg	10.13
Cape Winelands	9.49
Xhariep	0.00

Ranking of district's iMMR due to obstetric haemorrhage

District	Obstetric haemorrhage
Capricorn	67.28
RS Momati (DC 39)	39.76
OR Tambo	38.98
Fezile Dabe	36.93
NM Molema (DC 38 - Central)	35.53
C Hani	34.98
Pixley ka Seme	34.14
Nkangala	33.94
John Taolo Gaetsewe (Kalagadi)	33.92
Thabo Mfutsanyane	33.25
Ehlanzeni	33.05
Sarah Baartman	32.56
Francis Baard	29.09
West Rand	28.94
Gert Sibande	28.69
Uthukela	27.54
Bojanala Platinum	26.15
Vhembe	26.14
Mangaung	24.17
Ekhuruleni	23.00
Waterberg	22.85
Namakwa	22.01
Gauteng Province	21.79
Lejwelesputwa	21.49
Johannesburg	21.35
Sedibeng	21.13
Uthungulu	20.62
Gr Sekekhune	19.82
Mopani	19.74
Joe Qwabe	19.35
Tshwane	18.90
uMkanyakude	18.37
Amatole/Buffalo City	17.38
K Kaunda DC 40 (Southern)	16.53
Zwelentlanga Fatman Mgcawu (Siyanda)	16.49
Alfred Nzo	16.10
Umzinyathi	15.14
Zululand	14.88
NMM	13.78
Umgungungluvu	13.73
Ethekweni	13.53
Amajuba	12.80
Ugu	12.53
Eden	10.77
iLembe	9.52
Sisonke	8.15
Cape Town	7.48
Cape Winelands	7.12
West Coast	6.46
Xhariep	0.00
Central Karoo	0.00
Overberg	0.00

Ranking of district's iMMR for hypertensive disorders in pregnancy

District	Hypertensive disorders of pregnancy
Capricorn	66.03
Nkangala	47.51
C Hani	46.63
Francis Baard	41.55
West Rand	40.07
Mangaung	38.67
OR Tambo	37.90
NM Molema DC 38 - Central)	35.53
Uthungulu	34.37
Thabo Mfutsanyana	33.25
Central Karoo	33.10
Zwelentlanga Fatman Mgcawu (Siyanda)	32.98
RS Momati (DC 39)	32.53
Johannesburg	31.52
Lejwelesputwa	28.65
Amatole/Buffalo City	28.08
Bojanala Platinum	27.79
NMM	27.56
K Kaunda DC 40 (Southern)	27.55
Uthukela	27.54
Gert Sibande	26.78
Gauteng Province	26.18
Sedibeng	25.83
Tshwane	25.65
Fezile Dabe	23.08
Ugu	22.55
Amajuba	22.41
Gr Sekekhune	21.14
Mopani	21.05
John Taolo Gaetsewe (Kalagadi)	20.35
Umgungungluvu	19.61
Ethekweni	19.41
Ehlanzeni	18.76
Umzinyathi	18.17
Ekhuruleni	17.52
Eden	14.35
Waterberg	13.71
Joe Qwabe	12.90
Vhembe	11.98
Zululand	10.63
iLembe	9.52
Cape Winelands	9.49
Cape Town	9.08
Alfred Nzo	8.05
Sarah Baartman	5.43
Sisonke	4.08
uMkanyakude	2.30
Xhariep	0.00
Namakwa	0.00
Pixley ka Seme	0.00
Overberg	0.00
West Coast	0.00

Caesarean deliveries (CD) per province and district and Case Fatality Rate (CFR) per CD and CFR of bleeding during or after CD (BLDACD)

Dist_Metro	Total CD	MD with CD	CFR CD/ 100000 CDs	Total del.	CD rate (%)	BLDACD	CFR BLDACD
ec Alfred Nzo District Municipality	7191	5	69.5	37264	19.3	1	13.9
ec Amatole*	19289	36	186.6	74791	25.8	5	25.9
ec Chris Hani District Municipality	7249	16	220.7	34309	21.1	5	69.0
ec Sarah Baartman District Municipality	4441	4	90.1	18426	24.1	0	0.0
ec Nelson Mandela Bay Municipality	23282	22	94.5	58061	40.1	4	17.2
ec Oliver Tambo District Municipality	27948	70	250.5	92350	30.3	8	28.6
ec Joe Gqabi District Municipality	1861	1	53.7	15502	12.0	0	0.0
Eastern Cape	**91261**	**154**	**168.7**	**330703**	**27.6**	**23**	**25.2**
fs Fezile Dabi District Municipality	5083	6	118.0	21663	23.5	0	0.0
fs Lejweleputswa District Municipality	6702	8	119.4	27919	24.0	2	29.8
fs Mangaung Metropolitan Municipality	13330	21	157.5	41379	32.2	2	15.0
fs Thabo Mofutsanyana District Municipality	7664	21	274.0	36091	21.2	3	39.1
fs Xhariep District Municipality	0	0		2364	0.0	0	
Free State	**32779**	**56**	**170.8**	**129416**	**25.3**	**7**	**21.4**
gp Ekurhuleni Metropolitan Municipality	46577	72	154.6	182608	25.5	12	25.8
gp City of Johannesburg Metropolitan Municipality	58694	117	199.3	196730	29.8	9	15.3
gp Sedibeng District Municipality	11694	14	119.7	42594	27.5	4	34.2
gp City of Tshwane Metropolitan Municipality	39157	76	194.1	148162	26.4	9	23.0
gp West Rand District Municipality	10786	23	213.2	44919	24.0	7	64.9
Gauteng	**166908**	**302**	**180.9**	**615013**	**27.1**	**41**	**24.6**
kz Amajuba District Municipality	11625	18	154.8	31240	37.2	0	0.0
kz eThekwini Metropolitan Municipality	58180	73	125.5	170020	34.2	10	17.2
kz iLembe District Municipality	8862	12	135.4	31510	28.1	1	11.3
kz Harry Gwala District Municipality	6436	6	93.2	24529	26.2	0	0.0
kz Ugu District Municipality	13694	12	87.6	39904	34.3	1	7.3
kz uMgungundlovu District Municipality	19935	30	150.5	50998	39.1	1	5.0
kz Umkhanyakude District Municipality	7458	6	80.5	43558	17.1	3	40.2
kz Umzinyathi District Municipality	7651	8	104.6	33019	23.2	2	26.1
kz Uthukela District Municipality	9276	23	248.0	36306	25.5	4	43.1
kz King Cetshwayo District Municipality	18903	38	201.0	58189	32.5	6	31.7
kz Zululand District Municipality	10527	10	95.0	47050	22.4	4	38.0
KwaZulu-Natal	**172547**	**236**	**136.8**	**566323**	**30.5**	**32**	**18.5**
lp Capricorn District Municipality	17900	87	486.0	80262	22.3	26	145.3
lp Mopani District Municipality	12762	20	156.7	75697	16.9	9	70.5
lp Sekhukhune District Municipality	14252	20	140.3	76005	18.8	5	35.1
lp Vhembe District Municipality	15052	28	186.0	91801	16.4	8	53.1
lp Waterberg District Municipality	9199	13	141.3	43767	21.0	1	10.9
Limpopo	**69165**	**168**	**242.9**	**367532**	**18.8**	**49**	**70.8**
mp Ehlanzeni District Municipality	20800	49	235.6	111954	18.6	18	86.5
mp Gert Sibande District Municipality	10742	19	176.9	52276	20.5	6	55.9
mp Nkangala District Municipality	10534	34	322.8	58936	17.9	8	75.9
Mpumalanga	**42076**	**102**	**242.4**	**223166**	**18.9**	**32**	**76.1**

Dist_Metro	Total CD	MD with CD	CFR CD/ 100000 CDs	Total del.	CD rate (%)	BLDACD	CFR BLDACD
nw Bojanala Platinum District Municipality	11289	28	248.0	61184	18.5	4	35.4
nw Dr Kenneth Kaunda District Municipality	9104	26	285.6	36292	25.1	1	11.0
nw Ngaka Modiri Molema District Municipality	11020	23	208.7	45038	24.5	8	72.6
nw Dr Ruth Segomotsi Mompati District Municipality	5076	7	137.9	27664	18.3	1	19.7
North West	**36489**	**84**	**230.2**	**170178**	**21.4**	**14**	**38.4**
nc Frances Baard District Municipality	7063	14	198.2	24067	29.3	3	42.5
nc John Taolo Gaetsewe District Municipality	2286	3	131.2	14741	15.5	1	43.7
nc Namakwa District Municipality	760	0	0.0	4543	16.7	0	0.0
nc Pixley ka Seme District Municipality	1162	2	172.1	8787	13.2	2	172.1
nc Zwelentlanga Fatman Mgcawu District Municipality	2175	6	275.9	12130	17.9	0	0.0
Northern Cape	**13446**	**25**	**185.9**	**64268**	**20.9**	**6**	**44.6**
wc City of Cape Town Metropolitan Municipality	55781	53	95.0	187127	29.8	8	14.3
wc Cape Winelands District Municipality	13571	6	44.2	42131	32.2	1	7.4
wc Central Karoo District Municipality	606	0	0.0	3021	20.1	0	0.0
wc Eden District Municipality	8419	9	106.9	27867	30.2	3	35.6
wc Overberg District Municipality	1938	1	51.6	9874	19.6	0	0.0
wc West Coast District Municipality	3038	5	164.6	15487	19.6	1	32.9
Western Cape	**83353**	**74**	**88.8**	**285507**	**29.2**	**13**	**15.6**
South Africa	**708024**	**1201**	**169.6**	**2752106**	**25.7**	**217**	**30.6**

Ranked CFR of CD/100000 CDs per province

Province	CD rate (%)	CFR CD/100000
Limpopo	18.82	242.90
Mpumalanga	18.85	242.42
North West	21.44	230.21
Northern Cape	20.92	185.93
Gauteng	27.14	180.94
Free State	25.33	170.84
South Africa	25.73	169.63
Eastern Cape	27.60	168.75
KwaZulu-Natal	30.47	136.77
Western Cape	29.19	88.78

Ranked CFR of BLDACD/100000 CDs per province

Provinces	BLDACD	CFR BLDACD
Mpumalanga	32	76.05
Limpopo	49	70.85
Northern Cape	6	44.62
North West	14	38.37
South Africa	217	30.65
Eastern Cape	23	25.20
Gauteng	41	24.56
Free State	7	21.36
KwaZulu-Natal	32	18.55
Western Cape	13	15.60

Ranked CFR of CD/100000 CDs per district

Dist_Metro	CD rate (%)	CFR CD/100000
lp Capricorn District Municipality	22.30	486.03
mp Nkangala District Municipality	17.87	322.76
nw Dr Kenneth Kaunda District Municipality	25.09	285.59
nc Zwelentlanga Fatman Mgcawu District Municipality	17.93	275.86
fs Thabo Mofutsanyana District Municipality	21.24	274.01
ec Oliver Tambo District Municipality	30.26	250.47
nw Bojanala Platinum District Municipality	18.45	248.03
kz Uthukela District Municipality	25.55	247.95
mp Ehlanzeni District Municipality	18.58	235.58
ec Chris Hani District Municipality	21.13	220.72
gp West Rand District Municipality	24.01	213.24
nw Ngaka Modiri Molema District Municipality	24.47	208.71
kz King Cetshwayo District Municipality	32.49	201.03
gp City of Johannesburg Metropolitan Municipality	29.83	199.34
nc Frances Baard District Municipality	29.35	198.22
gp City of Tshwane Metropolitan Municipality	26.43	194.09
ec Amatole*	25.79	186.63
lp Vhembe District Municipality	16.40	186.02
mp Gert Sibande District Municipality	20.55	176.88
nc Pixley ka Seme District Municipality	13.22	172.12
wc West Coast District Municipality	19.62	164.58
fs Mangaung Metropolitan Municipality	32.21	157.54
lp Mopani District Municipality	16.86	156.72
kz Amajuba District Municipality	37.21	154.84
gp Ekurhuleni Metropolitan Municipality	25.51	154.58
kz uMgungundlovu District Municipality	39.09	150.49
lp Waterberg District Municipality	21.02	141.32
lp Sekhukhune District Municipality	18.75	140.33
nw Dr Ruth Segomotsi Mompati District Municipality	18.35	137.90
kz iLembe District Municipality	28.12	135.41
nc John Taolo Gaetsewe District Municipality	15.51	131.23
kz eThekwini Metropolitan Municipality	34.22	125.47
gp Sedibeng District Municipality	27.45	119.72
fs Lejweleputswa District Municipality	24.01	119.37
fs Fezile Dabi District Municipality	23.46	118.04
wc Eden District Municipality	30.21	106.90
kz Umzinyathi District Municipality	23.17	104.56
wc City of Cape Town Metropolitan Municipality	29.81	95.01
kz Zululand District Municipality	22.37	94.99
ec Nelson Mandela Bay Municipality	40.10	94.49
kz Harry Gwala District Municipality	26.24	93.23
ec Sarah Baartman District Municipality	24.10	90.07
kz Ugu District Municipality	34.32	87.63
kz Umkhanyakude District Municipality	17.12	80.45
ec Alfred Nzo District Municipality	19.30	69.53
ec Joe Gqabi District Municipality	12.00	53.73
wc Overberg District Municipality	19.63	51.60
wc Cape Winelands District Municipality	32.21	44.21
nc Namakwa District Municipality	16.73	0.00
wc Central Karoo District Municipality	20.06	0.00
fs Xhariep District Municipality	0.00	

