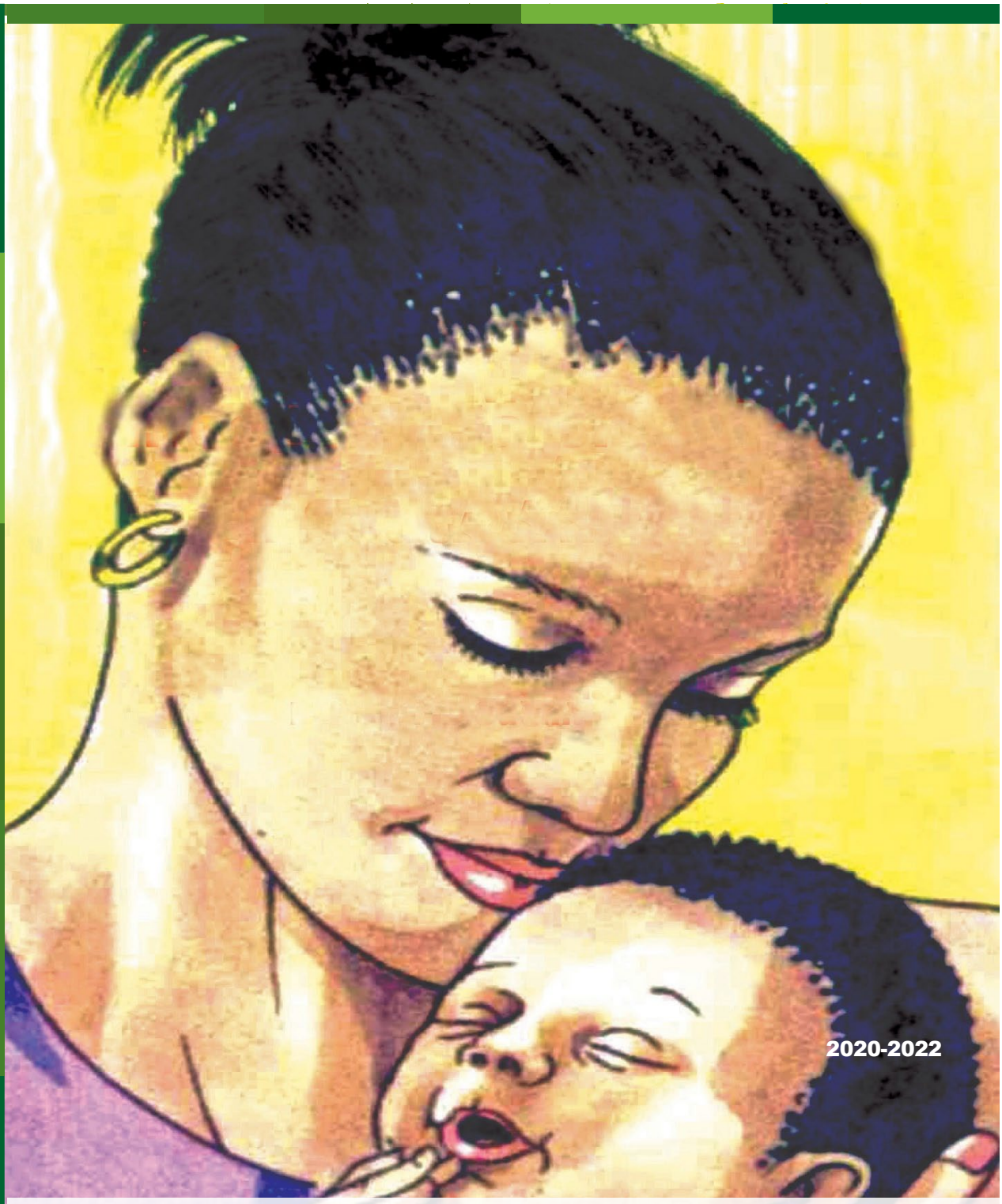
Saving Mothers



2020-2022

Eighth Comprehensive Triennial report into Maternal deaths in South Africa, 2020-2022; includes data for COVID-19 pandemic: second edition

health
Department:
Health
REPUBLIC OF SOUTH AFRICA

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Ms Bontle Mamabolo (South African Medical Research Council's Maternal and Infant Healthcare Strategies Unit) processed and analysed the MAMMAs data for the NCCEMD.
Acknowledgements for the assistance of the previous editor, Professor R Pattinson and previous NCCEMD committee chaired by Professor J Moodley until August 2020.

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ABBREVIATIONS

AR	Anaesthetic related
ART	Antiretroviral Therapy
BBA	Born before arrival
BLDACD	Deaths associated with Bleeding at or after Caesarean delivery
BMI	Body mass index
BP	Blood pressure
CD	Caesarean delivery
CEO	Chief Executive Officer
CFR	Case Fatality rate
CHC	Community Health Centre
CHW	Community health worker
CLEVER	Clinical care; Labour ward management; Eliminate barriers; Verify care; EOST; Respectful care
Clinic	Primary healthcare clinic
DCST	District Clinical Specialist Teams
DDPCP	Death During Pregnancy, Childbirth and the Puerperium
DH	District hospital
DHIS	District health information system
EC	Eastern Cape province
EOST	Emergency obstetric simulation training
ESMOE	Essential Steps in Managing Obstetric Emergencies
FDC	Fixed dose combination
FRANC	First referral for antenatal care
FS	Free State province
GP	Gauteng Province
HIV	Human immunodeficiency virus
HPD	Hypertensive disorders in pregnancy
HOI	Head of Institution
iMMR	In Facility Maternal Mortality Ratio
IUCD	Intrauterine contraceptive device
KZN	KwaZulu-Natal province
LARC	Long acting reversible contraception
LP	Limpopo province
MaMMAS	Maternal Morbidity and Mortality Audit System

MD	Maternal death
M&S	Medical and Surgical conditions
MP	Mpumalanga province
MVA	Manual vacuum aspiration
NaPeMMCo	National Perinatal Morbidity and Mortality Committee
NC	Northern Cape province
NCCEMD	National Committee for Confidential Enquiries into Maternal Deaths
NCH	National central hospital
NPRI	Non-pregnancy related infections
NW	North West province
OH	Obstetric haemorrhage
MBU	On-site Midwife Birthing Unit
PHC	Primary healthcare
PMTCT	Prevention of Mother-to-Child Transmission
PPE	Personal Protective Equipment
PPH	Postpartum haemorrhage
PRS	Pregnancy related sepsis
RH	Regional Hospital
TB	Tuberculosis
TH	Tertiary hospital
TOP	Termination of pregnancy
TXA	Tranexamic acid
VTP	Vertical Transmission Prevention
WBOT	Ward based outreach teams
WC	Western Cape province

FOREWORD

The death of a woman during pregnancy, childbirth, or the puerperium still remains one of the greatest possible tragedies. The right to life is everyone's constitutional right, and women also deserve it. Everyone has the right to have access to healthcare services, including reproductive healthcare. All women must feel safe when faced with the need to seek care everywhere within our health system, and it's everyone's moral obligation to ensure that safety.

In South Africa, a system of national confidential enquiries into maternal deaths exists to review maternal deaths. This team consists of highly committed healthcare professionals who dedicated their time to the confidential assessments of individual maternal deaths in all nine provinces of South Africa. This confidential enquiry identifies challenges in the health system and makes recommendations for improvement. The recommendations are produced in the form of annual and triennial reports, which highlight shortcomings in the healthcare system, avoidable factors in individual clinical care, and whether the death could have been prevented or not.

The NCCEMD works as a ministerial team which reports to the Honourable Minister of Health, Dr J Phaahla, his Honourable Deputy Minister, Dr S Dhlomo with support from the NDOH MCWH team.

It is quite a mammoth task to bring such triennial and annual reports to fruition, and it involves tremendous effort, energy, and meticulous attention to detail. Professor S Fawcus (editor) of the Saving Mothers' Reports and Ms B Mamabolo (SAMRC-UP) deserve special mention and South Africa's gratitude for these thoughtful documents and the contributions that they have made to decrease maternal and newborn deaths in South Africa.

We would also like to thank the chapter heads who have provided Abstracts for their chapters in Section 7. Furthermore, we would also like to thank provincial assessors (named in section 8 of the report) who assessed all the maternal deaths in their provinces and thus generated the data for the MaMMAS database from which these reports are generated. Without you, these reports would not have happened.

South Africa was just celebrating the fruits of implementation of these recommendations from the latest triennial report (Saving Mothers' Report 2017–2019), which demonstrated that the assessment of individual maternal deaths and the lessons learned leading to recommendations, do result in good news. For the first time since the initial report in 1998, the institutional maternal mortality ratio had dropped to less than 100 per 100,000 live births in 2019. This was certainly an achievement for South Africa, one of the few countries in the world that has such an assessment system of individual deaths and implements the recommendations. However, the unexpected happened. The COVID-19 pandemic came when we least expected it; South African women were not spared, and its aftermath is still evident. We also lost a significant number of healthcare workers. It had both direct and indirect effects on our health system, as highlighted in this triennial report, where maternal deaths increased by 30% in 2020 and 47% in 2021, during the COVID-19 pandemic, compared to 2019 but decreased to pre-pandemic level in 2022 to just above a 100 maternal deaths per 100,000 live births level. The pandemic set back progress towards achieving the SDG goal of MMR 70 maternal deaths per 100,000 live births by 2030, but now we're back on track, and hopefully great lessons are learned for the future.

In November 2023, the Executive summary of the 2020-2022 Saving Mothers report was published. The Comprehensive report presented here includes more detailed data, detailed recommendations with allocation of responsibilities, abstracts of the Primary Obstetric cause chapters and Provincial reports.

Of note, the detailed chapters for each Primary Obstetric Cause which were only available as Abstracts in the first edition of this report (2024), have now been included as comprehensive chapters in section 7 of the second edition of the report.

Let us continue to grow South Africa together in our journey to save lives. Together, we can!

Dr Sylvia N Cebekhulu: NCCEMD Acting Chairperson

SYNOPSIS/KEY FINDINGS ON MATERNAL DEATHS IN SOUTH AFRICA 2020-2022, AND SUMMARY OF KEY RECOMMENDATIONS

Maternal deaths and Maternal Mortality rates.

There were 1234, 1507, and 1062 maternal deaths in 2020, 2021 and 2022 respectively giving a corrected triennial total of 3803, which is greater than 3347 deaths reported in the previous triennium (2017-2019). There were 3,019165 live births, reported by public health facilities via DHIS in 2020-2022, giving a corrected iMMR of 126 MDs per 100,000 live births compared to 113.8 in the previous triennium.

It is notable that during 2020 and 2021, the iMMR was 30% and 47% respectively higher than for the pre-pandemic year 2019 when it was 98.8. However, the iMMR declined to 109.7 in 2022, which is less than the iMMR in the previous triennium. This shows that the steep decline from 2010 was reversed in 2020 and 2021 but stabilised in 2022.

The increase in iMMR in 2020 and 2021, occurred in all provinces in South Africa.

Primary obstetric causes of maternal deaths

Non-Pregnancy Related Infections (NPRI) were the major causal grouping in all three years as in previous triennia but showed a very large increase in 2020 and 2021, where it accounted for 322 (27.1% all MDs) in 2020 and 561 (37.7% of MDs) in 2021. In 2022 it accounted for 180 deaths (18.6% MDs) which is lower than in previous triennia. For the whole triennium it was the leading cause accounting for 29.1% of all MDs.

COVID-19 pneumonia and complications constituted the majority of these NPRI deaths accounting for 124 (38.5% of NPRI deaths) in 2020, and 369 (66.6% of NPRI deaths and 25% of all MDs) in 2021. In 2022, there were only 12 deaths directly due to COVID-19.

Obstetric haemorrhage (OH) deaths increased to become the second most common cause, accounting for deaths in 599 women (16.4% of total MDs).

Hypertensive disorders (HDP) were the third most common cause, accounting for 539 MDs (14.7%)
Medical and surgical (M&S) disorders were the fourth cause accounting for 513 MDs (14% of total MDs)
Early pregnancy deaths from miscarriage and ectopic accounted for 269 deaths (7.3%) and thus Early Pregnancy complications combined are the fifth most common cause.

There were 39 Anaesthetic deaths in 2022 which is twice the number in previous years, and although not a major cause, almost all of these deaths were preventable.

In terms of comparisons with the previous triennium, the iMMR for NPRI increased from 27.1 MDs per 100,000 live births in 2017-2019 to 35.2 in 2020 to 2022. However, the iMMR for Obstetric Haemorrhage and Medical and Surgical disorders remained similar between the two triennia (OH iMMR 19.1 in 2017-2019 and 19.8 in 2020-2022; M&S iMMR 16.9 in 2017-2019 and 17 in 2020-2022). In contrast, the iMMR for Hypertension declined from 20.2 to 17.9, and for Early Pregnancy complications from 11.4 in 2017-2019 to 8.9 in 2020-2022.

Location of maternal deaths

In the 2020-2022 triennium, the majority of deaths (90.1%) occurred at public hospitals with a larger number (6.1%) in private hospitals than in previous years, especially during 2021. This shows that the COVID-19 pandemic affected all classes of society.

Caesarean delivery rates and fatality rates

The Caesarean Delivery (CD) rate for all deliveries in 2020 and 2021 was 28%, the same as in 2019, but in 2022 it was 31.1%. The CD Case Fatality Rate increased to 145.7 CD associated deaths per 100,000 CDs in 2020 and 203.6 in 2021, compared to 112.5 in 2019. This could reflect the fact that many sick women with COVID-19 in the third trimester had CD for severe respiratory compromise, and it may not have been a direct effect of the CD. In 2022, the CD CFR had declined to 118.4, similar to 2019.
There were 198 deaths from bleeding associated with CD, giving a BLDACD CFR for the triennium of 22.3, similar to 2017-2019 when it was 23.6.

Preventability of maternal deaths

Deaths were assessed to be possibly or probably preventable by the health system for 58% of women who died in 2020, 56% in 2021, and 59% in 2022; the most common causes of preventable deaths being OH, and HPD deaths, with lesser numbers in the NPRI group. In the 2020-2022 triennium, 57.4% of deaths were potentially preventable compared to 62.4% in the previous triennium. This decrease was probably due to the large numbers of deaths from COVID-19 in 2020-2022, most of which were assessed as being unavoidable. There was a notable increase in the proportion of probably preventable anesthetic deaths in 2022, and this will be further elucidated in the chapter on anaesthetic deaths. Of note, the proportion of deaths with Administrative preventable factors increased in 2020 (57.1%) and 2021 (52.6) compared to 48.1% in the previous triennium.

Conclusion

The NCCEMD process was impacted by the COVID-19 pandemic because of increased workload and sickness of Healthcare Workers.

Maternal deaths increased by 30% in 2020 and 47% in 2021 compared to 2019, during the severe years of the COVID-19 pandemic, but the IMMR decreased to pre-pandemic levels in 2022.
This trend was seen in all provinces.
COVID-19 pneumonia /NPRI deaths were the major contributor to the steep increase in 2020 and 2021.
Deaths from Obstetric Haemorrhage increased in 2020 and 2021, reflecting collateral impact of the COVID-19 pandemic on functioning of the health system.
Of concern, anaesthetic deaths were twice as high in 2022 compared to 2020 and 2021.
Hypertensive deaths and deaths from Medical and Surgical disorders were the third and fourth most common causes, followed by Early Pregnancy complications. The decline in Hypertension and Early pregnancy deaths in the current triennium is encouraging, but the possibility of under-reporting of maternal deaths during the pandemic must also be considered.
The pandemic reversed progress towards achieving the SDG goal of a MMR 70 by 2030, but progress is now back on track, with KwaZulu-Natal, Western Cape and Limpopo province closest to achieving this goal.

Key Recommendations

This is a summary of Crucial recommendations arising from both the 2017-2019 and the 2020-2022 triennial reports.

All maternity sites must conduct morbidity and mortality review meetings, where:

- Minutes are kept,
- Actions are assigned to individuals.
- There is follow-up to check that the actions have been performed and there is accountability.

Maternal and neonatal health services must be prioritised irrespective of existing parallel programmes by:

- Political commitment by NDOH and provinces in line with the International Maternal and Neonatal Health Conference (IMNHC) declaration. (The DOH, SA signed the IMNHC Commitment to achieve the SDG of an MMR of 70 maternal deaths per 100,000 live births by 2030; and to promote respectful, dignified, and safe care for women in maternity services in South Africa).
- MECs must ensure that the non-negotiable essential functions for MNH are in place and function properly. This includes ensuring that all equipment, medicines and other consumables required to implement the maternal and newborn package of care are in place in all health facilities/service points, and to feedback to the Ministry of Health quarterly.
- Financial Investment - funding for MNH services must be directed towards addressing the leading causes of maternal and neonatal mortality and should be ring fenced.

Provincial health system interventions and oversight to ensure:

- The NCCEMD process functions effectively as mandated by DOH in each province, and data is submitted accurately and timeously.
- Integration of HIV care, COVID-19 care, Contraception, Safe Surgery and Mental Health services into maternity and neonatal health services.

- Regular monitoring and evaluation of progress towards implementing NCCEMD recommendations and progress towards the SDG.
- Strengthen lines of communications at all levels of care. Support is required for frontline healthcare workers from the province down to the lowest levels of care. HODs and MECs to visit institutions and engage with clinicians and patients on their daily challenges.
- Ensure functional communication channels exist for consultation with and referral to higher levels of care (inter-facility). Promote easy access to maternity care by the community.
- Establish On-site Midwife run Birthing Units (OMBUs) at all large district, regional and tertiary hospitals which currently conduct large numbers of births of low-risk women. This will allow healthcare workers to focus on those women with risk factors.

General Clinical management interventions:

Focus to be on the top five leading cause of maternal deaths, five **Hs** by:

- Institutionalising COVID-19 pandemic lessons about maintaining MNH and SRH services during humanitarian or service delivery crises.
- Contraceptive services need to be expanded to include postpartum LARCs (esp. IUCD insertion), and Contraceptive availability at all facilities caring for women and at high-risk medical clinics must be ensured.
- Antenatal care restructured to ensure every problem case is reviewed on-site prior to referral by the most experienced midwife, and all antenatal clients to be assessed at least once between 28-34 weeks gestation by an experienced antenatal care provider (midwife or doctor).
- Clinical examination skills during antenatal, intrapartum and postpartum care must be emphasised with ongoing training.
- Prior to discharge from a ward and facility, specific criteria must be checked and documented, with appropriate action taken for abnormal findings, and to ensure women are not discharged in unstable condition.

Specific interventions for 5Hs:

- **H**IV - Implement the updated PMTCT protocol now named Vertical Transmission Prevention (VTP) for better HIV management and TB detection (viral load suppression and escalation for second line agents when needed).
- Ensure CD4 results are reviewed, and high-risk women treated appropriately to prevent and treat HIV associated infections
- **H**aemorrhage -Establish a Safe Labour minimum standards criteria and evaluation programme like the Safe Caesarean Delivery (surgery and anaesthesia) programme.
  Continue implementation of pre-existing initiatives e.g., NASG, Massive blood transfusion protocol, safe CD audits; and evaluate their impacts.
  Implementation of new approach for early detection and management of PPH in all maternity sites: EMOTIVE drape and care bundle for PPH.
- **H**ypertension - Guideline dissemination with training.
  Early pregnancy counselling service and access to safe MTOP when indicated
  Community awareness for earlier initiation of antenatal care.
- **H**eart (medical and surgical disorders) - Medical Obstetric clinics to be established at regional and tertiary hospitals for women with medical disorders requiring multi-disciplinary care.
  Screening questions and Clinical examination skills during antenatal care. Screening for mental health issues and identifying women at risk of suicide.
- first **H**alf of pregnancy complications – Develop strategies to improve management of early pregnancy complications (miscarriage, TOP and ectopic pregnancy).
  Pregnancy testing to be available at all health facilities and in the community
  Early recognition and Diagnosis of pregnancy complications, and prompt referral to higher levels of care when indicated.
  Outreach to primary care gynaecology services in CHCs for training and clinical support
  Early pregnancy counselling service and improved access to safe TOP; all health facilities must either provide a safe TOP service or have a clear referral policy to a facility that provides safe TOP.

Training and policies

- ESMOE board to be constituted, ESMOE modules updated and programme to restart.
- ESMOE Training (including anaesthetic ESMOE) to be compulsory for all new staff and two-yearly updates for existing staff.
- EOST drills/exercises must occur monthly in maternity facilities. This is especially so at primary care and district hospital level as the rarity of conditions makes doing emergency drills essential to maintain skills.
- Each hospital and CHC should have at least one on-site trainer able to run the relevant ESMOE modules and drills.
- Adherence to new SA Maternity Care Guideline.

1. INTRODUCTION

The eighth triennial Saving Mothers Comprehensive Report (for 2020-2022) presents an overview of maternal mortality, with underlying causes, trends, associated factors and preventability compared to previous triennia. It is important to note that this report covers the COVID-19 pandemic period which was declared a public health emergency in South Africa in March 2020, and which was ended in May 2023. The pandemic contributed to the general excess mortality observed in 2020 and 2021, but less in 2022 when the variant was less virulent and vaccination had been introduced. Furthermore, the COVID-19 pandemic had a major impact on maternal health outcomes and utilisation of maternal and reproductive health services (1).

The pandemic also adversely affected the assessment process and data analysis process of the NCCEMD since many provincial assessors were heavily involved in managing the COVID-19 pandemic in their places of work.

In 2020 there was a change of the NCCEMD national committee, and very sadly just as the new committee was moving forward, it experienced the untimely death of the new chairperson Prof. Eddie Mhlanga in 2022; may his soul rest in peace.

The NCCEMD would also like to acknowledge the work of the previous Chairperson, Prof. J Moodley, and previous Saving Mothers editor, Prof RC Pattinson, and the previous committee. The MRC unit headed by Prof Pattinson, continued to collate the MAMMAs data for the Saving Mothers report and the NCCEMD is very grateful for Ms Bontle Mamabolo and previously Ms Cathy Bezuidenhout for their substantial contribution. Prof. Pattinson is acknowledged for his important and helpful contributions to this report.

The work of the NCCEMD continues to be supported by the National Department of Health's MCWH directorate which was headed by Dr Manala Makua during the 2020-2022 triennium.

Previous triennial reports focused on the triennium as a whole (2,3,4); this report maintains the same format but also shows details of the individual years which make up the triennium because of marked differences between the years 2020, 2021 and 2022.

This Comprehensive triennial report for 2020-2022 provides a detailed analysis of the Saving Mothers data, abstracts of individual chapters on each of the primary obstetric causes of death, provincial reports and detailed recommendations. The full chapters on each primary cause require a secondary review by chapter heads, which is in progress. They will be published later in 2024.

2. METHODS

The method used to compile this report is the same as used for all previous reports (2,3,4), and the database was closed in May 2023. All Deaths during Pregnancy, Childbirth and the Puerperium (DDPCP) were notified to the provincial MCWH office, assessed by independent assessors, and data entered anonymously into the secure password protected national MaMMAS database used by the NCCEMD. Maternal death (MD) numbers were calculated by subtracting coincidental deaths from DDPCP.

Collection of maternal death data for the Saving Mothers triennial report was severely hindered due to human

resource and other challenges in maintaining the NCCEMD process during the COVID-19 pandemic. Many provincial assessors were heavily involved in managing the COVID-19 pandemic in their places of work.

The classification of Maternal deaths used in South Africa is based on the WHO ICD 10 adaptation for maternal deaths (5).

Maternal deaths are classified by Primary Obstetric causes, for example Obstetric Haemorrhage (OH), Non pregnancy related infections (NPRI) etc. These are then subdivided into Causal Subcategories e.g. for OH: uterine atony, bleeding at Caesarean delivery (CD) etc; and for NPRI: TB, pneumonia etc. The classification can be found in NCCEMD documents (6).

Since SARS-CoV-2 or COVID-19 was a novel infection in 2020 with specific characteristics and high mortality, it needed to be incorporated into the classification in order to be identifiable. It was thus decided by the NCCEMD to code it as follows: NPRI /Other (specify COVID-19 complication). A death during pregnancy due to COVID-19 complications was thus categorised as an indirect maternal death.

There were also women who died from other primary causes such as Hypertension, but whose condition was possibly exacerbated by concurrent COVID-19 infection. In such cases, the NCCEMD decided that COVID-19 infection should be included as a final or contributory cause as: Other (specify COVID-19).

3. VALIDITY OF THE DATA AND CORRECTIONS

Table 1 gives the live births from the DHIS, and maternal deaths submitted to the NCCEMD and entered on the Maternal Morbidity and Mortality Audit System (MaMMAS) in 2020. It is important to note that all Deaths During Pregnancy, Childbirth, and the Puerperium (DDPCP), previously known as pregnancy related deaths, were reported. DDPCP include any woman who died during pregnancy or the puerperium and includes coincidental deaths such as those due to motor vehicle accidents, natural disasters, and assault. The definition of a maternal death excludes these coincidental deaths.

Table 1 also compares the number of maternal deaths (MDs) submitted to the NCCEMD and entered into the MaMMAS database with the numbers reported by the District Health Information system (DHIS) signed off in May 2023. In previous reports, MaMMAS has identified more maternal deaths than DHIS. This is because MaMMAS includes deaths which happen outside health facilities and deaths at private hospitals, whereas DHIS only includes public facility deaths. In 2020 to 2022, this pattern of more deaths reported to MaMMAS than to DHIS occurred for all provinces except Gauteng (GP) and Eastern Cape (EC) in 2020; GP in 2021; and GP, Limpopo (Lim) and KwaZulu-Natal (KZN) in 2022, where MaMMAS reported fewer. A correction was made for the provinces suspected of under-reporting, and involved correcting the numbers of maternal deaths upwards to match the DHIS numbers (shown in bold in Table One)

Table 1. All pregnancy related deaths reported to MaMMAS and to DHIS

2020-2022	DHIS MD	MaMMAS deaths (DDPCP)	Coincidental*	MaMMAS MD**	Corrected MDs***
2020	1121	1228	31	1197	**1234**
2021	1413	1513	24	1489	**1507**
2022	1035	993	24	969	**1062**
	3569	**3734**	**79**	**3655**	**3803**

*Coincidental deaths = Total coincidental deaths per year, per province
**MaMMAS MD = DDPCP minus coincidental deaths
*** Details of correction per province shown in Appendix one

Details of this data and corrections made for each year of the triennium and province are shown in Appendix one (section 9.1)
The corrections were applied for maternal death and iMMR calculations shown in Section 4.1. Data was not corrected for the analysis of Causes of death, Associated factors and Preventability shown in Sections 4.2 to 4.6.

4. RESULTS

4.1 Maternal deaths and iMMR for 2020-2022 and previous years/triennia

There were 1234, 1507, and 1062 maternal deaths (MDs) in 2020, 2021 and 2022 respectively giving a corrected triennial total of 3803, which is greater than 3347 deaths reported in the previous triennium (2017-2019). There were 3,019165 live births, reported by public health facilities via DHIS in 2020-2022, giving a corrected iMMR of 126 MDs per 100,000 live births compared to 113.8 in the previous triennium.

Table 2 shows the number of corrected maternal deaths per province per year 2017-2022, which covers the pre-COVID-19 years (2017-2019), the peak COVID-19 Years (2020-2021), and the year (2022) when the COVID-19 impact was becoming less. Numbers of Live births pre province is shown in Appendix 9.1.

Table 2. Number Maternal Deaths per province 2017-2022 (with corrections ©)

	c2017	c2018	c2019	c2020	c2021	c2022
Eastern Cape	138	131	118	c160	153	133
Free State	67	92	77	89	114	55
Gauteng	257	267	249	c271	c341	c266
KwaZulu-Natal	239	202	179	250	276	c189
Limpopo	174	152	166	166	196	c143
Mpumalanga	117	112	70	95	167	113
North West	82	95	78	81	116	70
Northern Cape	28	25	32	23	43	26
Western Cape	73	74	56	99	101	67
South Africa	**1175**	**1150**	**1022**	**1234**	**1507**	**1062**

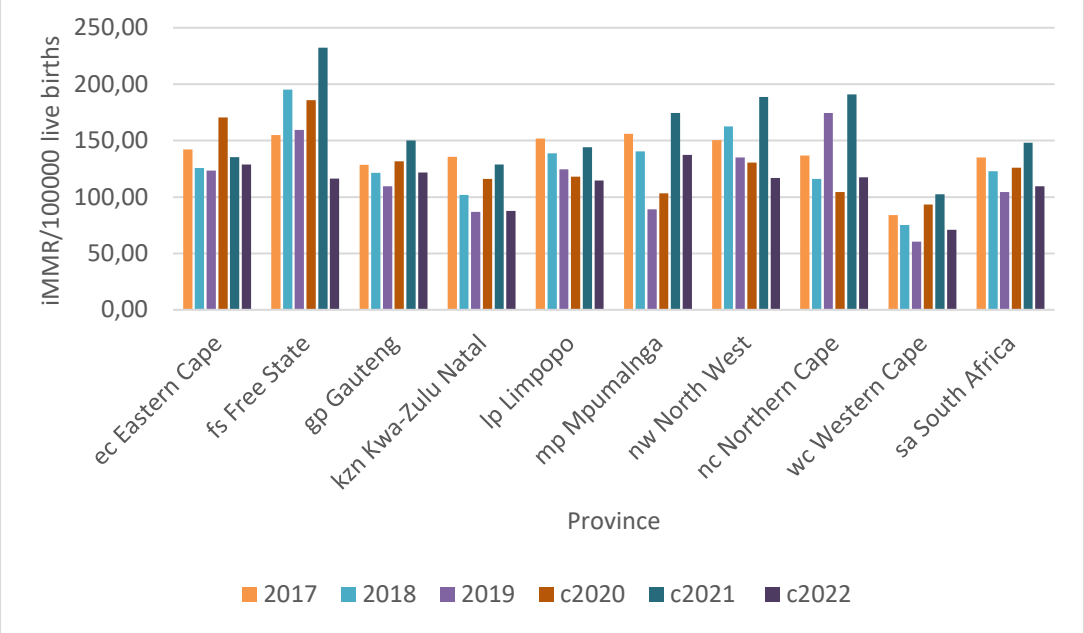
Table 3 shows the in-facility maternal mortality ratio (iMMR) per province per year, and for the whole triennium.

Table 3. iMMR per year 2020-2022 (with corrections©)

Corrected	2020 ©	2021 ©	2022 ©	2020-2022©
Eastern Cape	146.7	138.0	128.9	138.0
Free State	183.7	232.3	116.2	180.9
© Gauteng	112.8	150.1	121.7	128.0
© KwaZulu-Natal	116.4	128.8	87.8	111.0
© Limpopo	118.1	144.2	114.7	125.9
Mpumalanga	103.2	174.5	137.4	138.9
North West	130.6	188.5	116.8	145.5
Northern Cape	104.3	190.9	117.4	137.9
Western Cape	93.3	102.3	70.8	89.2
South Africa	**119.2**	**148.4**	**109.7**	**126.0**

It is notable that during 2020 and 2021, the iMMR was 30% and 47% respectively higher than for the pre-pandemic year 2019 when it was 98.8. However, the iMMR declined to 109.6 in 2022, which is closer to the iMMR in the previous triennium (Figure 1). This shows that the steep decline from 2010 was reversed in 2020 and 2021 but stabilised in 2022.

Figure 1. iMMR per province 2017-2022



The downward trend in iMMR per province in 2017-2019, increase in 2020 and 2021, and stabilisation in 2022 are shown in Figure one. Free state had the highest iMMR in this triennium (2020-2022) with Limpopo iMMR having declined considerably so now it is the province with the third lowest iMMR.
The iMMR per district 2020-2022 is shown in Appendix 2.

Yearly trends in maternal deaths and iMMR

Figure 2 shows the national number of maternal deaths recorded per year since the inception of the SA Confidential Enquiry into maternal deaths, and Figure 3 the trend in iMMR from 2005 to 2022. Following the

encouraging and steep decline from 2010, with an iMMR less than 100 in 2019, there was an increase in 2020 to 119.2 and even greater in 2021 to 148.4. The upturn correlated with the onset of the COVID-19 pandemic which started its impact in April 2020. In 2022 the iMMR came down to 109.7, similar to pre-pandemic levels. It is still far from the SDG goal of 70,000 live births by 2030.

Figure 3 shows the trend in iMMR from 2005 and shows a significant upsurge in 2020 compared to previous years. The iMMR increased by 30%. This is less than the 38% described in the SAHR chapter (1), which describes data for financial year 2020/2021, from April 2020 and thus did not cover the first quarter of the year before the onset of the pandemic.

Figure 2. Number of maternal deaths in SA from 1998-2022 (corrected ©)

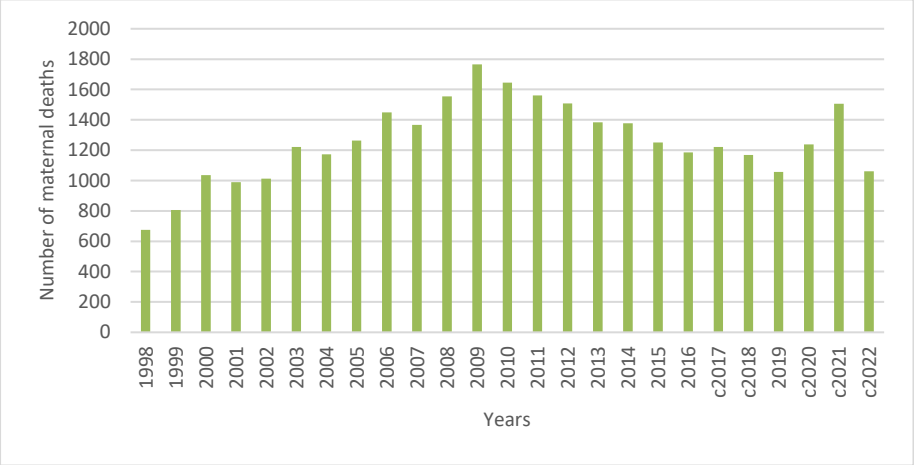


Figure 3. iMMR in SA per year 2005-2022 (corrected ©)

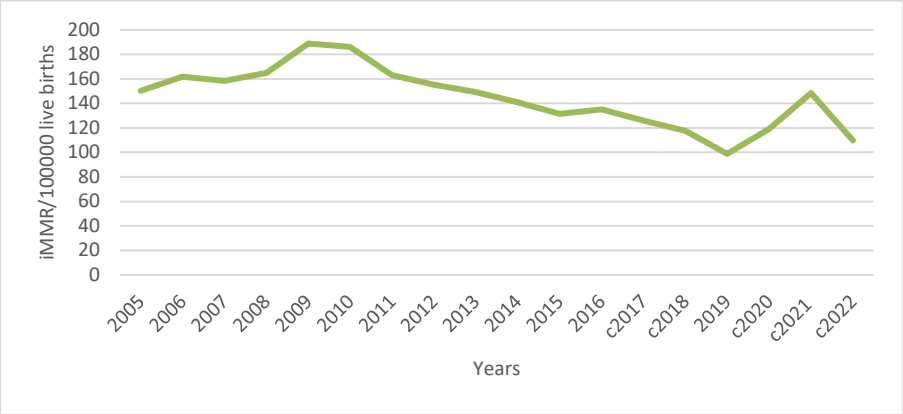
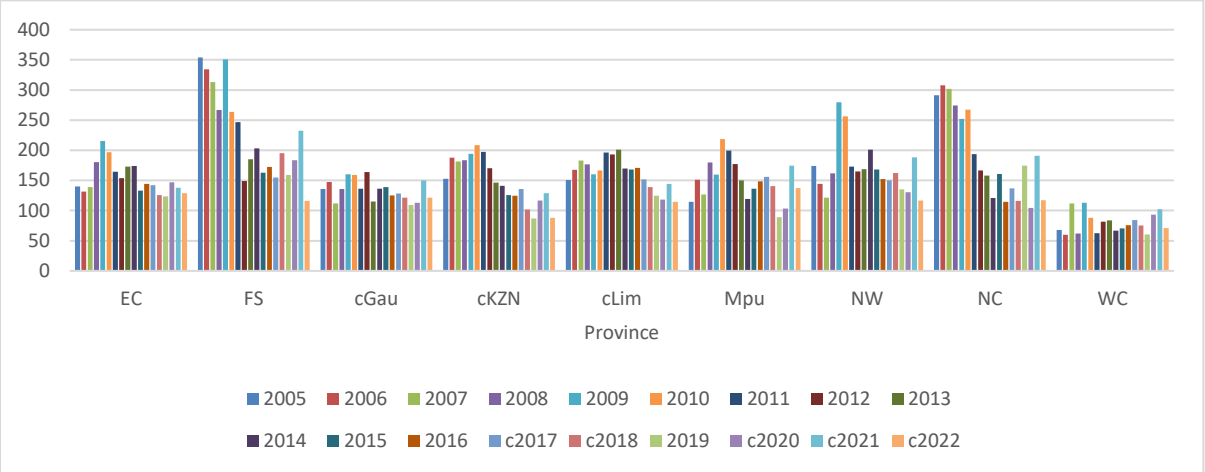


Figure 4 shows trends in iMMR for each province from 2005 to 2022 enabling annual comparisons to be made. Of note W. Cape (WC) has achieved an iMMR of less than 100 except in the COVID-19 years, and KwaZulu-Natal achieved an iMMR of less than 100 in 2019 and 2022, despite being a very populous rural province. All provinces have shown downward trends since 2010-2012, except for 2020 and 2021. Limpopo province has also shown remarkable progress.

Figure 4. iMMR per province 2005-2022



Triennial trends in maternal deaths and iMMR

Triennial comparisons are more reliable than annual comparisons because they deal with larger numbers. Figure 5 show a steady decline in iMMR per triennium from 2011 but an increase in the recent triennium. The 2020 to 2022 iMMR is heavily influenced by the high iMMR in 2020 and 2021.

Figure 5. Trends in iMMR per triennia in South Africa 2011-2022

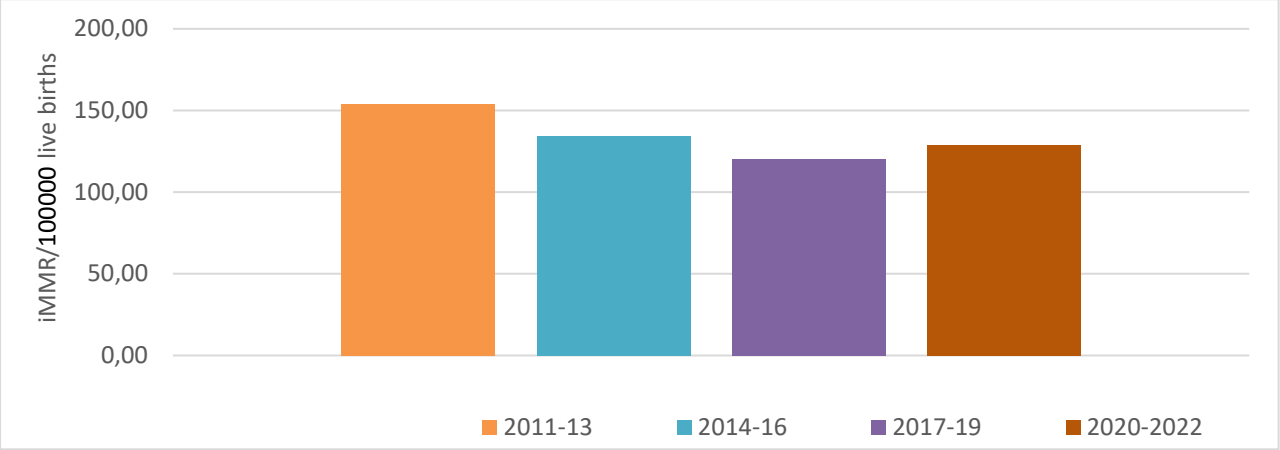


Table 4 and Figure 6a show triennial trends in iMMR per province from 2011.
All provinces showed a downward trend till 2017-2019 and excepting Limpopo which declined further in 2020-2022, they all showed an increased iMMR in the 2020-2022 triennium.

Table 4. iMMR per province for four triennia from 2011-2022

	2011-13	2014-16	2017-19	2020-22c
Eastern Cape	159.5	148.5	121.4	138.0
Free State	186.3	174.6	157.4	180.9
Gauteng	135.2	128.8	109.5	128.0
Kwa-Zulu Natal	168.6	127.1	103.1	111.0
Limpopo	191.1	165.2	134.1	125.9

	2011-13	2014-16	2017-19	2020-22c
Mpumalanga	172.9	132.2	123.0	138.9
North West	166.4	172.2	141.6	145.5
Northern Cape	152.2	121.4	122.3	137.9
wc Western Cape	71.0	68.3	65.2	89.2
sa South Africa	**154.1**	**134.3**	**113.8**	**126.0**

Figure 6a. iMMR per province for 4 triennia 2011-2022 (corrected)

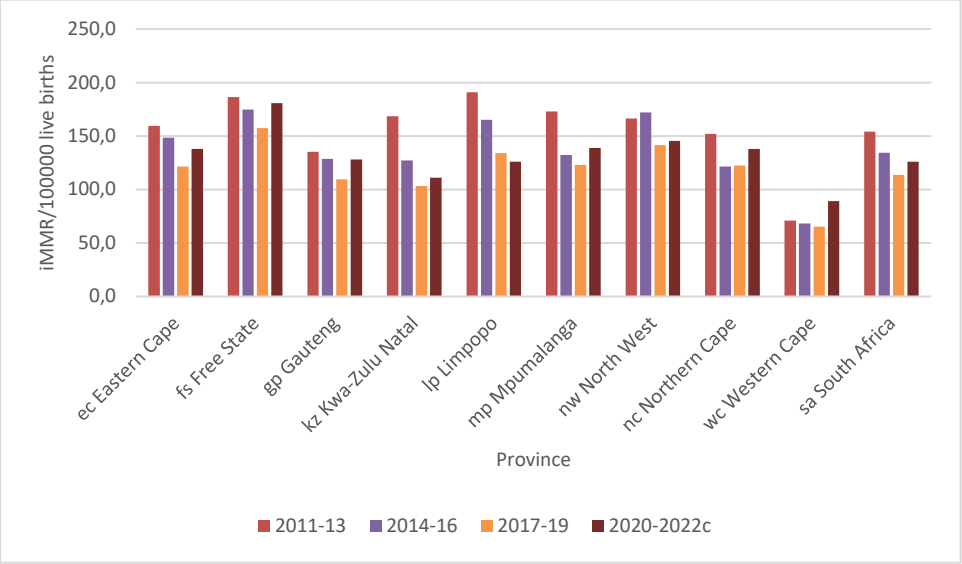
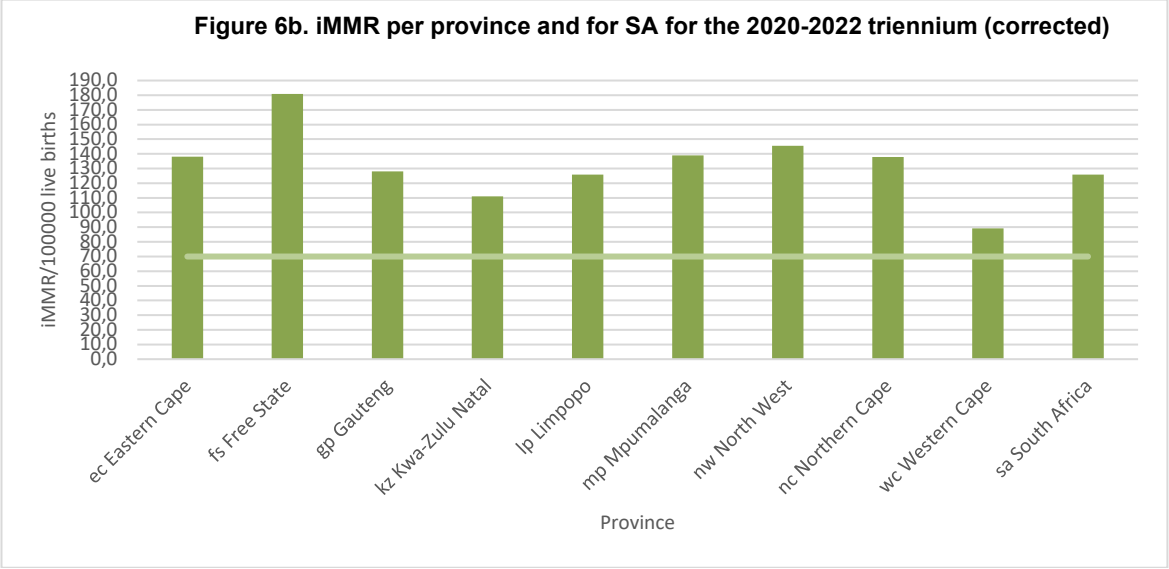


Figure 6b shows iMMR in the 2020-2022 triennium in relation to the SDG target of 70 by 2030. No province has yet reached the target, but Western Cape, KwaZulu-Natal and Limpopo appear to be closest in terms of trajectory.

Figure 6b. iMMR per province and for SA for the 2020-2022 triennium (corrected)



Maternal deaths per district and district iMMRs are shown in Appendix 9.2.

4.2 Primary Obstetric causes of Maternal Death (uncorrected data)

The Primary Obstetric Cause of death is shown in Table 5 for each year and the whole 2020-2022 triennium. Postmortems were performed for 26% of maternal deaths.

Table 5. Primary Obstetric Causes of Maternal deaths for 2020, 2021 and 2022, and triennium (uncorrected)

Primary obstetric problem	Number MDs (%) 2020 N= 1197	Number MDs (%) (2021) N=1489	Number MDs (%) (2022) N=969	Number MDs (%) (2020-2022) N=3655
Medical and surgical disorders	**183 (15.3)**	**190 (12.8)**	**(140 (14.4)**	**513 (14.0)**
Non-pregnancy-related infections*	**322** (27)**	**561 (37.7)***	**180(18.6)****	**1063 (29.1)**
Ectopic pregnancy	36 (3)	33 (2.2)	34 (3.5)	103 (2.8)
Miscarriage	49 (4.1)	54 (3.6)	63 (6.5)	166 (4.5)
Pregnancy-related sepsis	63 (5.3)	68 (4.6)	56 (5.8)	187 (5.1)
Obstetric haemorrhage	**200 (16.7)**	**237 (15.9)**	**162 (16.7)**	**599 (16.4)**
Hypertensive disorders of pregnancy	**185 (15.5)**	**188 (12.6)**	**166 (17.1)**	**539 (14.7)**
Anaesthetic complications	21 (1.8)	17 (1.1)	39 (4.0)	77 (2.1)
Adverse drug reactions	13 (1.1)	6 (0.4)	7 (0.7)	26 (0.7)
Embolism	33 (2.8)	43 (2.9)	40 (4.1)	116 (3.1)
Acute collapse - cause unknown	15 (1.3)	36 (2.4)	21 (2.2)	72 (2)
Miscellaneous	4 (0.3)	3 (0.2)	8 (0.8)	15 (0.4)
Unknown	73 (6.1)	53 (3.6)	53 (5.5)	179 (4.9)

**Includes COVIC-19 deaths **Includes 124 COVID-19 deaths in 2020*
****Includes 369 deaths in 2021 **** Includes 12 COVID-19 deaths in 2022*

Non-Pregnancy Related Infections (NPRI) was the major causal grouping in all three years as in previous triennia but showed a very large increase in 2020 and 2021, where it accounted for 322 (27.1% all MDs) in 2020 and 561 (37.7% of MDs) in 2021. In 2022 it accounted for 180 deaths (18.6% MDs) which is lower than previous triennia. For the whole triennium it was the leading cause accounting for 29.1% of all MDs

COVID-19 pneumonia and complications constituted the majority of these NPRI deaths in 2020 and 2021, accounting for 124 (38.5% of NPRI deaths) in 2020, and 369 (66.6% of NPRI deaths and 25% of all MDs) in 2021. In 2022, there were only 12 deaths directly due to COVID-19.