Ranked CFR of BLDACD/100000 CDs per district

Dist_Metro	BLDACD	CFR BLDACD
nc Pixley ka Seme District Municipality	2	172.12
lp Capricorn District Municipality	26	145.25
mp Ehlanzeni District Municipality	18	86.54
mp Nkangala District Municipality	8	75.94
nw Ngaka Modiri Molema District Municipality	8	72.60
lp Mopani District Municipality	9	70.52
ec Chris Hani District Municipality	5	68.98
gp West Rand District Municipality	7	64.90
mp Gert Sibande District Municipality	6	55.86
lp Vhembe District Municipality	8	53.15
nc John Taolo Gaetsewe District Municipality	1	43.74
kz Uthukela District Municipality	4	43.12
nc Frances Baard District Municipality	3	42.47
kz Umkhanyakude District Municipality	3	40.23
fs Thabo Mofutsanyana District Municipality	3	39.14
kz Zululand District Municipality	4	38.00
wc Eden District Municipality	3	35.63
nw Bojanala Platinum District Municipality	4	35.43
lp Sekhukhune District Municipality	5	35.08
gp Sedibeng District Municipality	4	34.21
wc West Coast District Municipality	1	32.92
kz King Cetshwayo District Municipality	6	31.74
fs Lejweleputswa District Municipality	2	29.84
ec Oliver Tambo District Municipality	8	28.62
kz Umzinyathi District Municipality	2	26.14
ec Amatole*	5	25.92
gp Ekurhuleni Metropolitan Municipality	12	25.76
gp City of Tshwane Metropolitan Municipality	9	22.98
nw Dr Ruth Segomotsi Mompati District Municipality	1	19.70
kz eThekwini Metropolitan Municipality	10	17.19
ec Nelson Mandela Bay Municipality	4	17.18
gp City of Johannesburg Metropolitan Municipality	9	15.33
fs Mangaung Metropolitan Municipality	2	15.00
wc City of Cape Town Metropolitan Municipality	8	14.34
ec Alfred Nzo District Municipality	1	13.91
kz iLembe District Municipality	1	11.28
nw Dr Kenneth Kaunda District Municipality	1	10.98
lp Waterberg District Municipality	1	10.87
wc Cape Winelands District Municipality	1	7.37
kz Ugu District Municipality	1	7.30
kz uMgungundlovu District Municipality	1	5.02
ec Sarah Baartman District Municipality	0	0.00
ec Joe Gqabi District Municipality	0	0.00
fs Fezile Dabi District Municipality	0	0.00
fs Xhariep District Municipality	0	0.00
kz Amajuba District Municipality	0	0.00
kz Harry Gwala District Municipality	0	0.00
nc Namakwa District Municipality	0	0.00
nc Zwelentlanga Fatman Mgcawu District Municipality	0	0.00
wc Central Karoo District Municipality	0	0.00
wc Overberg District Municipality	0	0.00

Appendix 3. Detailed maternal death data 2014-2016

Primary obstetric problems	2014-2016	Distribution per category (%)	2011-2013	Distribution per category (%)
Coincidental cause	**117**		**105**	
- MVA	40	34.2	40	38.1
- Other accidents	8	6.8	6	5.7
- Assault	13	11.1	11	10.5
- Other	56	47.9	48	45.7
Medical and surgical disorders	**467**		**493**	
- Cardiac disease	165	35.3	169	34.3
- Endocrine	19	4.1	20	4.1
- GIT	45	9.6	35	7.1
- CNS	41	8.8	50	10.1
- Respiratory	58	12.4	71	14.4
- Haematological	22	4.7	24	4.9
- Genito-urinary	12	2.6	9	1.8
- Auto-immune	6	1.3	3	0.6
- Skeletal	1	0.2	1	0.2
- Psychiatric	5	1.1	11	2.2
- Neoplasm	39	8.4	32	6.5
- Other	54	11.6	68	13.8
Non-pregnancy-related infections	**968**		**1374**	
- PCP pneumonia	177	18.3	226	16.4
- Other pneumonia	159	16.4	310	22.6
- TB	336	34.7	396	28.8
- Endocarditis	2	0.2	4	0.3
- UTI	5	0.5	6	0.4
- Appendicitis	1	0.1	0	0.0
- Malaria	15	1.5	12	0.9
- Cryptococcal meningitis	44	4.5	56	4.1
- Other meningitis	61	6.3	129	9.4
- Kaposi's sarcoma	19	2.0	26	1.9
- Toxoplasmosis	2	0.2	0	0.0
- Hepatitis	10	1.0	20	1.5
- Gastroenteritis	51	5.3	63	4.6
- Wasting syndrome	26	2.7	57	4.1
- Other	60	6.2	69	5.0
Ectopic pregnancy	**95**		**102**	
- Less than 20 weeks	90	94.7	94	92.2
- More than 20 weeks	5	5.6	8	7.8
Miscarriage	**165**		**185**	
- Septic miscarriage	107	64.8	114	61.6
- Haemorrhage (non-traumatic)	33	20.0	48	25.9
- Uterine trauma	9	5.5	6	3.2
- GTD	5	3.0	8	4.3
- Following legal TOP	11	6.7	9	4.9
Pregnancy-related sepsis	201		226	
- Chorioamnionitis (ruptured membranes)	6	3.0	8	3.5
- Chorioamnionitis (intact membranes)	2	1.0	2	0.9
- Puerperal sepsis after NVD	94	46.8	117	51.8
- Puerperal sepsis after C/section	85	42.3	88	38.9
- Bowel trauma at C/section	14	7.0	11	4.9

Primary obstetric problems	2014-2016	Distribution per category (%)	2011-2013	Distribution per category (%)
Obstetric haemorrhage	**624**		**684**	
- Abruption with hypertension	39	6.3	56	8.2
- Abruption without hypertension	41	6.6	54	7.9
- Placenta praevia	16	2.6	16	2.3
- Other APH not specified	12	1.9	8	1.2
- Ruptured uterus with previous c/s	46	7.4	52	7.6
- Ruptured uterus without previous c/s	48	7.7	51	7.5
- Retained placenta	43	6.9	45	6.6
- Morbidly adherent placenta	16	2.6	17	2.5
- Uterine atony	59	9.5	50	7.3
- Vaginal trauma	7	1.1	4	0.6
- Cervical trauma	23	3.7	21	3.1
- Inverted uterus	4	0.6	5	0.7
- Bleeding during Caesarean section	53	8.5	42	6.1
- Bleeding after Caesarean section	165	26.4	179	26.2
- Other PPH not specified	52	8.3	84	12.3
Hypertension	**661**		**640**	
- Chronic hypertension	40	6.1	28	4.4
- Proteinuric hypertension	181	27.4	169	26.4
- Eclampsia	347	52.5	347	54.2
- HELLP	85	12.9	85	13.3
- Liver rupture	8	1.2	6	0.9
Anaesthetic complications	**87**		**105**	
- General anaesthetic	18	20.7	30	28.6
- Epidural anaesthetic	1	1.1	0	0.0
- Spinal anaesthetic	68	78.2	75	71.4
Adverse drug reactions	**54**		**144**	
- ARV medication	27	50.0	130	90.3
- TB medication	2	3.7	0	0.0
- Other medication	9	16.7	0	0.0
- Herbal medication	14	25.9	14	9.7
- Blood transfusion reaction	2	3.7	0	0.0
Embolism	**111**		**102**	
- Pulmonary embolism	99	89.2	83	81.4
- Amniotic fluid embolism	12	10.8	19	18.6
Acute collapse - cause unknown	**77**		**106**	
Miscellaneous	**18**		**10**	
- Hyperemesis gravidarum	10	55.6	5	50.0
- Acute fatty liver	8	44.4	5	50.0
Unknown	**169**		**181**	
- Death at home or outside health services	100	59.2	88	48.6
- No primary cause found	34	20.1	34	18.8
- Lack of information	35	20.7	59	32.6
Total deaths during pregnancy, childbirth and puerperium	**3814**		**4452**	

Note: Categories for 2011-2013 were adjusted to meet the new classification of 2014-2016

Number of maternal deaths per category per year

Underlying cause	2011	2012	2013	2014	2015	2016
Direct	**745**	**738**	**672**	**689**	**702**	**648**
Hypertension	214	221	205	221	222	218
Obstetric haemorrhage	233	242	209	226	217	181
Ectopic pregnancy	38	22	42	23	36	36
Miscarriage	66	65	54	48	61	56
Pregnancy-related sepsis	84	68	74	65	65	71
Anaesthetic complications	41	41	23	34	28	25
Embolism	29	42	31	38	37	36
Acute collapse - cause unknown	38	36	32	26	31	20
Miscellaneous	2	1	2	8	5	5
Indirect	**715**	**658**	**624**	**571**	**442**	**422**
Non-pregnancy-related infections	550	509	445	395	310	263
Medical and surgical disorders	165	149	179	176	132	159
Unknown	64	65	52	57	51	61
Total maternal deaths	1524	1461	1348	1342	1212	1143*

* - Under-reporting, estimate 1185

iMMR per underlying cause per year

Underlying cause	2011	2012	2013*	2014	2015	2016*
Hypertension	22.90	23.48	22.69	23.19	24.07	25.78
Obstetric haemorrhage	24.94	25.71	23.13	23.71	23.53	21.41
Ectopic pregnancy	4.07	2.34	4.65	2.41	3.90	4.26
Miscarriage	7.06	6.91	5.98	5.04	6.61	6.62
Pregnancy-related sepsis	8.99	7.22	8.19	6.82	7.05	8.40
Anaesthetic complications	4.39	4.36	2.55	3.57	3.04	2.96
Embolism	3.10	4.46	3.43	3.99	4.01	4.26
Acute collapse - cause unknown	4.07	3.82	3.54	2.73	3.36	2.37
Non-pregnancy-related infections	58.87	54.08	49.24	41.44	33.61	31.11
Medical and surgical disorders	17.66	15.83	19.81	18.47	14.31	18.81
Unknown	6.85	6.91	5.75	5.98	5.53	7.21
Total:	163.11	155.23	149.17	140.81	131.41	135.19

* - 2013 and 2016 corrected for under-reporting

Comparison number and iMMR per underlying condition per triennium

Underlying cause	2011-13 N	2014-16 N	2011-13 iMMR	2014-16 iMMR
Medical and surgical disorders	493	467	17.53	16.97
Non-pregnancy-related infections	1504	968	53.47	35.17
Ectopic pregnancy	102	95	3.63	3.45
Miscarriage	185	165	6.58	6.00
Pregnancy-related sepsis	226	201	8.04	7.30
Obstetric haemorrhage	684	624	24.32	22.67
Hypertension	640	661	22.75	24.02
Anaesthetic complications	105	87	3.73	3.16
Embolism	102	111	3.63	4.03
Acute collapse - cause unknown	106	77	3.77	2.80
Unknown	181	169	6.44	6.14
Total Maternal Deaths	**4333**	**3697**	**154.06**	**134.33**
Total: DDPCP	4452	3814		
Coincidental cause	119	117		

Impact HIV infection on maternal deaths

Underlying causes	All	HIV Status unknown	Negative	Positive	On ART (FDC or HAART)
Medical and surgical disorders	**467**	**59**	**234**	**174**	**119**
- Cardiac disease	165	11	105	49	33
- Endocrine	19	4	9	6	2
- GIT	45	9	16	20	15
- CNS	41	8	15	18	10
- Respiratory	58	8	31	19	14
- Haematological	22	3	8	11	7
- Genito-urinary	12	2	4	6	5
- Auto-immune	6	1	3	2	0
- Skeletal	1	0	0	1	1
- Psychiatric	5	3	0	2	2
- Neoplasm	39	2	15	22	17
- Other	54	8	28	18	13
Non-pregnancy-related infections	**968**	**22**	**86**	**860**	**581**
- PCP pneumonia	177	1	1	175	104
- Other pneumonia	159	6	25	128	83
- TB	336	2	20	314	221
- Endocarditis	2	0	1	1	1
- UTI	5	0	1	4	4
- Appendicitis	1	0	1	0	0
- Malaria	15	5	5	5	2
- Cryptococcal meningitis	44	2	2	40	32
- Other meningitis	61	5	12	44	32
- Kaposi's sarcoma	19	0	0	19	13
- Toxoplasmosis	2	0	0	2	2
- Hepatitis	10	0	4	6	6
- Gastroenteritis	51	0	1	50	33
- Wasting syndrome	26	1	0	25	14
- Other	60	0	13	47	34
Ectopic pregnancy	**95**	**52**	**12**	**31**	**16**
- Less than 20 weeks	90	51	12	27	13
- More than 20 weeks	5	1	0	4	3
Miscarriage	**165**	**66**	**23**	**76**	**28**
- Septic miscarriage	107	48	15	44	12
- Haemorrhage (non-traumatic)	33	12	3	18	11
- Uterine trauma	9	2	2	5	0
- GTD	5	2	0	3	1
- Following legal TOP	11	2	3	6	4
Pregnancy-related sepsis	**201**	**18**	**74**	**109**	**82**
- Chorioamnionitis (ruptured membranes)	6	2	1	3	0
- Chorioamnionitis (intact membranes)	2	1	1	0	0
- Puerperal sepsis after NVD	94	9	30	55	40
- Puerperal sepsis after C/section	85	5	36	44	36
- Bowel trauma at C/section	14	1	6	7	6