Obstetric haemorrhage (OH) deaths increased to become the second most common cause, accounting for deaths in 599 women (16.4% of total MDs).

Hypertensive disorders (HDP) were the third most common causes, accounting for 539 MDs (14.7% of total)

Medical and surgical (M&S) disorders were the fourth cause accounting for 513 MDs (14% of total MDs)

Early pregnancy deaths from miscarriage and ectopic accounted for 269 deaths (7.3%) and thus Early

Pregnancy complications combined are the fifth most common cause.

There were 39 Anaesthetic deaths in 2022 which is twice the number in previous years, and although not a major cause, almost all of these deaths are preventable.

4.3 COVID-19 deaths

Table 6 shows the number of COVID-19 deaths per province for each year and the triennium. The total deaths specified in MAMMAs as due to COVID-19 was 505 and the majority occurred in 2021. Gauteng, KwaZulu-Natal, Western Cape, and Eastern Cape were particularly affected.

Table 6. COVID-19 deaths per province for each year and the whole triennnium, 2020-2022

Province	EC	FS	GAU	KZN	LIM	MPU	NW	NC	WC	TOTAL
NPRI/ COVID-19 2020	30	1	12	40	1	7	4	2	27	124
NPRI/ COVID-19 2021	32	17	78	89	43	33	20	14	43	369
NPRI/ COVID-19 2022	3	1	3	4	0	1	0	0	0	12
NPRI/ COVID-19 2020-2022	65	19	93	133	44	41	24	16	70	505

Causal subcategories for each Primary Obstetric Cause as well as Final and contributory cause for each condition can be found in Appendices 9.3 and 9.4 and will be described in more detail by Chapter heads in the Comprehensive report.

4.4. Trends in Primary causes of deaths and provincial comparisons

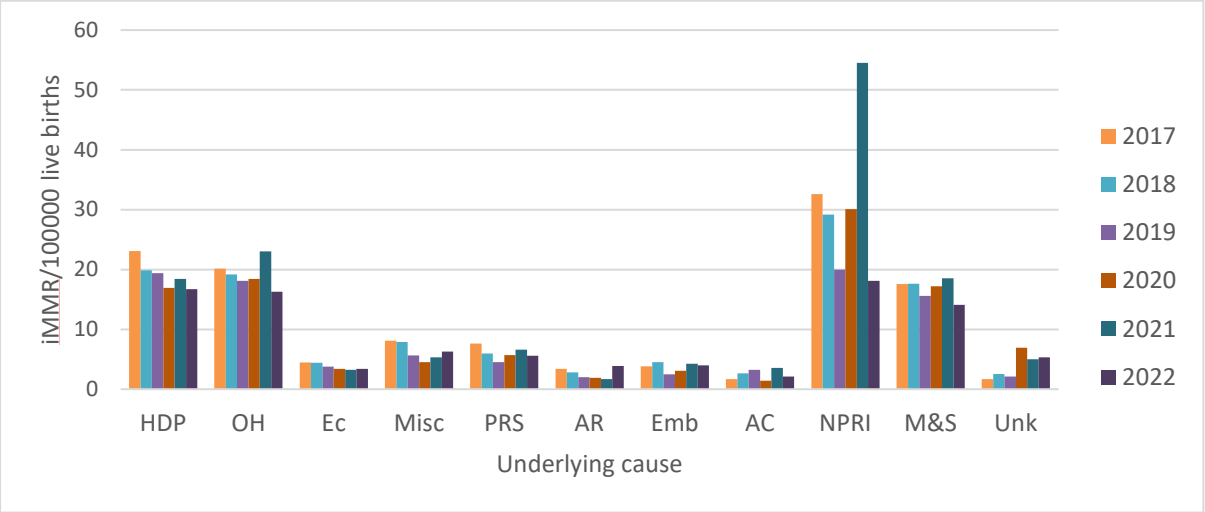
Table 7 presents the iMMR for each primary obstetric cause per year and for the whole triennium.

Table 7. iMMR for Primary Obstetric Cause per year 2020-2022 (uncorrected)

	2020	2021	2022	2020-2022
Hypertensive disorders of pregnancy	17.87	18.51	17.15	17.9
Obstetric haemorrhage	19.32	23.33	16.73	19.8
Ectopic pregnancy	3.48	3.25	3.51	3.4
Miscarriage	4.73	5.32	6.51	5.5
Pregnancy-related sepsis	6.09	6.9	5.78	6.2
Anaesthetic complications	2.03	1.69	4.03	2.6
Embolism	3.19	4.23	4.13	3.8
Acute collapse - cause unknown	1.45	3.54	2.17	2.4
Non-pregnancy-related infections	31	55.23	18.59	35.2
Medical and surgical disorders	17.68	18.7	14.46	17
Unknown	7.05	5.22	5.47	5.9
iMMR for all maternal deaths	**115.62**	**146.59**	**100.09**	**121**

Figure 7 compares iMMR per year starting from 2017 so that pre-pandemic iMMRs can be compared with the pandemic years (2020 and 2021) for primary obstetric cause.

Figure 7. iMMR per Primary Obstetric Cause of maternal death 2017-2022



In terms of comparisons with the previous triennium and triennia, the iMMR for NPRI increased from 27.1 MDs per 100,000 live births in 2017-2019 to 35.2 in 2020-2022. However the iMMR for Obstetric Haemorrhage and Medical and Surgical disorders remained similar between the two triennia (OH iMMR 19.1 in 2017-2019 and 19.8 in 2020-2022; M&S iMMR 16.9 in 2017-2019 and 17 in 2020-2022). In contrast, the iMMR for Hypertension declined from 20.2 to 17.9, and for Early Pregnancy complications from 11.4 in 2017-2019 to 8.9 in 2020-2022.

Figure 8. Comparison iMMR of 8 triennia per primary obstetric cause 1999-2022)-uncorrected

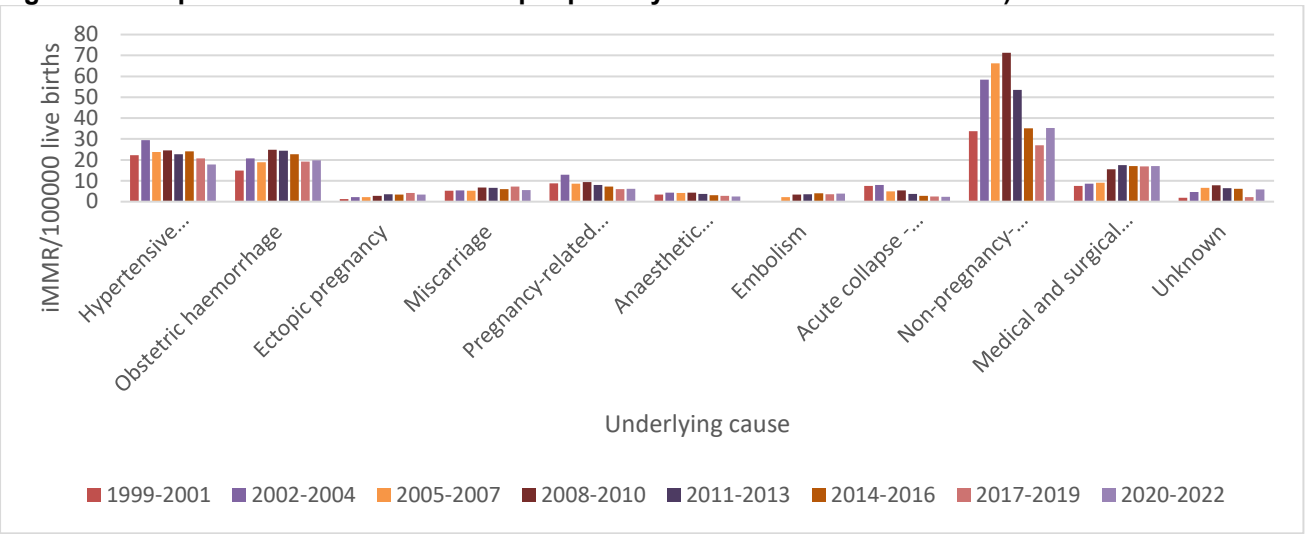


Table 8 shows the iMMR per province for primary obstetric cause with a ranking of priority causes.

For all provinces except Free State, NPRI was the most common cause, but the ranking of causes thereafter varied between provinces. The highest iMMR for OH occurred in Free State, Mpumalanga and North West. The highest iMMR for HDP occurred in Free State (where it was the most common primary obstetric cause) and Northern Cape. In the Western Cape M&S was the second most common cause. KwaZulu-Natal had the lowest iMMR from HDP, and Western Cape the lowest from OH.

Table 8. Maternal mortality ratio per underlying cause and province for the 2020-2022 triennium and the ranking of the four most common underlying causes

	EC	FS	GP	KZN	LP	MP	NW	NC	WC	SA
*M&S	17.64	28.30	17.20	17.23	15.71	15.92	19.07	14.99	11.69	16.99
*NPRI	47.97	34.52	27.26	39.89	26.68	35.92	40.33	38.97	36.74	35.21
Ec	2.48	6.21	3.79	3.10	4.49	2.59	3.27	5.99	1.67	3.41
Miscarriage	5.88	2.76	7.14	4.81	5.24	7.04	9.26	4.50	1.00	5.50
PRS	6.50	10.35	5.83	4.81	7.98	8.52	4.90	5.99	4.01	6.19
*OH	17.02	31.06	19.97	14.74	22.69	30.36	28.34	20.98	9.35	19.84
*HDP	20.73	35.90	17.49	9.78	21.69	20.00	25.07	26.98	10.69	17.85
AR	3.40	3.45	1.02	1.86	4.74	5.18	2.72	1.50	1.00	2.55
ADR	0.62	1.38	1.02	0.78	1.99	0.74	0.00	0.00	0.00	0.86
Emb	6.19	5.52	2.33	2.95	4.24	4.81	2.18	5.99	5.01	3.84
AC	1.86	0.00	3.94	2.02	0.75	1.85	3.81	1.50	3.34	2.38
Miscellaneous	0.31	1.38	0.00	0.47	0.50	0.74	0.00	1.50	1.34	0.50
Unknown	0.93	17.26	8.02	6.52	2.99	5.18	6.54	8.99	3.34	5.93

Key

*	Top four most common underlying causes
	Most common
	2nd most common
	3rd most common
	4th most common

4.5. Associated factors for women who died: Age, HIV status, Anaemia, Caesarean delivery.

Age

The age distribution amongst all live births was sourced from STATS SA (7), thus enabling age related maternal mortality to be calculated. Figure 9 shows that MMR increases with maternal age. Figure 10 shows that this trend was most marked for NPRI, probably due to higher age related COVID-19 mortality, and Obstetric haemorrhage. The previous U- shaped curve for Hypertension shown in the previous triennium was not observed in this triennium This could reflect better care of HPD for young teenagers related to the new HPD protocol published in 2019 (8).

Figure 9. iMMR per age category for the 2020-2022 triennium

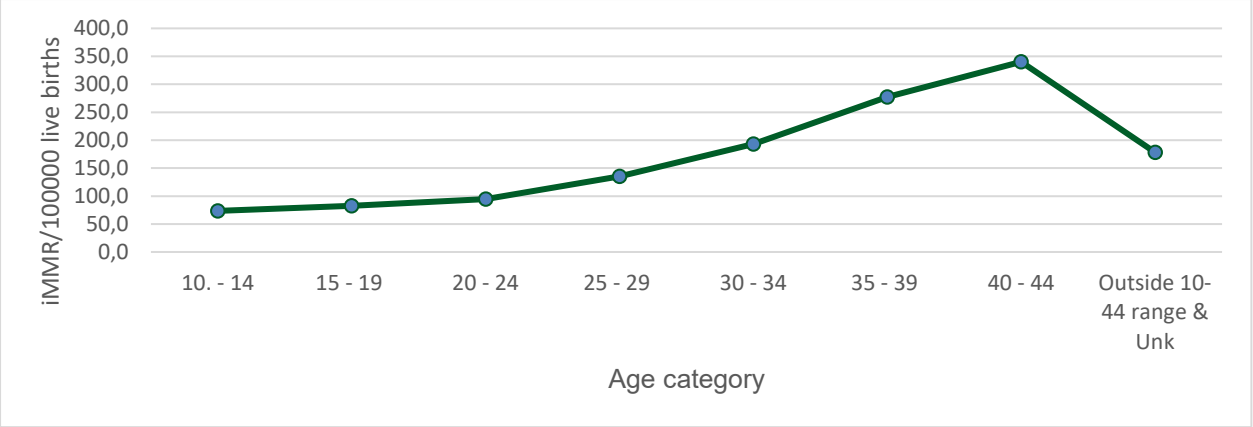
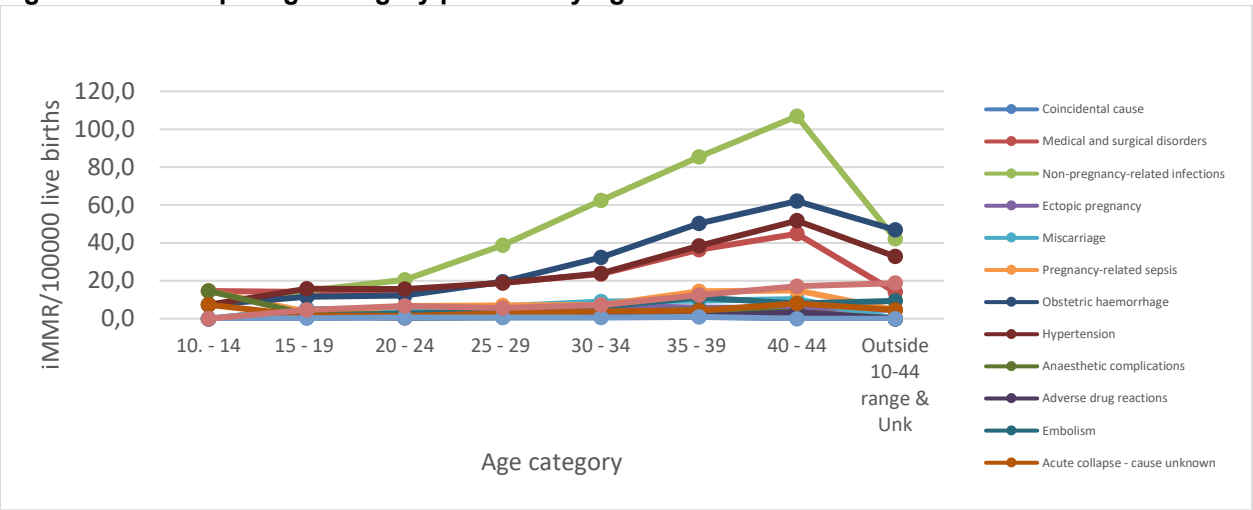


Figure 10. iMMR per age category per underlying cause for the 2020-2022 triennium



HIV status

Table 9 shows that HIV negative women exceeded HIV positive for maternal deaths in this triennium, unlike in previous triennia. This reflects improved testing, and treatment of HIV positive pregnant women and women in general. However, it remains a concern that HIV status was unknown for 13.4% of deaths, and that 14.4% of HIV positive women were not on antiretroviral treatment.

Table 9. Details of HIV testing and treatment

HIV Status	N	%
Positive	1475	39.5
Negative	1759	47.1
Declined test	1	0
Unknown	499	13.4
HIV Treatment	**Known Positive**	**% of known HIV positive**
None	213	14.4
TLD	300	20.3
TEE	531	36.0
Not specified	431	29.2

Anaemia

Anaemia defined as haemoglobin less than 10 gms/dl in pregnancy before the events that led to the death, occurred in 29.6% of maternal deaths and was over 35% for NPRI, and Medical and surgical disorders (Table 10). However, the high percentage of anaemia in women dying from ectopic and miscarriage is probably due to the only HB result available having been measured after the onset of the emergency event.

Table 10. Numbers maternal deaths with anaemia and underlying cause of death

Primary obstetric problems	No Anaemia	Anaemia	% Anaemia	Unknown
Medical and surgical disorders	268	145	35.1	100
Non-pregnancy-related infections	562	303	35.0	198
Ectopic pregnancy	26	47	64.4	30
Miscarriage	41	58	58.6	67
Pregnancy-related sepsis	102	35	25.5	50
Obstetric haemorrhage	385	114	22.8	100
Hypertension	366	64	14.9	109
Anaesthetic complications	64	10	13.5	3
Adverse drug reactions	14	7	33.3	5
Embolism	70	23	24.7	23
Acute collapse - cause unknown	45	13	22.4	14
Miscellaneous	12	2	14.3	1
- No primary cause found	13	7	35.0	6
- Lack of information	26	11	29.7	16
Maternal death	**1994**	**839**	**29.6**	**722**
- Death at home or outside health services	53	12	18.5	35
Coincidental cause	20	8	28.6	51
DDPCP	**2067**	**859**	**29.4**	**808**

Caesarean delivery

The national CD rate for 2020 to 2022 was 28.8% which is similar to the previous triennium (28.1%). The Case Fatality rate was 155.9 per 100,000 CD which has increased from 2019 (132.4 for 2017-2019 triennia and 112.5 in 2019). The CD Case Fatality Rate increased to 145.7 CD associated deaths per 100,000 CDs in 2020 and 203.6 in 2021, compared to 112.5 in 2019 (Table 11). This could reflect the fact that many sick women with COVID-19 in the third trimester had CD for severe respiratory compromise, and it may not have been a direct effect of the CD. In 2022, the CD CFR had declined to 118.4, similar to 2019.

This increase in CD CFR could reflect deterioration of quality of care relating to CD or could be due to the higher CD rates in women with severe COVID-19 pneumonia.

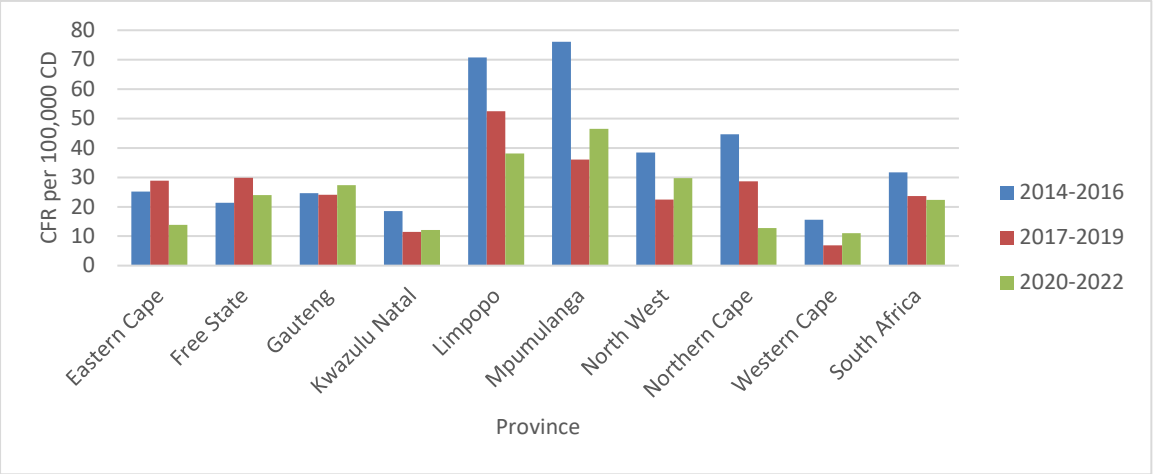
Table 11. Caesarean delivery and maternal deaths 2020-2022 ***(*CD CFR = Number CD deaths per 100,000 CDs)***

Province (2020)	Deliveries 2020	CD	CD rate (%)	MD with CD	CDCFR*
Eastern Cape	330739	100672	30.4	122	121.2
Free State	149849	45894	30.6	108	235.3
Gauteng	703334	207695	29.5	336	161.8
KwaZulu-Natal	662648	232152	35.0	257	10.7

Province (2020)	Deliveries 2020	CD	CD rate (%)	MD with CD	CDCFR*
Limpopo	409067	94513	23.1	190	201.0
Mpumalanga	273822	58057	21.2	143	246.3
North West	187657	43800	23.3	88	00.9
Northern Cape	68412	15586	22.8	33	211.7
Western Cape	306012	91123	29.8	109	119.6
South Africa	**3091540**	**889497**	**28.8**	**1387**	**155.9**

There were 198 deaths from bleeding associated with caesarean delivery (BLDACD), giving a BLDACD CFR for the triennium of 22.3, similar to 2017-2019 when it was 23.6. Of note in 2020-2022, is the wide discrepancy in BLDACD CFR between provinces with the highest rates in Mpumalanga (46.5 BLDACD deaths per 100,000 CDs) and Limpopo (38.1), with the lowest rates in Western Cape (10.0) and KwaZulu-Natal (12.1). However, Figure 11 shows some very encouraging trends in Limpopo and Northern Cape where BLDACD CFR is one a downward trend.

Figure 11. Bleeding associated with CD CFR per triennia and province from 2014-2022



4.6 Health system factors: Location and Level of Care, Antenatal care, Emergency Referrals

In the 2020-2022 triennium, the majority of deaths (90.1%) occurred at public hospitals with a larger number (6.9%) in private hospitals than in previous years, especially during 2021. This shows that the COVID-19 pandemic affected all classes of society (Tables 12 and 13)

Table 12. Location of DDPCP 2020-2022

	Facility* N (%)	In transit N (%)	Home/Outside N (%)	Total N (%)
2020	1093 (92.4%)	15 (1.3%)	75 (6.3%)	1183 (100%)
2021	1411 (94.3%)	14 (0.9%)	72 (4.8%)	1497 (100%)
2022	932 (93.9%)	11 (1.1%)	50 (5%)	993 (100%)
2020-2022	3436 (93.6 %)	40 (1.1%)	197 (5.4%)	3673 (100%)

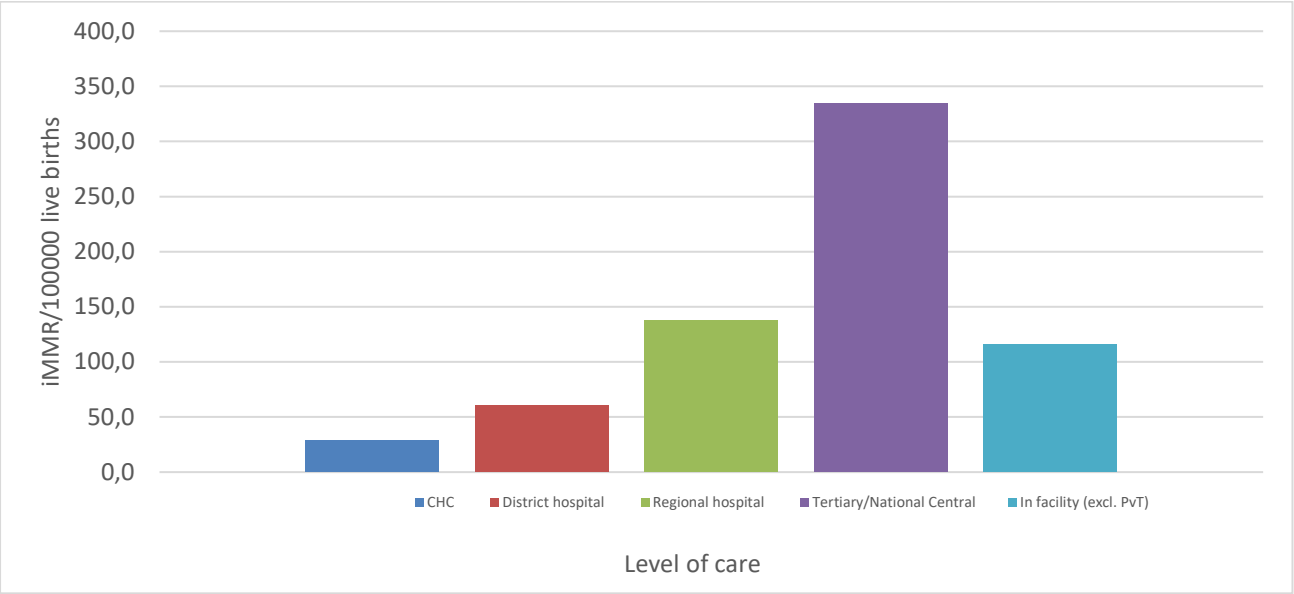
*2020. Included 80 deaths in private hospitals.
*2021. Included 128 deaths in private hospitals.

*2022. Included 36 deaths in private hospitals.
In 2020-2022 triennium, deaths in private hospitals were 244 compared to 115 in 2017-2019.

Table 13. Number maternal deaths per underlying category and level of care 2020-2022 (uncorrected)
In facility deaths include In-transit and in facility deaths

Primary obstetric problem	CHC	District hospital	Regional hospital	Tertiary/ National Central	Private hospital	In facility
Coincidental cause	4	15	15	25	3	62
Medical and surgical disorders	8	81	160	221	27	497
Non-pregnancy-related infections	14	194	333	380	124	1045
Ectopic pregnancy	7	33	28	30	1	99
Miscarriage	7	35	47	72	3	164
Pregnancy-related sepsis	2	22	64	84	10	182
Obstetric haemorrhage	21	167	186	174	36	584
Hypertension	19	92	172	220	20	523
Anaesthetic complications	0	34	26	15	2	77
Adverse drug reactions	2	4	9	10	1	26
Embolism	4	38	35	20	12	109
Acute collapse - cause unknown	7	25	13	19	1	65
Miscellaneous	0	2	6	7	0	15
Unknown	11	20	26	24	4	85
Total	**106 (3.0%)**	**762 (21.6%)**	**1120 (31.7%)**	**1301 (36.8%)**	**244 (6.9%)**	**3533 (100%)**

Figure 12. iMMR per level of care for the 2020-2022 triennium



The finding of an increased iMMR at higher levels of care is due to high-risk women or women with new obstetric complications being referred to higher levels of care and suggests that the referral system is working correctly;

although the condition in which women arrive at TH/NC could reflect substandard care by the lower level that refers, or transport delays. Section E will look at preventable factors for each level of care.

Booking status

Table 14 shows Antenatal care was received by 75% of maternal deaths, but only 57,3% booked before 20 weeks. Lowest attendance rates were in women dying from miscarriage or ectopic pregnancy, who would not have been expected to seek antenatal care.

Table 14. Antenatal care details amongst maternal deaths

Primary obstetric problems	No ANC	Unknown	Received ANC	Total ANC known	% known to have received ANC	<20 weeks	% <20weeks
Medical and surgical disorders	121	51	341	462	73.8	205	60.1
Non-pregnancy-related infections	232	97	734	966	76.0	432	58.9
Ectopic pregnancy	64	12	27	91	29.7	20	74.1
Miscarriage	119	19	28	147	19.0	23	82.1
Pregnancy-related sepsis	30	30	127	157	80.9	63	49.6
Obstetric haemorrhage	71	22	506	577	87.7	260	51.4
Hypertension	113	21	405	518	78.2	236	58.3
Anaesthetic complications	6	0	71	77	92.2	45	63.4
Adverse drug reactions	6	3	17	23	73.9	11	64.7
Embolism	16	12	88	104	84.6	53	60.2
Acute collapse - cause unknown	16	2	54	70	77.1	27	50.0
Miscellaneous	3	1	11	14	78.6	9	81.8
- No primary cause found	5	2	19	24	79.2	10	52.6
- Lack of information	10	5	38	48	79.2	22	57.9
Maternal death	**812**	**277**	**2466**	**3278**	**75.2**	**1416**	**57.4**
- Death at home or outside health services	15	12	73	88	83.0	41	56.2
Coincidental cause	27	32	20	47	42.6	10	50.0
DDPCP	**854**	**321**	**2559**	**3413**	**75.0**	**1467**	**57.3**

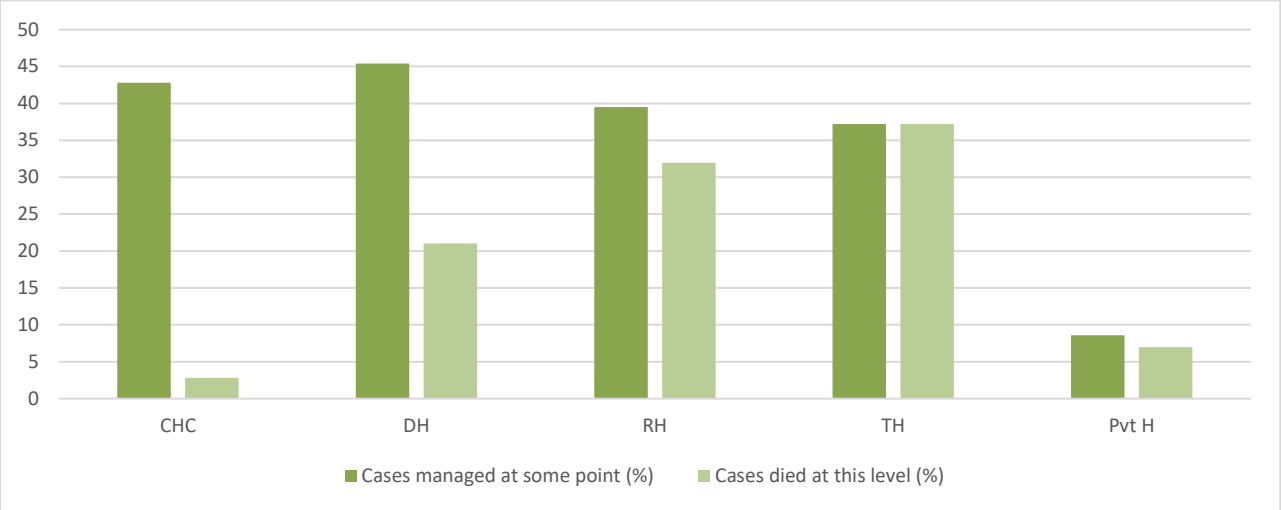
Emergency Referrals

There were 1912 (52.3%) maternal deaths who required an emergency inter-institution referral before they died (Table 15). The majority of referrals were from CHCs and DHs. Figure 13 shows the relationship between the number of DDPCP managed at some point at each level of care and the number dying at that level.

Table 15. Details of Emergency Referrals for maternal deaths.

Primary obstetric problems	No Referral	CHC	DH	RH	TH/NCH	PvT
Medical and surgical disorders	231	85	121	53	14	9
Non-pregnancy-related infections	517	199	227	62	12	46
Ectopic pregnancy	60	21	13	4	0	5
Miscarriage	83	28	43	8	1	3
Pregnancy-related sepsis	75	36	52	18	1	5
Obstetric haemorrhage	336	98	138	19	1	7
Hypertension	221	118	143	38	11	8
Anaesthetic complications	46	12	18	0	0	1
Adverse drug reactions	12	4	6	3	0	1
Embolism	69	27	17	0	0	3
Acute collapse - cause unknown	46	16	9	0	0	1
Miscellaneous	6	2	6	1	0	0
- No primary cause found	11	7	7	1	0	
- Lack of information	30	7	10	3	0	3
Maternal death	**1743**	**660**	**810**	**210**	**40**	**92**
- Death at home or outside health services	96	2	2			
Coincidental cause	53	5	15	4	0	2
DDPCP	**1892**	**667**	**827**	**214**	**40**	**94**

Figure 13. Comparison of percentage DDPCP managed at some point of those that died at that level



4.7 Preventable factors

Overall preventability and comparison with previous triennia

Table 16. Preventability of DDPCP 2020-2022 compared with 2017-2019 within the health system*

	2020 (DDPCP = 1183)	2021 (DDPCP= 1497)	2022 (DDPCP= 993)	2020-2022 (DDPCP= 3673)	2017-2019 DDPCP= 3289)
	N (%)	N (%)	N (%)	N (%)	N (%)
No suboptimal care identified	401 (33.9%)	528 (35.3%)	320 (32.2%)	**1249 (34%)**	924 (28.1%)
Suboptimal care, no impact on outcome	96 (8.1%)	132 (8.8%)	87 (8.8%)	**315 (8.6%)**	312 (9.5%)
Suboptimal care, possible impact on outcome	408 (34.5%)	538 (35.9%)	333 (33.5%)	**1279 (34.8%)**	1021 (31.0%)
Suboptimal care, probable impact on outcome	278 (23.5%)	299 (20%)	253 (25.5%	**830 (22.6%)**	1032 (31.4%)

**% potentially preventable 58% in 2020; 56% in 2021; 59% in 2022; and 57.4% in 2020-2022 compared to 62.4% in previous triennium.*

Deaths were assessed to be possibly or probably preventable by the health system (excluding patient/community related factors) for 58% of women who died in 2020, 56% in 2021, and 59% in 2022, the most common causes of preventable deaths being OH, and HPD deaths, with lesser numbers in the NPRI group (Table 16 and Figure 14). In the 2020-2022 triennium, 57.4% of deaths were potentially preventable compared to 62.4% in the previous triennium. This decrease was probably due to the large numbers of deaths from COVID-19 in 2020-2022, most of which were assessed as being unavoidable. The largest percentage of preventable deaths was found in OH, HYP and Anaesthetic deaths. The notable increase in the number of anesthetic deaths in 2022, shown in Table 5 will be further examined in relation to preventable factors in the chapter on anaesthetic deaths in the expanded comprehensive report.

Figure 14. Impact of suboptimal care per underlying cause for 2020-2022 triennium

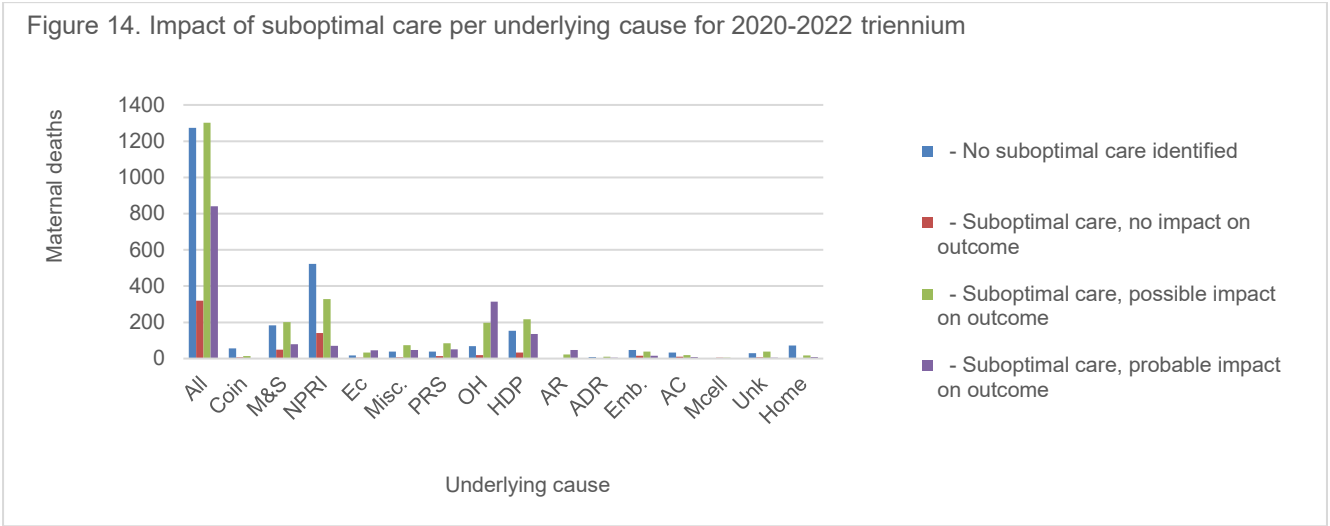


Table 17 shows that the most frequent patient/community related preventable factors were lack antenatal care and delay accessing care. These both decreased slightly in the 2020-2022 triennium compared to the previous one, indicating that women continued to seek care for their pregnancies, despite the COVID-19 pandemic.

Table 17. Patient/Community related Preventable factors 2020-2022 and comparison with previous triennium

2020-2022	Number 2020-22	%	% 2017-2019
Lack of information	400		
Assessable cases	3334		
No avoidable factor detected	1623	48.7	46.8
No antenatal care	609	16.3	19.9
Infrequent antenatal care	152	4.1	6.8
Delay in accessing medical help	1057	28.3	29.7
Declined medication/surgery/advice	277	7.4	8.6
Family problem	78	2.1	1.8
Community problem	31	0.8	0.6
Unsafe abortion	44	1.2	1.6
Other	259	6.9	1.7
Total	**3734**		

Overall, there was a small increase in the proportion of deaths with administrative avoidable factors (Table 18). However, comparing years, the proportion of deaths with Administrative avoidable factors increased in 2020 (57.1%) and 2021 (52.6) compared to 48.1% in the previous triennium. The most frequently cited avoidable factors in this category were appropriate skill not available on site/standby, lack of healthcare facilities (eg ICUs) and delay attending to patient due to overburdened services. This probably reflects the effects of the COVID-19 pandemic on functioning of the health system. The Human Resource categories cannot be properly compared between triennia due to changes in categories as shown in the footnote beneath the table. The category “appropriate skill not available not available onsite / on standby” refers to facilities where there is no one on duty with the skill designated for that level of care; for example, a primary care delivery unit without a registered midwife or a regional hospital without an obstetric specialist. This would be due to unfilled posts in most instances, but some cases were cited where the person with the appropriate level of skill was on duty, but not contactable or available to help.

Table 18. Administrative related preventable factors

Description	Number 2020-22	%	%2017-19
Lack of information	330		
Assessable cases	3404		
No avoidable factors	1702	50	51.6
Avoidable factors detected	**1702**	**50**	48.4
Transport problem: Home to institution	57	1.5	1,9
Transport problem: Institution to institution	234	6.3	6,2

Description	Number 2020-22	%	%2017-19
Lack of accessibility: Barriers to entry	47	1.3	1,2
Lack of accessibility: Other	50	1.3	0,7
Delay in attending to patient (Overburdened service)	**265**	**7.1**	6,4
Delay in attending to patient (Reason unknown)	185	5	
Lack of healthcare facilities: ICU	**328**	**8.8**	8,3
Lack of healthcare facilities: Blood/blood products	82	2.2	3,1
Lack of healthcare facilities: Other	119	3.2	2,9
Inadequate numbers of staff on duty*	**271**	**7.3**	
Appropriate skill not available on site / on standby*	**363**	**9.7**	
Communication problems: Technical	70	1.9	1,6
Communication problems: Interpersonal	63	1.7	3
Other	359	9.6	9,1
Total	**3734**		

*new categories in 2020-2022
compared to 2017-2019 categories: Lack appr trained staff Drs-20.5%, Nurses-13.7%

Medical care preventable factors are shown in Table 19. These were most common for district hospitals which had decreased slightly from the previous triennium. Preventable factors in private hospitals decreased. Poor problem recognition and sub-standard care remain the most frequent problems, similar to previous triennia.

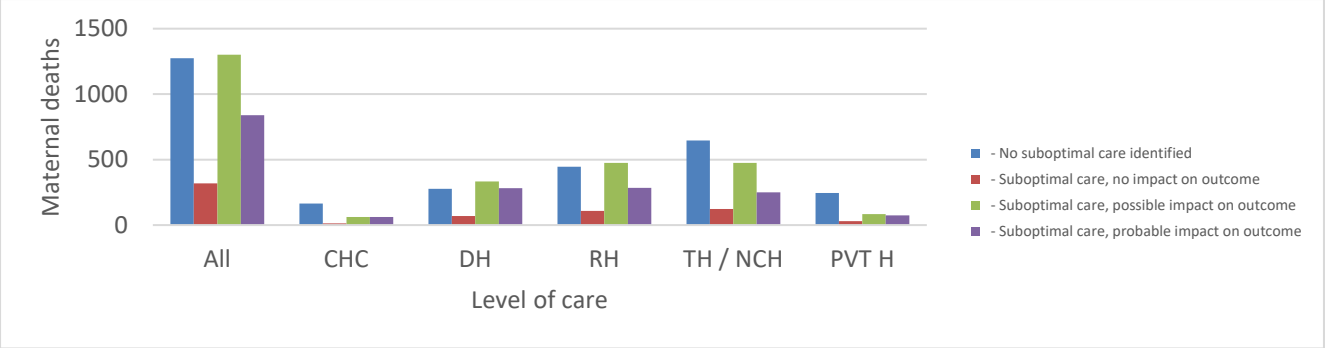
Table 19. Medical care related preventable factors

Proportion of deaths managed at each level with preventable factors (%)	CHC	DH	RH	TH/NC	Private
Any Preventable factors	42.1 *(39.3 in prev triennium)*	65.3 *(69.4 in prev triennium)*	57.3 *(59 in prev triennium)*	42.5 *(40.2 in prev triennium)*	45.9 *62.9 in prev triennium)*
Initial assessment	19.9	20.7	14	8.7	14.2
Problem with recognition / diagnosis	18.9	32.8	23.2	14.7	22.6
Delay in referring the patient	10.5	20	7.2	1.1	2.6
Managed at inappropriate level	4.3	15.3	5.2	0.8	0.6
Incorrect management (Wrong diagnosis)	3.1	9.5	7	3.5	5.8
Sub-standard management (Correct diagnosis)	10.9	25.2	29.1	22.5	17.7
Not monitored / Infrequently monitored	1.9	9.3	8.4	3.9	1.9

Proportion of deaths managed at each level with preventable factors (%)	CHC	DH	RH	TH/NC	Private
Prolonged abnormal monitoring with no action taken	2.9	10.8	11.2	6	6.1

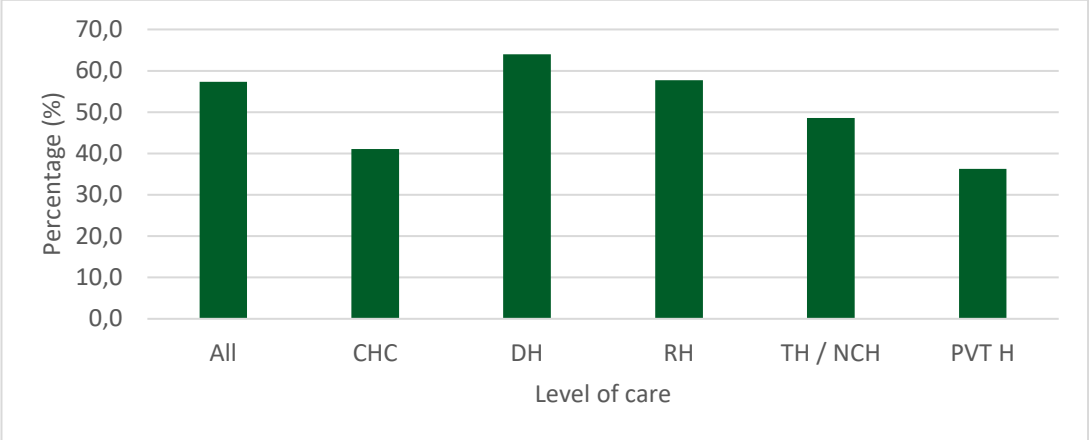
Preventability per level of care in the health system

Figure 15. Impact of suboptimal care for each level of care for 2020-2022 triennium



The highest proportion of potentially preventable deaths occurred at district hospitals, the first referral level for primary care facilities, often staffed by junior doctors and often far away from specialist care at higher level hospitals (figure 16).

Figure 16. Percentage of potentially preventable deaths (%), out of all deaths for each level of care



5. DISCUSSION AND CONCLUSION

Discussion

Notification, submission, and assessment of maternal death cases for the Saving Mothers report was severely hindered after the onset of the COVID-19 pandemic. This meant that the data may not be as accurate as in previous years.

An important finding of this report is the 30% and 47% increase in iMMR in 2020 and 2021 respectively compared to 2019, after correcting for under-reporting. This is similar to findings in other countries (9). Of note, the return in 2022 to pre pandemic levels suggests a resilient health system.

Assessment of the collateral impact of COVID-19 needs further interrogation of the data by chapter heads, although it is likely that the increase in OH deaths and deaths with administrative avoidable factors, reflects a decline in quality of maternity care during the worst years of the pandemic, because preventing maternal deaths

requires a fully functional health system. The increase in anaesthetic deaths needs to be investigated, especially given the concern in SA over several case reports of maternal deaths from inadvertent intrathecal tranexamic acid (TXA) injection.

In 2022, KwaZulu-Natal and Western Cape have iMMRs less than 100 per 100,000LBs and are closer to achieving the Sustainable Development Goal (SDG) of 70 maternal deaths per 100,000 live births by 2030. Limpopo province has made remarkable progress in reducing its iMMR, possible due to the Limpopo Obstetric Response Team (LORT) launched in early 2020.

Conclusion

- The NCCEMD process was impacted by the COVID-19 pandemic because of increased workload and sickness of Healthcare Workers.
- Maternal deaths increased by 30% in 2020 and 47% in 2021 compared to 2019, during the severe years of the COVID-19 pandemic, but the IMMR decreased to pre-pandemic levels in 2022.
- This trend was seen in all provinces.
- COVID-19 pneumonia /NPRI deaths were the major contributor to the steep increase in 2020 and 2021.
- Deaths from Obstetric Haemorrhage increased in 2020 and 2021, reflecting collateral impact of the COVID-19 pandemic on functioning of the health system.
- Of concern, anaesthetic deaths were twice as high in 2022 compared to 2020 and 2021.
- Hypertensive deaths and Deaths from Medical and Surgical disorders were the third and fourth most common causes, followed by Early Pregnancy complications. The decline in Hypertension and Early pregnancy deaths in the current triennium is encouraging, but the possibility of under-reporting of maternal deaths during the pandemic must also be considered.
- The pandemic reversed progress towards achieving SDG goal of MMR 70 by 2030, but progress is now back on track.

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6. DETAILED RECOMMENDATIONS

The impact of previous findings of the NCCEMD in raising awareness of critical issues and recommending interventions is noted: HIV/TB deaths in pregnant women; nevirapine toxicity when this was initially part of the first-line ART regimen for pregnant women; deaths from bleeding associated with caesarean delivery; hypertension deaths in teenagers etc. In addition, guidelines on PPH, Caesarean Delivery and hypertensive disorders of pregnancy have been produced.

Renewed energy is required to implement new recommendations arising from the findings in this report and previous ones that have not yet been fully implemented, in part due to the COVID-19 pandemic.
The Framework for Recommendations developed in the previous triennial report are in Appendix 9.5.