Underlying causes	All	HIV Status unknown	Negative	Positive	On ART (FDC or HAART)
Obstetric haemorrhage	**624**	**55**	**330**	**239**	**194**
- Abruption with hypertension	39	4	19	16	12
- Abruption without hypertension	41	9	21	11	9
- Placenta praevia	16	0	13	3	3
- Other APH not specified	12	2	5	5	4
- Ruptured uterus with previous c/s	46	7	18	21	18
- Ruptured uterus without previous c/s	48	3	31	14	13
- Retained placenta	43	7	16	20	12
- Morbidly adherent placenta	16	2	7	7	5
- Uterine atony	59	4	32	23	18
- Vaginal trauma	7	0	1	6	5
- Cervical trauma	23	1	12	10	9
- Inverted uterus	4	1	2	1	1
- Bleeding during Caesarean section	53	5	28	20	17
- Bleeding after Caesarean section	165	7	97	61	54
- Other PPH not specified	52	3	28	21	14
Hypertension	**661**	**85**	**409**	**167**	**122**
- Chronic hypertension	40	7	22	11	9
- Proteinuric hypertension	181	13	122	46	37
- Eclampsia	347	54	206	87	60
- HELLP	85	10	53	22	16
- Liver rupture	8	1	6	1	0
Anaesthetic complications	**87**	**6**	**55**	**26**	**22**
- General anaesthetic	18	4	8	6	6
- Epidural anaesthetic	1	0	1	0	0
- Spinal anaesthetic	68	2	46	20	16
Adverse drug reactions	**54**	**8**	**11**	**35**	**32**
- ARV medication	27	1	0	26	26
- TB medication	2	0	1	1	1
- Other medication	9	4	3	2	1
- Herbal medication	14	3	5	6	4
- Blood transfusion reaction	2	0	2	0	0
Embolism	**111**	**14**	**67**	**30**	**26**
- Pulmonary embolism	99	12	60	27	23
- Amniotic fluid embolism	12	2	7	3	3
Acute collapse - cause unknown	**77**	**12**	**41**	**24**	**18**
Miscellaneous	**18**	**3**	**11**	**4**	**3**
- Hyperemesis gravidarum	10	2	6	2	1
- Acute fatty liver	8	1	5	2	2
Unknown	**169**	**44**	**71**	**54**	**42**
- Death at home or outside health services	100	27	48	25	18
- No primary cause found	34	5	13	16	13
- Lack of information	35	12	10	13	11
Total	**3697**	**520**	**1453**	**1841**	**1293**

Distribution of underlying causes per province for 2014-2016

Underlying cause	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA
Medical and surgical disorders	72	28	90	104	69	22	30	7	45	467
Non-pregnancy-related infections	142	62	175	222	135	74	91	21	46	968
Ectopic pregnancy	6	5	24	20	17	9	8	0	6	95
Miscarriage	13	9	53	27	34	11	13	1	4	165
Pregnancy-related sepsis	25	13	54	36	37	10	12	1	13	201
Obstetric haemorrhage	84	36	135	86	123	72	49	18	21	624
Hypertension	94	41	161	105	102	63	52	17	26	661
Anaesthetic complications	13	3	10	19	24	7	7	0	4	87
Adverse drug reactions	5	2	9	18	8	8	2	1	1	54
Embolism	17	6	31	12	18	5	5	4	13	111
Acute collapse - cause unknown	5	8	23	17	7	5	5	3	4	77
Miscellaneous	1	0	3	4	6	0	0	0	4	18
Unknown	14	13	24	50	27	9	19	5	8	169
Total Maternal Deaths	491	226	792	720	607	295	293	78	195	3697

Key

	Highest number maternal deaths

Distribution of underlying causes per province 2014-2016

Underlying cause	EC	FS	Gau	KZN	Lim	Mpu	NW	NC	WC	SA	>15%	<15%
Medical and surgical disorders	21.77	21.64	14.63	18.36	18.77	9.86	17.63	10.89	15.76	16.97	19.51	14.42
Non-pregnancy-related infections	42.94	47.91	28.45	39.20	36.73	33.16	53.47	32.68	16.11	35.17	40.45	29.90
Ectopic pregnancy	1.81	3.86	3.90	3.53	4.63	4.03	4.70	0.00	2.10	3.45	3.97	2.93
Miscarriage	3.93	6.95	8.62	4.77	9.25	4.93	7.64	1.56	1.40	6.00	6.89	5.10
Pregnancy-related sepsis	7.56	10.05	8.78	6.36	10.07	4.48	7.05	1.56	4.55	7.30	8.40	6.21
Obstetric haemorrhage	25.40	27.82	21.95	15.19	33.47	32.26	28.79	28.01	7.36	22.67	26.07	19.27
Hypertension	28.42	31.68	26.18	18.54	27.75	28.23	30.56	26.45	9.11	24.02	27.62	20.42
Anaesthetic complications	3.93	2.32	1.63	3.35	6.53	3.14	4.11	0.00	1.40	3.16	3.64	2.69
Adverse drug reactions	1.51	1.55	1.46	3.18	2.18	3.58	1.18	1.56	0.35	1.96	2.26	1.67
Embolism	5.14	4.64	5.04	2.12	4.90	2.24	2.94	6.22	4.55	4.03	4.64	3.43
Acute collapse - cause unknown	1.51	6.18	3.74	3.00	1.90	2.24	2.94	4.67	1.40	2.80	3.22	2.38
Miscellaneous	0.30	0.00	0.49	0.71	1.63	0.00	0.00	0.00	1.40	0.65	0.75	0.56
Unknown	4.23	10.05	3.90	8.83	7.35	4.03	11.16	7.78	2.80	6.14	7.06	5.22
iMMR per province	148.47	174.63	128.78	127.14	165.16	132.19	172.17	121.37	68.30	134.33	154.48	114.18
Total: DDPCP	151.19	180.04	133.49	130.67	169.51	134.43	173.94	132.26	75.65	138.58	159.37	117.80
Coincidental cause	2.72	5.41	4.72	3.53	4.35	2.24	1.76	10.89	7.36	4.25		

Key

	Highest
	>15%
	Between 15% above and below
	<15%
	Lowest

Distribution of maternal deaths per age category 2014-2016

Underlying cause	< 20 N	20 - 24 N	25 - 29 N	30 - 34 N	35 - 39 N	40 - 44 N	45+ N	Unknown N	Total N
Coincidental cause	**28**	**33**	**22**	**18**	**14**	**1**	**0**	**1**	**117**
- MVA	7	13	5	7	6	1	0	1	40
- Other accidents	2	3	0	2	1	0	0	0	8
- Assault	2	3	4	2	2	0	0	0	13
- Other	17	14	13	7	5	0	0	0	56
Medical and surgical disorders	**54**	**73**	**121**	**112**	**68**	**35**	**4**	**0**	**467**
- Cardiac disease	21	32	42	35	19	16	0	0	165
- Endocrine	0	4	7	4	2	2	0	0	19
- GIT	10	4	12	10	8	1	0	0	45
- CNS	3	7	9	12	6	4	0	0	41
- Respiratory	8	8	17	13	8	3	1	0	58
- Haematological	1	5	8	3	5	0	0	0	22
- Genito-urinary	1	1	2	5	2	1	0	0	12
- Auto-immune	1	0	2	2	1	0	0	0	6
- Skeletal	0	0	0	0	1	0	0	0	1
- Psychiatric	2	3	0	0	0	0	0	0	5
- Neoplasm	3	3	10	11	7	3	2	0	39
- Other	4	6	12	17	9	5	1	0	54
Non-pregnancy-related infections	**47**	**149**	**262**	**299**	**162**	**43**	**5**	**1**	**968**
- PCP pneumonia	5	26	50	53	34	5	3	1	177
- Other pneumonia	8	27	35	53	27	8	1	0	159
- TB	12	49	93	120	52	9	1	0	336
- Endocarditis	0	0	2	0	0	0	0	0	2
- UTI	0	0	1	2	1	1	0	0	5
- Appendicitis	0	1	0	0	0	0	0	0	1
- Malaria	3	4	3	4	0	1	0	0	15
- Cryptococcal meningitis	3	6	10	12	8	5	0	0	44
- Other meningitis	6	14	12	14	11	4	0	0	61
- Kaposi's sarcoma	1	0	11	6	1	0	0	0	19
- Toxoplasmosis	0	1	0	0	1	0	0	0	2
- Hepatitis	0	3	3	0	3	1	0	0	10
- Gastroenteritis	2	7	16	15	9	2	0	0	51
- Wasting syndrome	1	4	10	9	1	1	0	0	26
- Other	6	7	16	11	14	6	0	0	60

Underlying cause	< 20 N	20 - 24 N	25 - 29 N	30 - 34 N	35 - 39 N	40 - 44 N	45+ N	Unknown N	Total N
Ectopic pregnancy	**7**	**16**	**27**	**21**	**19**	**5**	**0**	**0**	**95**
- Less than 20 weeks	7	14	27	18	19	5	0	0	90
- More than 20 weeks	0	2	0	3	0	0	0	0	5
Miscarriage	**10**	**22**	**44**	**44**	**38**	**6**	**1**	**0**	**165**
- Septic miscarriage	8	16	28	26	26	3	0	0	107
- Haemorrhage (non-traumatic)	0	3	8	11	8	2	1	0	33
- Uterine trauma	0	1	4	2	2	0	0	0	9
- GTD	1	1	1	1	1	0	0	0	5
- Following legal TOP	1	1	3	4	1	1	0	0	11
Pregnancy-related sepsis	**17**	**30**	**56**	**58**	**31**	**8**	**1**	**0**	**201**
- Chorioamnionitis (ruptured membranes)	0	1	0	0	5	0	0	0	6
- Chorioamnionitis (intact membranes)	0	0	0	1	1	0	0	0	2
- Puerperal sepsis after NVD	10	15	25	23	14	7	0	0	94
- Puerperal sepsis after C/section	7	13	26	26	11	1	1	0	85
- Bowel trauma at C/section	0	1	5	8	0	0	0	0	14
Obstetric haemorrhage	**28**	**86**	**135**	**158**	**156**	**54**	**7**	**0**	**624**
- Abruption with hypertension	4	6	9	8	6	4	2	0	39
- Abruption without hypertension	4	3	11	14	8	1	0	0	41
- Placenta praevia	0	2	4	4	6	0	0	0	16
- Other APH not specified	0	2	5	2	3	0	0	0	12
- Ruptured uterus with previous c/s	0	5	10	14	13	4	0	0	46
- Ruptured uterus without previous c/s	2	2	8	14	15	7	0	0	48
- Retained placenta	2	5	7	9	14	6	0	0	43
- Morbidly adherent placenta	0	3	1	6	4	2	0	0	16
- Uterine atony	4	8	12	17	15	3	0	0	59
- Vaginal trauma	1	2	2	2	0	0	0	0	7
- Cervical trauma	0	7	4	8	2	2	0	0	23
- Inverted uterus	0	1	2	0	1	0	0	0	4
- Bleeding during Caesarean section	2	4	9	15	16	7	0	0	53
- Bleeding after Caesarean section	5	27	37	39	37	15	5	0	165
- Other PPH not specified	4	9	14	6	16	3	0	0	52

Underlying cause	< 20 N	20 - 24 N	25 - 29 N	30 - 34 N	35 - 39 N	40 - 44 N	45+ N	Unknown N	Total N
Hypertension	**107**	**143**	**138**	**140**	**100**	**28**	**4**	**1**	**661**
- Chronic hypertension	3	3	8	9	13	3	1	0	40
- Proteinuric hypertension	20	38	47	46	22	7	1	0	181
- Eclampsia	75	85	61	57	52	14	2	1	347
- HELLP	8	16	19	28	10	4	0	0	85
- Liver rupture	1	1	3	0	3	0	0	0	8
Anaesthetic complications	**15**	**15**	**21**	**19**	**15**	**2**	**0**	**0**	**87**
- General anaesthetic	1	5	2	2	8	0	0	0	18
- Epidural anaesthetic	0	0	1	0	0	0	0	0	1
- Spinal anaesthetic	14	10	18	17	7	2	0	0	68
Adverse drug reactions	**6**	**12**	**9**	**17**	**9**	**1**	**0**	**0**	**54**
- ARV medication	0	5	4	11	7	0	0	0	27
- TB medication	1	0	0	1	0	0	0	0	2
- Other medication	2	3	0	3	1	0	0	0	9
- Herbal medication	2	3	5	2	1	1	0	0	14
- Blood transfusion reaction	1	1	0	0	0	0	0	0	2
Embolism	**10**	**21**	**27**	**25**	**17**	**10**	**1**	**0**	**111**
- Pulmonary embolism	9	18	24	22	15	10	1	0	99
- Amniotic fluid embolism	1	3	3	3	2	0	0	0	12
Acute collapse - cause unknown	**9**	**11**	**14**	**18**	**16**	**8**	**1**	**0**	**77**
Miscellaneous	**2**	**3**	**5**	**3**	**3**	**2**	**0**	**0**	**18**
- Hyperemesis gravidarum	1	2	4	1	1	1	0	0	10
- Acute fatty liver	1	1	1	2	2	1	0	0	8
Unknown	**18**	**32**	**43**	**34**	**25**	**16**	**0**	**1**	**169**
- Death at home or outside health services	9	19	21	23	16	12	0	0	100
- No primary cause found	3	5	13	8	3	2	0	0	34
- Lack of information	6	8	9	3	6	2	0	1	35

Distribution of the underlying cause per age category 2014-6

Underlying cause	< 20 %	20 - 24 %	25 - 29 %	30 - 34 %	35 - 39 %	40 - 44 %	45+ %	Unknown %	Total %
Medical and surgical disorders	16.4	11.9	13.4	11.8	10.3	16.1	16.7	0.0	12.6
Non-pregnancy-related infections	14.2	24.3	29.0	31.5	24.6	19.7	20.8	33.3	26.2
Ectopic pregnancy	2.1	2.6	3.0	2.2	2.9	2.3	0.0	0.0	2.6
Miscarriage	3.0	3.6	4.9	4.6	5.8	2.8	4.2	0.0	4.5
Pregnancy-related sepsis	5.2	4.9	6.2	6.1	4.7	3.7	4.2	0.0	5.4
Obstetric haemorrhage	8.5	14.0	15.0	16.7	23.7	24.8	29.2	0.0	16.9
Hypertension	32.4	23.3	15.3	14.8	15.2	12.8	16.7	33.3	17.9
Anaesthetic complications	4.5	2.4	2.3	2.0	2.3	0.9	0.0	0.0	2.4
Adverse drug reactions	1.8	2.0	1.0	1.8	1.4	0.5	0.0	0.0	1.5
Embolism	3.0	3.4	3.0	2.6	2.6	4.6	4.2	0.0	3.0
Acute collapse - cause unknown	2.7	1.8	1.6	1.9	2.4	3.7	4.2	0.0	2.1
Miscellaneous	0.6	0.5	0.6	0.3	0.5	0.9	0.0	0.0	0.5
Unknown	5.5	5.2	4.8	3.6	3.8	7.3	0.0	33.3	4.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Distribution of the age category of maternal death per underlying cause 2014-6