Detailed Recommendations arising from both the 2017-2019 and the 2020-2022 triennial reports are as follows:

Recommendation	Responsibility	References/tools
1. Every maternity site must participate in regular maternal and perinatal morbidity and mortality review meetings, which are mandatory and at which:		
• Minutes are kept • Actions are assigned to named individuals with reporting timelines. • There is follow-up to hold these individuals to account.	CEO, Head of institution (HOI), District manager etc	SA Maternity Care Guidelines 2016 (awaiting update)
2. Maternal and neonatal health services must be prioritised at national and provincial level, and must be maintained despite other parallel programmes or pandemics by:		
• Political commitment by NDOH and provinces in line with the International Maternal and Newborn Health Conference declaration (Cape Town May 2023); which specified a Commitment to SDG of achieving MMR of 70 MDs or less per 100,000 Live births by 2030; and the promotion of dignified, respectful care for women in maternity services.	Minister of Health, Provincial MECs, Provincial HODs	IMNHC declaration, Cape Town, May 2023. Sustainable Development Goals 2030
• MECs and HODs of provinces ensuring that the non-negotiable essential functions and requisite resources for MNH are in place and function properly. This means ensuring adequate human resources, infrastructure, equipment, medicines, and other consumables required to implement the maternal and newborn package of care in all health facilities/service points and managers must feedback on this to the National Ministry of Health quarterly.	Provincial MEC and HOD	WHO Basic Emergency Obstetric Care (BEMOC) and Comprehensive Emergency Obstetric Care (CEMOC) signal functions
• Financial investment in terms of increased funding for MNH services including for adequate staffing numbers in maternity wards to allow the quality care that will reduce deaths from the 5 leading causes of maternal death. Such funds must be ring-fenced. This includes funds to ensure specialist midwives are available for all designated labour wards at primary care level (PHC, CHC, MOUs, OMBU).	Provincial MEC, HOD, CFO	
3. Provincial health system interventions and oversight to ensure:		
• NCCEMD process functions in each province and data submitted accurately and timeously to NCCEMD. Provinces to ensure budgets are available for assessors' meetings.	Provincial HOD, CFO	NCCEMD Guidelines

Recommendation	Responsibility	References/tools
• Integration of services, for example, HIV care, COVID-19 care, contraception, mental health, safe surgery etc must be integrated with financial support into maternity care services	Provincial HODs, CFO, Provincial MCWH managers	NDOH 2022 COVID-19 Clinical and Operational Guideline for Mothers, Newborns and Children SA Maternity Care guidelines 2016 (updated version to appear 2024)
• Regular monitoring and evaluation of and reporting on progress towards implementing NCCEMD recommendations and progress towards the SDG by clinical managers and health service leadership.	Provincial MECs and HODs, reporting to NDOH	SDG 2030 NCCEMD 2020-2022 recommendations
• Strengthening of lines of communication between levels of care so that HODs and MECs can support front line health workers and hear their challenges. This will involve visits to facilities by MECs and HODs.	Provincial MECs and HODs	
• Functional communication channels must exist for consultation about and referral of patients to higher levels of care, and this is supported by agreed upon referral patterns and referral criteria. This includes ensuring equitable access to ICU level of care. Each province must have a clinical outreach policy, which specifies that clinicians at health facilities must, as part of their job description, provide outreach to the facilities within their catchment area.	Provincial HODs, CEOs and HOIs, District Managers.	
• Ensure that generalist doctors working at District hospitals are competent to perform safe caesarean section, laparotomy for ectopic and provide general and regional anaesthesia; and that these skills are part of their core competencies.	Provincial HODs, CEOs and HOIs, District Managers. Training institutions	WHO Comprehensive Emergency Obstetric Care (CEMOC) signal functions. Minimum s Standards for Safe CD in. South Africa (Saving Mothers 2015 interim report)
• Adequate, reliable, appropriate and accessible emergency transport with appropriate emergency personnel to transport critical patients, both from home to facility and between facilities, as well as reliable and accessible planned patient transport between different levels of care for stable pregnant women.	Provincial MECs and HODs Provincial EMS manager	EMS scope of practice document SA Maternity care guidelines and Referral criteria
• Establishment of On-site Midwife-run Birthing Units (OMBUs) at all large district, regional and tertiary hospitals that conduct large numbers of births for low-risk women.	Provincial MECs and HODs, CEOs/HOIs	Saving Mothers Sixth triennial report 2014-2016
4. Clinical management interventions: Focus to be on the top 5 leading causes of maternal death, 5 Hs: (NB**:** These apply to all causes but with more emphasis on leading causes**)**		
• Institutionalise COVID-19 pandemic lessons about maintaining MNH and SRH	District managers/CEO/HOI	NDOH COVID-19 Clinical and Operational Guideline for

Recommendation	Responsibility	References/tools
services during humanitarian crises. Ensure availability of high care beds in all labour wards in district and regional hospitals where women with obstetric complications can be more frequently monitored, as well as high care and ICU beds in all tertiary hospitals.	Provincial MECs /HODs, Provincial MCWH managers	Mothers, Newborns and Children 2022
• Contraception services need to be expanded to include postpartum LARCs (esp. IUCD and implant insertion); & ensuring contraceptive availability at all facilities and within all services caring for women (e.g., ART clinics and high-risk medical clinics).	National and Provincial MCWH/SRH, District managers, CEOs/HOIs	National Contraceptive Clinical Guidelines (2019)
• Contraception must be more accessible to teenagers, especially at high school level and tertiary institutions. Establish adolescent friendly family planning and maternity services. Strengthen collaboration with educational and training institutions to ensure easy access for contraceptive provision to teenagers	MECs, Provincial HODs, Provincial MCWH/SRH, District managers, Heads medical and nursing training institutions School health	National Contraceptive Clinical Guidelines (2019)
• Antenatal care must ensure every pregnant woman is reviewed by a the most experienced midwife or maternity doctor at least once between 28-34 weeks GA.	District Managers	BANC, SA maternity care guidelines
• Strengthen collaboration with training institutions and ESMOE national board to emphasise clinical examination skills during antenatal, intrapartum and postpartum care	ESMOE national board Heads medical, nursing and clinical associate training institutions	
• Prior to discharge from a ward and facility, specific criteria must be checked and documented (women with abnormal findings like tachycardia, pyrexia etc should not be discharged).	Medical and nursing managers, clinical and operational managers	MCR discharge checklist
• Provinces to adopt the new standardised national maternity case record and perioperative case record and ensure budget for its printing and distribution is ring-fenced	National and provincial MCWH, Provincial HOD, CFO	National MCR template for printing
5. Specific interventions for 5Hs:		
HIV • Implement the updated National VTP guidelines for better HIV management, viral load suppression and TB detection. • Ensure CD4 counts are checked to identify high-risk pregnant women for prevention and treatment of HIV associated infections.	Provincial MCWH, District managers, CEOs/HOIs	NDOH Guideline for Vertical Transmission Prevention of Communicable Infections
Haemorrhage • Establish minimum standards for safe and respectful care during labour that can be audited Incorporate the E Motive approach (uses	NCCEMD, Na PeMMCo	SA Maternity care Guideline, ESMOE

Recommendation	Responsibility	References/tools
an accurate blood collection method and a care bundle for reducing severe PPH after vaginal delivery) into ESMOE, SA Maternity care guidelines and all PPH training. Maintain focus on Safe CD programme, blood availability, NASG and ensure they are evaluated	Provincial MCWH, CFO, CEOS/HOIs, District managers, National ESMOE board Provincial MCWH, EMS managers, Medical, Nursing and EMS training institutions	(include E Motive approach)
• Renew focus on Safe Anaesthesia which is one component of the Safe CD programme. ESMOE programme to include updated anaesthetic module Every hospital, including district hospitals, should have a designated lead anaesthetic doctor, responsible for maintaining safe standards of anaesthetic care. District hospitals should be supported and mentored by outreach anaesthetists from the regional or tertiary hospitals.	CEOs, HOIs, District Managers, National ESMOE board, SA society of anaesthesiologists	ESMOE anaesthetic module
• Recommend that TXA is stored outside the operating room and is not placed on the anaesthetic trolley in theatre to mitigate against inadvertent intrathecal injection.	Operating Theatre operational manager	ACE NCCEMD newsletter alert November 2022 (DOH)
Hypertension • Guideline dissemination with training. • Advocacy with community structures to ensure earlier initiation of antenatal care Ensure sufficient numbers of functioning BP measurement devices (preferably pregnancy appropriate) are available and serviced.	Provincial MCWH, District managers, CEOs/HOIs, Operational managers	SA Hypertension in pregnancy guidelines. SA Maternity care guidelines
Heart (medical and surgical disorders) • Community engagement to encourage initiation of antenatal care as soon as pregnancy is suspected	MECs, HODs, Provincial MCWH, District managers	
• Screening for medical problems using clinical history taking and examination skills during antenatal care. Unexplained tachycardia should always be investigated	Medical/Clinical/Operational managers. Medical, and Nursing training institutions	
• Establish Medical Obstetric clinics at regional and tertiary level, where obstetric and internal medicine specialists/subspecialists conduct joint clinics for pregnant women with complex medical problems	CEO	
• Screening for mental health issues during antenatal care and identifying women at risk of suicide as specified in the new Maternity Case record	Operational managers	Maternity Case record mental health screening tool
First Half of pregnancy • Establish linkages between primary healthcare facilities and facilities where women with early pregnancy complications are managed so that	CEOs/HOIs	SA Maternity care Guidelines. Saving Mothers 2017-2019 technical report

Recommendation	Responsibility	References/tools
guidelines and training on detection and management of Ectopic pregnancy and miscarriage can be introduced. Introduce outreach to primary care gynae in CHCs.		Obstetrics and Gynaecology Forum 2020, vol 30, no 4
• Health workers in casualty departments to participate in training on the assessment, diagnosis and management of women with ruptured ectopic pregnancy and women with complications of miscarriage (ESMOE module)	CEOs/HOIs of district and regional/tertiary hospitals District manager, operational managers	ESMOE module on early pregnancy complications
• Every district hospital must have a lead anaesthetic doctor whose role is to achieve and maintain safe standards of anaesthetic care at the hospital, with support from regional specialists and this must include ability to provide anaesthetic for ruptured ectopic pregnancy	District managers/ CEOs/HOIs	
• Ensure pregnancy testing available at all primary care facilities, MOUs, and CHWs in the community.	District managers, operational managers	
• Early pregnancy counselling service and access to safe TOP for women who request it. All health facilities with a 24-hour birthing service and on-site doctors must manage women with safe (low-risk) miscarriages and provide / offer access to a Safe TOP service	District managers, operational managers	
6. Training and policies		
• Integrated national maternal and neonatal care guidelines must be electronically accessible to all maternity healthcare workers	NDOH MCWH	
• National Essential Medicines List guidelines for Primary healthcare and hospital level must be electronically accessible to all maternity healthcare workers	NDOH pharmaceutical services	
• ESMOE (including anaesthetic module) must be the standard programme used for in-service training of maternity healthcare workers and all the ESMOE training materials must be accessible via the Knowledge Hub	NDOH MCWH and ESMOE board	Knowledge hub and ESMOE training materials
• A national ESMOE board must be constituted to oversee and update the content of the programme and guide the scale-up of ESMOE training	NDOH MCWH	
• Each hospital and designated primary care level birthing unit (MOU or OMBU) should have at least one on-site trainer able to run the relevant ESMOE modules and drills.	Provincial MCWH, District managers, CEOs/HOIs	
• Need to ensure ESMOE training for all new staff and two-yearly updates for existing staff.	District managers, CEOs/HOIs	

Recommendation	Responsibility	References/tools
• EOST drills/exercises must occur monthly in maternity facilities. This is especially so at primary care and district hospital level as the rarity of conditions makes doing emergency drills essential to maintain skills.	District managers, CEOs/HOIs	

7. PRIMARY CAUSE OF DEATH CHAPTERS

7.1 Non-Pregnancy Related Infections *Dr Salome Komane*

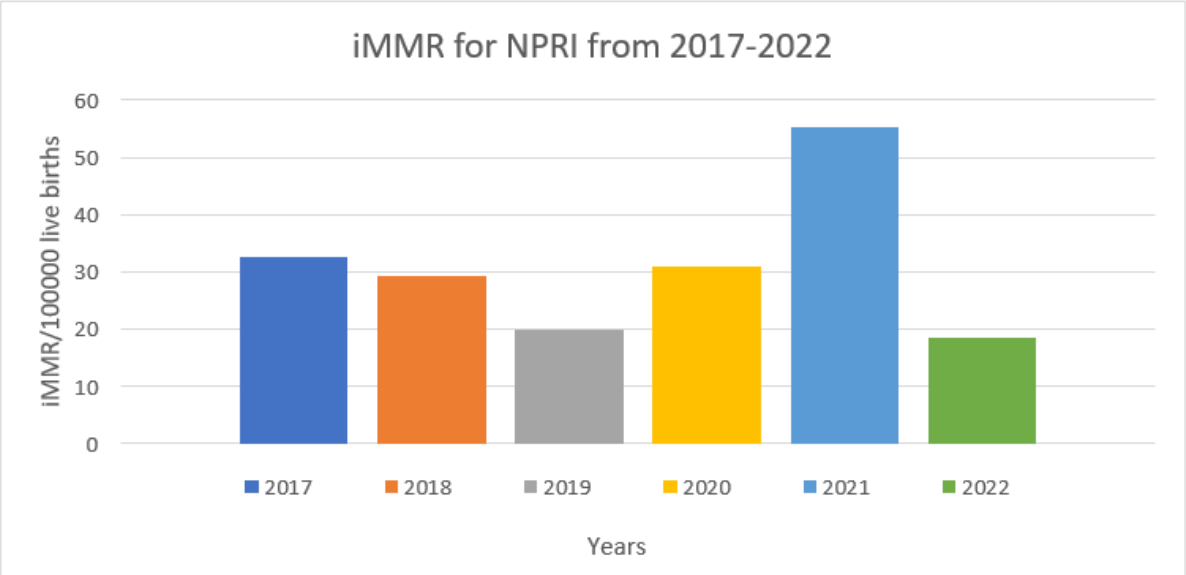
Abstract *(no full report available)*

Deaths due to Non-Pregnancy Related Infections remain the leading cause of maternal mortality for the triennium 2020-2022. However, there had been a steady reduction in numbers of NPRI maternal deaths from 2011 to 2019. With the advent of the COVID-19 pandemic in 2020, the number of maternal deaths increased substantially in South Africa as it did in several countries affected by the pandemic.

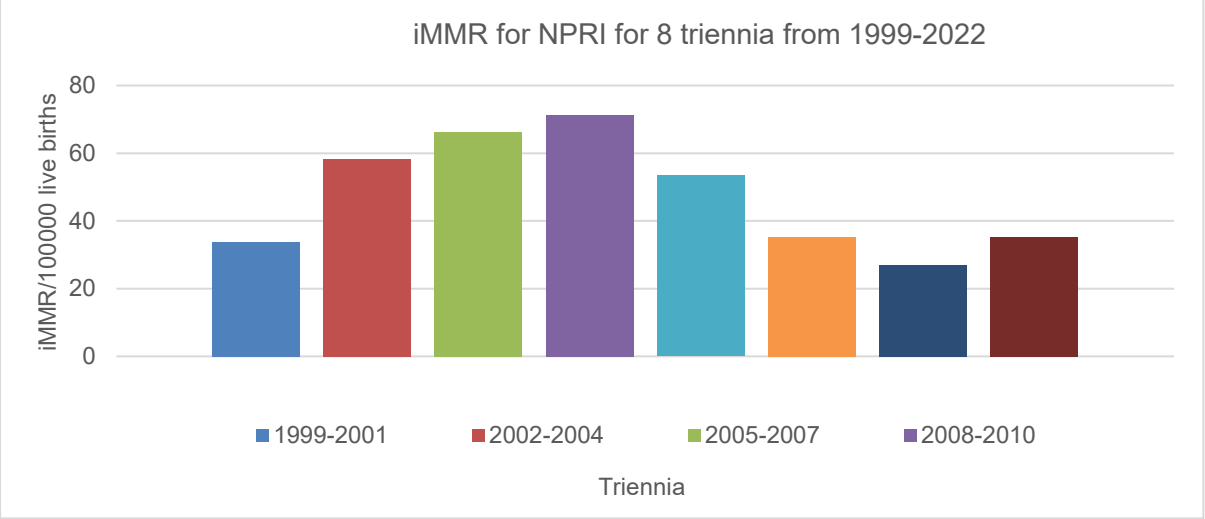
Summary of the Findings of Maternal deaths in the triennium 2020 – 2022

The Non-Pregnancy Related Infections (NPRI) category of maternal deaths constitute deaths from tuberculosis (TB), pneumonias, meningitis, malaria and gastroenteritis from a variety of infectious causes including HIV and COVID-19. The latter was a new infection, and it was agreed by NCCEMD that it be classified as NPRI/Other with COVID-19 specified.

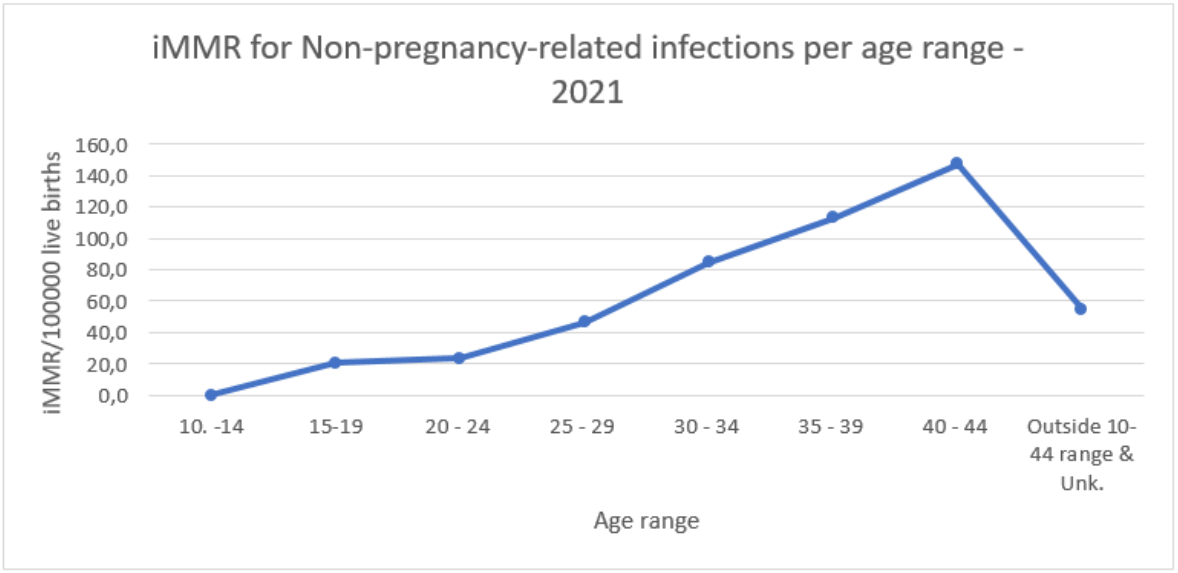
There were 1063 deaths reported in the NPRI category of maternal deaths in 2020-2022 compared to 770 deaths in 2017-2019. This is a substantial increase of 38% compared to the previous triennium (2017-2019). All provinces reported an increased number of deaths from NPRI with the highest numbers occurring in KwaZulu-Natal (n=257) followed by Gauteng (n=187), Eastern Cape (n=155) and Western Cape (n=110).



The distribution of the institutional maternal mortality ratios (iMMR) per underlying cause from 2011-2019 shows a significant decrease of NPRI over the years from 53.4 in 2011-2013 to 35.17 in 2014-2016, 27.07 in 2017 - 2019 and then a significant increase to 35.2 maternal deaths per 100,000 live births in 2020-2022 triennium.



The highest iMMR occurred at tertiary hospitals with 110.1 maternal deaths per 100,000 live births followed by national central hospitals (79.2), regional hospitals (40.8) and district hospitals (15.4). In this triennium there were more deaths at higher level institutions compared to previous trienniums and this is the effect of the COVID-19 pandemic. The distribution of maternal deaths per age showed that deaths due to NPRI were highest in the age groups 25-44 years at (n=484: 86.2%) in the year 2021, the year for which denominator data was sourced from STATs SA.



There were 627 women who were HIV infected among the 1063 women who died in the NPRI category of maternal deaths. Thus, HIV was an underlying factor in 35.2 per cent of overall maternal mortality in South Africa. In the NPRI category 58.98% deaths were HIV positive, 3.5% were negative and in 6.0% the HIV status was unknown. There were 516 (81.8%) on ART, and 18.2 per cent were not on treatment.

The major cause of death in the NPRI category was 'other' (550 deaths), of which 517 were specified as **directly** due to COVID-19 complications, mostly COVID-19 pneumonia. Of the 550 NPRI/other deaths, 208 were in fact HIV positive with 191 of these on ARVs, but as noted above, 517 deaths were **directly** attributed to COVID-19 complications. Of the 517 COVID-19 deaths, there were 132 deaths in 2020, 373 in 2021 and 12 in 2022. The highest iMMR in the NPRI category was the 'other' category at 15.5 maternal deaths per 100,000 live births, TB was second at 6.0, PCP pneumonia was third at 3.7 and other pneumonias were fourth at 3.1. These figures have changed as compared to that of the previous triennial report (2017-2019) where TB was the major cause of death.

Patient oriented problems were identified in 52.3% of the deaths and this was a 30% decrease from 2017-2019, indicating that patients continued to seek care despite the pandemic. Administrative problems were identified in

38.1% of deaths which is similar to 39.7% in 2017-2019.
Most of the deaths were referred from primary care and managed at district hospitals (n=445), regional hospitals (n=405), tertiary and above (n=381) and private (n= 152). 37.7% of the NPRI deaths assessed as potentially preventable compared with 75.2% from the previous triennium suggesting that the majority of COVID-19 deaths were not thought to have been preventable. Resuscitation problems were identified to be substandard in 15.9% of deaths, a huge reduction of 32.5% from the previous triennium.

Overall Comment

Of concern is that majority of the 1063 deaths occurred in 2020 and 2021 (883 deaths) during the height of the COVID-19 pandemic in South Africa. During these two years, COVID-19 complications accounted for 505 (57.2%) of NPRI deaths. This finding warrants a preparedness of a country for pandemics. A review of folders should assist in finding the reasons as to whether these deaths were due to lack of resources especially intensive care units (ICU) and lack of strict monitoring of infected mothers, or those who were known HIV positive interrupted treatment and presented early in pregnancy in a critical condition and died. It is likely that COVID-19 not only directly caused maternal deaths but may have contributed to increases in other direct causes of maternal deaths such as Obstetric haemorrhage because of its impact on functioning of the health system.

Recommendations

1. Primary prevention of HIV, especially among women of childbearing age.
2. Preventing unintended pregnancies by promotion of contraception especially the long acting reversible contraception (LARC) methods.
3. Ensure safe conception among women living with HIV.
4. HIV testing to identify all women who are HIV positive, including those who seroconvert during pregnancy.
5. Provide antiretroviral therapy (ART) on the same day that her HIV positive status becomes known, to optimise maternal health and to prevent mother to child transmission of HIV as per the New PMTCT (VTP) guideline 2020 and guidelines for maternity care in South Africa.
6. Monitor the maternal viral load to ensure that all HIV positive pregnant and breastfeeding women are virologically suppressed on ART.
7. Mandatory screening for TB and other infections at all subsequent antenatal visits.
8. All women eligible for TB preventative therapy (TPT) and prophylaxis of opportunistic infections (CPT) must be initiated as per guidelines without delays.
9. HIV positive pregnant women who are acute or chronically unwell need thorough investigation of TB and other opportunistic infections with involvement of internal medicine and infectious specialists early.
10. Training of healthcare providers on the new HIV, TB and ART guidelines.
11. Ensure continuous monitoring of HIV positive women during the post-partum and breastfeeding period for 24months and longer if indicated and link them to Community Healthcare Workers (CHW) for continuum of care.

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7.2 Maternal deaths due to Medical and Surgical disorders 2020 – 2022

(Dr Sibongile Mandondo, Dr Mustapha Makinde and Prof. Priya Soma-Pillay)

Introduction

The eighth triennial Saving Mothers Comprehensive Report for 2020-2022 presents an overview of maternal mortality, with underlying causes, trends, associated factors and preventability, compared to previous triennia (1). Maternal deaths are notifiable by law in South Africa. Following the death of a mother, it is the responsibility of the clinician caring for the mother to fill in the Maternal Death Notification form (MDNF). This form, together with a copy of the patient's clinical notes, must be sent to the Provincial Maternal Child and Woman's Health Office within seven days of the maternal death (2).

The data is entered anonymously into the secure password protected national MaMMAS database used by the NCCEMD. The data is extracted from 2020-2022 tables from the database. This is the same as used for all previous reports, and the database was closed in May 2023. (3,4,5) The number of live births was obtained from the DHIS database, and this is used as the denominator to calculate the institutional maternal mortality rates (iMMR). Home deaths are reported as well.

The classification of Maternal deaths (MDs) used in South Africa is adapted from the WHO ICD 10 adaptation for maternal deaths classified by primary cause (6).

Deaths from medical and surgical conditions (M&S) include cardiac conditions (cardiomyopathy, rheumatic heart, other), endocrine, gastrointestinal, central nervous system, respiratory, haematological, genito-urinary, psychiatric (suicide, substance abuse, other), neoplasm, auto-immune, skeletal, and other disorders.

Section A will describe all the deaths from medical and surgical disorders disorder (n =513) using data from the MaMMAS database of the NCCEMD and file review by the author. Since the most common causal subcategory was cardiac (n=157) of which cardiomyopathy (n=101) was the most common condition causing death, the latter were further investigated in Section B

Part B is an in-depth analysis of the deaths from cardiac disorders which constituted the largest causal subgroup (n=157), with a particular emphasis on the 101 deaths from cardiomyopathy. Data was derived from the MaMMAS database, and a case study /vignette of a woman who died from cardiomyopathy with pulmonary oedema is presented.

A. Overview of Maternal deaths from medical and surgical disorders 2020-2022

Trends in numbers of M&S maternal deaths and maternal mortality rates

Five hundred and thirteen mothers demised as a result of medical and surgical diseases during the 2020 – 2022 triennium. Medical and surgical diseases remain the fourth most common cause of maternal death in South Africa from the 2005-2007 triennium till the present triennium (2020-2022).
Although sixty-two more women died during the 2020-2022 triennium, when compared to the four previous triennia, the maternal mortality rate (iMMR) of 16.9 has remained similar for the last four triennia as shown in Figure 1.
Annual comparisons Table 1 and Figure 2 show the iMMR was highest in 2021 (the peak of the COVID-19 pandemic).

Figure 1. iMMR for M&S for eight triennia 1999-2022

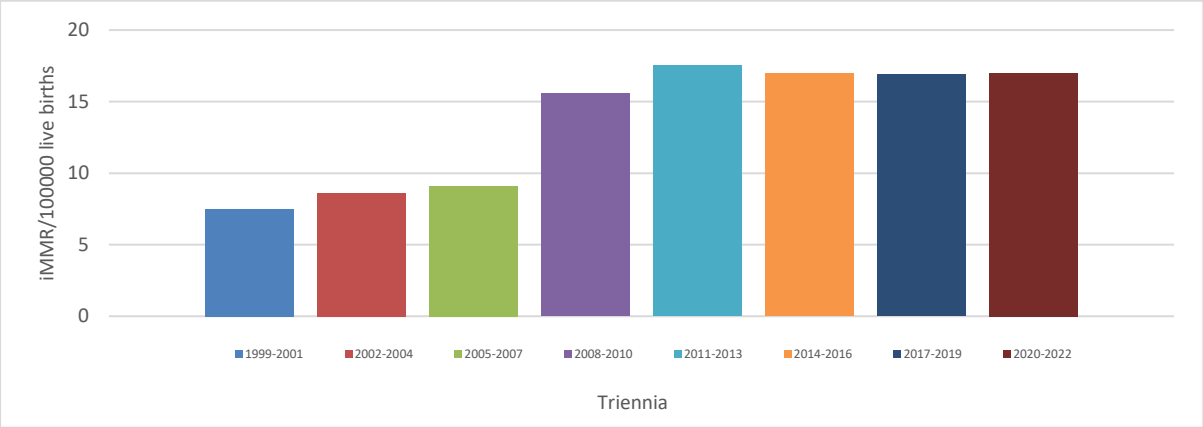
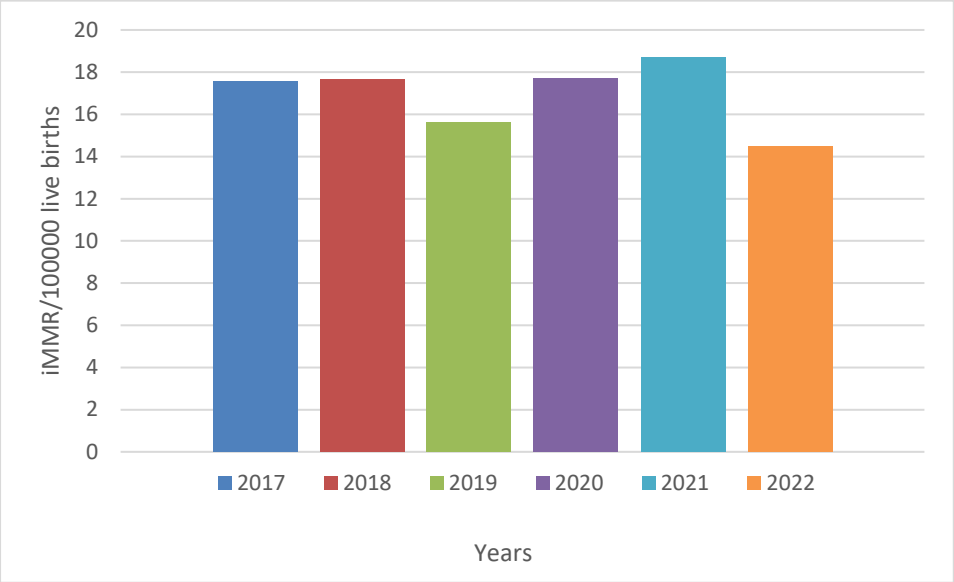


Table 1. Number of deaths from M&S 2017-2022

M&S	n	% of yearly total	iMMR
2017	161	13.1	17.6
2018	166	14	17.6
2019	154	14.7	15.6
2020	183	14.9	17.7
2021	190	12.6	18.7
2022	140	14.1	14.5

Figure 2. iMMR for medical and surgical disorders from 2017 to 2022



The highest number of deaths occurred in Gauteng (n=118), followed by KwaZulu-Natal (n=111), Limpopo (n=63), Eastern Cape (n=57) and Free State (n=41).
The national iMMR from M&S was 17.0 maternal deaths per 100,000 live births, and the provinces with the highest iMMRs were Free State (28.3), North West (19.1) and Eastern Cape (17.6) with Gauteng and KwaZulu-Natal both at 17.2. Western Cape had the lowest iMMR at 11.7. Most of the deaths in the Free State were caused by respiratory complications (iMMR 9.0) and cardiomyopathy (iMMR 4.8).

Causal Subcategories of deaths from M&S

The most common causes of death in this category were deaths due to cardiac disease (n=157), respiratory disease (n= 60), neoplasm (n=43), central nervous system (n= 38), gastrointestinal tract diseases (n=33) and suicide (n=26). Cardiac diseases account for a third (31%) of the deaths, with cardiomyopathy being the most common cause among the cardiac disease category, accounting for 101 deaths.

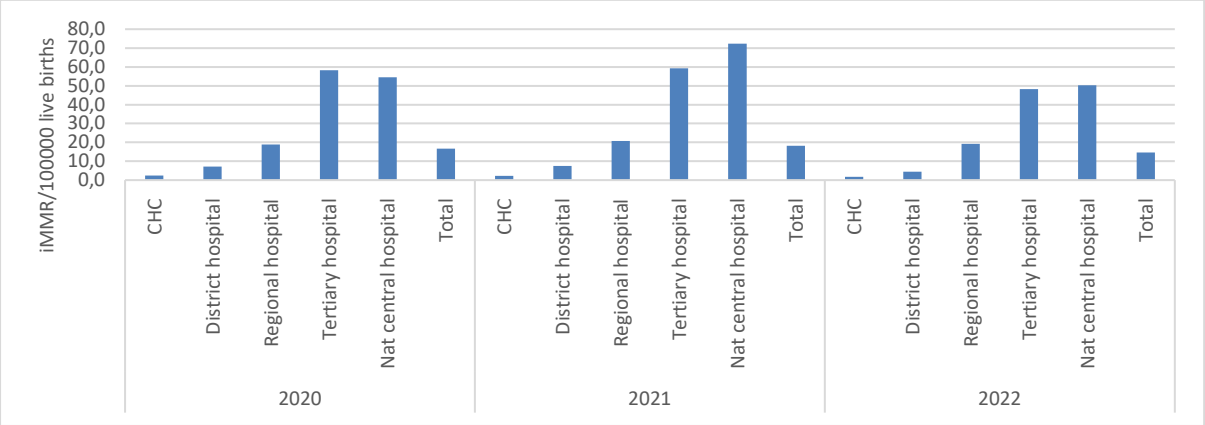
The iMMR for suicide was more than double the national average in the Eastern Cape and Mpumalanga. Similarly, cancer deaths were increased in Mpumalanga, Gauteng and KwaZulu-Natal. Screening programs for cancer and mental health should be strengthened in these provinces.

In the 2020-2022 triennium, out of 513 deaths, the final causes of maternal deaths were respiratory failure (n=178), metabolic failure (n=111), renal failure (n=90), circulatory failure (n=89) and cerebral complications (n=85).

Level of Care

Seventeen percent (n=89) of deaths occurred at district level or lower. This percentage is slightly lower than the 20% (n=87) of deaths reported in the 2017 -2019 triennium thus reflecting an improvement in the referral system. There has also been a significant decrease in the number of deaths that occurred at district and CHC level in 2022 (n=20) compared to the numbers during the COVID-19 pandemic (2020, n=34; 2021, n=35), Figure 3. This probably reflects the overburdening of the health system during the pandemic thus requiring healthcare workers at district level to care for tertiary level patients.

Figure 3. IMMR for Medical and Surgical disorders Deaths at different levels of care



National central hospitals experienced the highest M & S related mortality with iMMR at 58.9 maternal deaths per 100,000 live births, tertiary hospitals at 55.3 and regional hospitals at 19.9. In national central hospitals, neoplasm was responsible for the highest proportion of deaths, with iMMR of 10.1 followed by cardiomyopathy at 8.9 and rheumatic heart disease at 5.7. In tertiary hospitals, the highest iMMR was due to cardiomyopathy at 12.1 followed by gastro-intestinal disorders and respiratory disorders both at 5.6.

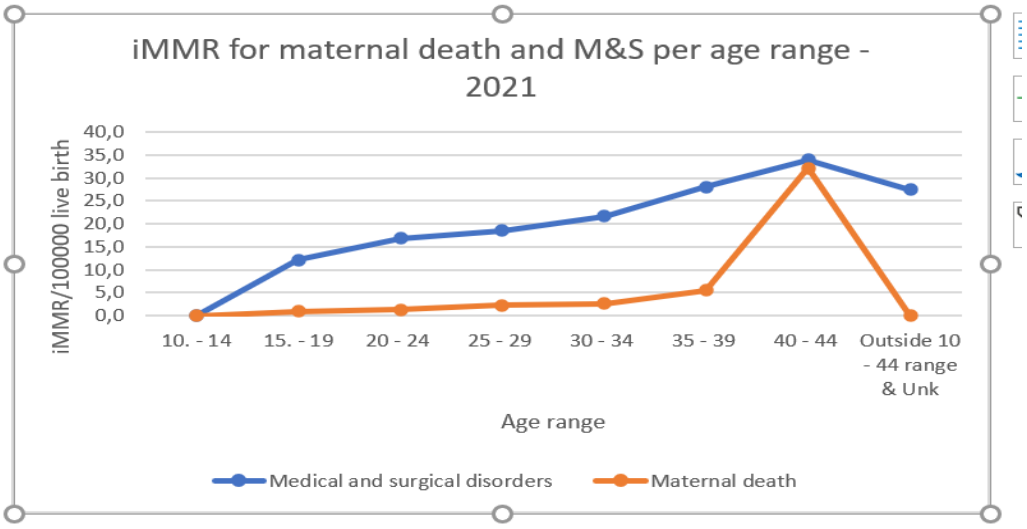
Twenty-one deaths (n=21) occurred in private institutions compared to twenty-four (n=24) in the 2017- 2019 triennium. Seventeen of women who died in the private sector were delivered by caesarean delivery (CD) and four by vaginal birth. Deaths due to cardiac and respiratory conditions made up 45.8 % in 2020-2022 compared to 62.5% in 2017-2019 of M&S deaths in private institutions.

Maternal age and parity

Women in the general population who become pregnant after the age of 40 years have a seven-times increased risk of dying compared to women under the age of 35. However, for women with underlying medical or surgical disorders this risk remains high (3 times the general population) from the age of 15 and remains increased for the entire reproductive period Figure 4a.

The highest iMMR (34) was recorded for women in the 40-44 year age category, followed by women in the 35-39 year age group at 28.1. Cardiac disease and neoplasm were responsible for the majority of deaths in both age groups.

Figure 4a. Comparison of age distribution* and iMMR for all maternal deaths, and M&S deaths

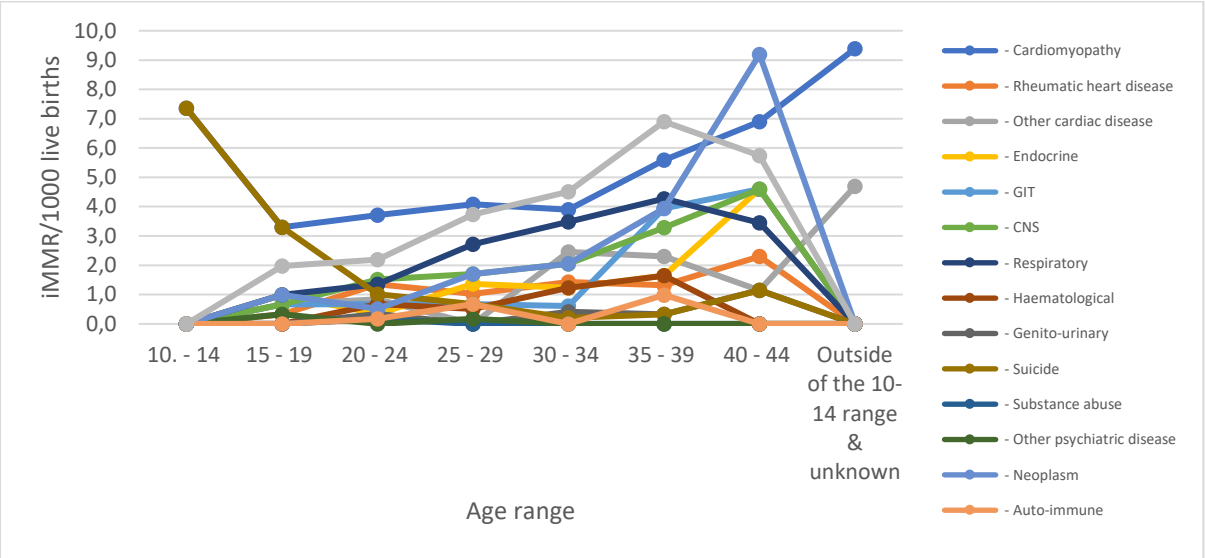


*Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021,

There is some overall improvement in deaths among teenagers from medical and surgical conditions. This may be due to improved access to antenatal attendance with implementation of learner pregnancy policy and comprehensive sexual reproductive health policy implementation and screening in schools.

However, Figure 4b shows significantly higher iMMR for deaths from suicide in the 10-19 yrs age group. Suicide is the leading cause of death in 15-19 age group followed by cardiac disorders and neoplasm.

Figure 4b. Comparison of age distribution and iMMR for causal subcategories of M&S deaths



Six out of nine women who died from suicide in 2021 were under the age of 24.
The increasing iMMR from cardiomyopathy in older age groups will be further discussed in section B
The increased risk of dying for women with M&S disorders highlights the importance of pre-conceptual counselling, contraception and general health awareness for women in the reproductive age categories.
Most deaths occurred among primigravid women (n=149, 29%) while less deaths occurred in higher order parity indicating that most women do not access medical services prior to pregnancy, hence prenatal diagnosis

and optimisation of their medical and surgical conditions was not possible.

HIV Status
The majority of patients were HIV negative (n=283), with a total of 165 patients being HIV positive. Ninety percent of HIV positive patients were on ARVs. This highlight's the need to integrate contraception counselling into ART management and ensure health workers in chronic stream of PHC clinics are competent at insertion of long-acting reversible contraception.

Mode of delivery

The caesarean delivery rate for women who died in this category was 51.6% (n=147). Most of the caesarean deliveries were conducted at regional hospitals (n=43) followed by tertiary hospitals (n=42) and national central hospitals (n=40). The high caesarean section rate may be attributed to the high-risk underlying disease condition. This may also be the reason why a higher percentage of these mothers were delivered in regional and tertiary institutions as compared to those delivered in the district hospitals (n=16).

Avoidable factors for M&S deaths

Maternal death assessors found that medical care was suboptimal in 329 (64.1%) cases, and 54.6% of deaths were probably avoidable within the health system. Patient /community oriented avoidable factors were present in 267 (52%) of deaths and administrative factors in 217 (42.3%) deaths. These patient /community factors included: delay in accessing medical help by patients (27.3%), no antenatal care (17.5%) and declined medication/surgery advice (9.9%).

Important administrative avoidable factors identified in the public sector were lack of appropriate skill onsite or on standby to deal with medical problems (6.8%), inadequate number of staff on duty (5.7%), delays in initiating critical care as a result of an overburdened service (5.7%), lack of healthcare facilities (5.2%) and transport problems from institution to institution (3.9%).

Out of the maternal deaths in which resuscitation was attempted, avoidable factors were identified in 217(42.3%) of those cases.

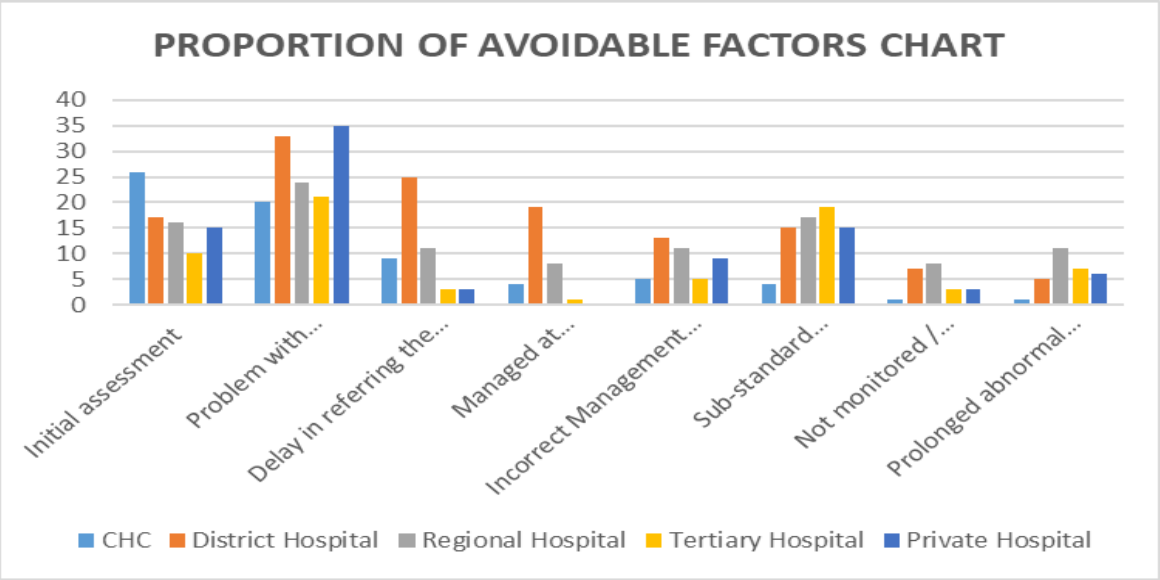
Medical care avoidable factors at CHC level were present for 43.2% of deaths, district hospitals were highest at 61.4%, regional hospitals at 53.5%, tertiary hospitals at 46% and private hospitals at 53.6%.
Medical care avoidable factors were assessed by level of care in public sector. Problems with initial assessment were highest in CHC at 26.2%. Poor problem recognition and diagnosis were high (32.8 %) in district hospitals compared with other levels, followed by delay in referring the patient at 24% and management at inappropriate level at 18.5%.

Regional hospitals' medical avoidable factors included: poor initial assessment for 24% compared with 21.1 % for tertiary hospitals. Prolonged abnormal monitoring with no action taken was higher in regional hospitals at 10.7 % compared to 6.5 % at tertiary level and above.

Substandard management with correct diagnosis was higher in tertiary level and above at 18.5 % compared to 17.3% in regional hospitals.

Private institutions were assessed for avoidable factors related to medical care and not administrative or patient-related factors. Fifty-three percent of deaths in private institutions were assessed as avoidable. The leading medical factor was poor problem recognition/diagnosis at 35.3% followed by substandard management with correct diagnosis and poor initial assessment both at 14.7 %.

Figure 5. Proportion of avoidable factors per level of care for M&S disorders



Recommendations

1. Sexual and reproductive health awareness and education should begin at schools. Young women should have easy access to contraception including emergency contraception in clinics. Contraceptive services should be made available after-hours for scholars. The role of technology and tele-health like the B-WISE app should be marketed to youth to enhance access to contraceptive care. Adolescent and Youth Friendly Services should be established at clinics where feasible.
2. Routine vital signs among pregnant patients should include respiratory rate in addition to blood pressure, pulse and urinanalysis, in order to triage patients appropriately. The antenatal early warning chart that is provided in the maternity case records should be used and abnormal vitals responded to with escalation of care.
3. Obstetric High care units in regional and tertiary hospitals should be adequately staffed to improve quality of care. Patients admitted in High Care should have a high care discharge summary provided to guide follow up at lower levels. This summary should include near miss interventions, the delivery plan or postnatal review plan.
4. Near miss audits should be institutionalised and an interdisciplinary morbidity meeting involving anaesthetists and physicians should be encouraged.
5. All healthcare workers providing chronic care and NIMART care should be trained on sexual and reproductive healthcare including LARC and should be familiar with the World Health Organization's medical eligibility criteria for contraceptive use.
6. Specialised care for medical diseases in pregnancy should be ring-fenced in regional and tertiary hospitals through joint clinics involving physicians and obstetricians.
7. Referral systems and outreach and in-reach programs should remain functional, and district hospitals should have a transitional high-care area to stabilise and manage women awaiting transfer to regional hospitals and tertiary hospitals.
8. Basic ICU care including emergency medical/cardiac modules should become part of the ESMOE course. All registrars in O&G should have a compulsory rotation in ICU.
9. Women presenting with shortness of breath and/or maternal tachycardia must be investigated and managed with multidisciplinary approach involving physicians and obstetricians.
10. Women should be screened for mental health conditions at the first ante-natal visit and offered the contact details for online counselling services. Teenagers are the most vulnerable group and need referral and linkages. Support groups at local clinics or community need to be established.

11. Gender based violence should be suspected in patients with recurrent admissions and negative findings on investigation after referral to other disciplines. Protocol to manage GBV and patients who screen positive for mental health need to be included in all BANC plus trainings

B. An analysis of maternal deaths from cardiac disorders with an emphasis on peripartum cardiomyopathy in South Africa, 2020–2022

Introduction

Peripartum cardiomyopathy (PPCM) is a significant contributor to maternal morbidity and mortality in South Africa. The disorder is generally defined as maternal heart failure with systolic dysfunction (left ventricular ejection fraction, <45%) that develops in the last month of pregnancy or in the first five months after delivery, in the absence of known pre-existing cardiac dysfunction (7,8). From the available literature, the incidence of PPCM appears to be around 1 in 2500–4000 in the USA, and 1 in 1000 in South Africa. One third to one half of cases occur in women with hypertensive diseases of pregnancy, including preeclampsia (9). Other strong risk factors for peripartum cardiomyopathy include multiple gestations, advanced maternal age, and anemia. The mode of delivery, such as caesarean delivery, is not recognized as a risk factor.

Results from a further analysis of the cardiac disorders sub-category of maternal deaths from M&S are presented in this section, with a particular emphasis on peripartum cardiomyopathy (PPCM) which was the largest sub-group causing death. A case study of a death from PPCM is also described which illustrates frequently encountered avoidable factors.

Results

Provincial variation in PPCM deaths and iMMR, 2020-2022.

Of the 157 MDs from cardiac disorders, 101 were from PPCM, 28 from rheumatic heart disease (RHD) and 28 from other cardiac conditions. The maternal death assessors form from which data is entered into the MaMMAS database did not always indicate whether the diagnosis of PPCM was clinical or whether an echocardiogram (ECHO) was conducted.

Table 2 shows the provincial variation of death from cardiac causes. The highest number of deaths from PPCM occurred in KwaZulu-Natal (n=27), Gauteng (n=19) and Limpopo (n=19). The lowest number of deaths occurred in Western Cape and Mpumalanga (N=8 each).

Table 2. Provincial distribution of MD Deaths from cardiac conditions

2020-2022	EC	FS	GP	KZN	LP	MP	NW	NC	WC	Total
Medical and surgical disorders	**57**	**41**	**118**	**111**	**63**	**43**	**35**	**10**	**35**	513
- Cardiomyopathy	6	7	19	27	18	8	6	2	8	101
- Rheumatic heart disease	5	1	5	11				1	5	28
- Other cardiac disease	6	1	5	8		5	1		2	28

Table 3 shows the provincial variation of iMMR. The national iMMR from PPCM was 3.3 per 100 000 live births, compared to 0.9 for rheumatic heart disease and 0.9 for other cardiac diseases. The provinces with the highest iMMR from PPCM were Free State (4.8), followed by Limpopo (4.5), KwaZulu-Natal (4.2) and North West (3.3), all above the national average. The Eastern Cape had the lowest iMMR from PPCM at 1.9.

Table 3. Provincial variation of iMMR from cardiac conditions

2020-2022	EC	FS	GP	KZN	LP	MP	NW	NC	WC	Total
Medical and	**17.6**	**28.3**	**17.2**	**17.2**	**15.7**	**15.9**	**19.1**	**15.0**	**11.7**	**17.0**

2020-2022	EC	FS	GP	KZN	LP	MP	NW	NC	WC	Total
surgical disorders										
- Cardiomyopathy	1.9	4.8	2.8	4.2	4.5	3.0	3.3	3.0	2.7	3.3
- Rheumatic heart disease	1.5	0.7	0.7	1.7	0.0	0.0	0.0	1.5	1.7	0.9
- Other cardiac disease	1.9	0.7	0.7	1.2	0.0	1.9	0.5	0.0	0.7	0.9

Level of Care

Table 4 illustrates deaths per level of care for the deaths from cardiomyopathy

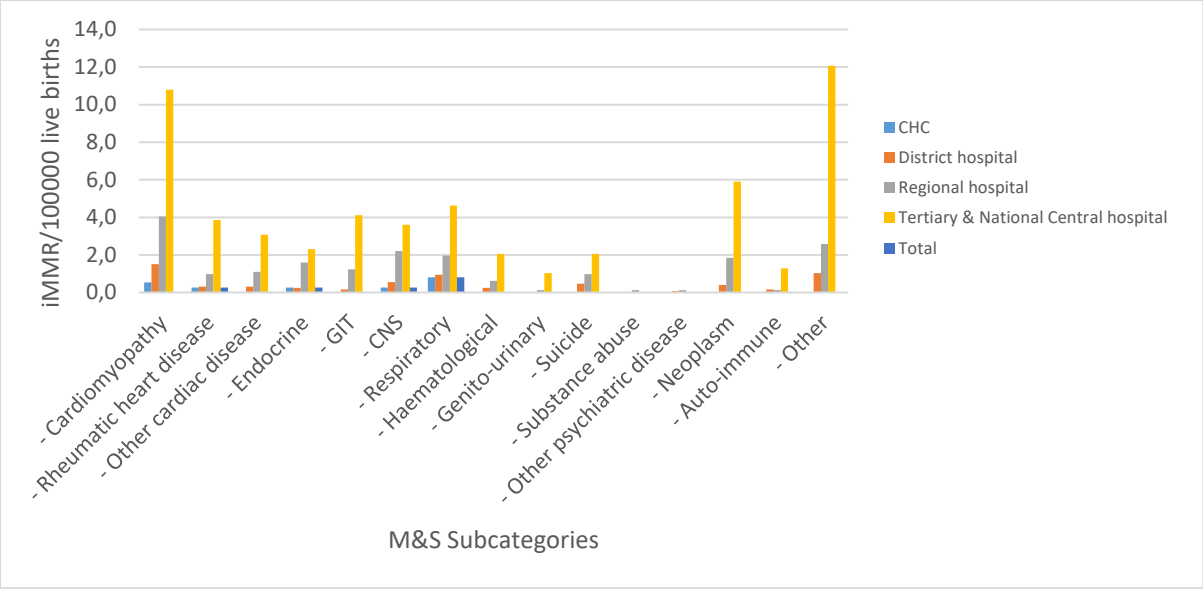
Table 4. Shows Cardiac deaths by level of care

	CHC	District hospital	Regional hospital	Tertiary & National Central Hospital	Deaths outside facility & private hospital	Total
Cardiomyopathy	2	19	33	42	5	101
Rheumatic heart disease	1	4	8	15	0	28
Other cardiac disease	0	4	9	12	3	28

There were 48% (n=42) in tertiary and central hospitals, thirty three percent (n=33) in regional hospitals and 17% (n=21) of deaths at district level or lower. This reflects an improvement in the referral system and problem recognition as compared to the 2011-2013 triennium when 36% of deaths occurred in the DH of lower level. The number of deaths that occurred at district and CHC level improved within the triennium; in 2022 there were 20 compared to the numbers during the COVID-19 pandemic (2020, n=34; 2021, n=35) suggesting access challenges during the pandemic.

Figure 6 shows the iMMR by level of care. It shows that PPCM deaths had the highest iMMR (10.1 deaths per 100 000 live births) at tertiary/national central hospitals, reflecting referrals of these women to higher levels of care.

Figure 6. iMMR by level of care for M&S deaths



Demographic and obstetric factors in women who died of PPCM

Strong risk factors for peripartum cardiomyopathy include multiple gestations, advanced maternal age, and anemia. In South Africa, the 2020-2022 triennium report shows that anaemia, occurred in 29.6 per cent of all maternal deaths and over 35 per cent for patients with M&S disorders (1). Anaemia occurred in 20.2 per cent of patients with cardiomyopathy and occurred in 32% of patients with rheumatic heart disease Anaemia was defined as Hb of less than 10g/dL before the events that led to the death.

Anaemia occurred in 20.2 per cent of PPCM deaths, but was most common in deaths from other cardiac disorders (42.5 %) and occurred in 32% of deaths from rheumatic heart disease.
The demographic data are summarised in Table 5.

Table 5. Demographic details and Obstetric factors in women who died from PPCM

	Number	Percentage
Attended ANC	83	82.1%
HIV positive	34	34%
HIV negative	61	G1%
Unknown HIV status	6	5%
HIV Positive on ART	29	85%
Anaemic (Haemoglobin < 10g/dl at presentation)	20	20%
Mode delivery caesarean delivery (CD)	36	35.6%
Mode delivery normal vertex delivery (NVD)	41	40.5%

HIV status

82.1% of the patients attended antenatal care. The majority of patients (n=61) were HIV-negative. It was noted that 34 mothers were HIV-positive with the majority (n=29) on antiretroviral therapy. Of the total maternal deaths due to PPCM, 12% had an unknown retroviral status.

Gravidity

35% of the maternal deaths due to PPCM were primigravida and 25% were Para 1. These findings are similar to the study of maternal deaths from the 2011-2013 triennium report (12) where the demographics showed a mean age of 28.6 years and a parity of less than 2.

Mode of delivery

The mode of delivery for 41 patients was vaginal delivery. Thirty-six patients had an anaesthetic for caesarean delivery and three for other indications not specified. The majority of CD (n=21) were done at tertiary/national central level of care. Twenty-four of the women who died from PPCM were undelivered.

Age

Figure 4b (in section A) shows iMMR for causal subcategories of M&S deaths by age group. The iMMR for PPCM was higher in older age groups, over 5.6 deaths per 100,000 live births in ages over 30 -35yrs.

Timing of emergency and death in patients with PPCM

Table 6 shows that the majority (75%), of the PPCM deaths occurred postpartum compared to 48 % of patients

dying from RHD. There were 55% where the emergency occurred postnatally (n=59) compared to 28 who presented in the antenatal period. Two patients were only diagnosed at the time of anaesthetic when they complicated during surgery. Of the women who died from RHD, the timing of the emergency was different with 42 % (n=12) of patients presenting antenatally.

This highlights the importance of a postnatal examination as well as adherence to criteria for discharge using the checklist in the maternal case record, since maternal tachycardia is a common sign. This is expected considering the pathophysiology of the disease.

Early warning charts have been included in the new record.

The counselling of pregnant women on danger signs and where to present when they experience shortness of breath post-delivery is vital.

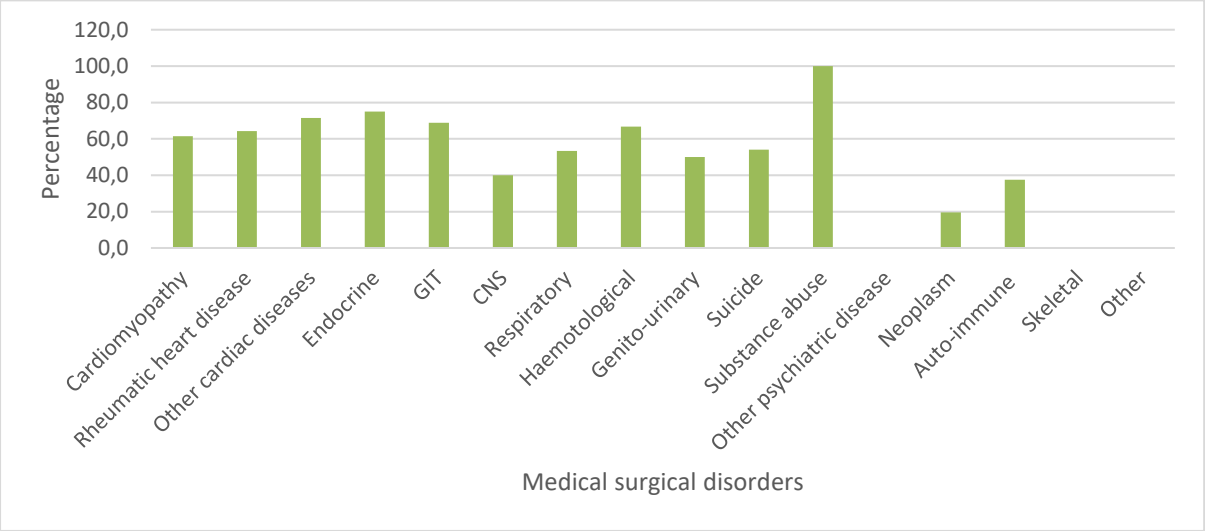
Table 6. Timing of Emergency and Timing of Death

Timing of emergency	Cardiomyopathy	Rheumatic heart disease
Total no patients	101	28
- Early pregnancy	6	3
- Antenatal period: 20w +	28	12
- Intrapartum period	8	3
- Postpartum period	59	10
- Anaesthesia	0	0
Timing of death		
- Early pregnancy	6	3
- Antenatal period: 20w +	13	8
- Intrapartum period	5	2
- Postpartum period	75	15
- Anaesthesia	2	0

Preventability of maternal deaths and Health system issues

Maternal death assessments showed that medical care was suboptimal in 64.1% cases, ie in 61.4% of cases the maternal death was potentially preventable (Figure 7).

Figure 7. Potential preventability of deaths from M&S, 2020-2022



Patient / community oriented avoidable factors were present in 51.5% of deaths and administrative factors in 50.5%. Patient /community factors included delay in accessing medical help by patients (26.7%), declined medication/surgery advice (9.9%) and no antenatal care (7.9%).

Table 7 illustrates administrative avoidable factors that have been identified and compares them with the avoidable factors for cardiomyopathy versus M&S disorders. In the cardiomyopathy group, delays in initiating critical care due to an overburdened service were 7.9% compared to 5.7% for M&S disorders, followed by a lack of healthcare facilities at 6.9% versus 5.2%. Consideration must be given to staffing levels, as an inadequate number of staff on duty contributed to 6.9% of avoidable deaths. Communication issues and a lack of ICU facilities each contributed to 3%. It is also possible that some patients may have died prior to the need for critical care being established.

Table 7. Comparison of the administrative avoidable between all M&S and PPCM deaths

Administrative avoidable factors	M&S	Cardiomyopathy
Total cases	**513**	**101**
Proportion of avoidable factors		
Transport problem: Home to institution	1.2	1.0
Transport problem: Institution to institution	3.9	2.0
Lack of accessibility: Barriers to entry	2.1	3.0
Lack of accessibility: Other	1.0	2.0
Delay in attending to patient (Overburdened service)	5.7	7.9
Delay in attending to patient (Reason unknown)	2.3	3.0
Lack of healthcare facilities: ICU	7.0	3.0
Lack of healthcare facilities: Blood/blood products	0.8	
Lack of healthcare facilities: Other	4.9	6.9
Inadequate numbers of staff on duty	5.7	6.9
Appropriate skill not available on site / on standby	6.8	5.9
Communication problems: Technical	2.7	6.9

Administrative avoidable factors	M&S	Cardiomyopathy
Communication problems: Interpersonal	1.9	1.0
Other	10.9	10.9

Out of the 71.1% of PPCM maternal deaths in which resuscitation was attempted, avoidable factors were identified in 22 (28.3%) of those cases, circulation problems contributed 7.9%, and breathing problems and monitoring problems contributed 6.9%.

Case Study: Maternal death from Peripartum Cardiomyopathy with Pulmonary Oedema

Summary

14yrs, primigravida. Booked for antenatal care at a CHC before 20 weeks with normal booking bloods (TPHA, HIV). She had moderate anaemia with haemoglobin (Hb) of 8.6 gms/dl, normal BP and a heart rate of 95 bts per minute on the first visit. The anaemia was not treated. She had persistent tachycardia, with heart rates ranging from 110 to 125 at subsequent ANC visits which was not investigated. She was treated once for urinary tract infection during the pregnancy.

She presented at term to a district hospital with lower abdominal pains. The haemoglobin was not checked, The heart rate was 118, with normal BP. She was not in labour, and was advised to take ferrous Sulphate 200mg twice a day and discharged home. The tachycardia was not investigated and a general cardio-respiratory examination was not done.

She presented three days later complaining of shortness of breath since the evening of discharge. On admission, she had a heart rate of 120/min (tachycardia) and respiratory rate of 34 breaths per minute. Oxygen saturation was not measured. A CTG was commenced by the nurse which showed a fetal tachycardia. The woman developed severe shortness of breath and coughing of blood-stained frothing fluid. The CTG was stopped whilst patient rescuscitation was commenced with an immediate dose of iv frusemide. The doctor was called who arrived immediately.

A clinical diagnosis of pulmonary oedema with cardiomyopathy was made, the cardiac apex was displaced and the patient had severe anaemia. Treatment was given as per protocol with repeated doses of IV frusemide, oxygen and isorbide dinitrate 5mg sublingual with no improvement. Other doctors were called for help. CPAP was initiated but she continued frothing at the mouth and required intubation and ventilation. There was no blood gas machine. The patient arrested one hour after starting treatment. CPR was commenced, however, the baby was not delivered peri-mortem. She died within 2 hours of admission. Postmortem confirmed pulmonary oedema with peripartum cardiomyopathy .

Assessment

Primary Obstetric Cause: Cardiomyopathy. *Final cause*: Pulmonary oedema . *Contributory* : Anaemia
Avoidablefactors:
Patient:nil;Administrative:Nil
Medical care: Poor problem recognition; Poor Initial assessment; Substandard care, Prolonged abnormal observations with no action.

Suggestions for prevention

Patients with tachycardia must be referred to hospital for investigation during the antenatal period. When patients present in labour, a proper history needs to be taken and all antenatal problem identified instead of only focusing on labour complaints, and a systemic examination conducted using the Big 5, forgotten 4, core 1 approach. The plotting of vital signs on the antenatal early warning chart will prompt escalation of care. Respiratory rate should be routinely measured in labour ward. Maternal resuscitation drills must be conducted. District hospitals must have skills for peri-mortem caesarean section. Transitional high care beds with CPAP need to be available in district hospitals. The mother must be stabilised before fetal monitoring is commenced.

Discussion

Peripartum cardiomyopathy has become the leading cause of maternal mortality due to medical and surgical conditions surgical disorders in South Africa. It accounted for 101 maternal deaths, 61.4% of which were potentially preventable. Fifty five percent of patients presented in the postpartum period and 75% died in the postpartum period mandating the department of health to focus on postnatal care. The pathogenesis of the disorder remains incompletely understood however some etiologies include pregnancy-related haemodynamic changes, hormonal fluctuations, prolactin cleavage, anti-angiogenic agents, various viral infections, weakened immunity in pregnancy and nutritional deficiencies (10).

The diagnosis of PPCM can be made up to five months post-partum, so it is under- reported in South Africa and many other countries which report on maternal deaths up to six weeks postpartum as per WHO definition and do not report on late maternal deaths (up to one year postpartum). (11)

Training healthcare workers in all levels of care should emphasise obstetric resuscitation, and identification and management of cardiovascular complications in pregnancy (12). At clinic level, a training package called the Adult Primary Care Guidelines and Competency Assessment may aid in the recognition of early warning signs in pregnancy. Access for healthcare workers to the Knowledge Hub allows for online learning and improvement of skills.

Efforts to improve awareness among healthcare providers aims to enhance early diagnosis and treatment. Although 82.1 percent of PPCM deaths attended antenatal care, many may not have been referred for specialist care and important signs like anaemia and tachycardia were missed.

Interventions such as the adaptation of the maternity care record to include modified early warning charts, discharge checklist and danger signs should all improve early detection and management of PPCM. Strengthening adherence to maternity guidelines and clinical governance including regular patient record audits are recommended by the NCCEMD. Community education using Community Health Workers about danger signs may improve outcomes (12).

In order to achieve the Sustainable Development Goal of maternal mortality rate of 70 maternal deaths per 100 000 live births, the quality of care for cardiac conditions must be prioritised.

Development of appropriate referral criteria by level of care and bypass criteria are important to reduce delays in accessing higher level care to prevent mortality. Transitional high care beds need to be available in district hospitals. Mortality rates remain higher in resource-limited settings, emphasising the need for improved healthcare access to specialist care and access to Echocardiography (13).

Handheld ultrasound devices are available and used in settings in family medicine clinics in South Africa as well as rural antenatal clinics for pregnancy dating. These devices can be used for echocardiography and modules included in undergraduate and postgraduate students. The learning curve for ECHO is short as demonstrated in a study that evaluated the ability of medical students who had previously received eight hour training in echocardiography to detect RHD. The study showed that the students' average sensitivity for diagnosing RHD was 81%, while specificity was 95% (14). Such positive studies should encourage centres to undertake basic-level echocardiography as part of their training of doctors of all levels.

South Africa has contributed significantly to PPCM research and the role of bromocriptine (15). Currently, the theoretical benefits of suppressing prolactin, whether with bromocriptine or by cessation of breast-feeding, must therefore be weighed against the benefits of breast-feeding to mother (16).

Postpartum contraception is emphasized to prevent future pregnancies, which can exacerbate the condition of PPCM. Counseling patients who are considering a subsequent pregnancy should be done since the disease recurs in 10 to 50% of cases, and recurrent disease can have worse outcomes, including death (17).

Limitations

This chapter is limited by the fact that, due to logistical problems, only a few files underwent secondary analysis by the chapter writer. Also, the form used by assessors does not make provision to state whether there was an ECHO performed to confirm the diagnosis of cardiomyopathy hence this info is not available on MaMMAS. Late maternal deaths from PPCM were not identified by the NCCEMD process.

Conclusions

- Deaths from PPCM have increased in the 2020-2022 period and have become the leading cause of maternal deaths in the Medical and Surgical disorders category.
- The increase occurred in 2020 and 2021 and is hypothesised to be due to the collateral effects of the COVID-19 pandemic, as numbers in 2022 were lower than the pre-pandemic period.
- Anaemia is a risk factor for PPCM, and the majority of cases were booked.
- 53% of patients presented postpartum and 79% died postpartum.
- 61.4% of PPCM MDs were potentially preventable within the health system.
- Development of appropriate referral criteria by level of care and bypass criteria are important to reduce avoidable mortality factors and strengthen communication between various levels of care.
- Plans are needed to strengthen the healthcare system to improve healthcare access to specialist training and diagnosis using handheld ultrasound to perform echocardiography.
- The implementation of bromocriptine used to suppress lactation should be further explored to reduce cardiac stress in the post-partum period. This, however, needs to be balanced against the need for exclusive breastfeeding to ensure infant nutrition and health.
- Strengthening access to emergency transport is necessary as well as improving delays in accessing care.
- Transitional high-care beds are needed in district-level care to ensure adequate care for patients awaiting transfer, especially in cases of delayed transport.

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7.3 Hypertensive disorders of Pregnancy 2020-2022

(Dr Makgobane Ramogale-Zungu and Prof Jagidesa Moodley)

Key points

- Despite a declining trend in the numbers of deaths from HDP over the years 2017-2022, these pregnancy disorders still accounted for 166 (14.7%) deaths in the year 2022. A substantial proportion of deaths had similar preventable factors identified in the 2017-2019) review.

- Delays in initiating immediate clinical care for immediate lowering of high blood pressure levels (>160/110 mm Hg) using rapid acting agents by both medical doctors and nurses were identifiable factors - the commonest direct causes of death were cerebral hemorrhage and cerebral edema.

- Adolescents and young women (14-24 years) were at particular risk of death associated with eclampsia and preeclampsia with severe features.

- Women >35 years of age were at great risk of mortality particularly if they were overweight /obese and had chronic hypertension (known or unaware).

- Emergency Referral Protocols must be discussed at regular intervals with all Healthcare Staff and Emergency Medical Services to prevent delays in transfer and to ensure transfer to appropriate hospitals and disciplines (not casualty departments).

- Improving Women's Knowledge on Reproductive Health issues - Community Health Workers must strengthen their role in advising women (including adolescents and women above the age of 35 years) about personal medical healthcare such as continuing treatment for chronic hypertension, advice on family planning services and a healthy life style (including appropriate diets and exercise, and the risks of hypertension and diabetes after the age of 35 years).

- Screening for and management of chronic hypertension in communities should be supported and made mandatory at every clinical encounter irrespective of the reason for the clinic visit. This recommendation is based on the fact that it is known that hypertension is present in over 70% of females in rural communities but only 7% are on treatment. A substantial number of women who died had newly diagnosed hypertension.

- **Professionalism** – The provision of care by a **team** of experienced **skilled** health professionals must be involved in cases of severe complications of HDP during the antenatal period, childbirth and the postpartum period. This will save the lives of women and their babies. Often a junior doctor was the only doctor on "the floor" to manage severely ill women.

- Identifying women with risk factors, advising on appropriate diet including the use of calcium if appropriate and providing antenatal care for such women at a regional facility will further minimize maternal and perinatal mortality.

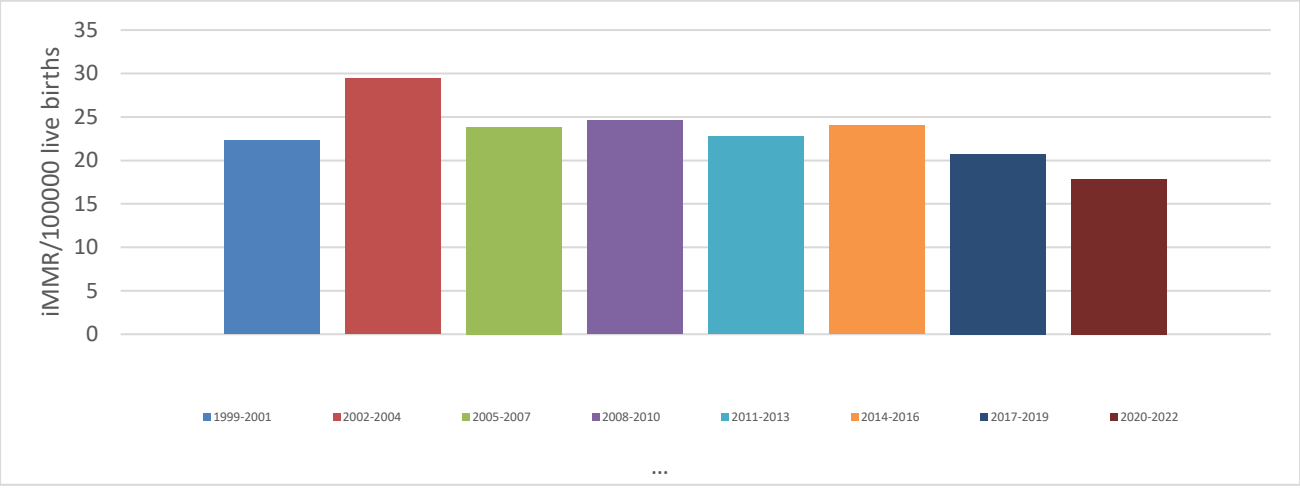
- Consideration must be given for the use of low dose aspirin for all pregnant women assessed to be at high risk for HDP.

A. Description of Maternal deaths due to Hypertensive Disorders of Pregnancy, Saving Mothers triennial report 2020-2022

The cluster of Hypertensive Disorders of Pregnancy (HDP) comprise: gestational hypertension, preeclampsia, preeclampsia with severe features, eclampsia, chronic hypertension preceding pregnancy or hypertension diagnosed for the first time before 20 weeks gestation. These conditions especially when accompanied by uncontrolled hypertension, thrombocytopenia, the HELLP syndrome (hemolysis, elevated liver enzymes and low platelets) and abnormal renal laboratory tests were associated with substantial maternal mortality in the triennium 2020-2022 in South Africa (SA).

HDP accounted for 17.9 deaths per 100,000 live births (n=539 or 14.7% of the total deaths) in the period 2020-2022 and was the third commonest cause of maternal mortality in SA. However, it should be noted that the iMMR for deaths from HDP had decreased from the 2017-2019 figure of 20.2 per 100,000 live births (Figure one). There was an increase and later a decline in iMMRs over the three years of the triennium, being 17.9 in the year 2020; 18.5 in 2021 and 17.2 in 2022.

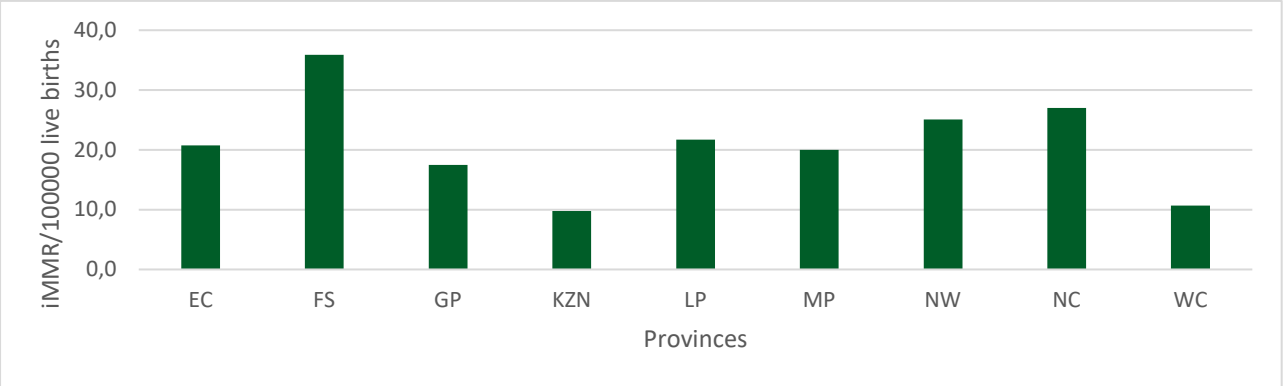
Figure 1. iMMR from hypertensive disorders of pregnancy for 8 triennia from 1999-2022



The number of deaths due to HDP in the current triennium in individual provinces ranged from 18 in the Northern Cape (NC) to 120 in Gauteng (GP).

The institutional Maternal Mortality Ratio (IMMR) for HPD was 17.85 deaths per 100,000 live births. There were 3,019,165 live births in the public sector in the 3-year period. Two provinces, Free State (35.9 per 100,000 live births) and North West (27) had the highest IMMRs (Figure 2).

Figure 2. iMMR for Hypertension per province for the 2020-2022 triennium



Eclampsia (n=264) accounted for the majority of deaths. The numbers of deaths in the other categories of HDP were Pre-eclampsia with severe features (n=108); HELLP (n=82); Pre-eclampsia without severe features (n=28); gestational hypertension (n=-6) chronic hypertension (n=21) and liver rupture (n=10).

Final Causes of deaths due to HDP:

- Cerebral complications accounted for 57.3% of all deaths due to HDP (eg. intracranial hemorrhage 164); cerebral edema 32 and brain death following a hypoxic event 66, etc)
- Cardiac failure/pulmonary edema (31.4%)
- Acute kidney injury (20%), DIC (10.4%) and liver failure (9.5%) were other major final causes of death.

The commonest final causes of death were due to acute rises in blood pressure levels leading to intracranial hemorrhage and cerebral edema, while pulmonary edema and multi-organ failure were the other major underlying causes for deaths. These final causes of deaths suggest that due attention is still not given to the use of rapid acting antihypertensive agents such as quick acting nifedipine and intravenous labetalol. In addition, the file reviews (section B), reveal that junior doctors prescribe these rapid acting anti- hypertensive agents but do not remain with the woman to see whether the high blood pressure is reduced. Protocols recording the rapid lowering of very high blood pressure with signs and symptoms

Furthermore, attention should be paid to restricting intravenous fluids as previously recommended. In fact, in many cases of PE with severe features magnesium sulphate was given and there was IV fluid loading but the immediate lowering of high blood pressure levels was not carried out.

Most deaths due to HDP occurred in Regional Hospitals (n=172), followed by tertiary hospitals (n= 147). National central hospitals had 73 deaths, District Hospitals had 92 deaths, and Community Health Centres had 19 deaths. There were 16,53, and one death due to pre-eclampsia with severe features, eclampsia and HELLP respectively in District Hospitals. Nine deaths due to eclampsia occurred in CHCs.

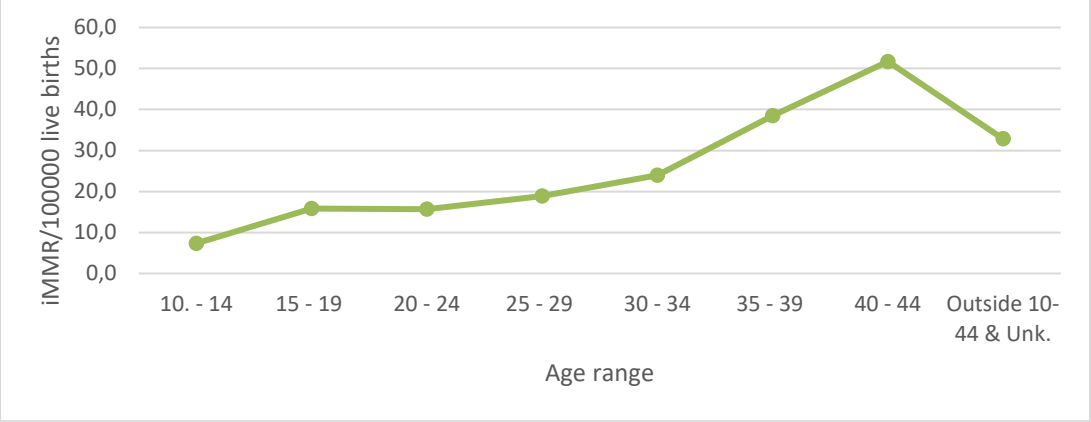
There were 20 maternal deaths due to HDP reported by Private Health Facilities (10 were due to eclampsia).
HIV Status and HDP Deaths: Of 539 deaths, the HIV status was unknown in 73 cases. Of those tested, 74.6% were HIV negative and 26% were HIV positive.

The iMMR for hypertension per age range is shown in Figure 3.

Maternal Age and HDP deaths: of 539 deaths, 1 was less than 15 years, 48 were 15-19 years, and 93 were aged 20 -24 years. A substantial proportion of deaths occurred in primigravidae (n=169), accounting for 31% of all HDP deaths.

The IMMR for those between the age of 10 and 14 years was 7.4 and 15.8 deaths per 100,000 live births for those aged 19 to 24 years (Figure 3). There was a linear increase of I MMR with age, unlike in the 2017-2019 triennium where iMMR was as high in the <15 yr group as in the >35 yr age group. This shift is encouraging and could be explained by less teenage pregnancies or better care of teenagers by the health system, or the predominance of older women dying due to COVID-19 and skewing the age breakdowns.

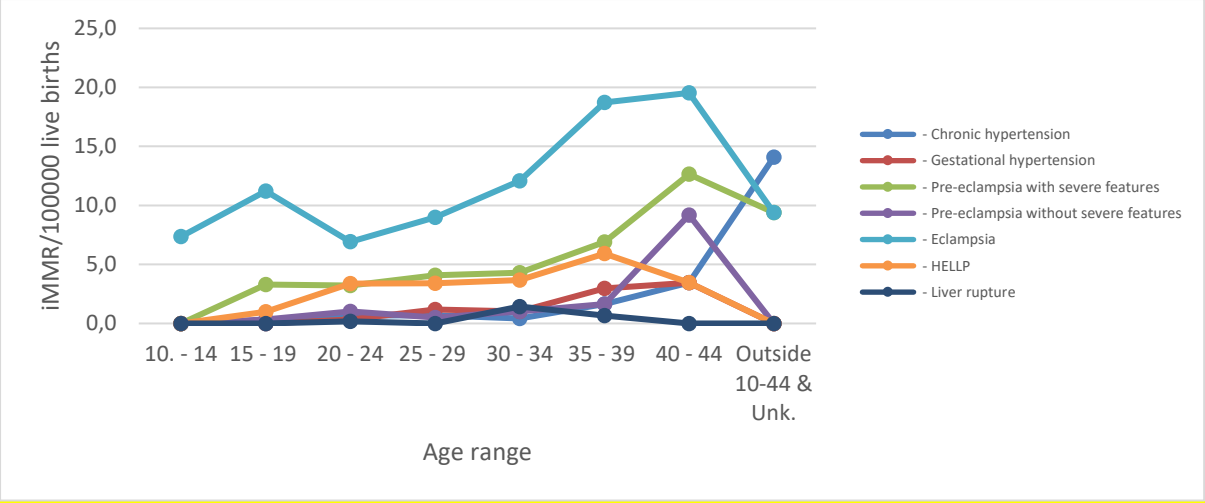
Figure 3. iMMR for Hypertension per age range* – 2020-2022 Triennium



*Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021

Figure 4 shows the iMMR for hypertension subcategory per age range.

Figure 4. iMMR for hypertension subcategories per age range*– 2020-2022 trennium



* Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021

In addition, 88 (33%) of the 264 women who died of eclampsia who died were primigravidae.

Approximately 51.2% of all HDP deaths had avoidable factors within the health system. These will be illustrated in the following case study, and will be described in more detail in section B.

Maternal death Case study: Eclampsia (Hypertensive disorder)

Clinical Summary

33 years old P1, m1, G3 booked at local clinic at 15wks
Patient had pré hypertension and tachycardia at 2 initial visits.
BP - 139/81, p- 110; and BP- 135/84 P- 120. No action taken and no referral. She was given a date for review in 2 months' time.
On a routine third antenatal visit, BP-187/107 and 181/128 with generalised body swelling. Patient was 32 weeks according to sonar.

She was referred to district hospital. No magnesium sulphate or antihypertensives were given. On arrival at district hospital, patient had symptoms of imminent eclampsia, she was loaded with MgSO4 and given antihypertensives (Methyldopa 1g and 10mg Nifedipine). The case was discussed with a regional/tertiary institution and patient was accepted. While awaiting transfer to a tertiary institution, she developed tonic clinic seizures. Patient fell and IV line came out. It had to be re-inserted. Patient had a second seizure and was unresponsive following the seizure. CPR was commenced. Wrong doses of adrenaline given (0.5mg). CPR stopped for more than two minutes to attempt intubation. Intubated on the 3rd attempt (difficult intubation).

Patient certified dead after an hour of resuscitation.
Sonar was done after patient s death and fetal heart was present, Perimortem CS was done and baby was extracted with Apgar score 2/10 and weight 1.6kg with a large retroplacental clôt.

Assessment:

Primary Obstetric cause of death: Eclampsia

Avoidable factors:
a. Patient - nil
b. Administrative - nil
c. Medical care

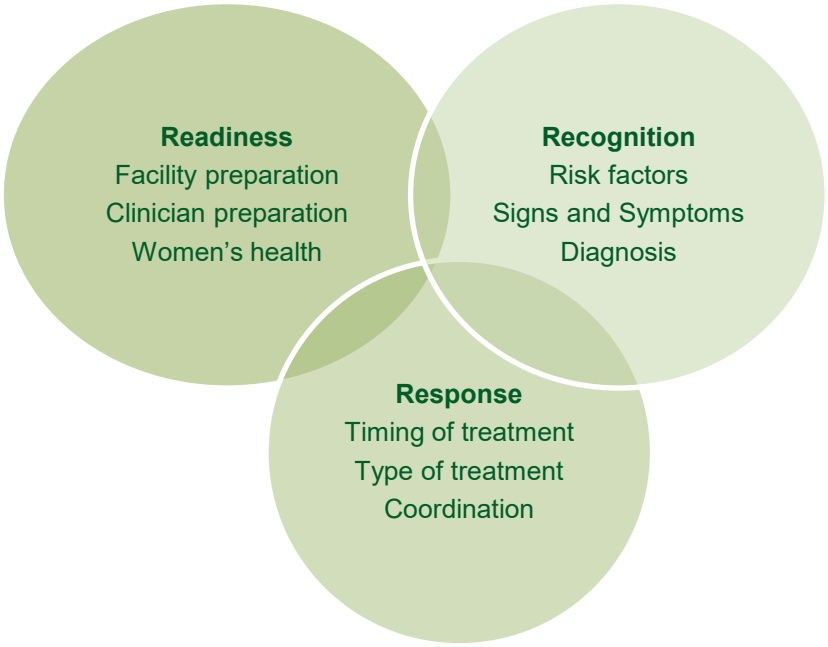
- Poor problem recognition, assessment and management of Hypertension at CHC
- Referral to inappropriate level
- Prolonged abnormal observations with no action

- Resuscitation problems

Lessons to learn and suggestions for prevention:
1. Need for clear referral criteria/ adherence to referral protocol.
2. Training of management of severe Pre-eclampsia at local clinic prior to transfer to hospital.
3. Training on Maternal resuscitation module.

B. In depth Clinical Case Reviews of Mortality associated with Hypertensive Disorders of Pregnancy for the triennium 2020-2022: Identifying Quality Improvement Opportunities.

The 4 R system was used by Professor J.Moodley to review the HPD death files and below is a diagram of the 4 domains (Figure 5).
The 4th domain is REPORTING.



The case reviews of deaths due to HDP indicate that there were a number of **Quality Improvement Opportunities (QIOs)** which could be used to improve the detection of women most likely to develop complications of HDP during the antenatal period, childbirth and the immediate post-partum period. These QIOs include:

1. RECOGNITION – Risk factors; Signs and Symptoms, Diagnosis.

Recognising Risk Factors that lead to the development of HDP is critical to take preventative steps such as use of low dose aspirin and calcium supplementation, more frequent antenatal visits between 24-34 weeks for women at risk to ensure early diagnosis and timely clinical management of these pregnancy disorders.

Risk factors include first pregnancies (primigravidae), or a new partner, a history of a previous HDP or an unexplained pregnancy loss, multiple pregnancy, a history of chronic hypertension, obesity or any underlying chronic medical condition such as diabetes or anaemia. In addition, young women (14-24 years) are at risk as well as and women over the age of 35 years. The latter may have unidentified chronic hypertension or hypertension prior to 20 weeks gestational age at their first antenatal visit, and, in such instances, the possibility of chronic hypertension must be considered. There were a number of women attending rural antenatal clinics who did not know that they had chronic hypertension.

In addition, recognising women at risk of developing a HDP, but having no "Clinical Management Care Plan" is a matter of concern. There were several instances in which women with risk features were managed at the wrong level of healthcare e.g. women with chronic hypertension and advanced reproductive age being managed antenatally at primary healthcare clinics in rural areas without evidence of a "Clinical Management Care Plan" or evidence of discussions with such women regarding their site of antenatal care, site of delivery, transport

issues when in early labour, the need for possible changes in the type and or dosages of antihypertensive agents and plans for future pregnancies.

Because women with chronic hypertension are at risk of developing superimposed PE and may have underlying cardiomyopathy, careful consideration must be given to their antenatal care being provided at a regional hospital by combined obstetric and internal medicine teams. Obese women with chronic hypertension should have an echocardiography to identify peripartum cardiomyopathy

In several cases reviewed, it appeared that when women are booked for a so-called "High Risk Clinic" they are often given a date which is "4-6 weeks down the line'' and in a number of such instances, women had developed complications prior to the date given for attendance at a high-risk clinic. Furthermore, in several cases inappropriate advice was given by doctors at high risk clinics in district hospitals, suggesting lack of experience and the need to upskill them. Each woman deserves to have a "Clinical Management Care Plan" discussed with her, her family and or support person/s of **HER** choice. It is also important to discuss with women the clinical signs which warrant urgent medical attention and the level of health facility she needs to go in such circumstances. In a number of cases when women had symptoms they often went to their antenatal clinic or a general practitioner which delayed prompt treatment of severe hypertension, pulmonary edema or eclamptic seizures.

One other striking feature in these case reviews which needs particular attention is **" pre-hypertension (slightly elevated blood pressure levels**") and **persistent tachycardia**. There were a number of cases in which young women had blood pressure levels of 130 -139 systolic and or diastolic of 80-89 mm Hg or pulse rates persistently >100 beats/minute – such findings **were not recognized as being potential "warning signs /red flags**" and women were given return dates to the clinic of 4-6 weeks later. In such instances, especially if the woman is in the mid-second trimester, she should be asked to return in one week or referred to a regional hospital. Although there are varying results on the impact of stage 1 hypertension -pre-hypertension (130-139 systolic/ and or diastolic of 80-89 mmHg , there were a sizeable number of cases of cases of stage 1 hypertension recorded in the maternity records of deaths from eclampsia and preeclampsia with severe features. Thus, it would be appropriate to ensure that these women are seen again within a week and blood pressures taken according to the recommendations indicated by the NDOH. Also, healthcare professionals must ensure that appropriate BP arm cuff-sizes are used and that BP machines are validated for use in pregnancy. Use of only one regular arm cuff size leads to inaccurate BP measurements; there is recent evidence that misuse of BP cuff-sizes leads to inaccurate measurements. Therefore, all antenatal clinics MUST place more effort into the selection of individual BP arm cuff size and ensure that appropriate steps are taking when the blood pressure measurements are done such as the women being seated in an appropriate chair (not a sofa), feet flat on the floor with the woman wearing loose fitting clothes. Furthermore, there may be advantages in using BP machines which give "traffic light alarms "-red if BP ≥ 140 systolic and the colour "amber" if BP is 130 mm Hg.

Two or three cases stand out which illustrates ***poor training in recognising red flags/ warning signs***; in one case a doctor discharged a woman from hospital (admitted with a diagnosis of Preeclampsia. She was a primigravidae at 38 weeks of pregnancy with a blood pressure of 150/80 mm Hg and proteinuria +, and was complaining of epigastric pain. The pain was regarded as "peptic ulcer pain" and she was given peptic ulcer treatment and asked to return in a week; but she returned with eclamptic seizures the next day. Junior doctors must obtain advice from an experienced medical doctor or specialist prior to hospital discharge of any pregnant woman with a diagnosis of HDP.

In another case, a medical doctor found a BP of 158 /85 mm Hg in a young woman (first pregnancy) who had delivered 12 hours previously. The doctor discharged the patient; she returned the next day with seizures. Health staff MUST recognize that most women with an HDP must remain under close surveillance for at least 3 days following birth. Blood pressure levels in HDP are variable in the first three days post-delivery and it is difficult to predict which woman will develop complications. In a third case a young woman complained of persistent headaches which the doctor ignored, and did not estimate her blood pressure levels or have her urine tested. She returned the next day with seizures and a low Glasgo Coma Scale.

Any symptoms and or signs suggestive of HDP during the antenatal, intrapartum and postpartum periods should alert medical doctors and midwives to take appropriate measures to rule out HDP. The symptoms of epigastric pain and the finding of tenderness in the epigastric area together with abnormal liver function tests may indicate liver rupture. There were six cases of liver rupture detected either at the primary caesarean birth or at repeat laparotomy for clinical signs of intraabdominal hemorrhage. Intrabdominal packing of the surface bleeding areas

was unsuccessful in these cases. Any suspicious signs of liver rupture should involve the presence of general surgeons.

Ongoing intensive training of medical doctors on the practical clinical management issues in pregnant women during the antenatal period, at the time of birth and following birth MUST occur in clinical practice under supervision of District Clinical Specialists and or Family Physicians. In addition, these points should be brought to the attention of interns, community service doctors and medical students whenever a teaching opportunity occurs.

The case reviews indicate that there is failure to follow clinical guidelines particular when women have symptoms or signs. For example, a primigravida with gestational hypertension at 39 weeks gestation but no symptoms was kept in a district hospital for at least 5 days without a decision being made to induce birth or advice sought from the regional hospital. She women developed Preeclampsia with severe features and then eclampsia and died from an intracranial bleed. Guidelines, both local and international, suggest that all women with gestational hypertension should be delivered at the end of 38 weeks if not earlier. This may be just one case but it illustrates that guidelines must be followed or advice from experienced medical doctors obtained.

Maternity Healthcare providers must also **recognise** that young women may also have chronic medical conditions, and be prepared to manage young women with chronic hypertension together with internal medicine specialists. There were four women, below the age of 20 years who presented with chronic hypertension since childhood. There was failure to recognise the likely complications and there was no "joint care plans to clinically manage these patients with "internal medicine specialists" at a regional hospital level. All developed superimposed PE and complications at the time of birth and the immediate puerperium. Such women and those with cardiac diseases must be given advice about contraception / family planning options and ensure that follow up care is arranged with physicians for their chronic condition.

Hypertension is a leading cause of death in Africa, its prevalence is up to 54% in Africa and it is most worrying that only 7% are on treatment with their blood pressures well controlled. In South Africa in the 2020-2022 triennium, a substantial number of women died from preeclampsia superimposed on chronic hypertension.