Primary obstetric problem	< 20 %	20 – 24 %	25 – 29 %	30 – 34 %	35 – 39 %	40 – 44 %	45+ %	Unknown %	Total %
Medical and surgical disorders	11.6	15.6	25.9	24.0	14.6	7.5	0.9	0.0	100.0
Non-pregnancy-related infections	4.9	15.4	27.1	30.9	16.7	4.4	0.5	0.1	100.0
Ectopic pregnancy	7.4	16.8	28.4	22.1	20.0	5.3	0.0	0.0	100.0
Miscarriage	6.1	13.3	26.7	26.7	23.0	3.6	0.6	0.0	100.0
Pregnancy-related sepsis	8.5	14.9	27.9	28.9	15.4	4.0	0.5	0.0	100.0
Obstetric haemorrhage	4.5	13.8	21.6	25.3	25.0	8.7	1.1	0.0	100.0
Hypertension	16.2	21.6	20.9	21.2	15.1	4.2	0.6	0.2	100.0
Anaesthetic complications	17.2	17.2	24.1	21.8	17.2	2.3	0.0	0.0	100.0
Adverse drug reactions	11.1	22.2	16.7	31.5	16.7	1.9	0.0	0.0	100.0
Embolism	9.0	18.9	24.3	22.5	15.3	9.0	0.9	0.0	100.0
Acute collapse – cause unknown	11.7	14.3	18.2	23.4	20.8	10.4	1.3	0.0	100.0
Miscellaneous	11.1	16.7	27.8	16.7	16.7	11.1	0.0	0.0	100.0
Unknown	10.7	18.9	25.4	20.1	14.8	9.5	0.0	0.6	100.0
Total	**8.9**	**16.6**	**24.4**	**25.6**	**17.8**	**5.9**	**0.6**	**0.1**	**100.0**

Distribution of maternal deaths per parity 2014-6

Underlying cause	P0 N	P1 N	P2 N	P3 N	P4 N	P5 N	P6+ N	Unknown N	Total N
Coincidental cause	**44**	**21**	**17**	**3**	**1**	**0**	**1**	**30**	**117**
- MVA	14	11	4	1	0	0	0	10	40
- Other accidents	4	0	2	0	1	0	0	1	8
- Assault	3	0	3	0	0	0	1	6	13
- Other	23	10	8	2	0	0	0	13	56
Medical and surgical disorders	**137**	**139**	**95**	**56**	**14**	**4**	**8**	**14**	**467**
- Cardiac disease	56	45	29	21	5	1	2	6	165
- Endocrine	6	6	2	4	0	0	0	1	19
- GIT	13	18	9	4	1	0	0	0	45
- CNS	9	15	8	2	1	0	2	4	41
- Respiratory	20	14	12	6	2	1	2	1	58
- Haematological	5	5	6	6	0	0	0	0	22
- Genito-urinary	2	2	4	3	1	0	0	0	12
- Auto-immune	2	2	2	0	0	0	0	0	6
- Skeletal	0	0	0	1	0	0	0	0	1
- Psychiatric	3	2	0	0	0	0	0	0	5
- Neoplasm	6	22	6	2	2	1	0	0	39
- Other	15	8	17	7	2	1	2	2	54
Non-pregnancy-related infections	**193**	**293**	**250**	**117**	**59**	**18**	**5**	**33**	**968**
- PCP pneumonia	40	57	51	17	6	1	1	4	177
- Other pneumonia	40	41	43	19	8	0	0	8	159
- TB	59	114	79	40	26	5	3	10	336
- Endocarditis	0	2	0	0	0	0	0	0	2
- UTI	1	0	2	2	0	0	0	0	5
- Appendicitis	0	1	0	0	0	0	0	0	1
- Malaria	3	5	4	1	1	1	0	0	15
- Cryptococcal meningitis	4	14	10	8	2	4	0	2	44
- Other meningitis	14	15	15	11	1	3	0	2	61
- Kaposi's sarcoma	2	8	6	2	0	0	0	1	19
- Toxoplasmosis	1	0	0	0	0	0	0	1	2
- Hepatitis	2	3	3	1	1	0	0	0	10
- Gastroenteritis	10	13	13	5	5	1	1	3	51
- Wasting syndrome	4	8	7	1	4	1	0	1	26
- Other	13	12	17	10	5	2	0	1	60

Underlying cause	P0 N	P1 N	P2 N	P3 N	P4 N	P5 N	P6+ N	Unknown N	Total N
Ectopic pregnancy	**19**	**32**	**18**	**5**	**3**	**1**	**0**	**17**	**95**
- Less than 20 weeks	17	31	17	5	3	1	0	16	90
- More than 20 weeks	2	1	1	0	0	0	0	1	5
Miscarriage	32	47	44	19	5	2	2	14	165
- Septic miscarriage	19	31	28	14	2	1	1	11	107
- Haemorrhage (non-traumatic)	6	12	6	4	2	1	1	1	33
- Uterine trauma	0	2	5	0	0	0	0	2	9
- GTD	2	1	1	1	0	0	0	0	5
- Following legal TOP	5	1	4	0	1	0	0	0	11
Pregnancy-related sepsis	52	56	46	22	9	5	3	8	201
- Chorioamnionitis (ruptured membranes)	2	1	0	3	0	0	0	0	6
- Chorioamnionitis (intact membranes)	0	0	1	1	0	0	0	0	2
- Puerperal sepsis after NVD	25	25	23	7	4	3	3	4	94
- Puerperal sepsis after C/section	23	23	17	11	5	2	0	4	85
- Bowel trauma at C/section	2	7	5	0	0	0	0	0	14
Obstetric haemorrhage	**102**	**141**	**178**	**96**	**49**	**30**	**21**	**7**	**624**
- Abruption with hypertension	9	8	10	4	3	2	3	0	39
- Abruption without hypertension	8	7	14	9	1	1	1	0	41
- Placenta praevia	2	4	5	3	2	0	0	0	16
- Other APH not specified	4	4	0	3	0	0	1	0	12
- Ruptured uterus with previous c/s	0	11	17	8	5	3	1	1	46
- Ruptured uterus without previous c/s	4	9	11	10	10	3	1	0	48
- Retained placenta	4	7	13	9	3	2	2	3	43
- Morbidly adherent placenta	4	3	5	3	0	1	0	0	16
- Uterine atony	10	16	13	11	2	2	5	0	59
- Vaginal trauma	2	1	3	1	0	0	0	0	7
- Cervical trauma	8	2	4	6	2	0	0	1	23
- Inverted uterus	1	0	3	0	0	0	0	0	4
- Bleeding during Caesarean section	6	13	15	7	4	5	1	2	53
- Bleeding after Caesarean section	27	46	51	16	14	7	4	0	165
- Other PPH not specified	13	10	14	6	3	4	2	0	52
Hypertension	**279**	**145**	**118**	**73**	**16**	**12**	**7**	**11**	**661**
- Chronic hypertension	10	9	11	5	2	0	1	2	40
- Proteinuric hypertension	79	41	29	19	3	4	1	5	181
- Eclampsia	156	75	63	32	7	6	4	4	347
- HELLP	32	18	14	14	4	2	1	0	85
- Liver rupture	2	2	1	3	0	0	0	0	8

Underlying cause	P0 N	P1 N	P2 N	P3 N	P4 N	P5 N	P6+ N	Unknown N	Total N
Anaesthetic complications	**27**	**28**	**14**	**10**	**4**	**2**	**1**	**1**	**87**
- General anaesthetic	4	8	1	2	1	1	0	1	18
- Epidural anaesthetic	0	0	1	0	0	0	0	0	1
- Spinal anaesthetic	23	20	12	8	3	1	1	0	68
Adverse drug reactions	**14**	**16**	**14**	**5**	**2**	**2**	**0**	**1**	**54**
- ARV medication	3	9	9	4	0	2	0	0	27
- TB medication	1	1	0	0	0	0	0	0	2
- Other medication	3	2	3	0	1	0	0	0	9
- Herbal medication	5	4	2	1	1	0	0	1	14
- Blood transfusion reaction	2	0	0	0	0	0	0	0	2
Embolism	**37**	**29**	**16**	**16**	**4**	**3**	**3**	**3**	**111**
- Pulmonary embolism	34	24	14	15	4	3	2	3	99
- Amniotic fluid embolism	3	5	2	1	0	0	1	0	12
Acute collapse - cause unknown	**20**	**19**	**20**	**9**	**4**	**5**	**0**	**0**	**77**
Miscellaneous	**6**	**5**	**4**	**2**	**1**	**0**	**0**	**0**	**18**
- Hyperemesis gravidarum	4	2	2	1	1	0	0	0	10
- Acute fatty liver	2	3	2	1	0	0	0	0	8
Unknown	**39**	**47**	**37**	**24**	**8**	**3**	**1**	**10**	**169**
- Death at home or outside health services	19	24	23	16	5	2	1	10	100
- No primary cause found	7	13	9	5	0	0	0	0	34
- Lack of information	13	10	5	3	3	1	0	0	35

Distribution of underlying cause of maternal death per parity 2014-6

Underlying cause	P0 %	P1 %	P2 %	P3 %	P4 %	P5 %	P6+ %	Unknown %	Total %
Medical and surgical disorders	14.3	13.9	11.1	12.3	7.9	4.6	15.7	11.8	12.6
Non-pregnancy-related infections	20.2	29.4	29.3	25.8	33.1	20.7	9.8	27.7	26.2
Ectopic pregnancy	2.0	3.2	2.1	1.1	1.7	1.1	0.0	14.3	2.6
Miscarriage	3.3	4.7	5.2	4.2	2.8	2.3	3.9	11.8	4.5
Pregnancy-related sepsis	5.4	5.6	5.4	4.8	5.1	5.7	5.9	6.7	5.4
Obstetric haemorrhage	10.7	14.1	20.8	21.1	27.5	34.5	41.2	5.9	16.9
Hypertension	29.2	14.5	13.8	16.1	9.0	13.8	13.7	9.2	17.9
Anaesthetic complications	2.8	2.8	1.6	2.2	2.2	2.3	2.0	0.8	2.4
Adverse drug reactions	1.5	1.6	1.6	1.1	1.1	2.3	0.0	0.8	1.5
Embolism	3.9	2.9	1.9	3.5	2.2	3.4	5.9	2.5	3.0
Acute collapse - cause unknown	2.1	1.9	2.3	2.0	2.2	5.7	0.0	0.0	2.1
Miscellaneous	0.6	0.5	0.5	0.4	0.6	0.0	0.0	0.0	0.5
Unknown	4.1	4.7	4.3	5.3	4.5	3.4	2.0	8.4	4.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Distribution of parity within the underlying cause of maternal deaths 2014-6

Underlying cause	P0 %	P1 %	P2 %	P3 %	P4 %	P5 %	P6+ %	Unknown %	Total %
Medical and surgical disorders	29.3	29.8	20.3	12.0	3.0	0.9	1.7	3.0	100.0
Non-pregnancy-related infections	19.9	30.3	25.8	12.1	6.1	1.9	0.5	3.4	100.0
Ectopic pregnancy	20.0	33.7	18.9	5.3	3.2	1.1	0.0	17.9	100.0
Miscarriage	19.4	28.5	26.7	11.5	3.0	1.2	1.2	8.5	100.0
Pregnancy-related sepsis	25.9	27.9	22.9	10.9	4.5	2.5	1.5	4.0	100.0
Obstetric haemorrhage	16.3	22.6	28.5	15.4	7.9	4.8	3.4	1.1	100.0
Hypertension	42.2	21.9	17.9	11.0	2.4	1.8	1.1	1.7	100.0
Anaesthetic complications	31.0	32.2	16.1	11.5	4.6	2.3	1.1	1.1	100.0
Adverse drug reactions	25.9	29.6	25.9	9.3	3.7	3.7	0.0	1.9	100.0
Embolism	33.3	26.1	14.4	14.4	3.6	2.7	2.7	2.7	100.0
Acute collapse - cause unknown	26.0	24.7	26.0	11.7	5.2	6.5	0.0	0.0	100.0
Miscellaneous	33.3	27.8	22.2	11.1	5.6	0.0	0.0	0.0	100.0
Unknown	23.1	27.8	21.9	14.2	4.7	1.8	0.6	5.9	100.0
Total	25.9	27.0	23.1	12.3	4.8	2.4	1.4	3.2	100.0