Therefore, the NDOH must strengthen the socio-economic and educational aspects of ensuring that preventative measures are taken to prevent hypertension through appropriate diet, exercise and the spread of personal healthcare to the population at large

2. READINESS – Facility Preparedness; Clinician's preparedness; Improving Women's Knowledge/Sharing information during the antenatal period with the woman and her family; and Drugs and immediate treatment

There were a number of instances in which the "Eclampsia Box " was not available or did not have all the requisite equipment and drugs for the immediate management of eclampsia or PE with severe features leading to delays in treatment especially in lowering "very high levels of Blood pressure". Magnesium sulphate was usually given but as stated there were delays in lowering very high blood pressure levels with appropriate rapid acting antihypertensive agents. This may be due to the fact that professional nursing staff are the first-line health professionals at District Hospitals and probably await medical officers to arrive to provide emergency care. Professional nurses must be allowed to give rapid acting agents in such circumstances. Chart reviews also indicate that professional nurses often "fluid loaded" women with eclampsia and preeclampsia with severe features. This may be a misinterpretation of the guidelines; it is important to "Be Cautious' and give fluids slowly. Fluid load women with HDP may result in pulmonary edema.

Referral patterns

There were number of instances in which cases of eclampsia and PE with severe features were transferred from clinics to district hospital and then onwards to regional hospitals resulting in delays in treatment. Provincial Health Authorities should ensure that transfer/referral protocols are regularly reviewed with the emergency ambulance services and all staff (nursing and medical) so that they are regularly reminded and updated (if appropriate) of referral protocols and emergency management at frequent intervals

Clinician Preparedness

There were several instances when medical doctors needed assistance to resuscitate women who had

collapsed and had to seek the help of anesthetists or ICU staff. The hospital administration must ensure **that all medical doctors, in particular recently qualified medical doctors,** must take part in an ESMOE course and/or additional ICU refresher resuscitation course on a regular basis.

In addition, hospital administration fails to recognise and put in measures to ensure that Obstetric Emergencies such as eclampsia /PE with severe features /pulmonary edema WARRANT team management with a team leader directing emergency care at the bedside rather than telephonically from home. Hospital administration must ensure that in such cases, there is a Clinical Management Care Plan and a team leader present to ensure that treatment and laboratory investigations are done timeously. In most instances, case reviews show that only one inexperienced doctor is left to deal with two emergencies at the same time. In such instances the doctor on call must call for help. There must be a team approach to clinical management of all obstetric emergencies. Furthermore, even specialists must be involved in refresher causes and be informed to be actively involved in the physical assessment of woman. This is illustrated by the following case. A woman was admitted at night (23 hrs) with eclampsia at 24 weeks gestational age with an IUD; and her Glasgow Coma scale was 11/15 . A specialist was contacted and the medical officer was informed " Not for caesarean section" to be written clearly in the hospital records. This was done without the specialist seeing the patient physically. The patient demised 6-8 hours later from an ICH. It emphasises the need for the experienced doctors to examine all severe PEs and eclamptics themselves, regardless of the time of day or night. Hospital administration must ensure this occurs.

Women's Knowledge

There were a number of women over the age of 35 years who had not planned the pregnancy, and it appears were not aware of contraception or family planning services.

Community Health Workers MUST play a significant role in informing all women, especially in the age group above 35 years, about Family Planning services and also about "health check-ups". In a number of instances women above the age of 35 years did not know that they had chronic hypertension. Furthermore, it appears from the chart review that some women in this age group would "first visit traditional healers" or in the case of young women their families may take "sick pregnant women" to traditional healers initially. Community Health Workers should play a important role in educating women and their families about appropriate healthcare during pregnancy and in general. Community Health Workers and School Nursing Professionals should also take messages regarding teenage pregnancies and the likely complications that occur in young women, the advantages of family planning services and the availability of medical termination of pregnancy when requested. There were several instances of eclampsia in teenagers and young women (under the age of 24 years).

3. RESPONSE – Timing of treatment; Type of treatment; Co-ordination of care; Follow -up Care

There were several instances especially at clinics and district hospitals in which treatment was delayed because a doctor was busy attending to other pregnant women. Hospital Administrators must ensure that measures are instituted to overcome such clinical circumstances. Again, there must be a team approach, ie an emergency team should be in place to deal with obstetric emergencies. Low dose aspirin should be used for all women at risk of a HDP. There is now sufficient evidence from large clinical studies to show that low dose aspirin (81 mgms) prevents early onset PE if initiated from 12-14 weeks to term. It is relatively cheap, easily available and safe to use in pregnancy. Therefore, calcium 500mgms thrice a day and low dose aspirin (81 mgms) taken at night after the evening meal should be considered to reduce early onset PE.

In addition, women at risk of HDP should not follow the normal antenatal clinic intervals but be seen more frequently.

Care must be taken at the time of hospital discharge of women who had a HDP. They should be observed for at least three days following delivery. There were several instances in which women returned in the first 12 days following birth with pulmonary edema or severe hypertension.

Women should then be seen again at their place of birth and ensure that advice is given about future pregnancies and the risk of PE recurring, and the risk of chronic hypertension, cardiomyopathy and diabetes in later life. Therefore, women especially those who had a HDP should see a medical doctor at least six monthly, exercise regularly, reduce weight if appropriate and have a healthy lifestyle.

Lessons for Health Professionals and Managers from Case reviews

- Health system failures – detect HDP and manage appropriately before the development of clinical complications
- Administration of Magnesium Sulphate and lowering severe hypertension (>160/110 mm Hg) for patients with an obstetric emergency using a team approach and ensuring professionalism whilst improving the quality of care such as respect for the patient, avoiding mistreatment and abuse
- Health System failures – Health managers must improve the numbers and quality of staff; address shortages of medical supplies; and ensure refresher courses for nurses, doctors and ambulance staff; in order to improve the quality of care in particular to young women and adolescents.

Lessons for Community Health Workers involved in pre-pregnancy care in communities

- Strengthen discussions with communities (women, their families or partners) regarding Pregnancy Planning /Contraception/Abortion services/ Postpartum Care / D.iet and exercise between pregnancies and complications associated with pregnancies at 35 years and greater.
- Discuss with communities and schools on Reproductive Health Issues/ Chronic Medical Conditions such as chronic hypertension, diabetes, obesity; Dietary habits; and Adolescent pregnancies.
- Attend District Health Review meetings to provide Messages to communities eg about: Chronic Medical Complications such as Chronic Hypertension, and Diabetes; early attendance at antenatal clinics; antenatal attendees to give full information of previous pregnancies and any mishaps that may have occurred in a previous pregnancy; to inform women about the need to use folic acid prior to pregnancy and use of calcium and low dose aspirin if provided by the professional nurses and the need to let nurses know of any chronic medications that they might be using.
- The NDOH should highlight and strengthen community information and education on risk factors for HDP, hypertension, hypertension prevention, treatment, antihypertensive medication adherence and life style changes including exercise and annual check-ups.

7.4 Maternal deaths from Obstetric Haemorrhage 2020-2022

(Professor SR Fawcus, Dr Su-Ritha Wessels).

ABSTRACT

Introduction

The SA National Confidential Enquiry into Maternal Deaths (NCCEMD) produces triennial reports, the most recent being for 2020 to 2022, which showed marked increase in iMMR during the COVID-19 years (2020-2021). The purpose of this paper was to perform an in-depth analysis of deaths from obstetric haemorrhage (OH) during 2020-2022.

Methods

Data on OH deaths were retrieved from the database, MaMMAS, of the NCCEMD. In addition, a secondary analysis was performed by the chapter author from a review of the hard copy files of OH maternal deaths which contained the clinical notes, Maternal Death Notification Forms and Assessors forms. The analysis of deaths is all descriptive.

Results

Maternal deaths (MDs) from OH increased in the 2020-2022 triennium, and accounted for 599 maternal deaths (16.4% of total maternal deaths) compared to 544 (15.7%) in 2017-20119. OH was the second most common cause of maternal death with an iMMR of 19.8 deaths per 100,000 live births compared to 19.1 in 2017-2019; with considerable variation between provinces.

The higher number of OH deaths in 2020 and 2021 probably reflected an indirect effect of the COVID-19 pandemic which adversely affected the functioning of the health system due to staff shortages, reallocation of duties, overburdened ICUs and stretched emergency transport services.

The major causal subcategory groupings of OH deaths were: Bleeding associated with Caesarean delivery (33.1%); Postpartum haemorrhage (PPH) following vaginal delivery (30.7%) from uterine atony, genital tract trauma, retained placenta and unspecified PPH; Antepartum haemorrhage (21.2%) mostly from abruptio placentae; Ruptured uterus (15.0%), equally from a scarred and unscarred uterus.

The majority of OH deaths (88%) had antenatal care, and occurred at public hospitals; 27.9% at district hospitals (DH), 31.1% at regional hospitals (RH) and 29% at tertiary hospitals (TH/NC). There were 56.1% of the OH deaths who had been referred, mostly from CHCs (16.3%) and District hospitals (23%) demonstrating the importance of availability of emergency transport and optimizing care before and during referral. Assessors judged the majority (85.5%) of the OH deaths to be possibly or probably avoidable. Patient /community related factors occurred in 35.4%, and administrative avoidable factors in 69.8%, highlighting major problems in health facility management and training. Health worker/medical related avoidable factors occurred for 41% of assessable deaths at CHC level, 83.2% at DH, 74.4% at RH, 61% at TH/NC and 80% at private hospitals. Vignettes are presented to illustrate problems identified; and a list of key recommendations is presented.

Conclusion

The promising decrease in obstetric haemorrhage deaths up to 2019 was set back by the COVID-19 pandemic, with OH became the second most common cause of MD with the majority being potentially preventable by the health system. Important interventions such as E Motive approach, surgical safety at CS, Blood transfusion protocols and availability and prevention of anaemia should all facilitate improvement in the coming years

Introduction

The eighth triennial Saving Mothers Comprehensive Report for 2020-2022 presents an overview of maternal mortality, with underlying causes, trends, associated factors and preventability, compared to previous triennia. It is important to note that this report covers the COVID-19 pandemic period which was declared a public health emergency in South Africa in March 2020, until May 2023.

The purpose of this paper is to perform an in-depth analysis of deaths from obstetric haemorrhage during 2020-2022.

Methods

The method used to compile the triennial report was the same as used for previous reports (1,2,3). All maternal Deaths (MDs) were notified to the provincial MCWH office, assessed by independent assessors, and data entered anonymously into the secure password protected national MaMMAS database used by the NCCEMD. The classification of maternal deaths (MDs) used in South Africa is based on the WHO ICD 10 adaptation for maternal deaths (4,5) whereby maternal deaths are classified by Primary Obstetric cause, for example Obstetric Haemorrhage (OH), Non pregnancy related infections (NPRI) etc. The number of live births was obtained from the DHIS database, and this is used as the denominator to calculate maternal mortality rates. The term institutional MMR is used (iMMR) to reflect the fact that the MD Enquiry is predominantly facility based with under reporting of home deaths and births.

Data tables on OH were derived from the MaMMAS database. In addition, a secondary analysis was performed by the chapter author from a review of the hard copy files of OH MDs which contained the clinical notes, Maternal Death Notification Forms and Assessors forms. The analysis of deaths is all descriptive.

A. Results of Analysis of Maternal deaths due to Obstetric Haemorrhage 2020-2022

Trends in Numbers of OH maternal deaths and Maternal Mortality Rates

Maternal deaths from obstetric haemorrhage (OH) increased slightly in the 2020-2022 triennium and accounted for 599 maternal deaths (16.4% of total maternal deaths) compared to 544 (15.7%) in 2017-2019. OH was the second most common cause of maternal death with an iMMR of 19.8 deaths per 100,000 live births compared to 19.1 in 2017-2019. Thus, the promising reduction in OH MMR seen in the last triennium was not sustained.

(Figure 1)

Figure 1. iMMR for OH for 8 triennia

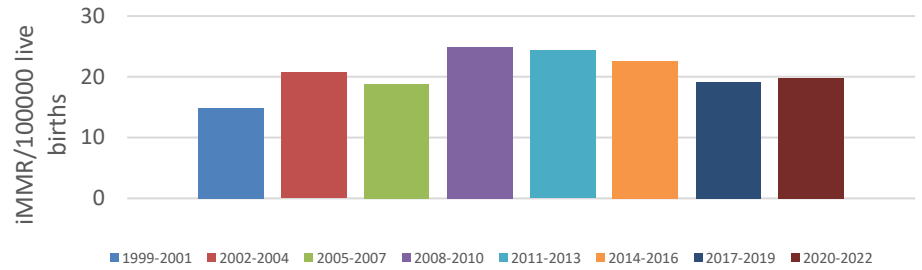


Table one shows that the increase in OH deaths was largely seen in 2020 (200 deaths) and 2021 (237 deaths) but not in 2022 (162 deaths). The high number of OH deaths in 2020 and 2021 reflect an indirect effect of the COVID-19 pandemic which had its greatest impact in these two years; and adversely affected the functioning of the health system due to staff shortages, reallocation of duties, overburdened Intensive Care Units and stretched emergency transport services (6).

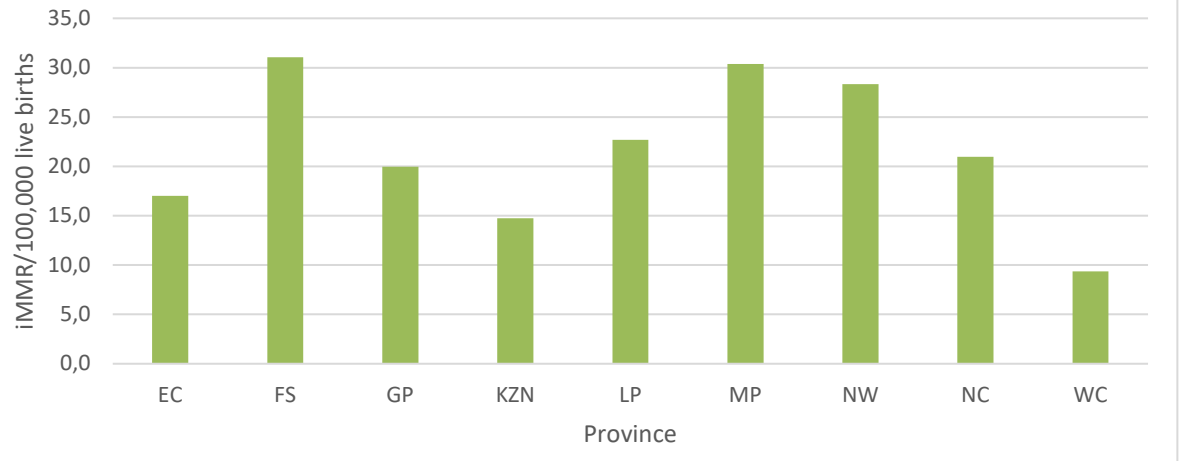
Table 1. Annual OH maternal deaths and iMMR 2017-2022

Obstetric haemorrhage	n	%	iMMR
2017	184	15.0	20.13
2018	181	15.3	19.19
2019	179	17.1	18.09
2020	200	16.3	19.32
2021	237	15.7	23.33
2022	162	16.3	16.73

Provincial variation in OH deaths and iMMR; and Trends

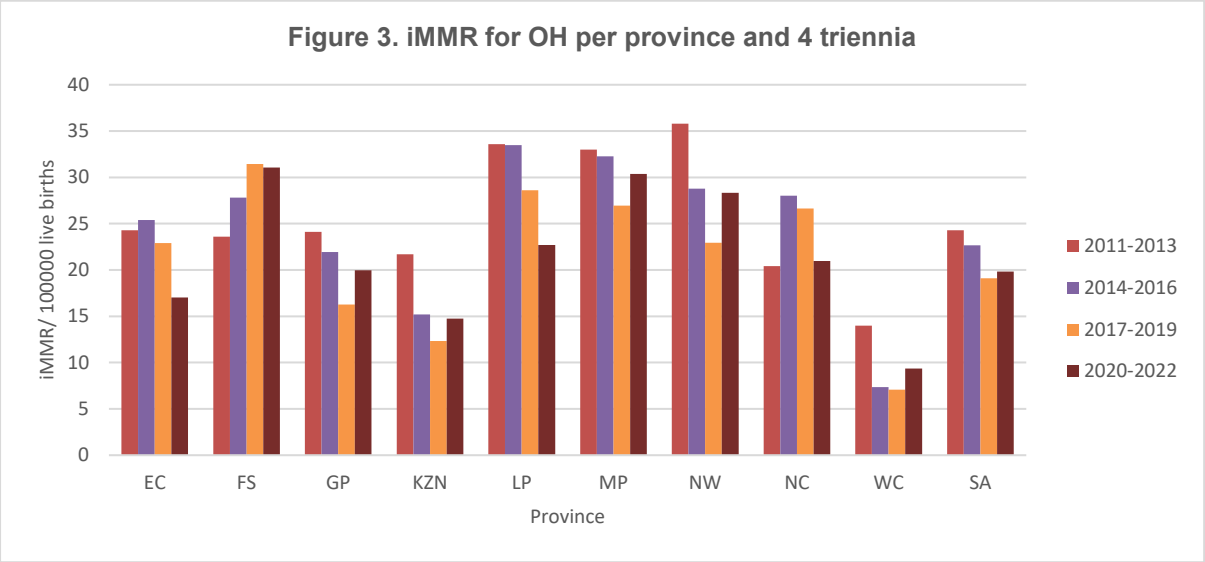
Figure 2 shows that there was considerable provincial variation with the triennial iMMR due to OH being highest in Free State (iMMR 31.1), Mpumalanga (iMMR 28.6) and North West (iMMR 28.3); and lowest in KwaZulu-Natal (iMMR 14.7) and Western Cape (iMMR 9.4).

Figure 2. iMMR for Obstetric haemorrhage for the 2020-2022 triennium



EC Eastern Cape; FS Free State; GP Gauteng; KZN KwaZulu-Natal; LP Limpopo; MP Mpumalanga; NW North West; NC Northern Cape; WC Western Cape

Figure 3. shows provincial trends in iMMR per province over four triennia



EC Eastern Cape; FS Free State; GP Gauteng; ZN KwaZulu-Natal; LP Limpopo; MP Mpumalanga; NW North West; NC Northern Cape; WC Western Cape

Demographic and obstetric factors in women who died from OH.

Background features in OH deaths were: maternal age over 35 yrs (36.1%), prolonged labour (14.7%), anaemia (22.8%), HIV positive (33.2%), induced labour (14%), previous Caesarean Delivery (CD, 33.9%), and CD in the index pregnancy (49.4%). Figure 4 shows that increasing age was associated with higher iMMR for OH.

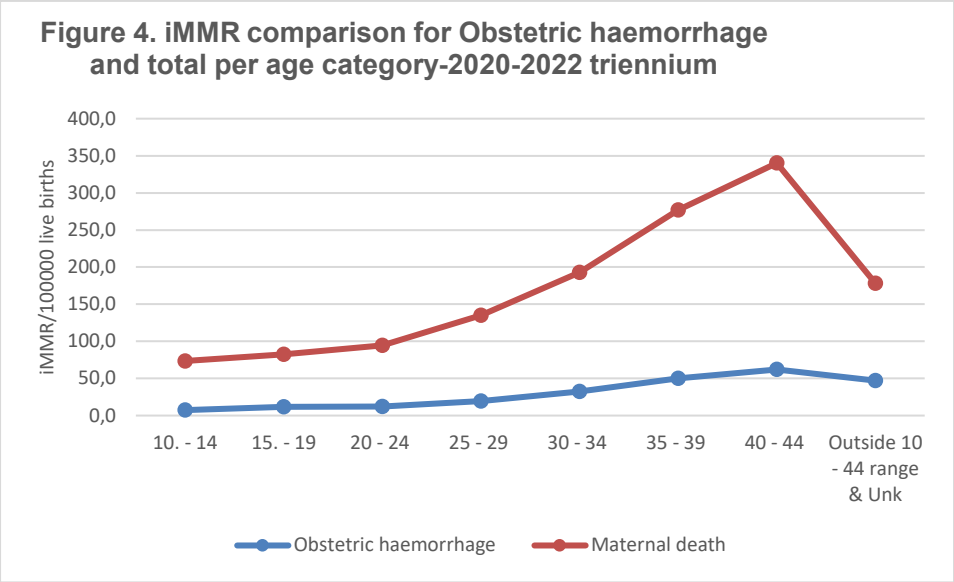
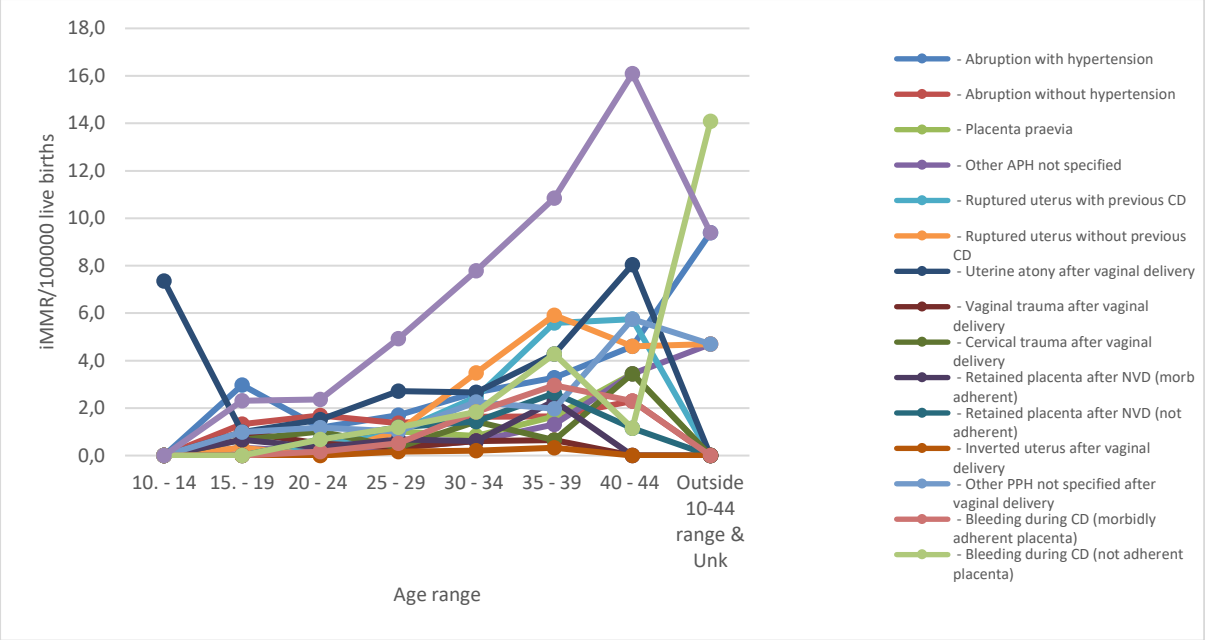


Figure 5 shows that when OH is subdivided into causal subcategories, teenagers under 15years had a higher iMMR from uterine atony.

Figure 5. iMMR per OH subcategory-2020-2022 triennium



Major Causal Subcategories of OH deaths

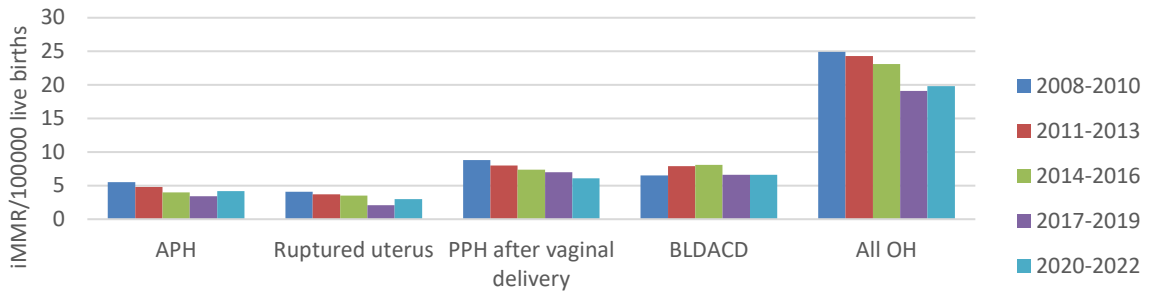
There are 16 major causal subcategory groupings of OH in the MaMMAS database and shown in Figure 5, but to simplify the analysis, these were grouped into four broad causal subgroupings of OH death as shown in Table 2 and include:

1. Bleeding associated with Caesarean delivery (BLDACD, 33.1%, iMMR 6.6 per 100,000 live births), mostly detected after CD.
2. Postpartum haemorrhage (PPH) following vaginal delivery (30.7%, iMMR 6.1 per 100,000 live births), from uterine atony, genital tract trauma, retained placenta and unspecified PPH.
3. Antepartum haemorrhage (21.2%, iMMR 4.2) mostly from abruptio placentae but also from placenta praevia
4. Ruptured uterus (15.0%, iMMR 3) equally from a scarred and unscarred uterus. OH from BLDACD and PPH after vaginal delivery remain the two largest causal subcategories. Compared to 2017-2019, the iMMR from PPH after vaginal delivery has decreased slightly, and remained similar for BLDACD, but iMMR for APH and ruptured uterus have increased slightly.
   Reviewing the last 5 triennia from 2008-2022, there had been a sequential decrease in iMMR for APH, and Ruptured uterus which was not sustained in 2020-2022. PPH after vaginal delivery has shown gradual decline, and BLDACD MMR increased in 2011-2013 and 2014-2016 before declining in 2017-2019 and 2020-2022, Figure 6.

Table 2. Causal subcategories of OH 2020-2022, compared with 2017-2019

Haemorrhage 2020-2022	Number Haemorrhage	% Haemorrhage	% Haemorrhage 2017-2019
Antepartum Haemorrhage	127	21.2	17.6%
Ruptured uterus	90	15.0	11.2%
PPH after vaginal delivery	184	30.7	34.0%
Bleeding at/after Caesarean delivery	198	33.1	37.1%
Total	**599**	**100**	**100%**

Figure 6. iMMR for the broad subcategories of Obstetric Heamorhhage per triennium 2008-2022



For all provinces, the two subcategories BLDACD and PPH after vaginal delivery, were the most common groupings, with APH third except in the Western Cape where it was fourth (Figures 7 and 8).

Fig 7. Obstetric haemorrhage cause of maternal death per causal subgroup per province

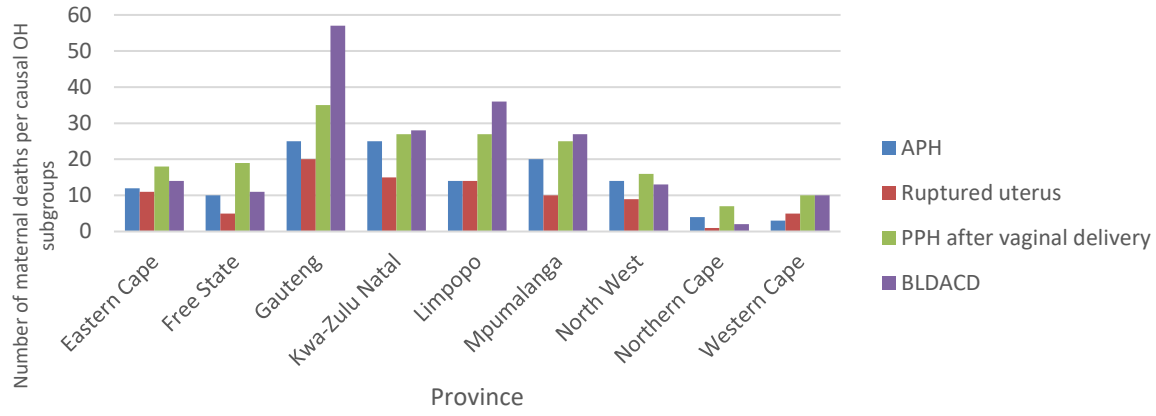


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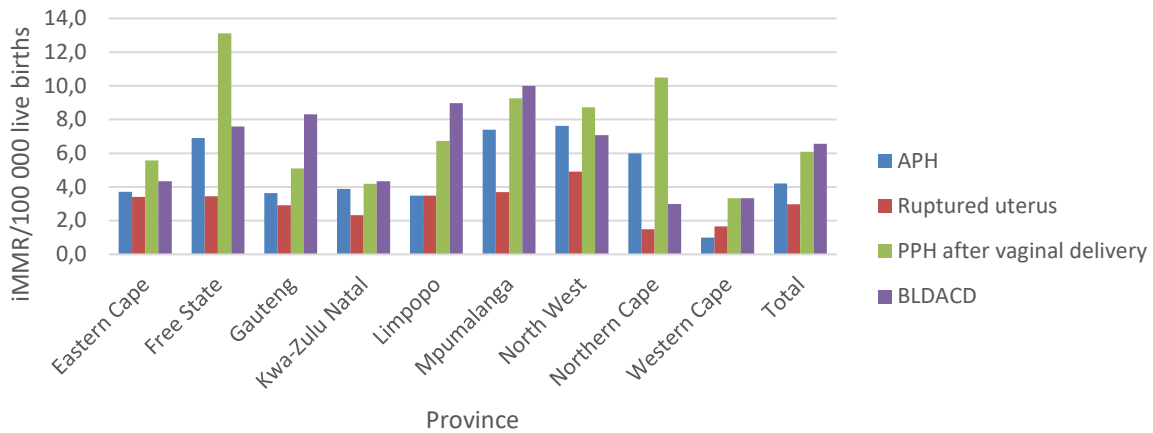
Fig 8. iMMR obstetric heamorrhage causal subcategories per province



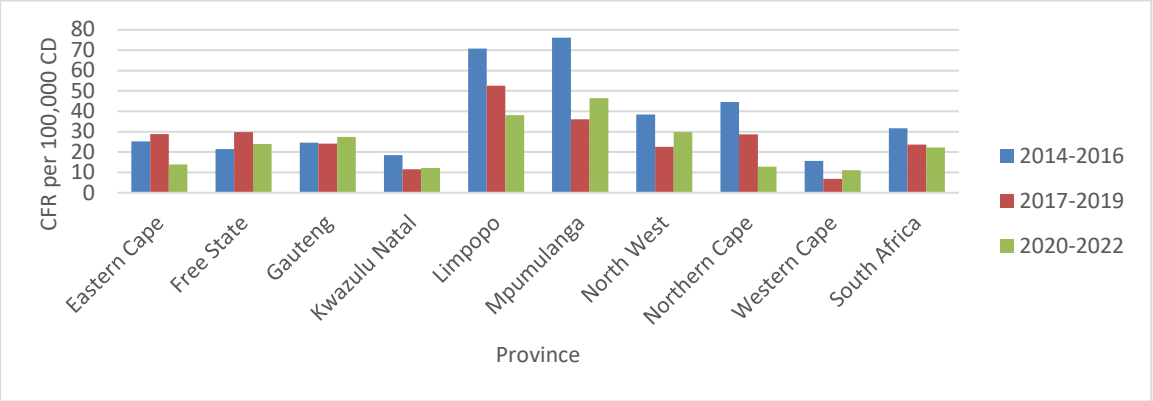
Deaths from bleeding at/after Caesarean delivery

During 2020-2022, 889,497 caesarean deliveries (CDs) were performed, giving a national CD rate of 28.8% (ranging from 21.2% in Mpumalanga to 35% KwaZulu-Natal). There were 198 deaths from BLDACD, 20 from morbidly adherent placenta, 34 from bleeding during CD and 119 from bleeding after CD. The case fatality rate (CFR) from BLDACD in 2020-2022 was 22.3 BLDACD deaths per 100,000 CDs, which is similar to 2017-2019 (23.6), thus it remained lower than in the 2014-2016 and 2011-2013 triennia. Of note in 2020-2022, is the wide discrepancy in BLDACD CFR between provinces with the highest rates in Mpumalanga (46.5 BLDACD deaths per 100,000 CDs) and Limpopo (38.1), with the lowest rates in Western Cape (10.0) and KwaZulu-Natal (12.1).Table 3 and Figure 9.

Table 3. BLDACD deaths and BLDACD rates per province 2020-2022

Province	CD 2020-2022 N	CD Rate 2020-2022 %	BLDACD death 2020-2022 N	BLDACD CFR 2020-22 per 100,000 CD	BLDACD CFR 2017-19 per 100,000 CD	BLDACD CFR 2014-16 per 100,000 CD
Eastern Cape	100672	30.4	14	13.9	28.9	25.2
Free State	45894	30.6	11	24	29.8	21.4
Gauteng	207695	29.5	57	27.4	24.1	24.6
KwaZulu-Natal	232152	35	28	12.1	11.5	18.5
Limpopo	94513	23.1	36	38.1	52.5	70.8
Mpumalanga	58057	21.2	27	46.5	36.1	76.1
North West	43800	23.3	13	29.7	22.5	38.4
Northern Cape	15586	22.8	2	12.8	28.7	44.6
Western Cape	91123	29.8	10	11	6.9	15.6
South Africa	**889497**	**28.8**	**198**	**22.3**	**23.6**	**31.7**

Figure 9. Bleeding associated with CD CFR per triennia and province from 2014-2022

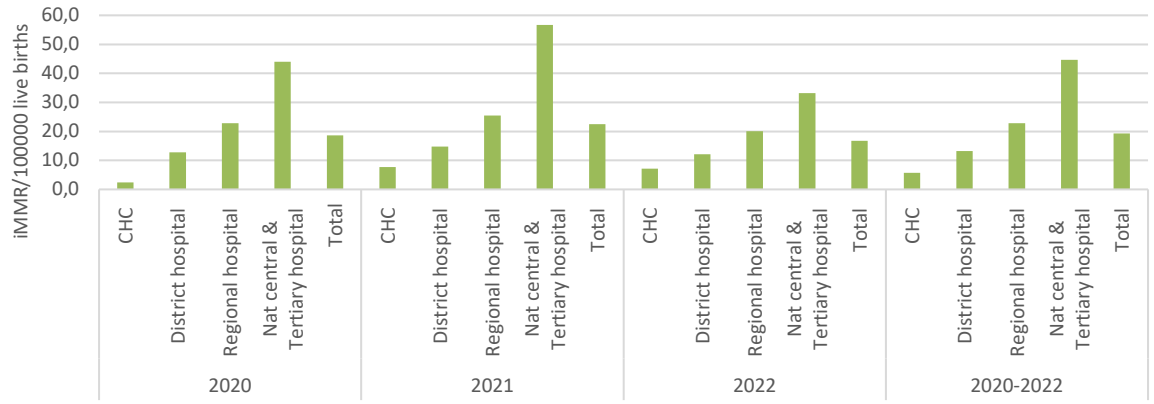


Health system issues: Antenatal care, Level of care that woman died and obstetric referrals

Antenatal care was received by 87.7% of women who died from OH. The majority of OH deaths (88%) occurred at public hospitals; 27.9% at district hospitals (DH), 31.1% at regional hospitals (RH) and 29% at tertiary hospitals (TH/NC). There were 21 deaths at CHCs, 36 in private hospitals, 15 outside a health facility and 13 in

transit to or between facilities. The corresponding triennial iMMR for level of care was 5.7 maternal deaths per 100,00 LBs in CHCs, 13.2 in DHs, 22.8 in RHs and 44.7 in TH/NCs (Figure 10). These level of care statistics refer to where the women died, not where they delivered, and it must be noted that many women were referred from district level due to bleeding *after* vaginal delivery or CD.

Figure 10. iMMR for Obstetric haemorrhage per level of care from 2020-2022



There were 56.1% of the OH deaths who had been referred, mostly from CHCs (16.3%) and district hospitals (23%) demonstrating the importance of availability of emergency transport and optimising care before and during referral.

Table 4 shows the different causal subcategories of OH deaths per level of care. PPH after vaginal delivery was the most frequent cause of death outside a facility (80% of 15 deaths), at CHCs (57.1% of 21 deaths), and at district hospitals (38.3% of 186 deaths). BLDACD was the most frequent cause of death at regional hospitals (35.5% of 186 deaths), tertiary/national central hospitals (35.1% of 174 deaths), and private hospitals (69.4% of 36 deaths).

Table 4. Subcategory of OH cause per level of care

OH causal subcategory	Outside	CHC	District hospital	Regional hospital	Tertiary/ NC hospital	Private Hospital	Total
Antepartum haemorrhage	0	8	32	46	40	1	127
Ruptured uterus	3	1	25	32	25	4	90
PPH after vaginal delivery	12	12	64	42	48	6	184
Bleeding at/after Caesarean delivery	0	0	46	66	61	25	198
Total	**15**	**21**	**167**	**186**	**174**	**36**	**599**

Preventability of maternal deaths due to obstetric haemorrhage

Assessors judged the majority (85.5%) of the OH deaths to be possibly or probably avoidable by the health system, slightly less than 89.5% in the previous triennium; and 52.4% were thought to be probably avoidable. Patient related avoidable factors, mostly delay in seeking care, were present for 35.4% of women who died. Administrative avoidable factors occurred for 69.8%, highlighting major problems in human resources, health facility management and training. This included lack of blood (8.5%), delays in inter-institution transport (11.4%), delays initiating clinical care due to overburdened services (12.2%), lack of staff (13.4%) and lack of staff with appropriate skill (18.5%). Health worker/medical related avoidable factors occurred for 41% of assessable deaths at CHC level, 83.2% at DH, 74.4% at RH, 61% at TH/NC and 80% at private hospitals. At CHC and DH, problems were identified with initial assessment and problem recognition. For example, many women were discharged from labour ward to postnatal ward with abnormal vital signs and unrecognised PPH. At all three levels of hospital, substandard care was the most frequent problem. Emergency hysterectomy was performed in 27.4% of all OH deaths (19.4% of deaths from bleeding associated with CD and 10.2% of women dying from

PPH after vaginal delivery).

B. Key findings of substandard care identified by folder review

The following overarching themes emerged from folder review and will be presented as general problems, and those specific to different causal subcategories of OH.

General

1. *Late detection of PPH after vaginal delivery and at / after CD.* For PPH after vaginal delivery: the diagnosis was frequently made too late in labour ward only after changes in vital signs had occurred when the women had already lost more than 1000mls blood; or the diagnosis was made in the postnatal ward with the patient having been discharged from labour ward with abnormal vital signs.
   At Caesarean delivery: excessive bleeding was frequently not noticed because the surgery was done too quickly and the abdomen closed without careful checking; or abnormal vital signs in the recovery area were not acted upon; or the patients were sent too early to the postnatal ward because of insufficient midwives to staff the recovery area.
2. *Poor prevention, detection and management of anaemia*. Routine surveillance of haemoglobin was frequently not done at each antenatal visit or in labour; and the only antenatal treatment given was oral iron with minimal use of parenteral iron.
3. *Problems with inter-institution referrals.* This was most frequently observed from district hospitals, and was due to long distances, lack of ambulances and non-availability of paramedics to accompany bleeding patients who required ongoing resuscitation.

PPH after vaginal delivery

Late detection of PPH (see above) was a common problem. Improvement was noticed compared to previous reports in the first medical response to PPH. However, there was an inadequate approach to refractory or ongoing PPH with poor recognition of causes other than uterine atony. This occurred particularly at DHs where inadequate blood, inadequate support, lack of skills in surgery and anaesthesia limited the response to further treatment measures for refractory PPH.

Although inverted uterus is a very rare cause of PPH and only accounted for three maternal deaths, it was poorly managed in all three, with non-recognition of the diagnosis and no approach to treatment.

Bleeding at/after CD

The majority (119 of 173 deaths) were only recognised after the CD, although it is probable that the problem must have occurred during the CD and was not detected. Reluctance to re-operate at DHs with evidence of postoperative bleeding (due to inadequate blood, inadequate support, lack of skills in surgery and anaesthesia) was observed with patients being transferred out to a higher level of care and dying during the referral process. There was also poor prediction and recognition of cases of morbidly adherent placentae.

Abruptio Placentae

Many of these deaths had been inadequately resuscitated. Inappropriate use of CD was observed in cases where the fetus was thought to be still alive, but the CTG was actually detecting a maternal tachycardia rather than fetal heart. Also, CD was sometimes done too soon when amniotomy and resuscitation would have allowed more time to achieve vaginal delivery.

Placenta praevia

Most of the deaths due to placenta praevia had had the condition diagnosed antenatally by ultrasound. However, inadequate precautions were made prior to CD in terms of ensuring availability of blood and a skilled surgeon and anesthetist. A few cases of morbidly adherent placenta were not predicted (and thus not prepared for) despite the patients having anterior placenta praevia and several repeat CDs.

Ruptured uterus

These deaths occurred equally in women with scarred and unscarred uteri. With scarred uteri, the diagnosis was made appropriately but if it was at a DH, medical staff were unskilled to manage it even though uterine tourniquet, NASG and referral were treatment options within the scope of medical officers. There was frequently delay in diagnosis of uterine rupture in women with unscarred uteri which meant that laparotomy was delayed, or the rupture was a postmortem diagnosis. Also, in several of these deaths, excessive doses of misoprostol were used for IOL.

Sub-analyses of the MaMMAS data showed that induction of labour was performed in 2 (5.4%) of the 43 MDs with scarred uteri, and 16 (34%) of the 47 MDs with unscarred uteri. This confirms the risks associated with IOL.

The above themes are illustrated in the following case summaries/vignettes.

Maternal death from PPH after vaginal delivery (VBAC)

34 years, para 2, previous CD x1. Booked, HIV positive with suppressed viral load, No anaemia.
Vaginal Birth After Caesarean Delivery (VBAC) at district hospital (DH). Normal labour progress with vaginal delivery of live baby and placenta.
Blood loss 1000mls detected at 30 mins. Diagnosis: Uterine atony vs Cervical tears?
Treated with 20 units oxytocin infusion, Syntometrine im, Tranexamic acid iv, iv fluids, Voluven, three units blood, two units fresh dried plasma (FDP).
Considered taking patient to Operating Theatre (OT) for exploration and possible laparotomy, but second doctor unconfident to perform General Anaesthetic.
Decided to refer to Regional hospital (four hours drive away), patient accepted. Ambulance collected her after 90 minutes.
Died in ambulance on route and returned to DH.
Postmortem excluded uterine rupture, trauma or retained products, but showed uterine atony with uterus full of blood.

Assessment

Primary Obstetric Cause: PPH after vaginal delivery/ uterine atony.
Final cause: hypovolaemic shock. *Contributory*: Coagulopathy (DIC)
Avoidable factors: Patient: Nil. Administrative: Ambulance delay; Lack of appropriate skill on site at DH. No NASGs.
Medical care: Poor problem recognition/late detection PPH; Substandard care, Patient should have been taken to OT at DH, Patient needed NASG for transfer.
Suggestions for prevention. E MOTIVE approach for early detection PPH and early escalation of care for refractory PPH. Doctors at DHs must have skills for postpartum laparotomy and general anaesthesia, and be supported by regional hospital. NASG to be available at DHs. Should VBACs be performed at DHs?

Bleeding at/after emergency CD following IOL at district hospital

28 years, P2G4. Booked. HIV pos with LDL.
Induction of labour for prolonged pregnancy. Misoprostol 200mcgms po two hourly.
Emergency CD for fetal distress. Difficult delivery of baby, Fresh still birth.
Excessive bleeding from tears in right broad ligament and lower segment. Applied B Lynch compression suture, sutured tears and ligated right uterine artery.
Shortage of blood. Planned to transfer to RH, but RH declined, advised observation. Accepted on second phone call.
Patient died four hours post operatively awaiting ambulance.

Assessment

Primary Obstetric Cause: Bleeding associated with caesarean delivery/trauma.
Final cause: hypovolaemic shock. *Contributory* : Coagulopathy (DIC).
Avoidable factors: Patient: Nil. Administrative: Shortage blood products, No NASG.
Medical Care: Excessive doses misoprostol for IOL leading to precipitate labour, trauma and still birth.
RH should have advised relaparotomy with tourniquet prior to referral and been more supportive.
Suggestions for prevention. Correct dosage regimens for IOL. Blood product availability. Skills development for DH doctors with support from RHs.

Placenta praevia/ Morbidly adherent placenta

34 years, P2 G4. Booked at regional hospital. HIV pos. LDL. Previous two CD.
Ultrasound (early) showed major placenta praevia plus possible percreta.
Managed as outpatient till 38 weeks.
Booked for CD plus TL. No preparation (not counselled TAH, no ICU, no specialist involved).
CD by medical officer. Placenta praevia percreta. Called more senior medical Officer. Attempted placental removal. Massive bleeding. Delay calling specialist.
Specialist performed hysterectomy, bladder injury.
Patient severely shocked. No ICU in this regional hospital so referred to another RH. No NASG.
Died soon after arrival at second RH.

Assessment

Primary Obstetric Cause: Morbidly adherent placenta praevia.
Final cause: Hypovolaemic shock. *Contributory*: Coagulopathy (DIC)
Avoidable factors: Patient: Nil. Administrative: Lack critical care capacity at RH
Medical Care: Substandard management of major placenta praevia and suspected percreta antenatally
Substandard preparation for very high risk CD
No specialist at the CD
Incorrect for MO to attempt placenta removal
No re-laparotomy /packing prior to referral. No NASG
Suggestions for prevention. Surgery for Major placenta praevia and suspected morbidly adherent placenta should be performed at tertiary or regional level with available skilled specialists, blood products and appropriate pre-operative preparations should be made with mulitdisciplinary team, and patient Consent for hysterectomy.

Discussion

Not only are obstetric haemorrhage deaths the second most common cause of maternal death in South Africa, but they account for the most preventable deaths; 85.5% could have been prevented by health system and medical care improvements. They are therefore the 'low hanging fruit' that must be urgently addressed in order for SA to reduce its MMR and achieve the SDG of 70 MDs per 100,000 LBs by 2030. Over the years Saving Mothers reports have described the same problems in the management of OH. It is urgent they are addressed to halt this unnecessary and tragic loss of women's lives.

Many interventions were developed following the 2014-2016 triennial report which contributed to the decline of OH mortality in 2017-2019: the focus on Safe CD, updated ESMOE OH protocols and introduction of emergency drills, together with improved health of HIV positive women due to expanded ARV provision. Other interventions introduced in 2019 (Non pneumatic Anti Shock Garment for referrals, Massive Haemorrhage Transfusion Protocols and use of tranexamic acid for PPH) would have been expected to have reduced OH MMR further in this triennium, but the potential impact was counteracted by the impact of the COVID-19 pandemic in 2020 and 2021, previously mentioned in this chapter. At an international level, three important contributions have been made to PPH management: (a) International PPH roadmap developed in 2023 by a WHO led consultative process has highlighted the importance and urgency of reducing preventable maternal deaths from OH (7); (b) Recent research has shown that Anaemia is not only a risk factor for death from PPH, but actually is a cause for PPH (8), and (c) The E Motive trial, conducted in four African countries including SA has shown how improving accurate early detection of OH with a calibrated drape and using a bundle of interventions concurrently as first response for PPH treatment can reduce severe bleeding and adverse outcomes by 60% (9). These are all important in defining new Recommendations.

Conclusion

- Deaths from OH and iMMR increased in 2020-2022 to become the second most common cause of MD.
- The increase occurred in 2020 and 2021, probably due to the collateral effects of the COVID-19 pandemic, but in 2022 numbers were lower than pre-pandemic.
- PPH after vaginal delivery and after CD are the main causal subcategories followed by antepartum. haemorrhage and ruptured uterus.
- Wide inequities between provinces remain.
- 85.5% of OH MDs were preventable within the health system.

- The problems identified in this report that contribute to these OH maternal deaths must be urgently addressed.

Key recommendations

- Protect maternity services in future pandemics.
- Implement E Motive nationally at all levels of care.
- Focus on preventing and treating anaemia in pregnancy as well as in childhood and adolescence: addressing heavy menstrual bleeding in women, screening and treatment of chronic infections, and adequate nutrition. This requires advocacy.
- No woman should be discharged from labour ward or theatre to the postnatal area if Systolic BP is <100, and/or Pulse is ≥ 110, and/or there is ongoing bleeding.
- Resume implementation of ESMOE/EOST training, use of NASG, and the Safe CD audit.
- Implement the updated PPH algorithms in the updated Integrated SA Maternal and Perinatal care guidelines (10), which incorporate E Motive and Massive Obstetric Haemorrhage Transfusion Protocols.
- Direct Telephonic / IT links for 24-hour specialist support to district hospital doctors.
- Inequities in outcomes between provinces require attention to staffing levels and clinical governance.
- Develop training packages for community health workers and ward-based outreach teams to sensitise communities to problem of PPH.
- Work with Ambulance services to ensure appropriate prioritisation of bleeding patients, training of ambulance personnel in OH, and availability of urgent paramedic assisted ambulances.

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7.5 Early Pregnancy deaths
Dr N Moran

Abstract

Summary of Findings

There were 269 early pregnancy deaths in 2020-2023, a 17% decrease compared to 2017-2019. The problem of under-reporting of maternal deaths by some provinces is described in the main article. One hundred and three (103) were caused by ectopic pregnancy (13% decrease), and 166 by complications of miscarriage (19% decrease). This reverses the increasing trend that was noted with concern in the 2017-19 report. Forty-five percent (45%) of ectopic pregnancy deaths and 28% of miscarriage deaths were clearly avoidable within the health system during the 2020-22 triennium. The equivalent figures for the 2017-19 triennium were 57% for ectopic deaths and 34% for miscarriage deaths, suggesting some improvement in the quality of care for these

early pregnancy complications. This suggests that the recommendations made in the last Saving Mothers report (2017-19) for reducing early pregnancy deaths have been implemented at least to some extent. Nonetheless at least 93 women died unnecessarily due to the poor quality of care rendered to women with complications of early pregnancy across all levels of care. The recommendations in the current report therefore remain similar to those in previous Saving Mothers reports. Ongoing efforts are required to implement these recommendations.

Ectopic pregnancy

Deaths from ectopic pregnancy occurred with similar frequency at district hospitals (32%), tertiary/central (29%) and regional (27%) hospitals. Twelve cases (12%) were classified as extrauterine pregnancy beyond 20 weeks' gestation. Although only 61% of women who died from ectopic pregnancy had known HIV status, of those who were tested, 68% were HIV infected. The final cause of death was hypovolaemic shock in 66%. The most frequent patient behaviour-related avoidable factors were delay in accessing medical help and lack of antenatal care. The most frequent administrative avoidable factors were unavailability of appropriate skill on-site and delay in attending to the patient due to an overburdened service. Regarding management by healthcare providers, there were avoidable factors in 86% of cases at district hospital, 65% of cases at regional hospital level and at primary healthcare level, and 59% of cases at tertiary level. The most frequent healthcare provider-related avoidable factors were inadequate initial assessment and failure to make the diagnosis, and therefore incorrect management; substandard care despite making the right diagnosis; and substandard resuscitation of hypovolaemic shock. In 23% of cases, there was no resuscitation attempted. Anaesthesia was only administered in 38% of cases, clearly indicating missed opportunities for surgical intervention.

Miscarriage

Deaths from miscarriage occurred most frequently at tertiary/central hospitals (43%) followed by regional (28%), and district (21%) hospitals. Of the subcategories of miscarriage, 64% were classified as septic miscarriage, 19% as deaths from haemorrhage (non-traumatic), 4% as deaths from uterine trauma, and 7% were classified as gestational trophoblastic disease. Nine cases (5%) followed a legal termination of pregnancy, which raises some concern about the standards of safety at some legal TOP sites. HIV status was only obtained from 60% of women who died from miscarriage. Of those who were tested, 55% were HIV infected. The final cause of death was septic shock in 56% and hypovolaemic shock in 31%. 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 16% of miscarriage deaths where avoidable factors were assessable, a reduction from the 25% in 2017-2019. The most frequent administrative avoidable factors were unavailability of appropriate skill on-site, delay in attending to the patient due to an overburdened service and lack of access to an intensive care unit. Regarding management by healthcare providers, there were avoidable factors in 74% of cases at district hospital level, 65% of cases at regional hospital and 58% of cases at tertiary/central level. The most frequent healthcare provider-related avoidable factors were inadequate initial assessment and failure to make the diagnosis, substandard care despite making the right diagnosis, and substandard resuscitation of circulatory shock, whether due to sepsis or hypovolaemia. In 16% of cases, there was no resuscitation attempted. At district hospital level specifically, delay in referral or failure to refer was an additional prominent avoidable factor. Anaesthesia was only administered in 55% of cases, suggesting missed opportunities for surgical intervention.

Key recommendations

1. Family planning and contraception services (including emergency contraception) must be promoted in all communities and must be made more accessible to those who would benefit from them, including teenagers. Contraception services must be integrated into healthcare services for HIV and other chronic diseases
2. Fighting the HIV/AIDS epidemic must remain a priority, with multiple strategies including integration of HIV/AIDS screening and care, as well as care for ART treatment failure, into maternal and women's care services
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 patient

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 health facilities must either provide termination of pregnancy (TOP) services or have a clear referral facility for TOP services, based on an agreed district referral pattern, to ensure that all women have access to free and 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.

Introduction

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

Data is presented on maternal deaths in early pregnancy from the MaMMAS database 2020-2022, and from a secondary review of patient folders by the chapter author.

Numbers of deaths and Provincial distribution

Of note, comparison of the DHIS data and the data on maternal deaths (including cause of death) entered into the MaMMAS programme during this triennium has suggested that in some Provinces there was a modest under-reporting of maternal deaths into the MaMMAS programme. This has been corrected for in terms of the total numbers of maternal deaths and the overall MMRs reported in this 2020-22 Saving mothers report. However, no correction has been made for the unreported causes of death. This means that the numbers of deaths listed in this report per cause will be a modest underestimate. The extent of the correction suggests that approximately 4% of data on causes of death is missing. This should be taken into account when interpreting trends in numbers and rates per causes of death when compared to the previous triennium. Any decreasing trend is likely to be slightly exaggerated, and any increasing trend is likely to be a slight underestimate.

There were 269 early pregnancy deaths in 2020-2022, a 17% decrease from the 323 reported in 2017-2019. This decrease is due to a 13% decrease in ectopic pregnancy deaths (103 compared to 119 in 2017-19) and a 19% decrease in miscarriage deaths (166 compared to 204 in 2017-19). The true extent of this decrease must be a little less than these figures for the reasons explained in the note above. Nonetheless it is clear that the numbers of early pregnancy deaths have declined, reversing the increasing trend that was noted with concern in the 2017-19 report.

The institutional maternal mortality ratios (iMMR) per province and nationally are shown in Table 1a for deaths from ectopic pregnancy, and in Table 1b for deaths from miscarriage. The iMMR in 2020-22 is compared to that in 2017-19. The iMMR is calculated using the District Health Information System (DHIS) data for the provinces to provide the number of live births in the institutions (the denominator), while the numerator is the number of maternal deaths from the specific cause as reported through this confidential enquiry (NCCEMD). The cause-specific iMMR is expressed as number maternal deaths from that cause per 100,000 live births.

Table 1a. Institutional maternal mortality ratio (iMMR) for ectopic pregnancy deaths per province

	iMMR 2017-19	iMMR 2020-22
Eastern Cape	1.6	2.5

	iMMR 2017-19	iMMR 2020-22
Free State	4.3	6.2
Gauteng	4.4	3.8
KwaZulu-Natal	3.7	3.1
Limpopo	5.9	4.5
Mpumalanga	6.3	2.6
North West	6.3	3.3
Northern Cape	4.7	6.0
Western Cape	2.0	1.7
Total	**4.2**	**3.4**

Table 1b. Institutional maternal mortality ratio (iMMR) for miscarriage deaths per province

	iMMR 2017-19	iMMR 2020-22
Eastern Cape	3.9	5.9
Free State	15.0	2.8
Gauteng	7.8	7.1
KwaZulu-Natal	6.8	4.8
Limpopo	6.7	5.2
Mpumalanga	13.1	7.0
North West	9.2	9.3
Northern Cape	7.8	4.5
Western Cape	1.0	1.0
Total	**7.2**	**5.5**

Overall, the iMMR for deaths from ectopic pregnancy was 3.4 per 100,000 live births. The iMMR for ectopic pregnancy deaths decreased compared to 2017-2019 in all provinces except Eastern Cape, Free State and Northern Cape, where there was an increase. Free State had the highest iMMR for ectopic pregnancy deaths. Northern Cape was the only province where ectopic pregnancy was amongst the top five causes of maternal death (equal 5th).

The national iMMR for deaths from miscarriage was 5.5 per 100,000 live births. The iMMR for miscarriage deaths either remained similar or decreased compared to 2017-2019 in all provinces except Eastern Cape, where there was a notable increase. North West province had the highest iMMR for miscarriage deaths. Out of all causes of deaths, miscarriage was one of the top five causes (5th or equal 5th) in three Provinces: Gauteng, KwaZulu-Natal and North West.

Age and parity

Ectopic pregnancy

The relationship between deaths from ectopic pregnancy and maternal age is shown in Table 2a. The proportion of deaths in each age category is compared to the proportion of all pregnant women in South Africa who fall within that same age category. What this demonstrates is that a pregnancy at age 25-35 carries an increased risk for death from ectopic pregnancy, and that pregnant women under 25 are at a lower risk.

Table 2a. Relationship of ectopic pregnancy deaths to maternal age 2020-22

Age category (years)	N	%	General pregnant population* %
10 – 14	0	0	0.3
15 - 19	2	1.9	11.2
20 - 24	7	6.8	23.2
25 - 29	36	35.0	25.5
30 - 34	34	33.0	21.8
35 - 39	18	17.5	13.5
40 - 44	5	4.9	3.7
Other/Unknown	1	1.0	0.8
Total N	**103**	**100**	**100**

*Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021, November 2023 P0305

The relationship between deaths from ectopic pregnancy and parity is shown in Table 2b. Deaths from ectopic pregnancy were most common in nulliparous women, and rarely occurred in women with a parity of more than three.

Table 2b. Relationship of ectopic pregnancy deaths and parity 2020-22

Parity	n	%
P0	32	31.1
P1	24	23.3
P2	18	17.5
P3	17	16.5
P4	4	3.9
P5	0	0.0
P6+	0	0.0
Unknown	8	7.8
Total	**103**	

Miscarriage

The relationship between miscarriage deaths and maternal age is shown in Table 3a.

Table 3a. Relationship of miscarriage deaths to maternal age 2020-22

Age category (years)	N	%	General pregnant population* %
10 - 14	0	0	0.3
15 - 19	15	9.0	11.2
20 - 24	31	18.7	23.2

Age category (years)	N	%	General pregnant population* %
25 - 29	38	22.9	25.5
30 - 34	44	26.5	21.8
35 - 39	29	17.5	13.5
40 - 44	9	5.4	3.7
Other/Unknown	0	0	0.8
Total N	**166**	**100.0**	**100.0**

*Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021, November 2023 P0305

The deaths are spread over a wide range of ages, with no obvious association between a specific age group and a higher risk of miscarriage death.
The relationship between deaths from miscarriage and parity is shown in Table 3b.

Table 3b. Relationship of miscarriage deaths and parity 2020-22

Parity	n	%
P0	37	22.3
P1	46	27.7
P2	41	24.7
P3	18	10.8
P4	10	6.0
P5	4	2.4
P6+	0	0
Unknown	10	6.0
Total	**166**	

Sub-Categories of deaths from ectopic pregnancy and miscarriage

Tables 4a and 4b show the distribution of deaths according to the sub-categories of ectopic pregnancy and miscarriage respectively. These sub-categories classify the deaths under a more specific disease entity or primary cause of death.

The majority of deaths due to miscarriage were classified as septic miscarriage (64.5%). The second most common sub-category was miscarriage death due to haemorrhage (non-traumatic) (19.3%). The predominance of the sub-category “septic miscarriage” is somewhat misleading, as a review of the case files suggests that many of these cases were not typical “septic miscarriages”. The term septic miscarriage should refer to a miscarriage where there is an infective focus in the uterus, which is causing signs of systemic sepsis. It is often associated with unsafe or illegal termination of pregnancy, performed in an unsterile way. A proportion of the “septic miscarriages” in this report were in fact miscarriages which occurred in women who were already critically ill with unrelated underlying conditions, such as pneumonia (including COVID-19), viral hepatitis, cardiac failure, malignancy, and even following ingestion of tablets in order to commit suicide. In such cases it did not appear that the miscarriage itself contributed to the death. In some of these cases it would have been more appropriate to classify the death as a death due to non-pregnancy-related infection, or medical and surgical conditions. Thus, the number of deaths resulting from unsafe, or illegal termination of pregnancy cannot be simply equated to the number of deaths classified as “septic miscarriage”. These findings demonstrate that more guidance and orientation needs to be provided for confidential enquiry assessors.

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

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

Nine cases were classified as miscarriage deaths which followed legal TOP, which raises some concern about the standards of safety at some legal TOP sites.

There were twelve cases of death assessed as being due to gestational trophoblastic disease (GTD). Maternal deaths due to GTD are deaths related to molar pregnancies and their immediate complications. The main message that emerges from these cases is that they present a high risk of catastrophic bleeding, particularly when taken to theatre for evacuation of the uterus. All cases should be referred for management to a specialist centre.

Table 4a. Distribution of sub-categories of ectopic pregnancy deaths 2020-22

Ectopic	n	%
- Less than 20 weeks	91	88.3
- More than 20 weeks	12	11.7

There were twelve deaths assessed as being due to ectopic pregnancy at more than 20 weeks’ gestation (advanced extra-uterine pregnancy), three more than in 2017-19. This means that the 17% decrease in ectopic pregnancy deaths in 2020-22, compared to 2017-19, is entirely due to a decrease in ectopic pregnancy below 20 weeks. There were several cases of death related to advanced extra-uterine pregnancy where the diagnosis was never considered until a caesarean section was attempted. The deaths mainly related to difficulties at surgery, including excessive bleeding and anaesthetic complications. While there are clinical lessons to be learnt here about diagnosing advanced extra-uterine pregnancies, and the value of management at a specialist level of care, the rarity of the condition means that it is not a major contributor to maternal deaths in South Africa and the condition will not be further discussed in this chapter.

Table 4b. Distribution of sub-categories of miscarriage deaths 2020-22

Miscarriage	n	%
- Septic miscarriage	107	64.5
- Haemorrhage (non-traumatic)	32	19.3
- Uterine trauma	6	3.6
- GTD	12	7.2
- Following legal TOP	9	5.4

Levels of care where deaths occurred

Table 5a shows what proportion of women who died from ectopic pregnancy died at each level of care. Deaths from ectopic pregnancy occurred with similar frequency at district hospitals (32%), tertiary/central (29%) and regional (27%) hospitals.

Table 5b shows what proportion of women who died from miscarriage died at each level of care. Deaths from miscarriage occurred most frequently at tertiary/central hospitals (43%) followed by regional (28%), and district

(21%) hospitals.

Table 5a. Distribution of ectopic deaths across levels of care 2020-22

	Home %	CHC (%)	District hospital (%)	Regional hospital (%)	Tertiary hospital (%)	Private hospital (%)	Total
Ectopic pregnancy	4 (3.9)	7 (6.8)	33 (32.0)	28 (27.2)	30 (29.1)	1 (1.0)	103
- Less than 20 weeks	3	7	32	23	25	1	91
- More than 20 weeks	1	0	1	5	5	0	12

Table 5b. Distribution of miscarriage deaths across levels of care 2020-22

	Home (%)	CHC (%)	District hospital (%)	Regional hospital (%)	Tertiary hospital (%)	Private hospital (%)	Total
Miscarriage	2 (1.2)	7 (4.2)	35 (21.1)	47 (28.3)	72 (43.4)	3 (1.8)	166
- Septic miscarriage	1	2	24	30	50	0	107
- Haemorrhage (non-traumatic)	1	4	9	8	8	2	32
- Uterine trauma	0	0	0	2	3	1	6
- GTD	0	0	1	3	8	0	12
- Following legal TOP	0	1	1	4	3	0	9

HIV status of deaths

Tables 6a and 6b show the HIV status and ART use of women who died from ectopic pregnancy and from miscarriage, in terms of numbers and percentages respectively. The HIV status at the time of death was unknown in 38.8% of ectopic cases and in 40.4% of miscarriage cases. This does not necessarily imply suboptimal care by the health workers involved, in not testing for HIV, nor does it reflect refusal by patients to test for HIV (none of these women declined HIV testing). Most women who died from these causes presented early during pregnancy and were not booked for antenatal care. Therefore, for those whose HIV status was not already known, there may not have been an opportunity for the health workers to offer an HIV test, particularly as many of these women presented in a critical condition and died within a short time of presenting to the health facility. If only those cases where an HIV test result was available are considered, the HIV test was positive in 43 out of 63 cases (68.3%) of maternal death from ectopic pregnancy, and in 54 out of 99 cases (54.5%) of maternal death from miscarriage. Given that the underlying antenatal HIV prevalence in South Africa during the period of this report was about 27.5%[1], this does suggest a strong association between HIV infection and maternal deaths from both ectopic pregnancy and miscarriage. While the link between HIV–infection and miscarriage-related deaths seems logical, as immunocompromise due to HIV infection would make the woman more susceptible to septic complications of miscarriage, the reason for a link between HIV and ectopic pregnancy deaths is not obvious.

Table 6a. Distribution of ectopic pregnancy and miscarriage deaths with respect to HIV status (numbers) 2020-22

	Negative	Positive	Positive, not on ART	Positive on ART	Declined testing	Unknown	Total
Ectopic pregnancy	20	43	8	35	0	40	103
Miscarriage	45	54	13	41	0	67	166

Table 6b. Distribution of ectopic pregnancy and miscarriage deaths with respect to HIV status (percent of all deaths due to that cause) 2020-22

	Negative	Positive	Positive, not on ART	Positive on ART	Declined testing	Unknown
Ectopic pregnancy	19.4	41.7	7.8	34.0	0	38.8
Miscarriage	27.1	32.5	7.8	24.7	0	40.4

Final cause of death and other complications

Tables 7a and 7b list the final cause of death and the other complications in cases of maternal death due to ectopic pregnancy and miscarriage respectively. For each death a single final cause of death is supposed to be assigned by the assessor, which describes the critical organ failure which most directly led to the patient's death. However, there were a few cases where the assessor selected more than one final cause of death. In addition, if the death was associated with other organ system failures these were documented as other complications (can be more than one per death).

For both ectopic pregnancy deaths and miscarriage deaths, the great majority of patients died due to circulatory shock. Whereas the shock was predominantly hypovolaemic shock in cases of ectopic pregnancy, there were 17 cases where the final cause of death was assessed to be septic shock, which in some cases was due to later complications of the ectopic pregnancy surgery. Both hypovolaemic shock and septic shock were common in cases of miscarriage death, and it was often difficult to assess which of the two types of shock was the predominant problem.

Table 7a. Distribution of final cause of death and other complications in ectopic pregnancy deaths 2020-22

	Final Cause		Other complications	
	n	% of deaths	n	% of deaths
Hypovolaemic shock	68	66.0	5	4.9
Septic shock	17	16.5	2	1.9
Respiratory failure	5	4.9	9	8.7
Pulmonary oedema	3	2.9	6	5.8
Acute collapse due to embolism	1	1.0	2	1.9
Renal failure	0	0	5	4.9
Intracranial haemorrhage	0	0	1	1.0
Unspecified cerebral event	1	1.0	1	1.0
Maternal ketoacidosis	0	0	1	1.0
Electrolyte imbalance	1	1.0	2	1.9
Thyroid crisis	0	0	1	1.0
Lactic acidosis	1	1.0	3	2.9
Other metabolic complication	0	0	1	1.0
DIC	2	1.9	15	14.6
Severe anaemia	2	1.9	18	17.5
Immune system failure	3	2.9	5	4.9
Unknown	5	4.9	0	0
Other	0	0	4	3.9
Total deaths	**103**		**103**	

Table 7b. Distribution of final cause of death and other complications in miscarriage deaths

	Final cause		Other Causes	
	n	% of deaths	n	% of deaths
Hypovolaemic shock	51	30.7	4	2.4
Septic shock	93	56.0	11	6.6
Respiratory failure	10	6.0	24	14.5
Pulmonary oedema	4	2.4	11	6.6
Acute collapse due to embolism	3	1.8	4	2.4
Renal failure	6	3.6	31	18.7
Liver failure	2	1.2	10	6.0
Intracranial haemorrhage	1	0.6	1	0.6
Cerebral oedema resulting in coning	0	0	1	0.6
Cerebral emboli	0	0	1	0.6
Brain death following hypoxic event	1	0.6	2	1.2
Unspecified CNS complication	0	0	1	0.6
Maternal ketoacidosis	3	1.8	8	4.8
Electrolyte imbalance	1	0.6	11	6.6
Thyroid crisis	1	0.6	0	0
Lactic acidosis	2	1.2	14	8.4
Other metabolic	0	0	1	0.6
DIC	6	3.6	39	23.5
Severe anaemia	1	0.6	36	21.7
Immune system failure	3	1.8	5	3.0
Unknown	0	0	1	0.6
Other	7	4.2	5	3.0
Total deaths	**166**		**166**	

Surgical interventions

Tables 8a and 8b present the number of cases where anesthesia was administered for surgical intervention for the ectopic death cases and the miscarriage death cases respectively.

Table 8a. Number and percentage of cases where anaesthesia was administered per subcategory of ectopic pregnancy death cases 2020-22

	No Anaesthesia	Anaesthesia	% Anaesthesia of total	Total
Ectopic pregnancy	**64**	**39**	**37.9**	**103**
- Less than 20 weeks	59	32	35.2	**91**
- More than 20 weeks (extrauterine pregnancy)	5	7	58.3	**12**

In cases of ruptured ectopic pregnancy, the patient is likely to bleed to death without surgical intervention.

Depending on the rate of the bleeding, death may ensue within a matter of hours. Furthermore, fluid resuscitation may not be effective as long as the bleeding is not controlled. Thus, once the diagnosis of a ruptured ectopic is made, there is an urgent need for surgical intervention, and district hospitals should be able to provide this life-saving surgery, as delaying surgery in order to transport the patient to a higher level facility may result in preventable death. Thus, it is very disappointing that anaesthesia was only administered in 38% of the women who died from ectopic pregnancy, clearly indicating missed opportunities for surgical intervention

Table 8b. Number and percentage of cases where anaesthesia was administered per subcategory of miscarriage death cases 2020-22

	No Anaesthesia	Anaesthesia	% Anaesthesia of total	Total
Miscarriage	**74**	**92**	**55.4**	**166**
- Septic miscarriage	46	61	57.0	107
- Haemorrhage (non-traumatic)	15	17	53.1	32
- Uterine trauma	1	5	83.3	6
- GTD	6	6	50.0	12
- Following legal TOP	6	3	33.3	9

Surgery can be a life-saving intervention in some cases of miscarriage, particularly cases of septic miscarriage causing septic shock, where hysterectomy is likely to be necessary to prevent death. In cases of hypovolaemic shock due to heavy bleeding from a miscarriage, surgery, sometimes just a simple uterine evacuation procedure, may also be life-saving. Thus, it is disappointing that anaesthesia was only administered in 55% of cases of death due to miscarriage, suggesting missed opportunities for surgical intervention.

Table 9 documents how many hysterectomies were done according to the various sub-categories of death due to miscarriage. The fact that only 30% of women assessed to have died from septic miscarriage had a hysterectomy suggests that in some cases an opportunity was missed to save the patient's life by doing a hysterectomy. However, it is difficult to quantify this problem as it is likely that in some cases of "septic shock" the source of the sepsis was not of uterine origin, while in others the patient died before any initial resuscitation was attempted and the shock could potentially have been reversed simply through adequate resuscitation without the need for hysterectomy (see above section on sub-categories of death).

A hysterectomy for septic uterus is a procedure that should be done at a specialist level of hospital, where gynaecology and anaesthetic specialists and ICU facilities are available. The fact that only a minority of women who died from septic miscarriage had a hysterectomy suggests that the severity of the presenting condition was often not recognised and there was therefore delay in transferring the patient to a specialist level of care. This is borne out by an analysis of the avoidable factors identified (see table 13b below).

Table 9. Number of hysterectomies performed per sub-category of miscarriage death 2020-22

	No Hysterectomy n	Hysterectomy Done n (% of sub category)	Total
Miscarriage	**116**	**50 (30.1)**	**166**
- Septic miscarriage	69	38 (35.5)	107
- Haemorrhage (non-traumatic)	25	7 (21.9)	32
- Uterine trauma	5	1 (16.7)	6
- GTD	11	1 (8.3)	12
- Following legal TOP	6	3 (33.3)	9

Avoidable factors

Each maternal death is assessed to see whether there were avoidable factors or missed opportunities which contributed to the death, and whether substandard care was rendered by the health system. The avoidable factors are classified separately according to whether they are patient behaviour-related, administrative or health worker-related. Regarding the health-worker related avoidable factors, they are sub-classified according to the level of institution at which the avoidable factor took place. Problems with resuscitation during the acute emergency which directly led to the death are assessed separately. If inadequate information is available from the case notes to make an assessment about avoidable factors / substandard care, then it is documented that there is lack of information. The remainder of the cases (either assessed as having no avoidable factors, or alternatively if one or more avoidable factors have been identified) are referred to as assessable cases. Tables 10a and 10b present the numbers of assessable cases in each category of avoidable factor for ectopic pregnancy and miscarriage deaths respectively. In addition, the number and percentage of assessable cases with one or more avoidable factors is presented for each category of avoidable factor.

Table 10a. Distribution of avoidable factors in ectopic deaths 2020-22

Category	Assessable cases (n)	Number (%) of assessable cases with avoidable factors
Patient orientated	87	45 (51.7)
Administrative factors	90	51 (56.7)
Health worker management problems		
Primary healthcare level	23	15 (65.2)
District hospital level	43	37 (86.0)
Regional hospital level	35	23 (65.7)
Tertiary hospital level	27	16 (59.3)
Private hospital level	4	1 (25.0)
Resuscitation		

Note: assessable cases for health worker related factors means that the patient was managed at least for some time at that level of care, and the case notes provided some information to allow assessment of the quality of care rendered at that level.

Table 10b. Distribution of avoidable factors in miscarriage deaths 2020-22

Category	Assessable cases (n)	Number (%) of assessable cases with avoidable factors
Patient orientated	141	119 (84.4)
Administrative factors	151	83 (55.0)
Health worker management problems		
Primary healthcare level	36	15 (41.7)
District hospital level	70	52 (74.3)
Regional hospital level	55	36 (65.5)
Tertiary hospital level	62	36 (58.1)
Private hospital level	8	3 (37.5)
Resuscitation		

Note: assessable cases for health worker related factors means that the patient was managed at least for some time at that level of care, and the case notes provided some information to allow assessment of the quality of care rendered at that level

The following tables (11 to 14) provide more detail on the different categories of avoidable factor.

Table 11. Number and percentage of assessable deaths with patient behaviour-related avoidable factors: ectopic pregnancy and miscarriage deaths 2020-22

Description of avoidable factor	Ectopic		Miscarriage	
	Number	Percentage of assessable deaths	Number	Percentage of assessable deaths
No avoidable factor	42	48.3	22	15.6
No antenatal care	23	26.4	58	41.1
Infrequent antenatal care	0	0	2	1.4
Delay in accessing medical help	36	41.4	98	69.5
Declined medication/surgery/advice	4	3.9	9	6.4
Family problem	0	0	3	2.1
Community problem	0	0	4	2.8
Unsafe abortion	0	0	23	16.3
Other	2	1.9	8	5.7

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

Table 12. Number and percentage of assessable deaths with administrative avoidable factors: ectopic pregnancy and miscarriage deaths 2020-22

Description of avoidable factor	Ectopic		Miscarriage	
	Number	Percentage of assessable deaths	Number	Percentage of assessable deaths
No avoidable factor	39	43.3	68	45.0
Transport problem: Home to institution	3	3.3	3	2.0
Transport problem: Institution to institution	3	3.3	7	4.6
Lack of accessibility: Barriers to entry	1	1.1	1	0.7
Lack of accessibility: Other	3	3.3	1	0.7
Delay in attending to patient (overburdened service)	13	14.4	13	8.6
Delay in attending to patient (reason unknown)	6	6.7	8	5.3
Lack of healthcare facilities: ICU	5	5.6	13	8.6
Lack of healthcare facilities: Blood/blood products	5	5.6	9	6.0
Lack of healthcare facilities: Other	3	3.3	7	4.6
Inadequate numbers of staff on duty	6	6.7	12	7.9

Description of avoidable factor	Ectopic		Miscarriage	
	Number	Percentage of assessable deaths	Number	Percentage of assessable deaths
Appropriate level of skill not available on-site	16	17.8	19	12.6
Communication problems: Technical	0	0	3	2.0
Communication problems: Interpersonal	2	2.2	2	1.3
Other	7	7.8	13	8.6

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

Table 13a. Health worker related avoidable factors per level of care (number and percentage of assessable deaths in which each factor occurred): Ectopic pregnancy deaths 2020-22

	CHC N (%)	District N (%)	Regional N (%)	Tertiary N (%)	Private N (%)
No avoidable factors	8 (34.8)	6(14.0)	12(34.3)	11(40.7)	3(75)
Initial assessment	14(60.9)	13(30,2)	7(20.0)	7(25.9)	0
Problem with recognition / diagnosis	12(52.2)	27(62.8)	7(20.0)	4(14.8)	1(25)
Delay in referring the patient	4(17.4)	10(23.3)	2(5.7)	0	0
Managed at inappropriate level	3(13.0)	6(14.0)	1(2.9)	0	0
Incorrect management (wrong diagnosis)	2(8.7)	13(30.2)	6(17.1)	4(14.8)	0
Sub-standard management (Correct diagnosis)	3(13.0)	11(25.6)	14(40.0)	7(25.9)	1(25)
Not monitored / Infrequently monitored	1(4.3)	4(9.3)	4(11.4)	3(11.1)	0
Prolonged abnormal monitoring with no action taken	3(13.0)	11(25.6)	5(14.3)	1(3.7)	1(25)
Assessable cases	**23**	**43**	**35**	**27**	**4**

Notes: 1. There can be more than one avoidable factor per death 2. A case could be managed at more than one level of care

Table 13b. Health worker related avoidable factors per level of care (number and percentage of assessable deaths in which each factor occurred): Miscarriage deaths 2020-22

	CHC N (%)	District N (%)	Regional N (%)	Tertiary N (%)	Private N (%)
No avoidable factors	21(58.3)	18(25.7)	19(34.5)	26(41.9)	5(62.5)
Initial assessment	9(25.0)	25(35.7)	10(18.2)	10(16.1)	0
Problem with recognition / diagnosis	7(19.4)	30(42.9)	12(21.8)	8(12.9)	1(12.5)
Delay in referring the patient	5(13.9)	21(30.0)	5(9.1)	1(1.6)	1(12.5)
Managed at inappropriate level	2(5.6)	17(24.3)	1(1.8)	1(1.6)	0
Incorrect management (wrong diagnosis)	1(2.8)	8(11.4)	5(9.1)	4(6.5)	0
Sub-standard management (Correct diagnosis)	9(25.0)	30(42.9)	23(41.8)	24(38.7)	2(25.0)
Not monitored / Infrequently monitored	0	11(15.7)	3(5.4)	7(11.3)	0

	CHC N (%)	District N (%)	Regional N (%)	Tertiary N (%)	Private N (%)
Prolonged abnormal monitoring with no action taken	1(2.8)	10(14.3)	6(10.9)	2(3.2)	0
Assessable cases	**36**	**70**	**55**	**62**	**8**

Notes: 1. There can be more than one avoidable factor per death. 2. A case could be managed at more than one level of care

Table 14a. Number and percentage of assessable deaths with sub-standard resuscitation at the time of the acute event that led to the death: Ectopic pregnancy deaths 2020-22

Resuscitation problems	Number	Percentage of 90 assessable deaths
Lack of information	13	Not assessable
No avoidable factor	38	42.2
Airway problems	3	3.3
Breathing problems	4	4.4
Circulation problems	20	22.2
Drug problems	2	2.2
Investigation problems	8	8.9
Monitoring problems	5	5.6
Resuscitation not attempted	21	23.3

Table 14b. Number and percentage of assessable deaths with sub-standard resuscitation: Miscarriage deaths 2020-22

Resuscitation problems	Number	Percentage of 143 assessable deaths
Lack of information	23	Not assessable
No avoidable factor	77	53.8
Airway problems	4	2.8
Breathing problems	6	4.2
Circulation problems	31	21.7
Drug problems	1	0.7
Investigation problems	2	1.4
Monitoring problems	6	4.2
Resuscitation not attempted	27	18.9

Summary of Avoidable factors

Ectopic pregnancy

The most common patient behaviour-related avoidable factors were “lack of antenatal care” and “delay in accessing medical help”. Although identified by the assessors, it is questionable whether the lack of antenatal care was really an avoidable factor in most of these cases. Most of the women were unbooked because rupture

of ectopic pregnancy typically occurs early in the first trimester of pregnancy. Therefore, they should not be blamed for being unbooked. There would also be no guarantee that a routine early first trimester antenatal visit would detect an ectopic pregnancy.

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

The most common administrative factor was a lack of the appropriate level of skill on-site or on stand-by. This refers particularly to medical officers working at district hospitals, who are unable to perform a laparotomy for ectopic pregnancy, either from the surgical or anaesthetic aspect. This is one of the reasons why anaesthesia was only administered in 38% of the women who died from ectopic pregnancy, clearly indicating missed opportunities for surgical intervention.

Regarding management by healthcare providers, there were avoidable factors in 86% of cases at district hospital, 65% of cases at regional hospital level and at Primary healthcare level, and 59% of cases at tertiary level. There were several important health worker-related avoidable factors: failure to make the diagnosis at all levels of care, and therefore incorrect management; substandard care despite the right diagnosis having been made, again at all levels of care; and substandard resuscitation of hypovolaemic shock, including 23% of cases where resuscitation was not even attempted.

Miscarriage

The majority (84%) of women who died from miscarriage had patient behaviour-related factors which contributed to the death. There were 16% who had documented evidence of having had an unsafe (illegal) termination of pregnancy (TOP), which was a lower proportion than the 25% in the 2017-19 report. While this could well indicate better access to safe (legal) TOP services, it is likely that the figure remains an underestimate of the true contribution of unsafe TOP to the deaths from miscarriage. The majority (70%) delayed seeking medical care, which in some cases may have been because they were concealing the fact that they had had an illegal TOP.

The most common administrative factor was a lack of the appropriate level of skill on-site or on stand-by. Scrutiny of the case records suggests that this factor was often recorded by assessors when the doctor mismanaged the patient. It appears that the assessor made the inference that the doctor must be lacking the appropriate training. Thus, this avoidable factor in fact reflects sub-standard care by the doctors.

There is no doubt that lack of access to a Department of Health TOP service was an important administrative factor for some of the miscarriage deaths. However, the assessor does not usually have information about this when reviewing the cases notes, and thus it does not get recorded as a specific avoidable factor. The documented cases of unsafe TOP are evidence enough of a lack of access to safe TOP.

Regarding management by healthcare providers, there were avoidable factors in 74% of cases at district hospital level, 65% of cases at regional hospital and 58% of cases at tertiary/central level. The most frequent healthcare provider-related avoidable factors were inadequate initial assessment and failure to make the diagnosis, substandard care despite making the right diagnosis, and substandard resuscitation of circulatory shock, whether due to sepsis or hypovolaemia. In 16% of cases, there was no resuscitation attempted. At district hospital level specifically, delay in referral or failure to refer was an additional prominent avoidable factor.

Overall Avoidability of deaths

For each case, the assessors must make a judgement about the avoidability of the death by classifying the death according to the options presented in tables 15a and 15b, which also compare the avoidability of early pregnancy deaths to the previous triennium. In this classification, “sub-optimal care” refers only to the care the patient received within the health system (including administrative and health-care worker-related avoidable factors). It is not referring to problems with patient behaviour. Eighty-three percent (83%) of women who died from ectopic pregnancy had sub-optimal care, while 46 cases (45%) would probably have been saved with better care (clearly avoidable cases: the number decreased from 66 in 2017-19). Seventy-seven percent (77%) of women who died from miscarriage had sub-optimal care, and 47 (28%) would probably have been saved if the care had been better (clearly avoidable cases: the number decreased from 66 in 2017-19).

Table 15a. Distribution of avoidability in deaths due to ectopic pregnancy (103 deaths) 2017-19 and 2020-22

Percent per disease category	2017-19 N (%)	2020-22 N (%)
No suboptimal care	21 (18.6)	18(17.5)
Suboptimal care, different management would have made no difference to the outcome	5 (6.2)	5 (4.9)
Suboptimal care, different management might have made a difference to the outcome	19 (18.6)	34(33.0)
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	66 (56.6)	46(44.7)

The comparison to the previous triennium gives some indication of the trends in the quality of care being provided for women presenting with ectopic pregnancies or miscarriages to the health facilities in South Africa. The decreasing trend in clearly avoidable deaths suggests some improvement in the quality of care for these early pregnancy complications. This suggests that the recommendations made in the last Saving Mothers report (2017-19) for reducing early pregnancy deaths have been implemented at least to some extent. Nonetheless at least 93 women died unnecessarily due to the poor quality of care rendered to women with complications of early pregnancy across all levels of care. The recommendations in the current report therefore remain similar to those in previous Saving Mothers reports. Ongoing efforts are required to implement these recommendations.

Table 15b. Distribution of avoidability in deaths due to miscarriage (166 deaths) 2017-19 and 2020-22

Percent per disease category	2017-19 N (%)	2020-22 N (%)
No suboptimal care	41 (21.1)	39(23.5)
Suboptimal care, different management would have made no difference to the outcome	27 (13.9)	7(4.2)
Suboptimal care, different management might have made a difference to the outcome	60 (30.9)	73(44.0)
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	66 (34.0)	47(28.3)

Case studies / Vignettes

Ectopic pregnancy vignette

A 30 year-old Gravida 3 Para 2 was brought by ambulance to a regional hospital emergency (casualty) department at 21h00 having collapsed at a party. She complained of vomiting, abdominal pain and difficulty in breathing. She was noted to be very pale. She was seen by the senior doctor on duty in the emergency department who made the following assessment: “P1 triage category (i.e. highest priority indicating that the patient’s life is in immediate danger); unrecordable blood pressure (BP), cold peripheries, anaemia, missed last menstrual period and suspected ectopic pregnancy. BP improved with fluid resus.” The doctor made a decision to not admit the patient, but instead to divert the ambulance to another unspecified hospital, because of many other P1 patients in the “resus area”, and because there were already two ectopic pregnancy patients waiting for theatre. She arrived an hour later at 22:05 at the emergency department of another regional hospital. On arrival her BP was 58/31. Her haemoglobin level was 5,2 g/dl. She arrested a few minutes after arrival. Cardiopulmonary resuscitation, including intubation and ventilation, was initially successful at achieving a return of cardiac output. An adrenalin infusion was started, as was a unit of emergency blood. An ultrasound scan showed “+++ free fluid” in the abdomen. A urinary catheter was inserted, but no urine drained as she was in circulatory shock. The gynae doctor was called but refused to take over management of the patient until pregnancy was confirmed by a pregnancy test. This caused a delay in management as a blood sample had to be sent to the laboratory for βhCG level, which confirmed a pregnancy. A laparotomy was then planned, but transfer to the operating theatre was delayed because the anaesthetist wanted cross-matched blood to be

available first. On arrival in theatre at 01:00, three hours after admission, the anaesthetist assessed the patient to be dead already.
Recommendations relevant to this vignette (refer to “Key recommendations” section above): 1,3,4,5,9,10

Miscarriage vignette

A 27 year-old gravida 3 para 2 was brought by her boyfriend at 01h17 to a tertiary hospital casualty department feeling dizzy and weak, with a history of heavy per vaginal bleeding for several days after she had attended a private doctor and received medication for terminating the pregnancy. She was a known HIV positive woman who had stopped taking her antiretroviral therapy. On arrival her blood pressure (BP) was 81/49, her pulse rate 135 beats per minute, but she was fully conscious. She was attended to by the casualty doctor at 01h50, who noted that she was very pale. There was no abdominal tenderness and the uterus was not palpable abdominally. On vaginal examination the cervix was open and there were malodorous products of conception palpable in the cervical os. A diagnosis of haemorrhagic shock due to incomplete miscarriage was made. A peripheral intravenous line was put up and a urinary catheter inserted. The haemoglobin level was 3,5g/dl and the platelet count was 206. A plan was made to call the gynae team, and to cross match two units of blood for transfusion. At 02:19, a nursing note states that she is still bleeding in clots, and that her general condition is stable. At 03:30, the gynae doctor attended to the patient and noted that on speculum examination, the cervix was pink, not necrotic with no pus draining from it. BP was now 59/39. The doctor discussed the patient with his consultant who thought the patient was in septic shock. The consultant ordered that the patient be taken to theatre for hysterectomy, be started on inotropes and that an ICU bed be booked. The first unit of blood transfusion was started at 04:00. Up to this time, no drugs were administered or mechanical methods attempted specifically to stop the bleeding. At 05:00, she arrested while waiting to go to theatre. Cardiopulmonary resuscitation was initially successful at achieving a return of cardiac output, and she underwent hysterectomy the same morning. No pus was found in the abdomen, pelvis or uterus. She arrested again at the end of the procedure, while she was still in theatre. This time resuscitation was unsuccessful.
Recommendations relevant to this vignette (refer to “Key recommendations” section above): 1,2,3,4,5,6,7,8,10

Discussion

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

Themes relevant to both ectopic pregnancy deaths and miscarriage deaths

Need for improved family planning/ contraception services

The ongoing problem of deaths following unsafe miscarriages as well as legal TOPs indicate that miscarriage deaths often result from unwanted pregnancies. Furthermore, it is reasonable to assume that the great majority of the teenage pregnancies, which contributed to early pregnancy deaths, were unplanned pregnancies. This indicates the need for improving the accessibility of contraception/ family planning services in this country. The majority of tested women who died from miscarriage and ectopic pregnancy were HIV positive, suggesting that family planning is not adequately integrated into the management of chronic diseases such as HIV. New approaches are required to make contraception and family planning more accessible and acceptable to the community.

Need to maintain the intensity in the fight against HIV/AIDS

Many women who died from miscarriage and ectopic pregnancy had unknown HIV status, indicating that young women in society are still not given adequate education about HIV and an opportunity to test for HIV and maintain their health accordingly. It is too late for women to find out their HIV status when they are already pregnant or critically ill. Data from those who were HIV tested suggest that HIV is a major underlying risk factor for death from both miscarriage and ectopic pregnancy. Thus, maintaining wide-ranging interventions to combat HIV in society, including primary prevention of infection, and the recognition and effective management of ART treatment failure should reduce these early pregnancy deaths.

Need for community education about booking early, reporting early to hospital when early pregnancy complications arise, and about how to access safe TOP services

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

Need for improved resuscitative management of the shocked gynae patient, irrespective of the type of shock

The great majority of women who died following early pregnancy loss, died due to circulatory shock. Hypovolaemic shock and septic shock both contributed, and in some cases it was not clear which was the predominant cause of shock. Sub-standard resuscitation by the healthcare workers was documented in over half of the cases. It appeared that there were a mixture of factors contributing to this failure of resuscitation, including failure to recognise shock and lack of insight about the urgency of treating shock. Sub-standard management of shock was a problem across all levels of care. This is clearly an area where there is a need for training and retraining of staff. Modules on the management of shock as well as of miscarriage are included in the ESMOE programme. Such training must be made available to those who work in emergency care or casualty departments, not just those who work in gynaecology departments.

Need for shocked gynae patients to be prioritised in casualty departments. Shared responsibility of care between casualty/emergency department staff and gynae team

When presenting to hospital, many of the women who died following early pregnancy loss were first received and assessed in a general casualty or emergency department. There were often delays in assessment and delays in or lack of resuscitation for these patients while they remained in casualty. A common reason for this, particularly at regional hospitals, was that the casualty staff (doctors and nurses), once they had identified that the patient had a gynaecological problem, referred the patient on to the gynae team, and in the meantime did not take responsibility to assess and resuscitate the patient. There would often be delays before the gynae team would come to review the patient. This highlights the need for training of casualty staff as well as gynae department staff in the management of early pregnancy complications. Casualty department policies must ensure that a shocked gynae patient is given equal priority in resuscitation compared to other shocked patients, and that no patient is left unattended with neither casualty nor gynae staff taking responsibility to institute emergency care.

Need for facility managers to ensure that doctors and nurses are aware of their professional and ethical responsibilities on duty and to hold them accountable when they neglect these responsibilities

In many of the deaths, over and above a lack of knowledge or skill on the part of the doctors and nurses attending to the patient, there appeared to be a lack of interest or commitment to save the woman's life. In such cases the maternal death notification forms do not usually indicate that this lack of professionalism or ethics has been acknowledged or addressed. It is the facility manager's responsibility to clarify the standards expected of those working in the facility and to take remedial action when these standards are not respected. This is one of the reasons why it is essential that on-site audit of major adverse incidents including maternal deaths must routinely occur and must be attended by the senior facility managers and ideally by an external expert such as a district clinical specialist obstetrician or midwife, to ensure objectivity in the analysis of the case.

Themes specific to ectopic pregnancy deaths

Need for training on recognition of ectopic pregnancy, and management, particularly the need for prompt surgery if the patient is shocked

There were two common health worker-related avoidable factors specific to deaths from ectopic pregnancy. The first was failure to diagnose the ectopic pregnancy. This was mainly a problem of the doctor failing to even consider the diagnosis. The second problem was the failure to make a decision to do an urgent laparotomy when the diagnosis of ruptured ectopic pregnancy was made, particularly when the patient was already

shocked. A crucial mistake that was sometimes made was to defer the surgery, or to refer the patient to a higher level of hospital, because the patient was haemodynamically unstable. The principle in such cases is that the only way to stabilise the patient is to do a laparotomy and stop the bleeding. Delaying this step when the patient is already shocked is likely to result in death. The implication is that the emergency surgery should be performed at the district hospital, if referring the patient will create a delay.

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

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

Themes specific to miscarriage deaths

Need for access to safe legal termination of pregnancy (TOP) for all women

Twenty-five years after the implementation of the Choice on Termination of Pregnancy Act of 1996, it is clear that many women in South Africa still do not have access to safe and legal TOP. The data in this report provides evidence for this, as there continue to be deaths following unsafe miscarriage. In addition, it is well recognised that illegal TOP businesses are thriving. It appears that by far the most common method used for illegal TOPs in South Africa is now misoprostol, given in a variety of doses and regimes. While this may be safer than using unsterile instruments, it can still lead to life-threatening complications, particularly when the miscarriage is incomplete, and results in protracted blood loss and eventually sepsis. This happens because there is limited follow-up of the women after the TOP process has been initiated and no formal referral to hospital to take over the care of the incomplete miscarriage. It is not just unregistered practitioners who conduct this type of unsafe TOP. A common problem in this triennium was unsafe miscarriage conducted by general practitioners (GPs), again using misoprostol, and subsequently not following up or referring their patients.