Primary obstetric problem	Outside N	CHC N	District hospital N	Regional hospital N	Tertiary hospital N	Nat central hospital N	Private hospital N	Total N
Coincidental cause	**24**	**2**	**25**	**29**	**28**	**5**	**4**	**117**
- MVA	9	1	9	6	11	1	3	40
- Other accidents	2	0	2	1	3	0	0	8
- Assault	6	0	3	1	3	0	0	13
- Other	7	1	11	21	11	4	1	56
Medical and surgical disorders	**13**	**9**	**89**	**146**	**141**	**47**	**22**	**467**
- Cardiac disease	9	3	35	44	46	23	5	165
- Endocrine	0	0	3	11	5	0	0	19
- GIT	1	2	8	16	15	0	3	45
- CNS	0	0	3	19	12	6	1	41
- Respiratory	2	0	16	16	14	4	6	58
- Haematological	0	0	5	7	6	1	3	22
- Genito-urinary	0	0	3	4	3	2	0	12
- Auto-immune	1	0	0	1	4	0	0	6
- Skeletal	0	0	1	0	0	0	0	1
- Psychiatric	0	1	0	3	0	0	1	5
- Neoplasm	0	0	7	8	20	3	1	39
- Other	0	3	8	17	16	8	2	54
Non-pregnancy-related infections	**8**	**6**	**292**	**331**	**238**	**66**	**27**	**968**
- PCP pneumonia	0	0	52	54	45	16	10	177
- Other pneumonia	3	3	39	59	34	12	9	159
- TB	4	2	105	116	89	16	4	336
- Endocarditis	0	0	0	0	2	0	0	2
- UTI	0	0	1	2	1	1	0	5
- Appendicitis	0	0	1	0	0	0	0	1
- Malaria	0	0	5	5	5	0	0	15
- Cryptococcal meningitis	0	0	20	13	6	5	0	44
- Other meningitis	0	1	13	24	16	7	0	61
- Kaposi's sarcoma	0	0	2	9	6	1	1	19
- Toxoplasmosis	0	0	0	1	0	0	1	2
- Hepatitis	0	0	2	2	4	2	0	10
- Gastroenteritis	0	0	29	14	7	1	0	51
- Wasting syndrome	1	0	12	6	6	1	0	26
- Other	0	0	11	26	17	4	2	60

Primary obstetric problem	Outside N	CHC N	District hospital N	Regional hospital N	Tertiary hospital N	Nat central hospital N	Private hospital N	Total N
Ectopic pregnancy	**3**	**3**	**33**	**26**	**22**	**8**	**0**	**95**
- Less than 20 weeks	2	3	32	25	20	8	0	90
- More than 20 weeks	1	0	1	1	2	0	0	5
Miscarriage	**2**	**5**	**47**	**64**	**27**	**18**	**2**	**165**
- Septic miscarriage	0	4	29	40	19	15	0	107
- Haemorrhage (non-traumatic)	1	1	12	14	2	1	2	33
- Uterine trauma	0	0	2	5	1	1	0	9
- GTD	0	0	1	1	2	1	0	5
- Following legal TOP	1	0	3	4	3	0	0	11
Pregnancy-related sepsis	**4**	**1**	**39**	**75**	**59**	**17**	**6**	**201**
- Chorioamnionitis (ruptured membranes)	0	0	0	3	3	0	0	6
- Chorioamnionitis (intact membranes)	0	0	0	2	0	0	0	2
- Puerperal sepsis after NVD	1	0	27	33	25	8	0	94
- Puerperal sepsis after C/section	3	1	12	29	26	9	5	85
- Bowel trauma at C/section	0	0	0	8	5	0	1	14
Obstetric haemorrhage	**19**	**9**	**202**	**190**	**134**	**36**	**34**	**624**
- Abruption with hypertension	1	1	6	13	14	4	0	39
- Abruption without hypertension	1	1	10	14	6	4	5	41
- Placenta praevia	0	0	2	7	3	1	3	16
- Other APH not specified	2	2	4	2	2	0	0	12
- Ruptured uterus with previous c/s	0	1	16	20	4	2	3	46
- Ruptured uterus without previous c/s	1	0	17	13	11	4	2	48
- Retained placenta	3	1	15	16	5	3	0	43
- Morbidly adherent placenta	1	0	0	6	3	3	3	16
- Uterine atony	1	1	21	16	15	2	3	59
- Vaginal trauma	0	0	2	2	3	0	0	7
- Cervical trauma	2	0	8	12	0	0	1	23
- Inverted uterus	1	0	3	0	0	0	0	4
- Bleeding during Caesarean section	0	0	16	16	17	1	3	53
- Bleeding after Caesarean section	2	2	50	43	47	10	11	165
- Other PPH not specified	4	0	32	10	4	2	0	52
Hypertension	**25**	**20**	**141**	**204**	**177**	**70**	**24**	**661**
- Chronic hypertension	1	3	14	7	8	3	4	40
- Proteinuric hypertension	11	6	46	55	39	18	6	181
- Eclampsia	13	11	70	108	99	37	9	347
- HELLP	0	0	9	32	29	11	4	85
- Liver rupture	0	0	2	2	2	1	1	8

Primary obstetric problem	Outside N	CHC N	District hospital N	Regional hospital N	Tertiary hospital N	Nat central hospital N	Private hospital N	Total N
Anaesthetic complications	**0**	**0**	**49**	**22**	**14**	**1**	**1**	**87**
- General anaesthetic	0	0	6	7	5	0	0	18
- Epidural anaesthetic	0	0	0	0	0	0	1	1
- Spinal anaesthetic	0	0	43	15	9	1	0	68
Adverse drug reactions	**1**	**0**	**12**	**22**	**16**	**1**	**2**	**54**
- ARV medication	0	0	8	10	7	1	1	27
- TB medication	0	0	0	1	1	0	0	2
- Other medication	0	0	1	4	3	0	1	9
- Herbal medication	1	0	2	7	4	0	0	14
- Blood transfusion reaction	0	0	1	0	1	0	0	2
Embolism	**9**	**4**	**22**	**32**	**27**	**8**	**9**	**111**
- Pulmonary embolism	9	4	19	27	25	8	7	99
- Amniotic fluid embolism	0	0	3	5	2	0	2	12
Acute collapse - cause unknown	**10**	**6**	**21**	**20**	**8**	**7**	**5**	**77**
Miscellaneous	**0**	**0**	**3**	**5**	**8**	**1**	**1**	**18**
- Hyperemesis gravidarum	0	0	3	4	3	0	0	10
- Acute fatty liver	0	0	0	1	5	1	1	8
Unknown	**84**	**12**	**30**	**24**	**9**	**3**	**7**	**169**
- Death at home or outside health services	82	5	3	3	4	0	3	100
- No primary cause found	0	3	15	9	1	2	4	34
- Lack of information	2	4	12	12	4	1	0	35

Pattern of underlying causes per level of care

Underlying cause	Outside %	CHC %	District hospital %	Regional hospital %	Tertiary hospital %	Nat central hospital %	Private hospital %	Total %
Medical and surgical disorders	7.3	12.0	9.1	12.6	16.0	16.6	15.7	**12.6**
Non-pregnancy-related infections	4.5	8.0	29.8	28.5	27.0	23.3	19.3	**26.2**
Ectopic pregnancy	1.7	4.0	3.4	2.2	2.5	2.8	0.0	**2.6**
Miscarriage	1.1	6.7	4.8	5.5	3.1	6.4	1.4	**4.5**
Pregnancy-related sepsis	2.2	1.3	4.0	6.5	6.7	6.0	4.3	**5.4**
Obstetric haemorrhage	10.7	12.0	20.6	16.4	15.2	12.7	24.3	**16.9**
Hypertension	14.0	26.7	14.4	17.6	20.1	24.7	17.1	**17.9**
Anaesthetic complications	0.0	0.0	5.0	1.9	1.6	0.4	0.7	**2.4**
Adverse drug reactions	0.6	0.0	1.2	1.9	1.8	0.4	1.4	**1.5**
Embolism	5.1	5.3	2.2	2.8	3.1	2.8	6.4	**3.0**
Acute collapse - cause unknown	5.6	8.0	2.1	1.7	0.9	2.5	3.6	**2.1**
Miscellaneous	0.0	0.0	0.3	0.4	0.9	0.4	0.7	**0.5**
Unknown	47.2	16.0	3.1	2.1	1.0	1.1	5.0	**4.6**
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	**100.0**

Distribution of level of care which maternal deaths occurred per underlying cause

Primary obstetric problem	Outside %	CHC %	District hospital %	Regional hospital %	Tertiary hospital %	Nat central hospital %	Private hospital %	Total %
Medical and surgical disorders	2.8	1.9	19.1	31.3	30.2	10.1	4.7	100.0
Non-pregnancy-related infections	0.8	0.6	30.2	34.2	24.6	6.8	2.8	100.0
Ectopic pregnancy	3.2	3.2	34.7	27.4	23.2	8.4	0.0	100.0
Miscarriage	1.2	3.0	28.5	38.8	16.4	10.9	1.2	100.0
Pregnancy-related sepsis	2.0	0.5	19.4	37.3	29.4	8.5	3.0	100.0
Obstetric haemorrhage	3.0	1.4	32.4	30.4	21.5	5.8	5.4	100.0
Hypertension	3.8	3.0	21.3	30.9	26.8	10.6	3.6	100.0
Anaesthetic complications	0.0	0.0	56.3	25.3	16.1	1.1	1.1	100.0
Adverse drug reactions	1.9	0.0	22.2	40.7	29.6	1.9	3.7	100.0
Embolism	8.1	3.6	19.8	28.8	24.3	7.2	8.1	100.0
Acute collapse - cause unknown	13.0	7.8	27.3	26.0	10.4	9.1	6.5	100.0
Miscellaneous	0.0	0.0	16.7	27.8	44.4	5.6	5.6	100.0
Unknown	49.7	7.1	17.8	14.2	5.3	1.8	4.1	100.0
Total	**4.8**	**2.0**	**26.5**	**31.4**	**23.8**	**7.7**	**3.8**	**100.0**

Final causes of death per underlying cause

Final cause of death	M&S	NPRI	Ec	Misca	PRS	OH	HT	AR	ADR	Emb	AC	Miscel	Unk	All	Coin
- Hypovolaemic shock	39	34	79	73	16	563	56	11	5	4	1	3	6	890	31
- Septic shock	36	141	3	103	162	30	21	3	4	4	0	3	6	516	12
- Respiratory failure	155	661	13	35	54	59	153	38	18	31	13	4	24	1258	23
- Pulmonary oedema	165	50	5	7	11	39	227	13	2	17	5	3	5	549	12
- Acute collapse due to embolism	13	5	4	2	6	9	20	2	2	74	7	0	1	145	1
- Renal failure	58	127	6	33	56	41	114	5	19	6	1	12	7	485	10
- Liver failure	53	74	2	21	16	23	78	2	30	3	1	11	1	315	4
- Intracranial haemorrhage	34	2	0	1	2	4	191	2	2	1	2	0	3	244	15
- Cerebral oedema resulting in coning	9	6	0	1	4	1	37		1	0	0	0	0	59	3
- Meningitis	1	114	0	1	0	0	3		0	0	0	0	0	119	0
- Cerebral emboli	4	3	0		2	0	2		0	0	0	0	0	11	0
- Brain death following hypoxic event	21	9	2	1	2	9	72	23	1	1	1	0	0	142	6
- Unspecified cerebral problem	27	28		3	7	5	80	7	4	1	1	1	5	169	7
- Maternal ketoacidosis	19	12	1	2	3	7	13	1			1	1	0	60	0
- Electrolyte imbalance	40	103	4	17	26	18	28	1	6	2	1	8	7	261	8
- Thyroid crisis	2	3				1	2		0	0	0	1	0	9	0
- Lactic acidosis	10	15	1	15	9	10	15	1	4	3	1	2	1	87	5
- Other	4	11	1	1		3	3	1	2	1	1	1	0	29	1
- DIC	25	42	8	34	36	231	88	2	10	6		3	0	485	7
- Severe anaemia	45	118	22	55	35	135	41	2	5	6	3	1	6	474	8
- Immune system failure	78	608	8	36	62	71	40	8	15	12	1	0	22	961	3
Total	467	968	95	165	201	624	661	87	54	111	77	18	169	3697	

Note: There can be more than one condition given as the final cause of death

Distribution of final cause of death per underlying cause

Final cause of death	M&S	NPRI	Ec	Misca	PRS	OH	HT	AR	ADR	Emb	AC	Miscel	Unk	All
- Hypovolaemic shock	8.4	3.5	83.2	44.2	8.0	90.2	8.5	12.6	9.3	3.6	1.3	16.7	3.6	24.1
- Septic shock	7.7	14.6	3.2	62.4	80.6	4.8	3.2	3.4	7.4	3.6	0.0	16.7	3.6	14.0
- Respiratory failure	33.2	68.3	13.7	21.2	26.9	9.5	23.1	43.7	33.3	27.9	16.9	22.2	14.2	34.0
- Pulmonary oedema	35.3	5.2	5.3	4.2	5.5	6.3	34.3	14.9	3.7	15.3	6.5	16.7	3.0	14.8
- Acute collapse due to embolism	2.8	0.5	4.2	1.2	3.0	1.4	3.0	2.3	3.7	66.7	9.1	0.0	0.6	3.9
- Renal failure	12.4	13.1	6.3	20.0	27.9	6.6	17.2	5.7	35.2	5.4	1.3	66.7	4.1	13.1
- Liver failure	11.3	7.6	2.1	12.7	8.0	3.7	11.8	2.3	55.6	2.7	1.3	61.1	0.6	8.5
- Intracranial haemorrhage	7.3	0.2	0.0	0.6	1.0	0.6	28.9	2.3	3.7	0.9	2.6	0.0	1.8	6.6
- Cerebral oedema resulting in coning	1.9	0.6	0.0	0.6	2.0	0.2	5.6	0.0	1.9	0.0	0.0	0.0	0.0	1.6
- Meningitis	0.2	11.8	0.0	0.6	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	3.2
- Cerebral emboli	0.9	0.3	0.0	0.0	1.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
- Brain death following hypoxic event	4.5	0.9	2.1	0.6	1.0	1.4	10.9	26.4	1.9	0.9	1.3	0.0	0.0	3.8
- Unspecified cerebral problem	5.8	2.9	0.0	1.8	3.5	0.8	12.1	8.0	7.4	0.9	1.3	5.6	3.0	4.6
- Maternal ketoacidosis	4.1	1.2	1.1	1.2	1.5	1.1	2.0	1.1	0.0	0.0	1.3	5.6	0.0	1.6
- Electrolyte imbalance	8.6	10.6	4.2	10.3	12.9	2.9	4.2	1.1	11.1	1.8	1.3	44.4	4.1	7.1
- Thyroid crisis	0.4	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	5.6	0.0	0.2
- Lactic acidosis	2.1	1.5	1.1	9.1	4.5	1.6	2.3	1.1	7.4	2.7	1.3	11.1	0.6	2.4
- Other	0.9	1.1	1.1	0.6	0.0	0.5	0.5	1.1	3.7	0.9	1.3	5.6	0.0	0.8
- DIC	5.4	4.3	8.4	20.6	17.9	37.0	13.3	2.3	18.5	5.4	0.0	16.7	0.0	13.1
- Severe anaemia	9.6	12.2	23.2	33.3	17.4	21.6	6.2	2.3	9.3	5.4	3.9	5.6	3.6	12.8
- Immune system failure	16.7	62.8	8.4	21.8	30.8	11.4	6.1	9.2	27.8	10.8	1.3	0.0	13.0	26.0