Since 2012, mifepristone as well as misoprostol has been available for Department of Health (DOH) facilities to use to carry out medical TOP. The advantage of adding mifepristone to the regimen is that most cases of first trimester TOP can be successfully achieved without the need for any surgical procedure. A standard treatment guideline is available in the National Essential Medicines List book[2]. This provides an opportunity to make safe TOP much more widely available at DOH facilities than it has been before. The TOP could be managed medically through an outpatient department, with any doctor or TOP-trained nurse authorised to prescribe the drugs. The procedure would not have to be restricted to a dedicated TOP unit. Even for dedicated TOP units with the capacity to conduct surgical TOPs, the medical method will be applicable in the majority of cases, and will allow the unit to manage a larger number of cases, as the medical method is less time-consuming than the surgical.

All hospitals and community health centres with a 24-hour maternity service should be able to provide medical TOP as a minimum. Furthermore, all TOP units should have access to the drugs required for medical TOP. These two measures should greatly increase access to safe TOP for the community. Nonetheless, access may still be restricted because a large proportion of health workers are unwilling to be involved in the provision of a TOP service, for religious reasons. To overcome this problem, the facility manager (CEO) must take responsibility to either provide termination of pregnancy (TOP) services or have a clear referral facility for TOP services, based on an agreed district referral pattern

Need for training at all levels on recognition and management of different types of miscarriage

Review of the case notes of women who died from miscarriage repeatedly demonstrated lack of insight regarding both assessment and management of women presenting with miscarriage. Training is required regarding how to recognise the "unsafe" miscarriage which needs to be referred for specialist care. For those requiring evacuation of the uterus, facilities for safe evacuation must be made available at all hospitals and at selected community health centres. There were several cases where death followed a long delay after admission to hospital with a diagnosis of incomplete miscarriage, where the patient was kept waiting for an evacuation procedure to be done. The delay was often due lack of availability of "theatre space". Patients were often poorly monitored during this waiting period. Uncomplicated first trimester miscarriages can be safely and efficiently managed without having to undergo general anaesthesia and surgical curettage in a theatre complex. Options include manual vacuum aspiration of the uterus under analgesia or conscious sedation in the casualty theatre or gynae side ward, or alternatively medical management with misoprostol in selected cases. All facilities which manage early pregnancy complications should be able to provide these options and should have clear protocols for how to manage uncomplicated miscarriage, as well as how to recognise and manage complicated miscarriage. These aspects of care are covered in the miscarriage ESMOE module.

Conclusion

Since the previous triennium, there has been a decrease in maternal deaths related to ectopic pregnancy and to miscarriage. Nonetheless 45% of ectopic pregnancy deaths and 28% of miscarriage deaths were clearly avoidable within the health system. Many of these women bled to death in health institutions due to sub-standard management by the healthcare team. Unsafe and illegal terminations of pregnancy remain an important contributor to miscarriage deaths. HIV infection is an important underlying risk factor for both categories of early pregnancy deaths. In order to reduce deaths from these causes, more intensive and committed management of these patients by healthcare workers is needed when they present to health facilities. In addition, improving community access to contraception and safe TOP services will be required.

Relevant articles providing further detail on how to reduce early pregnancy deaths in South Africa, based on the confidential enquiry findings in previous triennia are listed amongst the references below[2,3].

References

1. The 2022 National Antenatal Sentinel HIV Survey in South Africa, National Department of Health. www.doh.gov.za
2. Moran N. Preventing maternal deaths due to ectopic pregnancy. South African Medical Journal. 2018;108(12)
3. Moran NF, Baloyi K. Strategies to reduce deaths in early pregnancy. O+G Forum 2020; 30(4):17-20

7.6 Maternal deaths from Pregnancy related sepsis following viable pregnancy

(Dr S Cebekhulu)

Abstract

Introduction

In South Africa, a system of National Confidential Enquiries into Maternal Deaths exists to review maternal deaths. The confidential enquiry identifies challenges in the health system and makes recommendations for improvement. To standardise maternal sepsis definition; the WHO defines maternal sepsis as the "life-threatening organ dysfunction resulting from the infection during pregnancy, childbirth, post-abortion or postpartum". Deaths from non-pregnancy related infections (NPRI) and septic miscarriage, although part of this new definition, are described elsewhere in this report. The purpose of this paper was to perform an in-depth secondary analysis of deaths from Pregnancy related sepsis (PRS) during 2020-2022.

Methods

Data on PRS deaths were retrieved from the database, MaMMAS, of the NCCEMD. In addition, a secondary analysis was performed by the chapter author from a review of the hard copy files of PRS maternal deaths which contained the clinical notes, Maternal Death Notification Forms and Assessors forms. The analysis of

deaths is all descriptive

Results

Between 2020 and 2022, 172 women died as a result of PRS. This is similar to 2017-2019 and it is the second lowest amongst all the triennia. The number of deaths decreased every triennium since 2008-2010 (258), 2011-2013 (226), 2014-2016 (205), 2017-2019 (170) and was almost unchanged in 2020-2022 (172). Of these 172 deaths, 71 women had sepsis after vaginal delivery, and 71 after caesarean section, 17 suffered bowel trauma during caesarean section and 13 deaths were caused by chorioamnionitis. The proportion of deaths after caesarean section fluctuates from 43.8 percent (2011-2013) to 49.3 percent (2014-2016), 47.2percent (2017-2019) and 41.3 percent for this triennium (2020-2022). The observed increase in the deaths from bowel injury at caesarean section may indicate a trend of increasing numbers of difficult repeat caesarean sections and this warrants a detailed further analysis.

For at least 12 percent of the women their HIV status was unknown (two per cent more, compared to 10 per cent in 2017-2019) and an increasing percentage of more than 90 percent was on ARV treatment compared to 75.6 percent in 2017-2019, 75.2 percent in 2014-2016, 49 per cent in 2011-2013 and only 20 per cent in 2008-2010.

Almost all the deaths (98.5 percent) occurred in hospital, mainly in regional and tertiary facilities. Free State still has the highest iMMR due to PRS at 10.4 maternal deaths per 100,000 live births and this increased from 9.29. North West PRS iMMR decreased from a high of 8.03 to 4.9. Mpumalanga increased to 8.5 (2020-2022) after maintaining the decrease of its iMMR from 12.8 to 4.48 then 4.21 in the previous three trienniums respectively. More than seventy percent of these deaths were potentially preventable with health systems administrative problems occurring in more than fifty percent due to overburdened services, lack of staff, appropriate skill not available etc. On the patient side, delay in accessing care is the most important contributor (50 percent, declined from 64.2 per cent). The severity of PRS is often underestimated by the healthcare providers and its management is inadequate, only 15.4% of women had hysterectomy. Avoidable factors associated with the healthcare providers were present in 55.1 per cent of cases in district hospitals, 73percent of cases in regional hospitals, 60.2% in tertiary hospitals and 66.7 percent in private hospitals and for private, this increased from 55.6 percent. Lastly, the majority (greater than ninety percent) of women with PRS died during the postpartum period.

Conclusion

While the rate of PRS deaths has shown a slow but steady decline in recent years, the high proportion of avoidable deaths is still of great concern and more efforts including pandemic preparedness are mandatory towards achieving desired target goals, SDG of 70 maternal deaths per 100,000 live births.

Introduction

In South Africa, a system of National Confidential Enquiries into Maternal Deaths exists to review maternal deaths. The confidential enquiry identifies challenges in the health system and makes recommendations for improvement. The Saving Mothers reports (until recently) uses the term “pregnancy-related sepsis” and that the deaths from pregnancy related sepsis (PRS) are those that are caused by infections in the genital tract or in tissues involved in the birth process in viable pregnancies. To standardise maternal sepsis definition; the WHO defines maternal sepsis as the “life-threatening organ dysfunction resulting from the infection during pregnancy, childbirth, post-abortion or postpartum”. Deaths from non-pregnancy related infections (NPRI) and septic miscarriage, though part of this new definition, are described elsewhere in this report. The purpose of this paper was to perform an in-depth analysis of deaths from Pregnancy related sepsis (PRS) during 2020-2022

Methods

Data on PRS deaths were retrieved from the database, MaMMAS, of the NCCEMD. In addition, a secondary analysis was performed by the chapter author from a review of the hard copy files of PRS maternal deaths which contained the clinical notes, Maternal Death Notification Forms and Assessors forms. The analysis of deaths is all descriptive.

Results

Between 2020 and 2022, 172 women died because of PRS, similar to 2017-2019 and it is the second lowest amongst all the triennia. The number of deaths decreased every triennium since 2008-2010 (258), 2011-2013 (226), 2014-2016 (205), 2017-2019 (170) and was almost unchanged in 2020-2022 (172) (figure 1). This lack of change is supported by the institutional maternal mortality rate (iMMR per 100,000 live births) which showed the same trends over the last five trienniums (Figure 2). The steady decline in the iMMR that was observed over the three years of the previous triennium (2017-2019) with the lowest at 4.11 in 2019 was not observed during this triennium mainly because of the COVID-19 pandemic. However, there was a promising decline for the year 2022(5.8), almost the same as the pre-pandemic rate in 2019 (Figure 3).

Figure 1. Triennial trends in number of maternal deaths from PRS

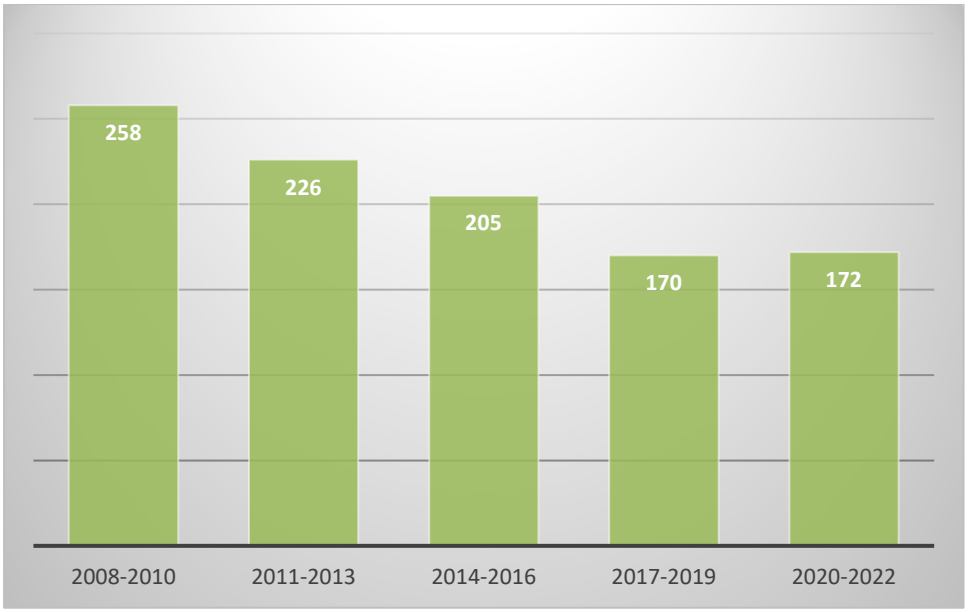


Figure 2. Trends in PRS iMMR for 8 triennia from 1999-2022

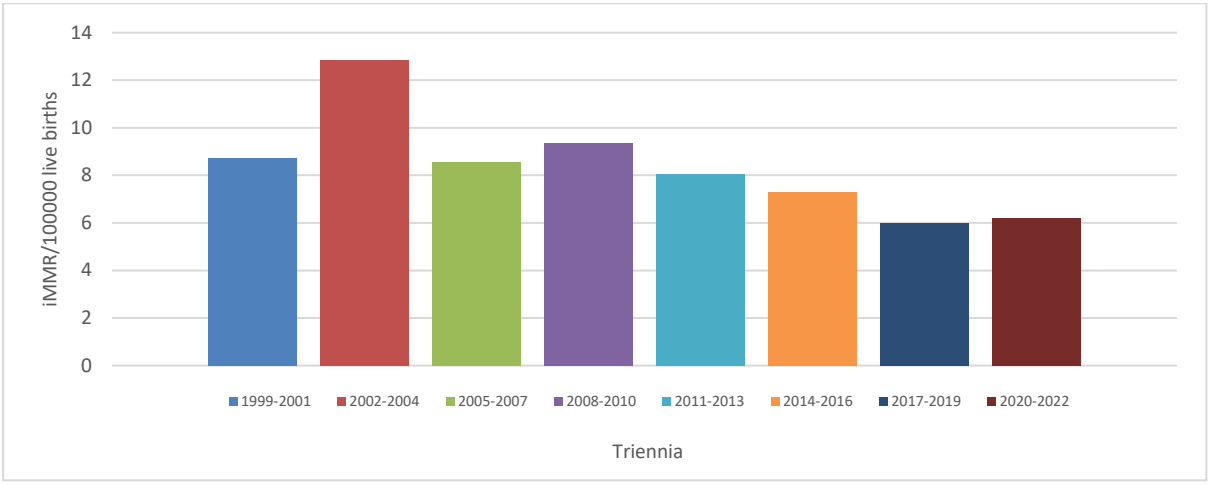
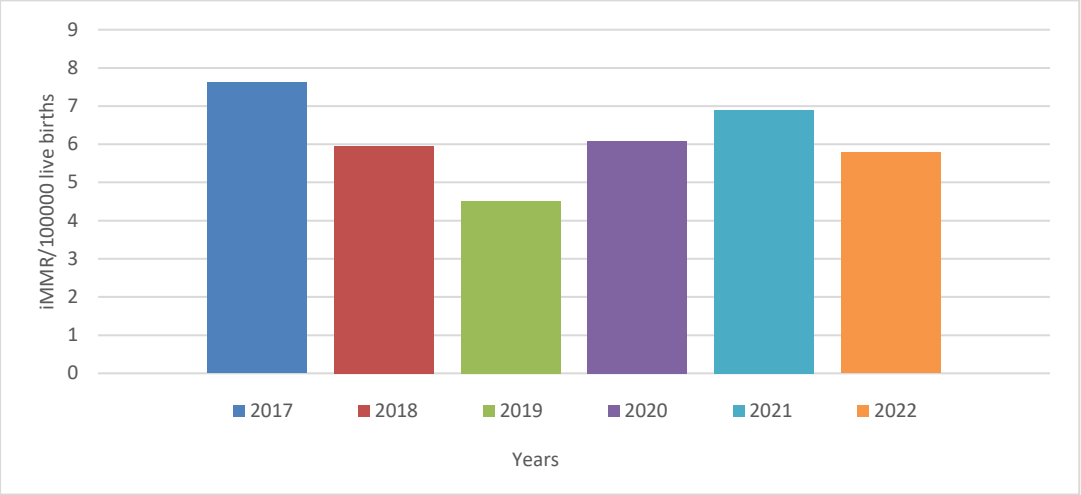
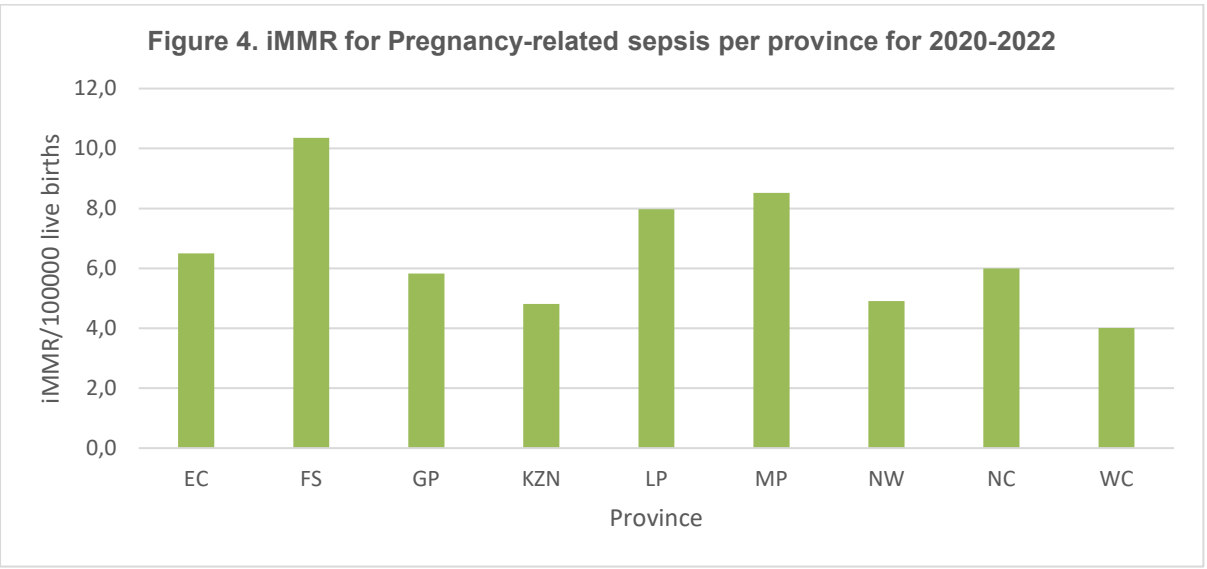


Figure 3. Annual trends in PRS iMMR over six years 2017-2022



Free State still has the highest iMMR due to PRS at 10.4 maternal deaths per 100,000 live births which increased from 9.29 in previous triennium. North West PRS iMMR decreased from a high of 8.03 in 2017-2019 to 4.9. Mpumalanga increased to 8.5 (2020-2022) after maintaining the decrease of its iMMR from 12.8 to 4.48 then 4.21 in the previous three triennia respectively (Figure 4).

Figure 4. iMMR for Pregnancy-related sepsis per province for 2020-2022



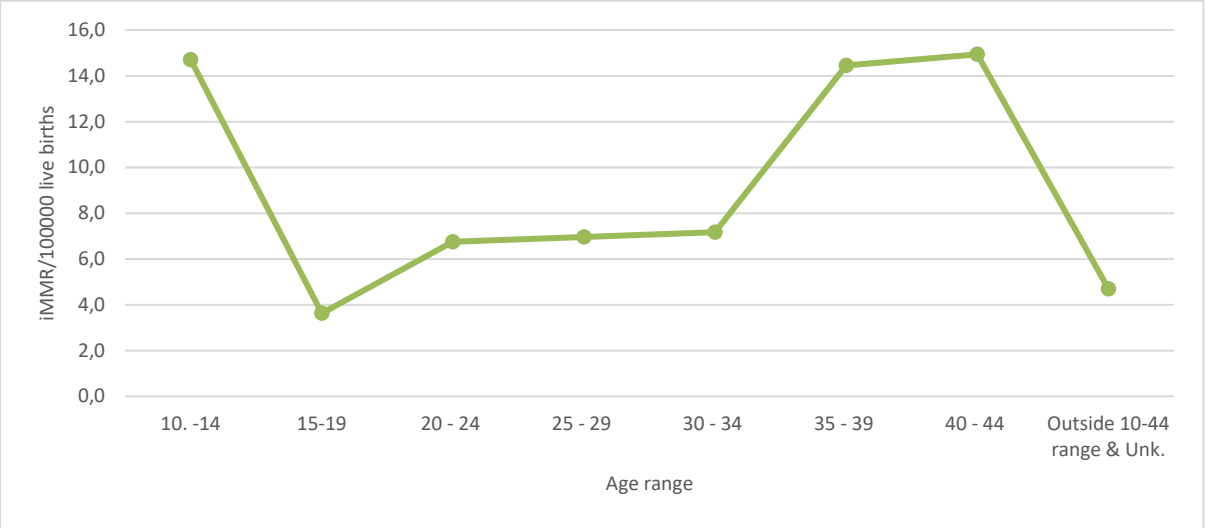
Demographic data

Forty-nine per cent of PRS deaths in 2020-2022 occurred at national central and tertiary hospitals and was the highest proportion, 37% at regional hospitals, and 13 % occurred at district hospitals (Table 1). Women dying in the extreme age categories (less than 19 years and greater than 35 years) are of greatest concern because of the risks associated with pregnancy in these age groups (Figures 5 and 6). Furthermore, most women who died from PRS were of low parity (Table 2).

Table 1. Levels of care for deaths from pregnancy related sepsis (by place of death) for 2020-2022

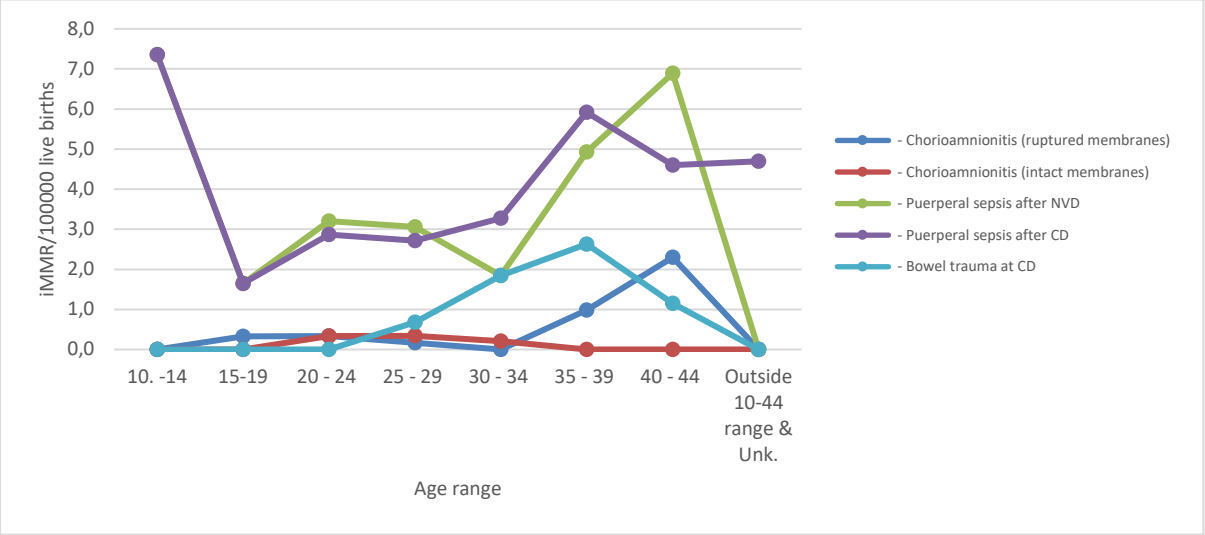
	CHC	District hospital	Regional hospital	NCH & TH	Total
Pregnancy-related sepsis	**2**	**22**	**64**	**84**	**172**

Figure 5. Maternal age* and deaths from pregnancy related sepsis 2020-2022



*Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021

Figure 6. Maternal age* and deaths from Pregnancy related sepsis



*Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021

Table 2. Parity for 2020-2022 triennium

Primary obstetric problem	P0	P1	P2	P3	P4	P5	P6	Unknown	Total
Pregnancy-related sepsis	**55**	**53**	**30**	**17**	**6**	**5**	**4**	**2**	**172**

Causal subcategories of PRS deaths

Puerperal sepsis after vaginal birth (41.3%) and puerperal sepsis after Caesarean delivery (41.3%) contributed equally as the most frequent causes of maternal death from PRS (Table 3). There were 17 deaths related to bowel injury occurring during Caesarean delivery; an analysis of which will be published elsewhere.

Table 3. Subcategories of Pregnancy-related sepsis for 2020-2022 triennium

	n	%
- Chorioamnionitis (ruptured membranes)	08	4.7
- Chorioamnionitis (intact membranes)	05	2.9
- Puerperal sepsis after NVD	71	41.3
- Puerperal sepsis after CD	71	41.3
- Bowel trauma at CD	17	9.8
Total	**172**	**100**

Tables 4 compares iMMR per province for the different causal subcategories. Table 5 describes level of care for different causal subcategories, and Table 6 compares parity for different causal subcategories.

Table 4. Institutional maternal mortality ratio for pregnancy related sepsis for all provinces

Primary obstetric problems	EC	FS	GP	KZN	LP	MP	NW	NC	WC	Total
Pregnancy-related sepsis	**6.5**	**10.4**	**5.8**	**4.8**	**8.0**	**8.5**	**4.9**	**6.0**	**4.0**	**6.2**
- Chorioamnionitis (ruptured membranes)	0.0	0.7	0.4	0.5	0.0	0.4	0.5	0.0	0.0	0.3
- Chorioamnionitis (intact membranes)	0.3	0.0	0.1	0.2	0.2	0.0	0.5	0.0	0.0	0.2
- Puerperal sepsis after NVD	2.8	4.8	1.9	1.2	4.2	2.6	1.6	3.0	2.3	2.4
- Puerperal sepsis after CD	2.5	4.1	3.1	2.2	2.7	3.7	1.6	1.5	1.3	2.6
- Bowel trauma at CD	0.9	0.7	0.3	0.8	0.7	1.9	0.5	1.5	0.3	0.7
Live births (2022-2022)	323133	144861	686071	644299	401082	270064	183505	66723	299427	3019165

Table 5. Levels of care for deaths from pregnancy related sepsis (by place of death) for 2020-2022

	CHC	District hospital	Regional hospital	NCH & TH	Total
Pregnancy-related sepsis	**2**	**22**	**64**	**84**	**172**
- Chorioamnionitis (ruptured membranes)	0	2	1	5	8
- Chorioamnionitis (intact membranes)	0	2	0	3	5
- Puerperal sepsis after NVD	1	14	26	30	71
- Puerperal sepsis after CD	1	4	32	34	71
- Bowel trauma at CD	0	0	5	12	17

Table 6. Parity for 2020-2022 triennium

Primary obstetric problem	P0	P1	P2	P3	P4	P5	P6	Unknown	Total
Pregnancy-related sepsis	**55**	**53**	**30**	**17**	**6**	**5**	**4**	**2**	**172**
- Chorioamnionitis (ruptured membranes)	4	1	2	0	1	0	0	0	8
- Chorioamnionitis (intact membranes)	2	2	1	0	0	0	0	0	5

Primary obstetric problem	P0	P1	P2	P3	P4	P5	P6	Unknown	Total
- Puerperal sepsis after NVD	23	19	9	9	3	4	3	1	71
- Puerperal sepsis after CD	23	24	13	8	1	1	0	1	71
- Bowel trauma at CD	3	7	5	0	1	0	1	0	17

Septic shock was the most common final cause of death reported in 96% of deaths from PRS. Multi-organ dysfunction, involving mostly renal, respiratory, metabolic and haematological failures, was frequent (Table 7).

Table 7. Final causes of death in Pregnancy- related sepsis (n=172) for 2020-2022 triennium

Cause of death	PRS
Circulatory system	**176**
- Hypovolaemic shock	11
- Septic shock	165
Respiratory failure	**32**
- Respiratory failure	32
Cardiac failure	**15**
- Pulmonary oedema	15
Embolism	**4**
- Acute collapse due to embolism	4
Renal failure	**51**
- Renal failure	51
Liver failure	**21**
- Liver failure	21
Cerebral complications	**8**
- Intracranial haemorrhage	
- Cerebral oedema resulting in coning	1
- Meningitis	2
- Cerebral emboli	2
- Brain death following hypoxic event	1
- Unspecified	2
Metabolic	**37**
- Maternal ketoacidosis	10
- Electrolyte imbalance	9
- Thyroid crisis	
- Lactic acidosis	13
- Other	5
Haematological	**28**
- DIC	21
- Severe anaemia	7
Immune system	**26**

Cause of death	PRS
- Immune system failure	26
Unknown	**2**
- Home death	
- Unknown	2
Other	**18**
- Other	18
Total:	**172**
% of total deaths:	5

Table 8. HIV status and deaths from pregnancy related sepsis

Primary obstetric problems	Positive	No Treatment	ARV's		
			TEE	TLD	Other
Pregnancy-related sepsis	**92**	**8**	**28**	**23**	**33**
- Chorioamnionitis (ruptured membranes)	5		3	1	1
- Chorioamnionitis (intact membranes)	3		1	2	
- Puerperal sepsis after NVD	34	5	11	6	12
- Puerperal sepsis after CD	39	2	12	10	15
- Bowel trauma at CD	11	1	1	4	5

Of the 172 women tested for HIV, 92 (53.4%) tested positive and were eligible for combination antiretroviral therapy (ART), and 84 of these (91%) were receiving ART when they died (Table 8).
The majority (96%) of women with PRS died during the postpartum period (Table 9).

Table 9. Timing of events

2020-2022		%	
Timing of emergency			
- Early pregnancy		1.6	
- Antenatal period: 20w +		9.6	
- Intrapartum period		7	
- Postpartum period		82.4	
- Anaesthesia		0	
Timing of death			
- Early pregnancy		0	
- Antenatal period: 20w +		1.6	
- Intrapartum period		2.1	
- Postpartum period		95.7	
- Anaesthesia		0.5	

Fifteen percent of women dying from PRS underwent hysterectomy.

Avoidable factors, missed opportunities and substandard care

At least seventy two percent of these deaths were potentially preventable (Table 10).

Table 10. Impact of suboptimal care

	PRS
Impact of suboptimal care	
Proportion of suboptimal deaths	
- No suboptimal care identified	20.3
- Suboptimal care, no impact on outcome	7.5
- Suboptimal care, possible impact on outcome	44.9
- Suboptimal care, probable impact on outcome	27.3
Potentially preventable deaths	72.2

Patient orientated avoidable factors were identified in 54.1% of deaths, administrative related avoidable factors in 59% and resuscitation related avoidable factors were identified in 43.8% of cases (Table 11).

Table 11. Avoidable factors, missed opportunities and substandard care in pregnancy related sepsis

2020-2022	PRS	% of total
Patient oriented problems		
- Avoidable factors identified	92	49.2
- No avoidable factors	79	42.2
- Lack of information	17	9.1
Assessable cases	170	
Proportion avoidable factors identified	54.1	
Administrative problems		
- Avoidable factors identified	100	53.5
- No avoidable factors	71	38
- Lack of information	18	9.6
Assessable cases	169	
Proportion avoidable factors identified	59.2	
Resuscitation problems		
- Avoidable factors identified	70	37.4
- No avoidable factors	90	48.1
- Lack of information	27	14.4
Assessable cases	160	
Proportion avoidable factors identified	43.8	

Delay in seeking professional care was the most frequent patient related avoidable factor (32.6%), followed by non-attendance at antenatal clinic (13.4%) (Table 12).

Table 12. Patient-related avoidable factors

PRS	Number
Proportion of assessable cases	
No antenatal care	13.4
Infrequent antenatal care	5.3
Delay in accessing medical help	32.6
Declined medication/surgery/advice	9.6
Family problem	2.1
Community problem	1.1
Unsafe abortion	1.6
Other	2.1

Common administrative related avoidable factors were the delay in attending to the patient (18.2%) due to either overburdened services (10.7%) or reason not specified (7.5%), Inadequate staff on duty (9.1%), and lack of intensive care facilities (8%) (Table 13).

Table 13. Administrative-related avoidable factors

PRS	%
Proportion of avoidable factors	
Transport problem: Home to institution	1.1
Transport problem: Institution to institution	6.4
Lack of accessibility: Barriers to entry	1.6
Lack of accessibility: Other	2.1
Delay in attending to patient (Overburdened service)	10.7
Delay in attending to patient (Reason unknown)	7.5
Lack of healthcare facilities: ICU	8
Lack of healthcare facilities: Blood/blood products	0.5
Lack of healthcare facilities: Other	2.1
Inadequate numbers of staff on duty	9.1
Appropriate skill not available on site / on standby	7
Communication problems: Technical	1.1
Communication problems: Interpersonal	2.1
Other	11.2

Frequent healthcare provider avoidable factors included problem recognition, failures in initial clinical assessment and diagnosis, treatment at an inappropriate level of care, delay in referral, and substandard clinical care (Table 14).

Table 14. Healthcare worker-related avoidable factors

Description	Community Health Centre	District Hospital	Regional Hospital	Tertiary Hospital / above	Private Hospital
Managed at this level	72	78	89	88	15
Lack of information	10	11	6	7	4
No avoidable factor	35	26	21	29	3
Assessable cases	62	67	83	81	11
% no avoidable factors	56.5	38.8	25.3	35.8	27.3
Avoidable factors	27	41	62	52	8
Initial assessment	11	13	13	6	6
Problem with recognition / diagnosis	15	23	30	15	5
Delay in referring the patient	7	20	13	1	0
Managed at inappropriate level	2	9	6	1	1
Incorrect management (Wrong diagnosis)	1	8	6	1	2
Sub-standard management (Correct diagnosis)	9	14	39	39	3
Not monitored / Infrequently monitored	1	5	9	3	0
Prolonged abnormal monitoring with no action taken	1	8	9	11	0
Proportion of avoidable cases					
Initial assessment	15.3	16.7	14.6	6.8	40
Problem with recognition / diagnosis	20.8	29.5	33.7	17	33.3
Delay in referring the patient	9.7	25.6	14.6	1.1	0
Managed at inappropriate level	2.8	11.5	6.7	1.1	6.7
Incorrect management (Wrong diagnosis)	1.4	10.3	6.7	1.1	13.3
Sub-standard management (Correct diagnosis)	12.5	17.9	43.8	44.3	20
Not monitored / Infrequently monitored	1.4	6.4	10.1	3.4	0
Prolonged abnormal monitoring with no action taken	1.4	10.3	10.1	12.5	0

Private hospitals had the highest proportion of assessable PRS deaths with avoidable factors. (Table 15).

Table 15. Proportion avoidable factors for PRS deaths per level of care

2020-2022	PRS
Medical care - CHC	
Proportion avoidable factors identified	45.2
- District hospital	
Proportion avoidable factors identified	64.2

2020-2022	PRS
- Regional hospital	
Proportion avoidable factors identified	78.3
- Tertiary & above	
Proportion avoidable factors identified	65.4
- Private hospital	
Proportion avoidable factors identified	90.9

Case study of maternal death from pregnancy related sepsis *(PRS from a Caesarean delivery complicated by bowel injury)*

Summary

28 year old P0G2 (previous ectopic pregnancy). She booked early at antenatal clinic, BMI 30kg/m2, not anaemic, HIV negative, syphilis test negative. She attended antenatal care as prescribed, and she was diagnosed with pregnancy induced hypertension (PIH) that was controlled on treatment. She was then admitted at 38 weeks gestation for elective caesarean section (CS) for breech and PIH at a district hospital. Caesarean section was done and reported by the surgeon as apparently uneventful. She was kept in hospital for monitoring and further treatment, and she had persistently worsening tachycardia in hospital since the second day post caesarean section. She was seen daily by both medical officers and nurses, assessed as stable though she reported abdominal discomfort. On the third day post CS, she was assessed as possible paralytic ileus/bowel obstruction and she was referred to a tertiary hospital where she was admitted, planned for laparotomy (delayed) as she had an acute abdomen with faecal matter oozing from the surgical wound subsequently operated and admitted to the critical care unit. She never improved, got worse until it was decided on the sixth day that she be taken to theatre for re-exploratory laparotomy (no intraoperative details were provided except that a colostomy was also performed). She continued to deteriorate, another relook laparotomy was done, and she died after twenty-eight days from multi-organ (renal, respiratory, and metabolic) failure.

Assessment of maternal death

1. Risk factors for bowel injury in this woman were previous surgery and being obese.
2. There were multiple areas of missed opportunities that could have led to better outcome for this woman.

Avoidable factors
Healthcare worker related avoidable factors
i. Late recognition- Missed bowel injury at initial surgery. ii. There was inadequate patient assessment with poor monitoring (incomplete vital signs at all levels of care). iii. Delayed and Inadequate treatment following diagnosis of bowel injury at tertiary hospital.
Patient related avoidable factors- None identified
Administrative avoidable factors- None identified
Key recommendations of the Surviving Sepsis campaign relevant to this case. 1. If hypoperfusion present: resuscitate with 30mL/kg of IV crystalloids within the first 3h. 2. Reassess perfusion status frequently using dynamic clinical parameters (heart rate, blood pressure. urine output, lactate levels, passive leg raising test). 3. Initiate broad-spectrum antimicrobials within the first hour. 4. Obtain routine cultures before starting antimicrobial therapy. 5. Identify site of infection and perform source control as soon as feasible. NB: Therefore, invariably, all patients with PRS must, within at least the 1st hour, receive the above-mentioned interventions and source control by the sixth hour [1,2].

Discussion

Pregnancy Related Sepsis is now the sixth most common direct obstetric cause of maternal death following early pregnancy causes (ectopic pregnancies and miscarriages combined at number five). Between 2020 and 2022, 172 women died because of PRS, similar to 2017-2019 and it is the second lowest number amongst all the triennia. The deaths from bowel injury at caesarean section may indicate a trend of increasing numbers of difficult repeat caesarean sections and this warrants a detailed further analysis. The upscaling of voluntary counselling and testing and universal treatment for all people living with HIV has been impressive. Pregnant women are a key intervention group. It is uplifting that an increasing percentage of more than 90 percent was on ARV treatment compared to 75.6 percent in 2017-2019. However, these women may have survived if they had received ART pre-pregnancy or early in their pregnancies. Every district health service in South Africa must strengthen systems to ensure detection and treatment of HIV infection as early as possible in and out of pregnancy, including strategies to ensure initiation of antenatal care as early as possible in gestation (before 14 weeks).

Almost all the deaths (98.5 percent) occurred in hospital, mainly in regional and tertiary facilities. Free State still has the highest iMMR due to PRS at 10.4 maternal deaths per 100,000 live births, increased from 9.29 in 2017-2019. North West PRS iMMR decreased from a high of 8.03 to 4.9. Mpumalanga increased to 8.5 (2020-2022) after maintaining the decrease of its iMMR from 12.8 to 4.48 then 4.21 in the previous three triennia respectively.

More than seventy percent of these deaths were potentially preventable. More than fifty percent had suboptimal care related to administrative health systems' related factors like overburdened services, lack of appropriately trained doctors and nurses and non-availability of appropriate skill etc. At patient /community level, delay in accessing care is the most important contributor (50 percent, declined from 64.2 per cent). The severity of PRS is often underestimated by the healthcare providers and its management is inadequate. Antibiotics are prescribed, but in septic shock, the patient requires more fluid support, intensive care and/or hysterectomy. The small proportion of women that underwent hysterectomy (15.4%) indicates that probably not enough was done. Clinicians, especially in district and regional hospitals, need to be reminded and educated about recognising septic shock in ill postpartum women, using fora such as morbidity and mortality meetings, or formal ESMOE training. Hospital admission, organ system evaluation (including qSOFA) and goal-directed resuscitation are needed for women with maternal sepsis. In lower levels of care (eg CHCs and district hospitals) prompt transfer to higher levels of care, after adequate fluid resuscitation, and administration of high-dose broad-spectrum antibiotics is mandatory. Critical care provision to women with septic shock was associated with problems in accessing critical care facilities in regional and tertiary hospitals. In these institutions, the capacity of staff and facilities to manage women with severe PRS should be audited and improved.

Avoidable factors associated with the healthcare providers were present in 55.1 per cent of cases in district hospitals, 73 percent of cases in regional hospitals, 60.2% in tertiary hospitals and 66.7 percent in private hospitals and for private, this increased from 55.6 percent. Lastly, the majority (greater than ninety percent) of women with PRS died during the postpartum period. All clinics and hospitals must ensure compliance with postnatal care protocols, with close monitoring and vigilance for early evidence of maternal sepsis. Healthcare workers (including nurses and doctors) who attend to postnatal women must be aware of criteria for hospital discharge, for antibiotic prophylaxis and treatment, and for hospital readmission. Women being discharged after delivery need information on danger signs suggesting maternal sepsis and clear instructions on what they must do if signs are experienced.

Conclusion

While the rate of PRS deaths has shown a slow but steady decline in recent years, the high proportion of avoidable deaths is still of great concern and more efforts including pandemic preparedness are mandatory towards achieving desired target goals.

Key recommendations

1. Ensure capacity and accessibility of facilities for outpatient postnatal care within six 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 septic shock in ill postpartum women, using fora such as morbidity and mortality meetings, or formal ESMOE training or other training platforms.
5. No woman should be discharged from the hospital if any abnormal vital signs are recorded, and immediate readmission is advised in women with any symptoms and signs suggestive of sepsis.
6. Proper initial triage of these patients and immediate implementation of maternal sepsis 'bundles' must always be done at all levels of care.
7. District hospital protocols, especially in rural areas, must emphasise recognition of septic shock and the need for early transfer of such women to higher levels of care, after the immediate implementation of sepsis 'bundles' as outlined in the maternity care guidelines.
8. In regional hospitals, audit the capacity of staff and facilities to manage women with septic shock. Recommended norms and standards for staff and facilities, including intensive care units, should be followed.
9. Educate all doctors performing Caesarean sections about precautions for preventing bowel injury at repeat Caesarean section (or any previous abdominal surgery). Ensure protocols are in place for intraoperative management of bowel injuries, including general surgical help, and transfer to higher levels of care (with immediate treatment).
10. Ensure that all junior healthcare professionals receive full supervision from their seniors.

References

1. Cebekhulu S, Pattinson RC. Maternal deaths due to sepsis: a slow but steady decline. O&G Forum 2020; 30: 22-23
2. Cebekhulu SN, Cornelissen L, Pattinson R. Too little, too late: the recurrent theme in maternal deaths due to sepsis. O&G Forum 2018; 28: 9–12

7.7 Acute Collapse and Embolism

Professor Lawrence Chauke

Abstract

Background: Maternal deaths due to embolism are increasingly recognised as an important cause of maternal mortality globally. This is attributed to rising risk factors among pregnant women, a lack of standardised risk assessment and stratification, and insufficient monitoring and thromboprophylaxis for those at-risk during pregnancy and the postpartum period.

Aim: This study aims to profile women who died due to embolism and acute collapse during the triennium of 2020-2022, identify avoidable factors, and use this information to make recommendations.

Method: This report presents an analysis of data of women who died from embolism and acute collapsed during the 2020-2022 triennium. The data has been sourced from the Maternal Mortality and Morbidity (MaMMAS) database and review of clinical records of women who died from embolism and acute collapse during the specified period.

Findings: Throughout the study period, there were 3,019,165 deliveries and 3,803 maternal deaths, 116 of which were due to embolism and 72 due to acute collapse. Among maternal deaths due to embolism, 102 (87.9%) were due to pulmonary embolism, while 14 (12.1%) were due to amniotic fluid embolism. The ages of women who died from embolism ranged from 20 to 44 years, with the majority aged 35 to 39 and having a parity of 0 to 3. HIV status was known for 95 (81.9%) of the maternal deaths; over half (54, 56.8%) of the mothers were HIV negative. Only 21 maternal deaths (19 from the embolism group and 2 from acute collapse of unknown cause) had an unknown HIV status. Among the 41 (43.1%) maternal deaths that were HIV positive, 37 (90.2%) were receiving antiretroviral therapy (ART). Notably, over half (54, 56.8%) of maternal deaths due to embolism occurred among HIV-negative women. The majority of embolism-related deaths (102 out of 116, or 87.9%) happened following caesarean deliveries compared to vaginal deliveries (51 vs. 31), with pulmonary embolism being the predominant cause. However, women delivering vaginally with risk factors also remained at risk for embolism-related complications.

Of the 116 maternal deaths due to embolism, most received care at district hospitals (38, 32.8%), followed by regional hospitals (35, 30.2%) and tertiary public hospitals (17, 14.7%). Four women (3.4%) died at a community health centre and 7 (6%) died outside of a health facility. The institutional maternal mortality ratio (iMMR) for embolism and acute collapse has been roughly constant since 2011, at approximately 3.6 and 2.53 per 100,000 live births, respectively, with a decline in iMMR for embolism noted in 2019. However, the 2020-2022 triennium registered a slight increase in iMMR for embolism (3.8) along with a decrease in maternal deaths due to acute collapse of unknown cause (2.38). It remains uncertain whether the slight rise in iMMR for embolism is related to the COVID-19 pandemic or if the decrease in deaths due to acute collapse signifies improvements in postmortem utilization or pulmonary embolism diagnosis.

The fatality rate for embolism increased with advancing maternal age, particularly for women aged 35 to 39, who were at the highest risk of succumbing to both amniotic fluid and pulmonary embolism. Avoidable factors were identified in 36.1% of the 105 assessable maternal deaths due to embolism, categorized as follows: patient-related factors (38, 36.2%), administrative factors (37, 35.2%), and resuscitation-related factors (43, 41%). In the 63 assessable cases of acute collapse of unknown cause, avoidable factors were found to be patient-related (24, 38.1%), administrative (26, 41.3%), and resuscitation-related (23, 36.5%).

Conclusion: Embolism and acute collapse ranked as the eighth most common cause of maternal mortality in South Africa during the 2020-2022 triennium, primarily affecting relatively young, HIV-negative women. The majority of women who died had risk factors. Urgent differentiation between acute collapse during pregnancy and the puerperium due to amniotic fluid embolism (AFE) or pulmonary embolism (PE) is necessary. Furthermore, most women with acute collapse remain undiagnosed, and more effort should be made to identify the underlying cause, starting with an assessment of risk factors, appropriate investigations when risk factors are identified, and culminating with postmortem examinations for those who die without a clear diagnosis. All facilities managing pregnant women should have risk assessment tools and standardized management protocols for those at risk that should include thromboprophylaxis for women at risk of thromboembolism.

Embolism

In 2020, 2021, and 2022, there were 1,234, 1,507, and 1,062 maternal deaths (MDs), respectively, resulting in a corrected triennial total of 3,803 which is higher than the 3,347 deaths reported during the 2017-2019 period. During the 2020-2022 triennium, there were 3,019,165 live births (according to District Health Information System), which translates to a maternal mortality rate (iMMR) of 126 per 100,000 live births, an increase compared to the 113.8 reported during the 2017-2019 triennium. Embolism was the seventh commonest cause of death account for 116 (3%) of maternal deaths with an iMMR of 3.8 deaths per 100,000 live births. The embolism numbers may be an underestimate, as some deaths classified under acute collapse could have been due to embolism. Among the 116 women who died from embolism, 102 (87.9%) were attributed to pulmonary embolism, while 14 (12.1%) were due to amniotic fluid embolism.

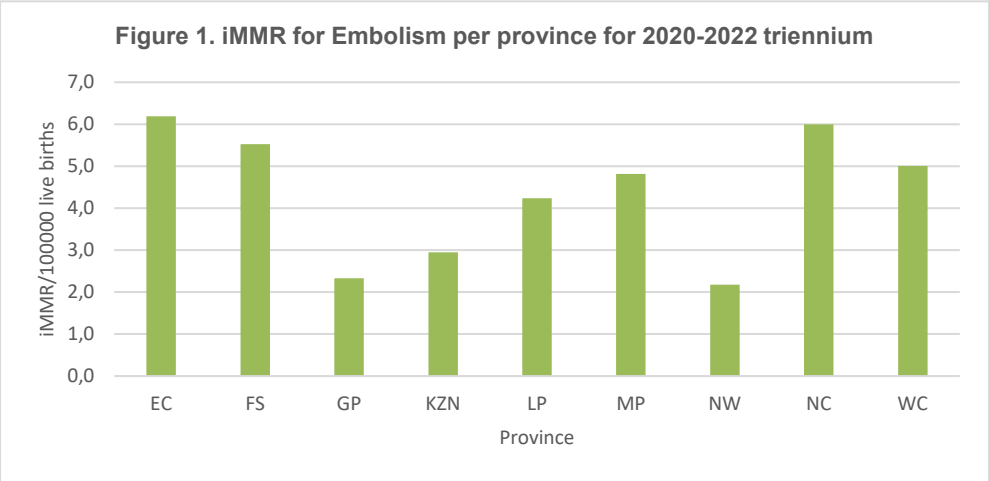
Provincial distribution

The Eastern Cape and KwaZulu-Natal reported the highest number of maternal deaths due to embolism, followed by Gauteng and the Western Cape, and pulmonary embolism was the leading cause of these embolism-related maternal deaths (Table 1). The Eastern Cape and Northern Cape also had the highest institutional maternal mortality ratios (iMMR) related to embolism, followed by the Free State and Western Cape. In contrast, two provinces, North West and Gauteng recorded the lowest rates, embolism related deaths amongst the nine provinces (Figure 1).