Underlying cause	All Delivered	Number CD	% CD
Coincidental cause	**21**	**9**	**42.9**
- MVA	5	3	60.0
- Other accidents	2	2	100.0
- Assault	2	1	50.0
- Other	12	3	25.0
Medical and surgical disorders	**262**	**137**	**52.3**
- Cardiac disease	99	56	56.6
- Endocrine	7	5	71.4
- GIT	21	9	42.9
- CNS	26	17	65.4
- Respiratory	31	13	41.9
- Haematological	5	4	80.0
- Genito-urinary	9	5	55.6
- Auto-immune	2	0	0.0
- Skeletal	1	0	0.0
- Psychiatric	1	1	100.0
- Neoplasm	28	13	46.4
- Other	32	14	43.8
Non-pregnancy-related infections	**511**	**124**	**24.3**
- PCP pneumonia	81	19	23.5
- Other pneumonia	76	20	26.3
- TB	190	40	21.1
- Endocarditis	2	0	0.0
- UTI	4	0	0.0
- Malaria	9	3	33.3
- Cryptococcal meningitis	23	10	43.5
- Other meningitis	31	6	19.4
- Kaposi's sarcoma	15	8	53.3
- Toxoplasmosis	1	1	100.0
- Hepatitis	5	0	0.0
- Gastroenteritis	25	2	8.0
- Wasting syndrome	14	2	14.3
- Other	35	13	37.1

Underlying cause	All Delivered	Number CD	% CD
Ectopic pregnancy	**2**	**1**	**50.0**
- Less than 20 weeks	1	1	100.0
- More than 20 weeks	1	0	0.0
Miscarriage	**4**	**0**	**0.0**
- Septic miscarriage	2	0	0.0
- Haemorrhage (non-traumatic)	1	0	0.0
- Following legal TOP	1	0	0.0
Pregnancy-related sepsis	**184**	**100**	**54.3**
- Chorioamnionitis (ruptured membranes)	3	3	100.0
- Puerperal sepsis after NVD	86	2	2.3
- Puerperal sepsis after C/section	81	81	100.0
- Bowel trauma at C/section	14	14	100.0
Obstetric haemorrhage	**552**	**345**	**62.5**
- Abruption with hypertension	32	17	53.1
- Abruption without hypertension	37	24	64.9
- Placenta praevia	15	14	93.3
- Other APH not specified	5	1	20.0
- Ruptured uterus with previous c/s	29	21	72.4
- Ruptured uterus without previous c/s	30	22	73.3
- Retained placenta	36	1	2.8
- Morbidly adherent placenta	16	13	81.3
- Uterine atony	59	10	16.9
- Vaginal trauma	6	0	0.0
- Cervical trauma	22	0	0.0
- Inverted uterus	3	0	0.0
- Bleeding during Caesarean section	50	50	100.0
- Bleeding after Caesarean section	164	164	100.0
- Other PPH not specified	48	8	16.7
Hypertension	**446**	**297**	**66.6**
- Chronic hypertension	19	10	52.6
- Proteinuric hypertension	119	81	68.1
- Eclampsia	232	155	66.8
- HELLP	70	47	67.1
- Liver rupture	6	4	66.7

Underlying cause	All Delivered	Number CD	% CD
Anaesthetic complications	**67**	**64**	**95.5**
- General anaesthetic	10	9	90.0
- Epidural anaesthetic	1	1	100.0
- Spinal anaesthetic	56	54	96.4
Adverse drug reactions	**27**	**9**	**33.3**
- ARV medication	16	3	18.8
- TB medication	1	1	100.0
- Other medication	4	3	75.0
- Herbal medication	5	1	20.0
- Blood transfusion reaction	1	1	100.0
Embolism	**76**	**43**	**56.6**
- Pulmonary embolism	68	40	58.8
- Amniotic fluid embolism	8	3	37.5
Acute collapse - cause unknown	**46**	**23**	**50.0**
Miscellaneous	**7**	**3**	**42.9**
- Hyperemesis gravidarum	1	0	0.0
- Acute fatty liver	6	3	50.0
Unknown	**83**	**38**	**45.8**
- Death at home or outside health services	53	19	35.8
- No primary cause found	14	8	57.1
- Lack of information	16	11	68.8

Underlying conditions	All Delivered*	Vaginal delivery	Number CD	% CD	CFR/100000 CD	CFR/100000 vaginal deliveries	Risk
Medical and surgical disorders	262	125	137	52.3	19.35	6.12	3.2
Non-pregnancy-related infections	511	387	124	24.3	17.51	18.93	0.9
Ectopic pregnancy	2	1	1	50.0	0.14	0.05	2.9
Miscarriage	4	4	0	0.0	0.00	0.20	0.0
Pregnancy-related sepsis	184	84	100	54.3	14.12	4.11	3.4
Obstetric haemorrhage	552	207	345	62.5	48.73	10.13	4.8
Hypertension	446	149	297	66.6	41.95	7.29	5.8
Anaesthetic complications	67	3	64	95.5	9.04	0.15	61.6
Adverse drug reactions	27	18	9	33.3	1.27	0.88	1.4
Embolism	76	33	43	56.6	6.07	1.61	3.8
Acute collapse - cause unknown	46	23	23	50.0	3.25	1.13	2.9
Miscellaneous	7	4	3	42.9	0.42	0.20	2.2
Unknown	83	45	38	45.8	5.37	2.20	2.4
Total	2267	1083	1184	45.8	167.23	52.98	3.2
Coincidental cause	21	12	9	42.9			
Total deliveries		2044082	708024				

* - Excludes all undelivered women, miscarriages and ectopic pregnancies less than 24 weeks

Summary avoidable factors

	All	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	Ad. Drug	Emb.	AC	Miscell.	Unk
Number	**3697**	**467**	**968**	**95**	**165**	**201**	**624**	**661**	**87**	**54**	**111**	**77**	**18**	**169**
PATIENT ORIENTED PROBLEMS														
- Avoidable factors identified	1756	208	588	38	125	93	201	275	16	23	29	26	7	80
- No avoidable factors	1762	214	327	47	26	87	399	345	69	27	70	39	11	55
- Lack of information	376	56	77	12	20	29	29	49	2	6	13	13	0	42
Accessible cases	3321	411	891	83	145	172	595	612	85	48	98	64	18	127
Percent avoidable factors	52.9	50.6	66.0	45.8	86.2	54.1	33.8	44.9	18.8	47.9	29.6	40.6	38.9	63.0
ADMINISTRATIVE PROBLEMS														
- Avoidable factors identified	1632	180	297	59	79	96	397	331	50	21	35	17	7	41
- No avoidable factors	1964	260	617	32	77	89	211	300	35	30	71	50	9	100
- Lack of information	271	39	60	6	12	21	24	43	3	3	5	11	3	29
Accessible cases	3426	428	908	89	153	180	600	618	84	51	106	66	15	140
Percent avoidable factors	47.6	42.1	32.7	66.3	51.6	53.3	66.2	53.6	59.5	41.2	33.0	25.8	46.7	29.3
RESUSCITATION PROBLEMS														
- Avoidable factors identified	1762	170	476	54	75	93	361	262	54	19	44	28	7	78
- No avoidable factors	1782	259	433	33	81	90	232	351	23	30	57	41	11	75
- Lack of information	288	39	64	8	12	20	36	48	10	5	11	8	0	17
Accessible cases	3409	428	904	87	153	181	588	613	77	49	100	69	18	152
Percent avoidable factors	51.7	39.7	52.7	62.1	49.0	51.4	61.4	42.7	70.1	38.8	44.0	40.6	38.9	51.3

Summary Health care provider avoidable factors

	All	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	Ad. Drug	Emb.	AC	Miscell.	Unk
Number	**3697**	**467**	**968**	**95**	**165**	**201**	**624**	**661**	**87**	**54**	**111**	**77**	**18**	**169**
MEDICAL CARE - CHC														
- Managed at this level	1603	177	380	24	41	78	297	347	48	24	45	29	10	80
- Avoidable factors identified	565	44	160	9	14	20	93	159	10	11	8	7	3	24
- No avoidable factors	921	116	190	14	18	49	194	169	36	11	35	21	6	47
- Lack of information	126	18	30	1	10	9	11	22	2	2	2	2	1	11
Accessible cases	1477	159	350	23	31	69	286	325	46	22	43	27	9	69
Percent avoidable factors	**38.3**	**27.7**	**45.7**	**39.1**	**45.2**	**29.0**	**32.5**	**48.9**	**21.7**	**50.0**	**18.6**	**25.9**	**33.3**	**34.8**
MEDICAL CARE - DISTRICT HOSPITAL														
- Managed at this level	1923	213	505	50	83	98	353	342	66	26	47	26	9	63
- Avoidable factors identified	1190	102	247	40	58	63	290	225	51	16	27	12	6	37
- No avoidable factors	627	101	221	9	17	30	52	102	11	7	19	14	3	17
- Lack of information	144	14	45	2	11	8	17	21	5	3	2	2	0	12
Accessible cases	1779	199	460	48	72	90	336	321	61	23	45	24	9	51
Percent avoidable factors	**66.9**	**51.3**	**53.7**	**83.3**	**80.6**	**70.0**	**86.3**	**70.1**	**83.6**	**69.6**	**60.0**	**50.0**	**66.7**	**72.5**
MEDICAL CARE - REGIONAL HOSPITAL														
- Managed at this level	1532	211	414	30	70	99	226	278	26	26	39	27	10	39
- Avoidable factors identified	812	113	175	21	46	69	150	149	20	12	17	14	4	14
- No avoidable factors	655	91	220	6	23	23	72	119	6	14	21	10	6	21
- Lack of information	97	14	26	4	2	11	7	14	0	1	1	4	0	6
Accessible cases	1435	197	388	26	68	88	219	264	26	25	38	23	10	33
Percent avoidable factors	**56.6**	**57.4**	**45.1**	**80.8**	**67.6**	**78.4**	**68.5**	**56.4**	**76.9**	**48.0**	**44.7**	**60.9**	**40.0**	**42.4**
MEDICAL CARE - TERTIARY & ABOVE														
- Managed at this level	1201	194	288	30	47	83	172	239	16	18	37	16	10	18
- Avoidable factors identified	471	64	90	11	26	35	89	99	7	7	17	9	4	6
- No avoidable factors	679	122	185	18	18	43	77	138	7	8	17	6	6	10
- Lack of information	61	11	15	1	4	5	6	5	2	3	4	1	0	2
Accessible cases	1140	183	273	29	43	78	166	234	14	15	33	15	10	16
Percent avoidable factors	**41.3**	**35.0**	**33.0**	**37.9**	**60.5**	**44.9**	**53.6**	**42.3**	**50.0**	**46.7**	**51.5**	**60.0**	**40.0**	**37.5**
MEDICAL CARE - PRIVATE HOSPITAL														
- Managed at this level	231	33	48	4	8	11	46	39	1	3	11	6	3	12
- Avoidable factors identified	94	16	15	1	7	5	27	15	0	1	4	0	1	2
- No avoidable factors	106	14	21	3	1	6	16	20	1	0	7	2	2	8
- Lack of information	37	6	12	0	0	0	5	5	0	2	0	4	0	2
Accessible cases	194	27	36	4	8	11	41	34	1	1	11	2	3	10
Percent avoidable factors	**48.5**	**59.3**	**41.7**	**25.0**	**87.5**	**45.5**	**65.9**	**44.1**	**0.0**	**100.0**	**36.4**	**0.0**	**33.3**	**20.0**

Timing of events and death

	All	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	Ad. Drug	Emb.	AC	Miscell.	Unk
Number	**3697**	**467**	**968**	**95**	**165**	**201**	**624**	**661**	**87**	**54**	**111**	**77**	**18**	**169**
TIMING OF EMERGENCY														
- Early pregnancy	542	71	171	83	91	2	8	20	3	8	9	6	10	27
- Antenatal period: 20w +	1375	208	440	2	11	15	101	388	6	26	20	21	5	66
- Intrapartum period	446	17	33	1	9	12	193	93	45	7	13	10	2	5
- Postpartum period	1430	169	330	6	55	172	323	161	9	13	69	39	2	70
- Anaesthesia	65	2	3	5	2	1	14	5	29	1	1	1	0	1
Distribution %														
- Early pregnancy	14.7	15.2	17.7	87.4	55.2	1.0	1.3	3.0	3.4	14.8	8.1	7.8	55.6	16.0
- Antenatal period: 20w +	37.2	44.5	45.5	2.1	6.7	7.5	16.2	58.7	6.9	48.1	18.0	27.3	27.8	39.1
- Intrapartum period	12.1	3.6	3.4	1.1	5.5	6.0	30.9	14.1	51.7	13.0	11.7	13.0	11.1	3.0
- Postpartum period	38.7	36.2	34.1	6.3	33.3	85.6	51.8	24.4	10.3	24.1	62.2	50.6	11.1	41.4
- Anaesthesia	1.8	0.4	0.3	5.3	1.2	0.5	2.2	0.8	33.3	1.9	0.9	1.3	0.0	0.6
TIMING OF DEATH														
- Early pregnancy	404	53	124	71	54	0	5	17	2	5	7	5	7	26
- Antenatal period: 20w +	748	124	256	1	5	4	21	174	1	14	17	17	3	57
- Intrapartum period	168	9	12	0	4	1	57	37	21	2	10	8	0	3
- Postpartum period	2422	277	575	19	95	193	525	429	32	33	77	46	8	83
- Anaesthesia	72	4	1	4	7	3	16	4	31	0	0	1	0	0
Distribution %														
- Early pregnancy	10.9	11.3	12.8	74.7	32.7	0.0	0.8	2.6	2.3	9.3	6.3	6.5	38.9	15.4
- Antenatal period: 20w +	20.2	26.6	26.4	1.1	3.0	2.0	3.4	26.3	1.1	25.9	15.3	22.1	16.7	33.7
- Intrapartum period	4.5	1.9	1.2	0.0	2.4	0.5	9.1	5.6	24.1	3.7	9.0	10.4	0.0	1.8
- Postpartum period	65.5	59.3	59.4	20.0	57.6	96.0	84.1	64.9	36.8	61.1	69.4	59.7	44.4	49.1
- Anaesthesia	1.9	0.9	0.1	4.2	4.2	1.5	2.6	0.6	35.6	0.0	0.0	1.3	0.0	0.0

Potentially preventable deaths

IMPACT OF SUBOPTIMAL CARE	All	M&S	NPRI	Ec	Miscar.	PRS	OH	HT	AR	Ad. Drug	Emb.	AC	Miscell	Unk	Total
- No suboptimal care identified	1094	184	372	15	33	28	57	137	5	13	35	34	5	88	1006
- Suboptimal care, no impact on outcome	403	57	180	1	20	13	19	56	1	8	13	10	4	16	398
- Suboptimal care, possible impact on outcome	1233	160	329	19	62	87	181	220	20	21	47	21	7	48	1222
- Suboptimal care, probable impact on outcome	1084	66	87	60	50	73	367	248	61	12	16	12	2	17	1071
Total		467	968	95	165	201	624	661	87	54	111	77	18	169	3697
Potentially preventable deaths	2317	226	416	79	112	160	548	468	81	33	63	33	9	65	2293
% potentially preventable deaths	60.7	48.4	43.0	83.2	67.9	79.6	87.8	70.8	93.1	61.1	56.8	42.9	50.0	38.5	62.0
IMPACT OF SUBOPTIMAL CARE															
iMMR of potentially preventable deaths	84.19	8.21	15.12	2.87	4.07	5.81	19.91	17.01	2.94	1.20	2.29	1.20	0.33	2.36	83.32

Note: Potentially preventable deaths = suboptimal care, possible impact on outcome, and suboptimal care, probable impact on outcome

Patient orientated avoidable factors

Description	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	ADR	Emb	AC	Miscel.	Unk.	All
Total cases	**467**	**968**	**95**	**165**	**201**	**624**	**661**	**87**	**54**	**111**	**77**	**18**	**169**	**3697**
Lack of information	56	77	12	20	29	29	49	2	6	13	13	0	42	376
Accessible cases	411	891	83	145	172	595	612	85	48	98	64	18	127	3321
No avoidable factor	214	327	47	26	87	399	345	69	27	70	39	11	55	1762
% no avoidable factors	**52.1**	**36.7**	**56.6**	**17.9**	**50.6**	**67.1**	**56.4**	**81.2**	**56.3**	**71.4**	**60.9**	**61.1**	**43.3**	**53.1**
Distribution of avoidable factors														
No antenatal care	81	202	22	56	17	67	102	3	7	8	9	2	27	622
Infrequent antenatal care	20	77	0	0	9	37	51	6	0	2	4	0	5	211
Delay in accessing medical help	111	319	19	73	61	99	121	4	4	14	9	3	46	894
Declined medication/surgery/advice	28	140	3	7	21	23	40	1	4	4	5	1	12	290
Family problem	3	6	1	2	0	2	8	1	6	3	1	0	5	46
Community problem	2	2	0	1	0	2	2	0	1	0	0	1	2	20
Unsafe abortion	0	0	0	36	2	0	1	0	1	0	0	0	0	41
Other	23	67	3	2	6	19	21	2	7	5	2	1	9	189
% distribution of avoidable factors														
No antenatal care	19.7	22.7	26.5	38.6	9.9	11.3	16.7	3.5	14.6	8.2	14.1	11.1	21.3	18.7
Infrequent antenatal care	4.9	8.6	0.0	0.0	5.2	6.2	8.3	7.1	0.0	2.0	6.3	0.0	3.9	6.4
Delay in accessing medical help	27.0	35.8	22.9	50.3	35.5	16.6	19.8	4.7	8.3	14.3	14.1	16.7	36.2	26.9
Declined medication/surgery/advice	6.8	15.7	3.6	4.8	12.2	3.9	6.5	1.2	8.3	4.1	7.8	5.6	9.4	8.7
Family problem	0.7	0.7	1.2	1.4	0.0	0.3	1.3	1.2	12.5	3.1	1.6	0.0	3.9	1.4
Community problem	0.5	0.2	0.0	0.7	0.0	0.3	0.3	0.0	2.1	0.0	0.0	5.6	1.6	0.6
Unsafe abortion	0.0	0.0	0.0	24.8	1.2	0.0	0.2	0.0	2.1	0.0	0.0	0.0	0.0	1.2
Other	5.6	7.5	3.6	1.4	3.5	3.2	3.4	2.4	14.6	5.1	3.1	5.6	7.1	5.7

Administrative avoidable factors

Description	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	ADR	Emb	AC	Miscell.	Unk.	All
Number of cases	**467**	**968**	**95**	**165**	**201**	**624**	**661**	**87**	**54**	**111**	**77**	**18**	**169**	**3697**
Lack of information	39	60	6	12	21	24	43	3	3	5	11	3	29	259
Accessible cases	428	908	89	153	180	600	618	84	51	106	66	15	140	3438
No avoidable factor	260	617	32	77	89	211	300	35	30	71	50	9	100	1881
% No avoidable cases	60.7	68.0	36.0	50.3	49.4	35.2	48.5	41.7	58.8	67.0	75.8	60.0	71.4	54.7
Transport														
Transport problem: Home to institution	2	6	1	1	1	14	16	0	0	0	0	0	4	45
Transport problem: Institution to institution	19	16	12	8	7	71	72	7	2	3	4	1	3	225
Cases referred between facilities	247	469	39	88	117	300	390	35	25	47	22	15	30	1824
% problems with transport	**7.7**	**3.4**	**30.8**	**9.1**	**6.0**	**23.7**	**18.5**	**20.0**	**8.0**	**6.4**	**18.2**	**6.7**	**10.0**	**12.3**

Administrative avoidable factors

Description	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	ADR	Emb	AC	Miscell.	Unk.	All
Accessible cases	**428**	**908**	**89**	**153**	**180**	**600**	**618**	**84**	**51**	**106**	**66**	**15**	**140**	**3438**
Distribution of avoidable factors														
Lack of accessibility: Barriers to entry	9	14	0	1	1	7	9	1	2	0	0	0	0	44
Lack of accessibility: Other	2	2	1	3	2	4	3	0	1	0	1	0	0	19
Delay initiating critical care (Overburdened service)	25	48	10	11	16	47	41	4	0	3	2	0	5	212
Lack of health care facilities: ICU	32	55	5	12	18	40	61	6	3	9	1	2	5	249
Lack of health care facilities: Blood/blood products	8	6	3	17	4	70	16	0	1	1	0	0	0	126
Lack of health care facilities: Other	17	20	4	5	6	19	14	3	0	4	2	0	3	97
Lack of appropriately trained staff: Doctors	52	91	29	25	42	186	107	35	5	11	5	4	16	608
Lack of appropriately trained staff: Nurses	31	71	13	13	22	114	83	11	7	9	2	0	12	388
Communication problems: Technical	7	5	1	2	2	5	8	0	1	0	0	0	2	33
Communication problems: Interpersonal	19	27	2	6	8	14	23	1	3	3	0	0	5	111
Other	40	61	9	10	11	47	55	4	4	6	2	0	4	253
Distribution of avoidable factors %														
Lack of accessibility: Barriers to entry	2.1	1.5	0.0	0.7	0.6	1.2	1.5	1.2	3.9	0.0	0.0	0.0	0.0	1.3
Lack of accessibility: Other	0.5	0.2	1.1	2.0	1.1	0.7	0.5	0.0	2.0	0.0	1.5	0.0	0.0	0.6
Delay initiating critical care (Overburdened service)	5.8	5.3	11.2	7.2	8.9	7.8	6.6	4.8	0.0	2.8	3.0	0.0	3.6	6.2
Lack of health care facilities: ICU	7.5	6.1	5.6	7.8	10.0	6.7	9.9	7.1	5.9	8.5	1.5	13.3	3.6	7.2
Lack of health care facilities: Blood/blood products	1.9	0.7	3.4	11.1	2.2	11.7	2.6	0.0	2.0	0.9	0.0	0.0	0.0	3.7
Lack of health care facilities: Other	4.0	2.2	4.5	3.3	3.3	3.2	2.3	3.6	0.0	3.8	3.0	0.0	2.1	2.8
Lack of appropriately trained staff: Doctors	12.1	10.0	32.6	16.3	23.3	31.0	17.3	41.7	9.8	10.4	7.6	26.7	11.4	17.7
Lack of appropriately trained staff: Nurses	7.2	7.8	14.6	8.5	12.2	19.0	13.4	13.1	13.7	8.5	3.0	0.0	8.6	11.3
Communication problems: Technical	1.6	0.6	1.1	1.3	1.1	0.8	1.3	0.0	2.0	0.0	0.0	0.0	1.4	1.0
Communication problems: Interpersonal	4.4	3.0	2.2	3.9	4.4	2.3	3.7	1.2	5.9	2.8	0.0	0.0	3.6	3.2
Other	9.3	6.7	10.1	6.5	6.1	7.8	8.9	4.8	7.8	5.7	3.0	0.0	2.9	7.4

Health care professional avoidable factors

Description	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	ADR	Emb	AC	Miscell.	Unk	All
COMMUNITY HEALTH CENTRE														
Managed at this level	177	380	24	41	78	297	347	48	24	45	29	10	80	1580
Lack of information	18	30	1	10	9	11	22	2	2	2	2	1	11	121
Accessible cases	159	350	23	31	69	286	325	46	22	43	27	9	69	1459
No avoidable factor	116	190	14	18	49	194	169	36	11	35	21	6	47	906
Initial assessment poor	11	61	5	4	8	38	55	2	2	1	3	0	11	201
Problem with recognition / diagnosis	27	77	6	5	6	53	89	6	5	4	3	1	16	298
Delay in referring the patient	15	64	3	4	7	39	63	4	6	4	1	1	7	218
Managed at inappropriate level	8	23	0	2	1	19	21	2	1	1	2	0	4	84
Incorrect management (Wrong diagnosis)	5	15	4	2	1	7	14	0	0	0	1	0	3	52
Sub-standard management (Corrrect diagnosis)	3	38	0	5	9	26	44	2	4	1	2	1	3	138
Not monitored / Infrequently monitored	4	5	1	2	0	8	11	1	2	0	1	0	2	37
Prolonged abnormal monitoring with no action taken	1	13	2	0	1	5	12	0	1	2	0	0	1	38
COMMUNITY HEALTH CENTRE Distribution %														
No avoidable factor	73.0	54.3	60.9	58.1	71.0	67.8	52.0	78.3	50.0	81.4	77.8	66.7	68.1	62.1
Initial assessment poor	6.9	17.4	21.7	12.9	11.6	13.3	16.9	4.3	9.1	2.3	11.1	0.0	15.9	13.8
Problem with recognition / diagnosis	17.0	22.0	26.1	16.1	8.7	18.5	27.4	13.0	22.7	9.3	11.1	11.1	23.2	20.4
Delay in referring the patient	9.4	18.3	13.0	12.9	10.1	13.6	19.4	8.7	27.3	9.3	3.7	11.1	10.1	14.9
Managed at inappropriate level	5.0	6.6	0.0	6.5	1.4	6.6	6.5	4.3	4.5	2.3	7.4	0.0	5.8	5.8
Incorrect management (Wrong diagnosis)	3.1	4.3	17.4	6.5	1.4	2.4	4.3	0.0	0.0	0.0	3.7	0.0	4.3	3.6
Sub-standard management (Corrrect diagnosis)	1.9	10.9	0.0	16.1	13.0	9.1	13.5	4.3	18.2	2.3	7.4	11.1	4.3	9.5
Not monitored / Infrequently monitored	2.5	1.4	4.3	6.5	0.0	2.8	3.4	2.2	9.1	0.0	3.7	0.0	2.9	2.5
Prolonged abnormal monitoring with no action taken	0.6	3.7	8.7	0.0	1.4	1.7	3.7	0.0	4.5	4.7	0.0	0.0	1.4	2.6

Description	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	ADR	Emb	AC	Miscel	Unk	All
DISTRICT HOSPITAL														**0**
Managed at this level	213	505	50	83	98	353	342	66	26	47	26	9	63	1881
Lack of information	14	45	2	11	8	17	21	5	3	2	2	0	12	142
Accessible cases	199	460	48	72	90	336	321	61	23	45	24	9	51	1739
No avoidable factor	101	221	9	17	30	52	102	11	7	19	14	3	17	603
Initial assessment poor	37	82	18	19	15	76	73	7	4	9	4	2	15	361
Problem with recognition / diagnosis	51	123	25	22	32	134	96	21	7	16	8	5	21	561
Delay in referring the patient	42	71	7	22	15	89	87	3	6	6	2	3	8	361
Managed at inappropriate level	31	62	4	11	17	75	68	6	5	2	3	1	4	289
Incorrect management (Wrong diagnosis)	20	34	21	3	7	34	38	5	1	6	4	0	7	180
Sub-standard management (Corrrect diagnosis)	23	98	14	35	29	174	97	36	5	8	3	4	16	542
Not monitored / Infrequently monitored	10	23	6	10	9	65	35	6	1	5	3	1	6	180
Prolonged abnormal monitoring with no action taken	8	23	6	8	21	49	30	8	2	4	4	1	9	173
DISTRICT HOSPITAL Distribution %														
No avoidable factor	50.8	48.0	18.8	23.6	33.3	15.5	31.8	18.0	30.4	42.2	58.3	33.3	33.3	34.7
Initial assessment poor	18.6	17.8	37.5	26.4	16.7	22.6	22.7	11.5	17.4	20.0	16.7	22.2	29.4	20.8
Problem with recognition / diagnosis	25.6	26.7	52.1	30.6	35.6	39.9	29.9	34.4	30.4	35.6	33.3	55.6	41.2	32.3
Delay in referring the patient	21.1	15.4	14.6	30.6	16.7	26.5	27.1	4.9	26.1	13.3	8.3	33.3	15.7	20.8
Managed at inappropriate level	15.6	13.5	8.3	15.3	18.9	22.3	21.2	9.8	21.7	4.4	12.5	11.1	7.8	16.6
Incorrect management (Wrong diagnosis)	10.1	7.4	43.8	4.2	7.8	10.1	11.8	8.2	4.3	13.3	16.7	0.0	13.7	10.4
Sub-standard management (Corrrect diagnosis)	11.6	21.3	29.2	48.6	32.2	51.8	30.2	59.0	21.7	17.8	12.5	44.4	31.4	31.2
Not monitored / Infrequently monitored	5.0	5.0	12.5	13.9	10.0	19.3	10.9	9.8	4.3	11.1	12.5	11.1	11.8	10.4
Prolonged abnormal monitoring with no action taken	4.0	5.0	12.5	11.1	23.3	14.6	9.3	13.1	8.7	8.9	16.7	11.1	17.6	9.9

Description	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	ADR	Emb	AC	Miscel	Unk	All
REGIONAL HOSPITAL														**0**
Managed at this level	211	414	30	70	99	226	278	26	26	39	27	10	39	1495
Lack of information	14	26	4	2	11	7	14	0	1	1	4	0	6	90
Accessible cases	197	388	26	68	88	219	264	26	25	38	23	10	33	1405
No avoidable factor	91	220	6	23	23	72	119	6	14	21	10	6	21	632
Initial assessment	28	46	5	17	19	30	30	6	2	4	4	0	5	196
Problem with recognition / diagnosis	56	76	9	16	28	54	51	11	6	9	9	3	7	335
Delay in referring the patient	32	21	1	4	11	15	20	3	1	2	2	0	0	112
Managed at inappropriate level	28	8	1	3	3	10	13	2	0	1	1	0	1	71
Incorrect management (Wrong diagnosis)	18	27	4	6	5	17	17	0	2	4	4	1	2	107
Sub-standard management (Corrrect diagnosis)	41	83	11	26	47	101	87	12	3	6	4	1	4	426
Not monitored / Infrequently monitored	11	18	5	9	7	25	24	4	2	4	2	0	2	113
Prolonged abnormal monitoring with no action taken	11	25	4	6	13	29	23	1	1	4	0	0	3	120
REGIONAL HOSPITAL Distribution %														
No avoidable factor	46.2	56.7	23.1	33.8	26.1	32.9	45.1	23.1	56.0	55.3	43.5	60.0	63.6	45.0
Initial assessment	14.2	11.9	19.2	25.0	21.6	13.7	11.4	23.1	8.0	10.5	17.4	0.0	15.2	14.0
Problem with recognition / diagnosis	28.4	19.6	34.6	23.5	31.8	24.7	19.3	42.3	24.0	23.7	39.1	30.0	21.2	23.8
Delay in referring the patient	16.2	5.4	3.8	5.9	12.5	6.8	7.6	11.5	4.0	5.3	8.7	0.0	0.0	8.0
Managed at inappropriate level	14.2	2.1	3.8	4.4	3.4	4.6	4.9	7.7	0.0	2.6	4.3	0.0	3.0	5.1
Incorrect management (Wrong diagnosis)	9.1	7.0	15.4	8.8	5.7	7.8	6.4	0.0	8.0	10.5	17.4	10.0	6.1	7.6
Sub-standard management (Corrrect diagnosis)	20.8	21.4	42.3	38.2	53.4	46.1	33.0	46.2	12.0	15.8	17.4	10.0	12.1	30.3
Not monitored / Infrequently monitored	5.6	4.6	19.2	13.2	8.0	11.4	9.1	15.4	8.0	10.5	8.7	0.0	6.1	8.0
Prolonged abnormal monitoring with no action taken	5.6	6.4	15.4	8.8	14.8	13.2	8.7	3.8	4.0	10.5	0.0	0.0	9.1	8.5

Description	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	ADR	Emb	AC	Miscell.	Unk	All
TERTIARY HOSPITAL / ABOVE														**0**
Managed at this level	194	288	30	47	83	172	239	16	18	37	16	10	18	1168
Lack of information	11	15	1	4	5	6	5	2	3	4	1	0	2	59
Accessible caases	183	273	29	43	78	166	234	14	15	33	15	10	16	1109
No avoidable factor	122	185	18	18	43	77	138	7	8	17	6	6	10	655
Initial assessment	15	20	3	6	5	14	17	2	1	3	2	0	1	89
Problem with recognition / diagnosis	24	37	5	8	14	27	27	4	5	8	5	0	4	168
Delay in referring the patient	3	4	1	2	1	0	3	1	0	0	1	0	0	16
Managed at inappropriate level	1	3	1	0	0	1	3	0	0	0	0	0	0	9
Incorrect management (Wrong diagnosis)	6	4	1	1	5	7	7	0	1	3	1	1	1	38
Sub-standard management (Corrrect diagnosis)	33	54	5	21	22	56	65	4	3	7	2	2	2	276
Not monitored / Infrequently monitored	4	11	3	1	3	17	14	1	0	3	1	0	1	59
Prolonged abnormal monitoring with no action taken	12	18	4	5	10	17	19	3	0	2	2	1	0	93
TERTIARY HOSPITAL / ABOVE Distribution %														
No avoidable factor	66.7	67.8	62.1	41.9	55.1	46.4	59.0	50.0	53.3	51.5	40.0	60.0	62.5	59.1
Initial assessment	8.2	7.3	10.3	14.0	6.4	8.4	7.3	14.3	6.7	9.1	13.3	0.0	6.3	8.0
Problem with recognition / diagnosis	13.1	13.6	17.2	18.6	17.9	16.3	11.5	28.6	33.3	24.2	33.3	0.0	25.0	15.1
Delay in referring the patient	1.6	1.5	3.4	4.7	1.3	0.0	1.3	7.1	0.0	0.0	6.7	0.0	0.0	1.4
Managed at inappropriate level	0.5	1.1	3.4	0.0	0.0	0.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Incorrect management (Wrong diagnosis)	3.3	1.5	3.4	2.3	6.4	4.2	3.0	0.0	6.7	9.1	6.7	10.0	6.3	3.4
Sub-standard management (Corrrect diagnosis)	18.0	19.8	17.2	48.8	28.2	33.7	27.8	28.6	20.0	21.2	13.3	20.0	12.5	24.9
Not monitored / Infrequently monitored	2.2	4.0	10.3	2.3	3.8	10.2	6.0	7.1	0.0	9.1	6.7	0.0	6.3	5.3
Prolonged abnormal monitoring with no action taken	6.6	6.6	13.8	11.6	12.8	10.2	8.1	21.4	0.0	6.1	13.3	10.0	0.0	8.4

Description	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	ADR	Emb	AC	Miscell.	Unk	All
PRIVATE HOSPITAL														**0**
Managed at this level	33	48	4	8	11	46	39	1	3	11	6	3	12	225
Lack of information	6	12	0	0	0	5	5	0	2	0	4	0	2	36
Accessible cases	27	36	4	8	11	41	34	1	1	11	2	3	10	189
No avoidable factor	14	21	3	1	6	16	20	1	0	7	2	2	8	101
Initial assessment	7	10	1	1	2	5	3	0	0	0	0	0	1	30
Problem with recognition / diagnosis	9	3	1	2	1	11	7	0	0	2	0	1	2	39
Delay in referring the patient	2	1	1	2	0	0	1	0	0	0	0	0	1	8
Managed at inappropriate level	1	1	0	2	0	1	1	0	0	0	0	0	0	6
Incorrect management (Wrong diagnosis)	3	1	0	2	0	2	3	0	0	1	0	0	0	12
Sub-standard management (Corrrect diagnosis)	3	6	0	3	4	16	6	0	1	2	0	0	1	42
Not monitored / Infrequently monitored	0	0	0	0	0	1	1	0	0	0	0	0	0	2
Prolonged abnormal monitoring with no action taken	1	1	0	0	0	10	5	0	0	0	0	0	0	17
PRIVATE HOSPITAL Distribution %														
No avoidable factor	51.9	58.3	75.0	12.5	54.5	39.0	58.8	100.0	0.0	63.6	100.0	66.7	80.0	53.4
Initial assessment	25.9	27.8	25.0	12.5	18.2	12.2	8.8	0.0	0.0	0.0	0.0	0.0	10.0	15.9
Problem with recognition / diagnosis	33.3	8.3	25.0	25.0	9.1	26.8	20.6	0.0	0.0	18.2	0.0	33.3	20.0	20.6
Delay in referring the patient	7.4	2.8	25.0	25.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	10.0	4.2
Managed at inappropriate level	3.7	2.8	0.0	25.0	0.0	2.4	2.9	0.0	0.0	0.0	0.0	0.0	0.0	3.2
Incorrect management (Wrong diagnosis)	11.1	2.8	0.0	25.0	0.0	4.9	8.8	0.0	0.0	9.1	0.0	0.0	0.0	6.3
Sub-standard management (Correct diagnosis)	11.1	16.7	0.0	37.5	36.4	39.0	17.6	0.0	100.0	18.2	0.0	0.0	10.0	22.2
Not monitored / Infrequently monitored	0.0	0.0	0.0	0.0	0.0	2.4	2.9	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Prolonged abnormal monitoring with no action taken	3.7	2.8	0.0	0.0	0.0	24.4	14.7	0.0	0.0	0.0	0.0	0.0	0.0	9.0

Emergency care problems

Description	M&S	NPRI	Ec	Miscarriage	PRS	OH	HT	AR	ADR	Emb	AC	Miscel	Unk.	All
Total cases	467	968	95	165	201	624	661	87	54	111	77	18	169	3697
Lack of information	39	64	8	12	20	36	48	10	5	11	8	0	17	278
Accessible cases	428	904	87	153	181	588	613	77	49	100	69	18	152	3419
No avoidable factor	259	433	33	81	90	232	351	23	30	57	41	11	75	1716
% no avoidable factor	**60.5**	**47.9**	**37.9**	**52.9**	**49.7**	**39.5**	**57.3**	**29.9**	**61.2**	**57.0**	**59.4**	**61.1**	**49.3**	**50.2**
Resuscitation not attempted	90	315	15	29	51	58	101	3	10	16	10	2	62	762
Accessible cases where resuscitation attempted	338	589	72	124	130	530	512	74	39	84	59	16	90	2657
Distribution of problems with resuscitation														
Airway problems	13	19	4	1	4	14	28	10	1	5	1	1	6	107
Breathing problems	39	119	3	15	16	31	71	26	3	16	10	2	4	355
Circulation problems	26	18	34	33	18	254	46	18	2	9	6	1	4	469
Drug problems	7	10	1	2	1	12	17	10	2	2	4	0	2	70
Investigation problems	10	15	5	3	8	9	12	0	1	2	0	0	2	67
Monitoring problems	9	17	6	5	5	44	20	8	3	1	1	2	4	125
% Distribution of problems with resuscitation														
Airway problems	3.8	3.2	5.6	0.8	3.1	2.6	5.5	13.5	2.6	6.0	1.7	6.3	6.7	4.0
Breathing problems	11.5	20.2	4.2	12.1	12.3	5.8	13.9	35.1	7.7	19.0	16.9	12.5	4.4	13.4
Circulation problems	7.7	3.1	47.2	26.6	13.8	47.9	9.0	24.3	5.1	10.7	10.2	6.3	4.4	17.7
Drug problems	2.1	1.7	1.4	1.6	0.8	2.3	3.3	13.5	5.1	2.4	6.8	0.0	2.2	2.6
Investigation problems	3.0	2.5	6.9	2.4	6.2	1.7	2.3	0.0	2.6	2.4	0.0	0.0	2.2	2.5
Monitoring problems	2.7	2.9	8.3	4.0	3.8	8.3	3.9	10.8	7.7	1.2	1.7	12.5	4.4	4.7