Table 1. Provincial distribution of embolism related maternal deaths

Primary obstetric problems	EC	FS	GP	KZN	LP	MP	NW	NC	WC	Total
Embolism	**20**	**8**	**16**	**19**	**17**	**13**	**4**	**4**	**15**	**116**
- Pulmonary embolism	18	7	14	19	15	10	4	4	11	102
- Amniotic fluid embolism	2	1	2		2	3			4	14

Primary obstetric problems	EC	FS	GP	KZN	LP	MP	NW	NC	WC	Total
Live births (2022-2022)	323133	144861	686071	644299	401082	270064	183505	66723	299427	3019165



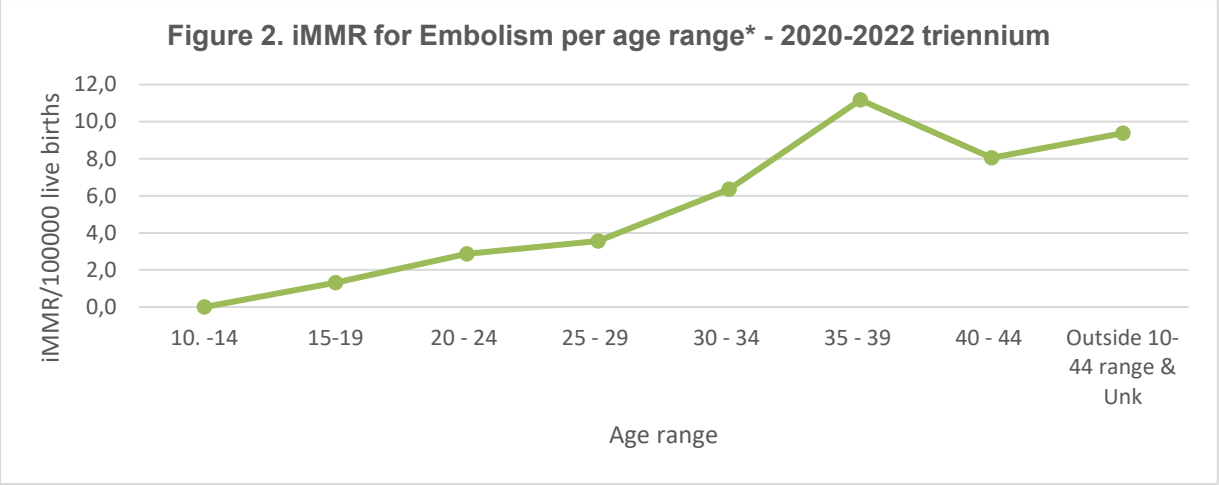
Maternal demographic and pregnancy characteristics

The ages of the women who died from embolism ranged from 20 to 44 years, with the age group of 35 to 39 recording the highest incidence (Table 3); and parity ranging from 0 to 3 (Table 4).

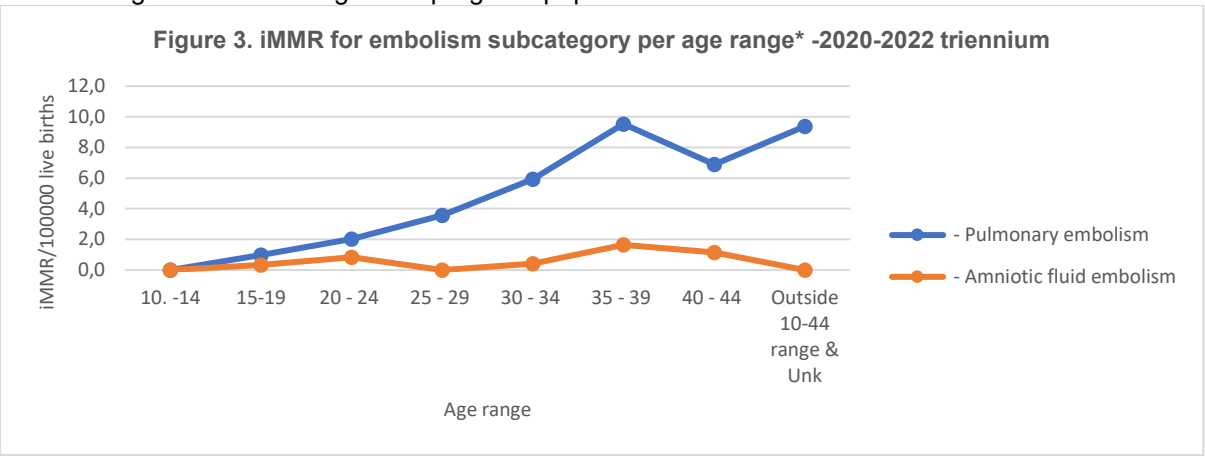
Table 3. Maternal age

Primary obstetric problem	10 -14	15-19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	Outside 10-44 range & Unk	Total
Embolism	**0.0**	**1.3**	**2.9**	**3.6**	**6.4**	**11.2**	**8.0**	**9.4**	**4.8**
- Pulmonary embolism	0.0	1.0	2.0	3.6	5.9	9.5	6.9	9.4	4.3
- Amniotic fluid embolism	0.0	0.3	0.8	0.0	0.4	1.6	1.1	0.0	0.6
Live births 2021 (Stats SA)	**13600**	**303250**	**592747**	**588679**	**488149**	**304295**	**87022**	**21309**	**2399050**

The iMMR for embolism demonstrated a gradual increase with advancing maternal age, peaking in the age group 35-39, primarily due to pulmonary embolism (PE) (Figure 2). There were no significant age-related differences in iMMR associated with amniotic fluid embolism. (Figure 3).



* Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021



* Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021

Table 4. Parity for 2020-2022 triennium

Primary obstetric problem	P0	P1	P2	P3	P4	P5	P6	Unknown	Total
Embolism	**29**	**28**	**29**	**17**	**5**	**2**	**2**	**4**	**116**
- Pulmonary embolism	23	26	24	17	4	2	2	4	102
- Amniotic fluid embolism	6	2	5	0	1	0	0	0	14

HIV Status for 2020-2022 triennium

The HIV status was known in 95 (81.9%) of the maternal deaths; just over half (54, 56.8%) of the mothers who died were HIV negative, while 21 of the maternal deaths (19 in the embolism group and two in the acute collapse of unknown cause) had an unknown HIV status. This is observation is concerning as pregnant women should be afforded an opportunity to test for HIV each time they present to healthcare facilities. Among the 41 (43.1%) women who tested HIV positive, 37 (90.2%) were on ART. Over half (54, 56.8%) of the embolism-related maternal deaths occurred among HIV-negative women.

Table 5. HIV status

Primary obstetric problems	All	Positive	Negative	Declined test and Unknown	ARV's
Embolism	**116**	**41**	**54**	**21**	**37**
- Pulmonary embolism	102	37	46	19	34
- Amniotic fluid embolism	14	4	8	2	3

The majority of maternal deaths related to embolism (51 out of 116, 43.9%) occurred among women who delivered via caesarean section, compared to those who delivered vaginally (31, 26.7%). It is important to note that while caesarean section delivery is associated with a higher risk, embolism can also occur among women who deliver vaginally who have other risk factors, therefore, this group of women should not be overlooked. Most of the deaths occurred in Regional Hospitals, followed by District and Tertiary/Central Hospitals (Table 6).

Table 6. Mode of delivery for 2020-2022 triennium

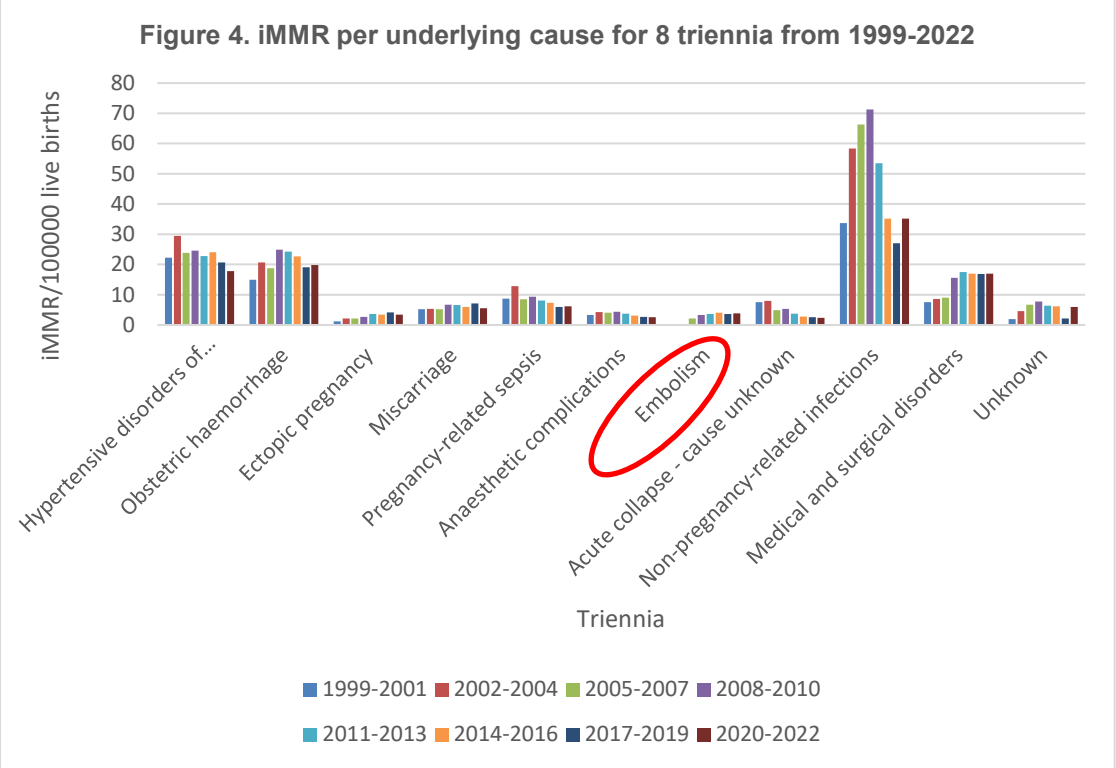
Primary obstetric problems	Vaginal	CD	CD CHC	CD DH	CD RH	CD NCH & TH	CD Pvt
Embolism	**31**	**51**	**1**	**15**	**18**	**12**	**10**
- Pulmonary embolism	28	43	1	13	13	11	10
- Amniotic fluid embolism	3	8		2	5	1	

Annual and Triennial trends in Embolism deaths

Compared to other conditions, the iMMR for embolism have remained stagnant for many years (Table 7 and 8, Figures 4 and 5) calling for more attention.

Table 7. Trends in iMMR for Embolism 1999-2022

	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019	2020-2022
Hypertensive disorders of pregnancy	22.26	29.43	23.85	24.58	22.75	24.02	20.73	17.85
Obstetric haemorrhage	14.93	20.72	18.82	24.91	24.32	22.67	19.11	19.84
Ectopic pregnancy	1.19	2.2	2.11	2.72	3.63	3.45	4.19	3.41
Miscarriage	5.27	5.34	5.21	6.73	6.58	6	7.18	5.5
Pregnancy-related sepsis	8.74	12.84	8.55	9.34	8.04	7.3	5.99	6.19
Anaesthetic complications	3.34	4.27	4.1	4.38	3.73	3.16	2.72	2.55
Embolism			**2.19**	**3.37**	**3.63**	**4.03**	**3.6**	**3.84**
Acute collapse - cause unknown	7.55	8.01	4.91	5.36	3.77	2.8	2.53	2.38
Non-pregnancy-related infections	33.72	58.4	66.28	71.29	53.47	35.17	27.05	35.21
Medical and surgical disorders	7.51	8.62	9.09	15.57	17.53	16.97	16.91	16.99
Unknown	1.93	4.64	6.67	7.82	6.44	6.14	2.14	5.93
iMMR	**106.42**	**154.48**	**151.77**	**176.22**	**153.88**	**134.33**	**113.77**	**121.06**



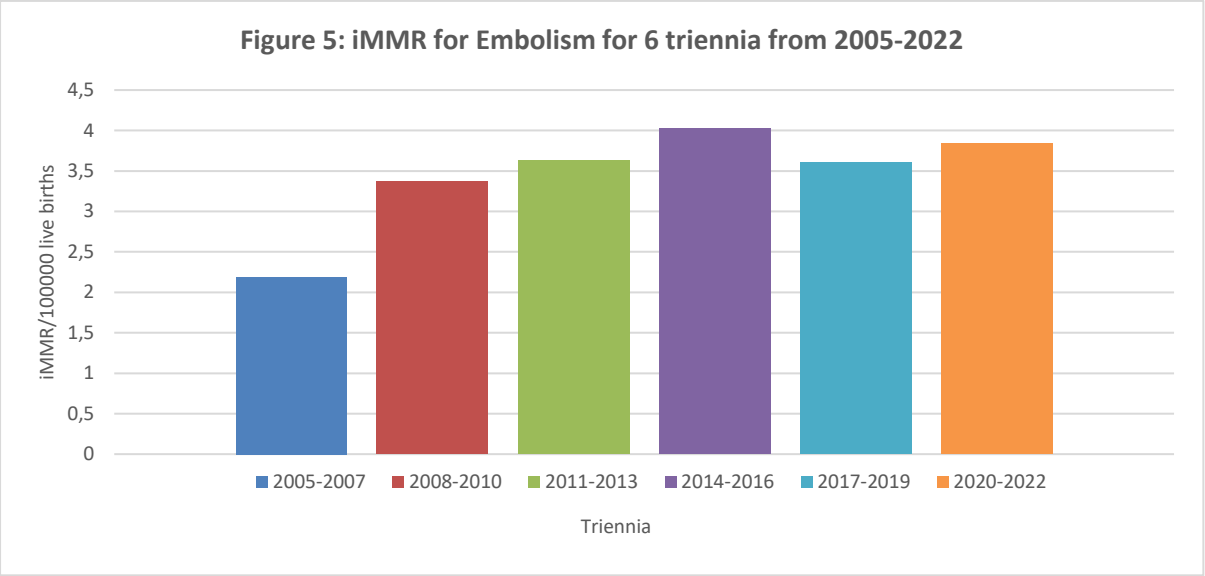


Table 8. Annual trend in the number of maternal deaths due to embolism and related iMMR

Embolism	n	% of yearly total	iMMR
2017	35	2.9	3.8
2018	43	3.6	4.5
2019	24	2.3	2.5
2020	33	2.7	3.2
2021	43	2.8	4.2
2022	40	4	4.1

The level of care at which embolism-related maternal deaths occurred was as follows: 38 at District Hospitals, 35 at Regional Hospitals, and 20 at Central and Tertiary Hospitals. Deaths occurring outside healthcare facilities and at Community Health Centres (CHCs) contributed a total of seven and four, respectively (Table 9).

Table 9. Level of care for 2020-2022

	Outside	CHC	District hospital	Regional hospital	Nat central & Tertiary hospital	Private hospital	Total
Embolism	**7**	**4**	**38**	**35**	**20**	**12**	**116**
- Pulmonary embolism	7	4	35	27	17	12	**102**
- Amniotic fluid embolism	0	0	3	8	3	0	**14**
Live birth (2020-2022)		**369653**	**1 260 587**	**815 341**	**389325**		**2834906**

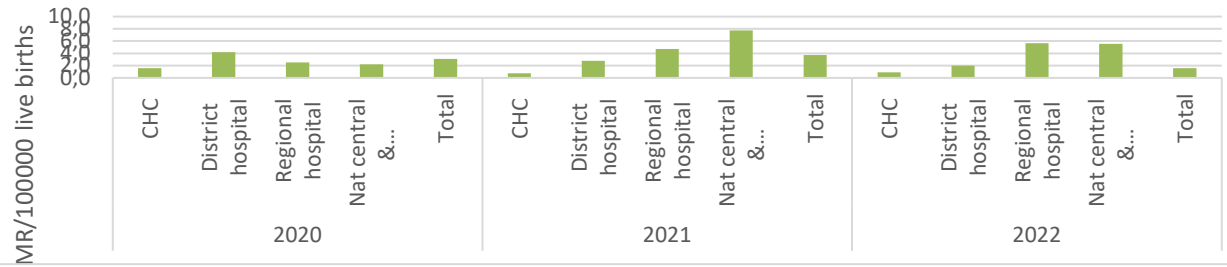
Table 10 below shows the distribution of embolism related maternal deaths by level of care for each year during the triennia.

Table 10. Annual Maternal Deaths Due to Embolism by Level of Care

	2020					2021					2022				
	CHC	District hospital	Regional hospital	Nat central & Central hospital	Total	CHC	District hospital	Regional hospital	Nat central & Central hospital	Total	CHC	District hospital	Regional hospital	Nat central & Central hospital	Total
Embolism	**1.6**	**4.2**	**2.5**	**2.2**	**3.1**	**0.8**	**2.8**	**4.7**	**7.8**	**3.7**	**0.9**	**2.0**	**5.7**	**5.5**	**1.6**
- Pulmonary embolism	1.6	3.7	1.4	2.2	2.6	0.8	2.8	4.0	7.0	3.4	0.9	1.7	4.5	4.0	1.6
- Amniotic fluid embolism	0.0	0.5	1.1	0.0	0.5	0.0	0.0	0.7	0.8	0.3	0.0	0.2	1.1	1.6	0.0
Live births	127201	429071	276124	134198	966594	129863	427716	274735	128677	960991	112589	403800	264482	126450	780871

In 2020, district hospitals (DHs) had the highest iMMR for embolism, followed by regional hospitals (RHs). However, in 2021, national/central hospitals reported the highest embolism-related iMMR, with regional and district hospitals following closely behind. By 2022, there was only a slight difference in embolism related iMMR between regional and central hospitals (Figure 6).

Figure 6. iMMR for Embolism per level of care from 2020-2022



Postmortems were done in 54 (46.5%) of the 116 cases. Diagnosis of pulmonary embolism was made using both postmortem examination and radiological investigations. Table 11 also shows that 39 (54.2%) of the acute collapse deaths had postmortem examination and 26 (36.1%) with an unknown cause of death.

Table 11. Number of Postmortems performed for maternal deaths and Cause of death as assigned by assessors

Primary Obstetric Problem	No PM	PM	Total	% PM of total POP
Medical and surgical disorders	371	142	513	27,68
Non-pregnancy-related infections	958	105	1063	9,88
Ectopic pregnancy	56	47	103	45,63
Miscarriage	133	33	166	19,88
Pregnancy-related sepsis	130	57	187	30,48
Obstetric haemorrhage	361	238	599	39,73
Hypertension	409	130	539	24,12
Anaesthetic complications	40	37	77	48,05
Adverse drug reactions	17	9	26	34,62
Embolism	62	54	116	46,55
Acute collapse - cause unknown	33	39	72	54,17
Miscellaneous	13	2	15	13,33
No primary cause found	13	13	26	50,00
Lack of information	36	17	53	32,08
Maternal death	**2632**	**923**	**3555**	**25,96**
Death at home or outside facility	69	31	100	31,00
Coincidental causes	40	39	79	49,37
DDPCP	**2741**	**993**	**3734**	**26,59**

Embolism was the regarded as the final cause of death in 75% of the cases, contributing to various organ failures (Table 12).

Table 12. Final cause for 2020-2022 triennium

Cause of death	Emb
Circulatory system	**7**
- Hypovolaemic shock	3
- Septic shock	4
Respiratory failure	**45**
- Respiratory failure	45
Cardiac failure	**16**
- Pulmonary oedema	16
Embolism	**75**
- Acute collapse due to embolism	75
Renal failure	**6**
- Renal failure	6
Liver failure	**5**
- Liver failure	5
Cerebral complications	**1**
- Intracranial haemorrhage	

Cause of death	Emb
- Cerebral oedema resulting in coning	
- Meningitis	
- Cerebral emboli	
- Brain death following hypoxic event	1
- Unspecified	
Metabolic	**1**
- Maternal ketoacidosis	1
- Electrolyte imbalance	
- Thyroid crisis	
- Lactic acidosis	
- Other	
Haematological	**6**
- DIC	4
- Severe anaemia	2
Immune system	**7**
- Immune system failure	7
Unknown	**4**
- Home death	2
- Unknown	2
Other	**7**
- Other	7
Total	**116**
% of total deaths:	**3.1**

Avoidable factors for maternal deaths due to Embolism.

Avoidable factors were identified in 36.1% of the 105 maternal deaths due to embolism that were assessable, categorised as follows: patient/ community related factors, 38 (36.2%); administrative factors, 37 (35.2%); and resuscitation-related factors, 43 (41%). (Tables 13 a – 13f). There were 54 deaths (38.1%) that were assessed as being potentially preventable within the health system (Table 13b).

Table 13a. Overview of Avoidable Factors

2020-2022	Embolism	% of total
Patient oriented problems		
- Avoidable factors identified	38	32.8
- No avoidable factors	69	59.5
- Lack of information	11	9.5
Assessable cases	105	
Proportion avoidable factors identified	36.2	
Administrative problems		
- Avoidable factors identified	37	31.9
- No avoidable factors	69	59.5
- Lack of information	13	11.2
Assessable cases	103	
Proportion avoidable factors identified	35.9	

2020-2022	Embolism	% of total
Resuscitation problems		
- Avoidable factors identified	43	37.1
- No avoidable factors	62	53.4
- Lack of information	11	9.5
Assessable cases	105	
Proportion avoidable factors identified	41.0	

2020-2022	Embolism	% of total	% of cases at this level
Medical care - CHC			
- Managed at this level	46	39.7	
- Avoidable factors identified	14		30.4
- No avoidable factors	28		60.9
- Lack of information	5		10.9
Assessable cases	111		
Proportion avoidable factors identified	12.6		
Medical care - district hospital			
- Managed at this level	57	49.1	
- Avoidable factors identified	33		57.9
- No avoidable factors	21		36.8
- Lack of information	4		7.0
Assessable cases	112		
Proportion avoidable factors identified	29.5		
Medical care - Regional hospital			
- Managed at this level	38	32.8	
- Avoidable factors identified	22		57.9
- No avoidable factors	14		36.8
- Lack of information	4		10.5
Assessable cases	112		
Proportion avoidable factors identified	19.6		
Medical care - Tertiary & above			
- Managed at this level	25	21.6	
- Avoidable factors identified	9		36.0
- No avoidable factors	14		56.0
- Lack of information	2		8.0
Assessable cases	114		
Proportion avoidable factors identified	7.9		
Medical care - Private hospital			

2020-2022	Embolism	% of total	% of cases at this level
- Managed at this level	11	9.5	
- Avoidable factors identified	2		18.2
- No avoidable factors	8		72.7
- Lack of information	2		18.2
Assessable cases	114		
Proportion avoidable factors identified	1.8		

Table 13b. Impact of suboptimal care

2020-2022	Embolism
Impact of suboptimal care	
- No suboptimal care identified	47
- Suboptimal care, no impact on outcome	15
- Suboptimal care, possible impact on outcome	38
- Suboptimal care, probable impact on outcome	16
Total	**116**
Proportion of suboptimal deaths	
- No suboptimal care identified	40.5
- Suboptimal care, no impact on outcome	12.9
- Suboptimal care, possible impact on outcome	32.8
- Suboptimal care, probable impact on outcome	13.8
Potentially preventable deaths	**46.6**

Table 13c. Patient/community orientated factors

2020-2022	Embolism
Lack of information	11
No avoidable factor	69
Assessable cases	105
% no avoidable factors	**65.7**
Avoidable factors	36
No antenatal care	6
Infrequent antenatal care	7
Delay in accessing medical help	24
Declined medication/surgery/advice	4
Family problem	2
Community problem	0
Unsafe abortion	2
Other	4

2020-2022	Embolism
Total	**116**
Proportion of assessable cases	
No antenatal care	5.2
Infrequent antenatal care	6
Delay in accessing medical help	20.7
Declined medication/surgery/advice	3.4
Family problem	1.7
Community problem	0
Unsafe abortion	1.7
Other	3.4

Table 13d. Administrative factors

2020-2022	Embolism
Lack of information	13
No avoidable factor	69
Assessable cases	103
% no avoidable factors	**67.0**
Avoidable factors	34
Transport problem: Home to institution	0
Transport problem: Institution to institution	5
Lack of accessibility: Barriers to entry	1
Lack of accessibility: Other	0
Delay in attending to patient (Overburdened service)	3
Delay in attending to patient (Reason unknown)	4
Lack of healthcare facilities: ICU	2
Lack of healthcare facilities: Blood/blood products	1
Lack of healthcare facilities: Other	0
Inadequate numbers of staff on duty	6
Appropriate skill not available on site / on standby	6
Communication problems: Technical	3
Communication problems: Interpersonal	1
Other	14
Total	**116**
Proportion of avoidable factors	
Transport problem: Home to institution	0
Transport problem: Institution to institution	4.3
Lack of accessibility: Barriers to entry	0.9

2020-2022	Embolism
Lack of accessibility: Other	0
Delay in attending to patient (Overburdened service)	2.6
Delay in attending to patient (Reason unknown)	3.4
Lack of healthcare facilities: ICU	1.7
Lack of healthcare facilities: Blood/blood products	0.9
Lack of healthcare facilities: Other	0
Inadequate numbers of staff on duty	5.2
Appropriate skill not available on site / on standby	5.2
Communication problems: Technical	2.6
Communication problems: Interpersonal	0.9
Other	12.1

Table 13e. Emergency Care factors

2020-2022	Embolism
Lack of information	11
Not attempted	18
No avoidable factor	62
Resuscitation attempted	
Avoidable factors	
Airway problems	6
Breathing problems	13
Circulation problems	10
Drug problems	1
Investigation problems	3
Monitoring problems	5
Total	**116**
Proportion of resuscitation attempted	
Avoidable factors	
Airway problems	5.2
Breathing problems	11.2
Circulation problems	8.6
Drug problems	0.9
Investigation problems	2.6
Monitoring problems	4.3

Table 13f. Medical care factors

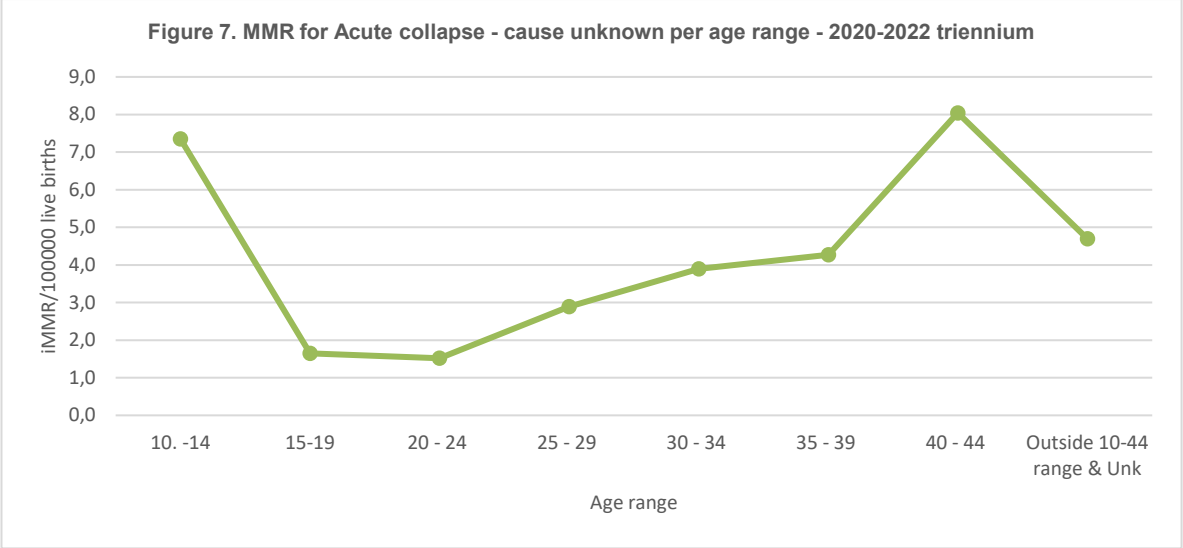
Description	Community health centre	District hospital	Regional hospital	Tertiary hospital / above	Private hospital
Managed at this level	46	57	38	25	11
Lack of information	5	4	4	2	2
No avoidable factor	28	21	14	14	8
Assessable cases	41	53	34	23	9
% no avoidable factors	**68.3**	**39.6**	**41.2**	**60.9**	**88.9**
Avoidable factors	13	32	20	9	1
Initial assessment	7	10	5	3	0
Problem with recognition / diagnosis	4	17	14	5	0
Delay in referring the patient	3	9	1	0	1
Managed at inappropriate level	1	8	5	1	0
Incorrect management (Wrong diagnosis)	0	3	5	1	2
Sub-standard management (Correct diagnosis)	3	9	6	5	0
Not monitored / Infrequently monitored	0	5	1	1	0
Prolonged abnormal monitoring with no action taken	0	4	5	3	0
Proportion of avoidable cases					
Initial assessment	15.2	17.5	13.2	12	0
Problem with recognition / diagnosis	8.7	29.8	36.8	20	0
Delay in referring the patient	6.5	15.8	2.6	0	9.1
Managed at inappropriate level	2.2	14	13.2	4	0
Incorrect management (Wrong diagnosis)	0	5.3	13.2	4	18.2
Sub-standard management (Correct diagnosis)	6.5	15.8	15.8	20	0
Not monitored / Infrequently monitored	0	8.8	2.6	4	0
Prolonged abnormal monitoring with no action taken	0	7	13.2	12	0

Acute collapse

Maternal characteristics

The precise cause of acute collapse was unknown for these 72 women, despite 39 (54.2%) of them having had postmortem examination (Table 11). The quality of postmortems needs further exploration.

The majority of the women who died of acute collapse from unknown cause belonged to the age groups 30-34 (19, 23.4%) followed by 25-29 (17, 23.6%) and 35-39 13, 18.1%) respectively (Figure 7 and Table 13) and most of them were HIV negative. Amongst those who were HIV positive, 19 out of 22 (86.4%) were on ARVs (Table 14)



* Data for age distribution of general pregnant population is derived from Stats SA Recorded Live Births 2021

Table 13. Maternal age range

Primary obstetric problem	10 -14	15-19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	Outside 10-44 range & Unk	Total
Acute collapse - cause unknown	1	5	9	17	19	13	7	1	72
Live births 2021 (Stats SA)	**13600**	**303250**	**592747**	**588679**	**488149**	**304295**	**87022**	**21309**	**2399050**

Primary obstetric problem	10 -14	15-19	20-24	25-29	30-34	35-39	40-44	Outside 10-44 range & Unk	Total
Acute collapse - cause unknown	7.4	1.6	1.5	2.9	3.9	4.3	8.0	4.7	3.0
Live births 2021 (Stats SA)	**13600**	**303250**	**592747**	**588679**	**488149**	**304295**	**87022**	**21309**	**2399050**

Table 14. HIV Status

Primary obstetric problems	All	Positive	Negative	Declined test & Unknown	ARV's
Acute collapse - cause unknown	72	22	39	11	19

Similar to the situation observed with embolism, the majority of women who died (24, 33.3%) were delivered via caesarean section. Most of the deaths occurred in central and tertiary hospitals, followed by regional and district hospitals. Similar to embolism, the majority (24, 33.3%) of women who died were delivered via caesarean section and most of the deaths occurred at Central and tertiary hospitals followed by Regional and District Hospitals (Table 15).

Table 15. Mode of delivery

Primary obstetric problems	Vaginal	CD	CD CHC	CD DH	CD RH	CD NCH & TH	CD Pvt
Acute collapse - cause unknown	**16**	**24**	**2**	**7**	**8**	**14**	**3**

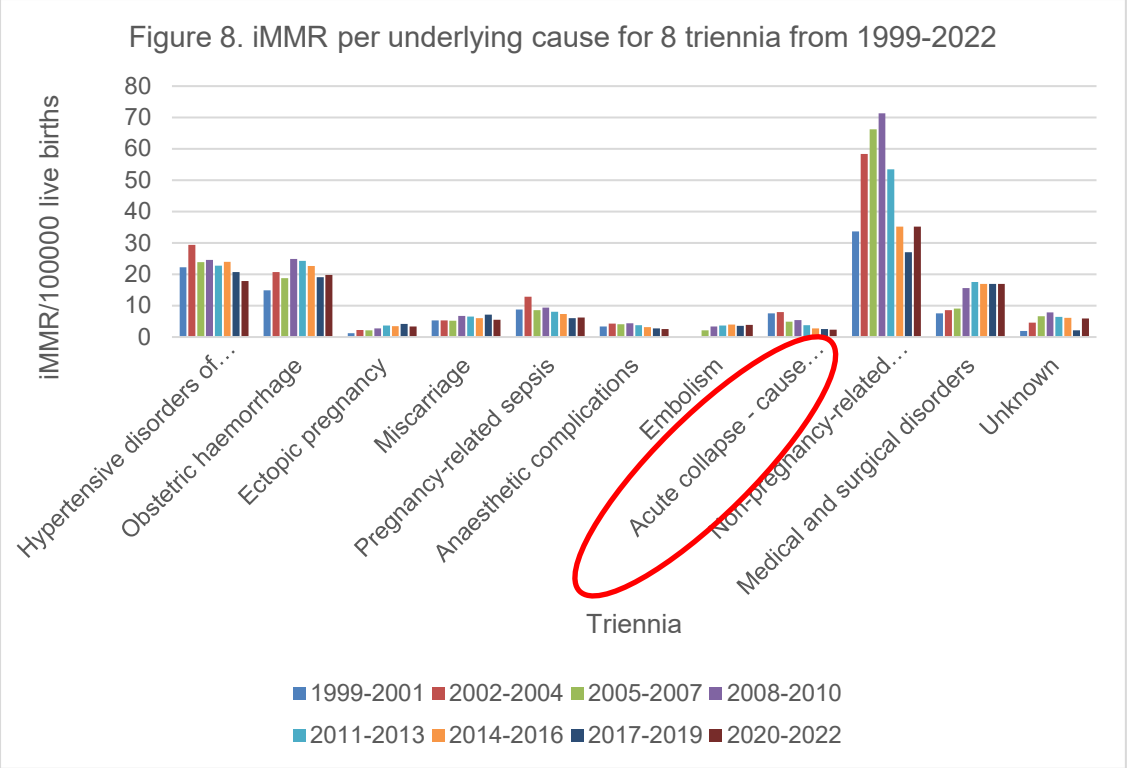
Unlike embolism, the incidence maternal deaths and corresponding of iMMR resulting from acute collapse has been declining since 1999 (see Table 16 and 17, Figures 8 and 9). What is not clear is whether the observed decrease in maternal deaths and iMMR under this category is due to t improved identification and management of underlying causes or true decreased incidence.

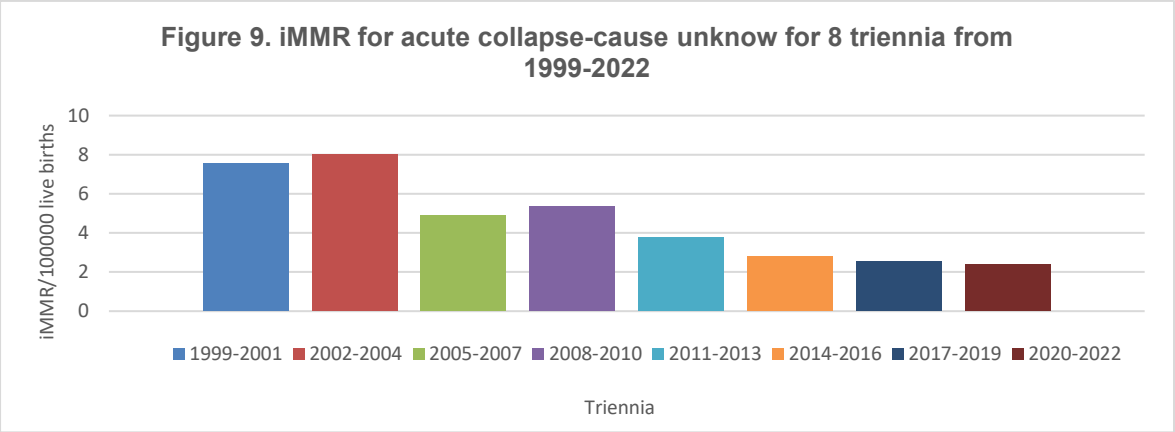
Table 16. Trends in iMMR related to acute collapse

	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019	2020-2022
Hypertensive disorders of pregnancy	22.26	29.43	23.85	24.58	22.75	24.02	20.73	17.85
Obstetric haemorrhage	14.93	20.72	18.82	24.91	24.32	22.67	19.11	19.84
Ectopic pregnancy	1.19	2.2	2.11	2.72	3.63	3.45	4.19	3.41
Miscarriage	5.27	5.34	5.21	6.73	6.58	6	7.18	5.5
Pregnancy-related sepsis	8.74	12.84	8.55	9.34	8.04	7.3	5.99	6.19
Anaesthetic complications	3.34	4.27	4.1	4.38	3.73	3.16	2.72	2.55
Embolism			2.19	3.37	3.63	4.03	3.6	3.84
Acute collapse - cause unknown	**7.55**	**8.01**	**4.91**	**5.36**	**3.77**	**2.8**	**2.53**	**2.38**
Non-pregnancy-related infections	33.72	58.4	66.28	71.29	53.47	35.17	27.05	35.21
Medical and surgical disorders	7.51	8.62	9.09	15.57	17.53	16.97	16.91	16.99
Unknown	1.93	4.64	6.67	7.82	6.44	6.14	2.14	5.93
iMMR	**106.42**	**154.48**	**151.77**	**176.22**	**153.88**	**134.33**	**113.77**	**121.06**

Table 17. Annual trend in maternal deaths due to acute collapse and corresponding iMMR

AC	n	% of yearly total	iMMR
2017	15	1.2	1.7
2018	25	2.1	2.6
2019	32	3.1	3.2
2020	15	1.2	1.5
2021	36	2.4	3.5
2022	21	2.1	2.2





Provincial distribution

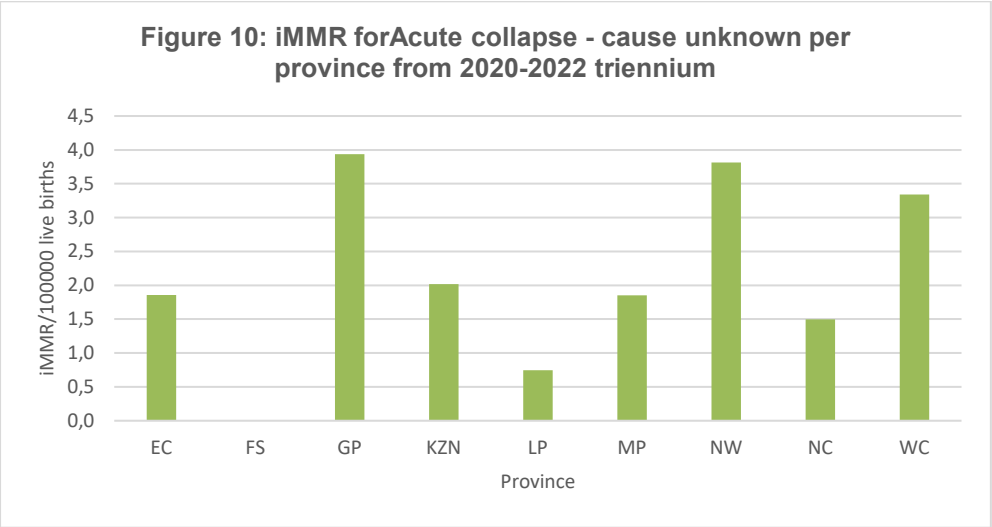
The highest number of acute collapses of unknown cause was reported in Gauteng and the Western Cape (Table 18).

Table 18. Provincial distribution of maternal deaths due to acute collapse during the 2020-2022 triennium

Primary obstetric problems	EC	FS	GP	KZN	LP	MP	NW	NC	WC	Total
Acute collapse - cause unknown (N)	6	0	27	13	3	5	7	1	10	72
Live births (2022-2022)	323133	144861	686071	644299	401082	270064	183505	66723	299427	3019165

Primary obstetric problems	EC	FS	GP	KZN	LP	MP	NW	NC	WC	Total
Acute collapse - cause unknown (iMMR)	1.9	0.0	3.9	2.0	0.7	1.9	3.8	1.5	3.3	2.4
Live births (2022-2022)	323133	144861	686071	644299	401082	270064	183505	66723	299427	3019165

Gauteng and North West recorded the highest iMMR for acute collapse, followed by the Western Cape, respectively (Figure 10). The province of Limpopo has the lowest iMMR in this category.



In terms of the level of care, the majority of maternal deaths due to acute collapse occurred in District, Central, and Tertiary hospitals, as well as regional hospitals, respectively. An equal number of deaths were recorded at Community Health Centres (CHCs) and outside healthcare facilities (see Table 19).

Table 19. Level of care for 2020-2022 triennium

	Outside	CHC	District hospital	Regional hospital	Nat central & Tertiary hospital	Private hospital	Total
Acute collapse - cause unknown	7	7	25	13	19	1	72

	CHC	District hospital	Regional hospital	Nat central & Tertiary hospital	Total (in facility)
Acute collapse - cause unknown	1.9	2.0	1.6	4.9	2.3
Live birth (2020-2022)	**369653**	**1 260 587**	**815 341**	**389325**	**2834906**

Avoidable Factors

Table 20a is a summary of avoidable factors as identified by the assessors. In the 63 cases of acute collapse of unknown cause that were assessable, avoidable factors were as follows: 24 (38.1%) patient-related, 26 (41.3%) administrative, and 23 (36.5%) related to resuscitation. In 38 of the cases (32.8%), suboptimal care

with possible impact on the outcome was identified (Table 20b).

Patient/ community level factors (23,33.3%), administrative (26, 36.1%), resuscitation (26, 36.1%), are further described for each of these categories in Tables 20c-f.

Table 20a. Overview of Avoidable factors

2020-2022	AC	% of total
Patient oriented problems		
- Avoidable factors identified	24	33.3
- No avoidable factors	40	55.6
- Lack of information	9	12.5
Assessable cases	63	
Proportion avoidable factors identified	38.1	
Administrative problems		
- Avoidable factors identified	26	36.1
- No avoidable factors	38	52.8
- Lack of information	9	12.5
Assessable cases	63	
Proportion avoidable factors identified	41.3	
Resuscitation problems		
- Avoidable factors identified	23	31.9
- No avoidable factors	41	56.9
- Lack of information	9	12.5
Assessable cases	63	
Proportion avoidable factors identified	36.5	

2020-2022	AC	% of total	% of cases at this level
Medical care – CHC			
- Managed at this level	36	50.0	
- Avoidable factors identified	6		16.7
- No avoidable factors	25		69.4
- Lack of information	5		13.9
Assessable cases	31		
Proportion avoidable factors identified	19.4		
Medical care - District hospital			
- Managed at this level	35	48.6	
- Avoidable factors identified	18		51.4
- No avoidable factors	16		45.7
- Lack of information	2		5.7
Assessable cases	33		

2020-2022	AC	% of total	% of cases at this level
Proportion avoidable factors identified	54.5		
Medical care - Regional hospital			
- Managed at this level	14	19.4	
- Avoidable factors identified	8		57.1
- No avoidable factors	5		35.7
- Lack of information	2		14.3
Assessable cases	12		
Proportion avoidable factors identified	66.7		
Medical care - Tertiary and above			
- Managed at this level	21	29.2	
- Avoidable factors identified	4		19.0
- No avoidable factors	15		71.4
- Lack of information	2		9.5
Assessable cases	19		
Proportion avoidable factors identified	21.1		
Medical care - Private hospital			
- Managed at this level	1	1.4	
- Avoidable factors identified	0		0.0
- No avoidable factors	1		100.0
- Lack of information	0		0.0
Assessable cases	1		
Proportion avoidable factors identified	0.0		

Table 20b. Impact of suboptimal care

2020-2022	AC
Impact of suboptimal care	
- No suboptimal care identified	33
- Suboptimal care, no impact on outcome	11
- Suboptimal care, possible impact on outcome	19
- Suboptimal care, probable impact on outcome	9
Total	**72**
Proportion of suboptimal deaths	
- No suboptimal care identified	45.8
- Suboptimal care, no impact on outcome	15.3

2020-2022	AC
- Suboptimal care, possible impact on outcome	26.4
- Suboptimal care, probable impact on outcome	12.5
Potentially preventable deaths	**38.9**

Table 20c. Patient /community orientated factors

2020-2022	AC
Lack of information	9
No avoidable factor	40
Assessable cases	63
% no avoidable factors	**63.5**
Avoidable factors	23
No antenatal care	12
Infrequent antenatal care	1
Delay in accessing medical help	10
Declined medication/surgery/advice	3
Family problem	0
Community problem	0
Unsafe abortion	1
Other	4
Total	**72**
Proportion of assessable cases	
No antenatal care	16.7
Infrequent antenatal care	1.4
Delay in accessing medical help	13.9
Declined medication/surgery/advice	4.2
Family problem	0
Community problem	0
Unsafe abortion	1.4
Other	5.6

Table 20d. Administrative factors

2020-2022	AC
Lack of information	9
No avoidable factor	38
Assessable cases	63
% no avoidable factors	**60.3**

2020-2022	AC
Avoidable factors	25
Transport problem: Home to institution	0
Transport problem: Institution to institution	3
Lack of accessibility: Barriers to entry	0
Lack of accessibility: Other	0
Delay in attending to patient (Overburdened service)	1
Delay in attending to patient (Reason unknown)	6
Lack of healthcare facilities: ICU	1
Lack of healthcare facilities: Blood/blood products	0
Lack of healthcare facilities: Other	4
Inadequate numbers of staff on duty	1
Appropriate skill not available on site / on standby	3
Communication problems: Technical	2
Communication problems: Interpersonal	1
Other	9
Total	**72**
Proportion of avoidable factors	
Transport problem: Home to institution	0
Transport problem: Institution to institution	4.2
Lack of accessibility: Barriers to entry	0
Lack of accessibility: Other	0
Delay in attending to patient (Overburdened service)	1.4
Delay in attending to patient (Reason unknown)	8.3
Lack of healthcare facilities: ICU	1.4
Lack of healthcare facilities: Blood/blood products	0
Lack of healthcare facilities: Other	5.6
Inadequate numbers of staff on duty	1.4
Appropriate skill not available on site / on standby	4.2
Communication problems: Technical	2.8
Communication problems: Interpersonal	1.4
Other	12.5

20e. Emergency care factors

2020-2022	AC
Lack of information	9
Not attempted	14

2020-2022	AC
No avoidable factor	41
Resuscitation attempted	49
Avoidable factors	8
Airway problems	0
Breathing problems	4
Circulation problems	5
Drug problems	0
Investigation problems	0
Monitoring problems	2
Total	**72**
Proportion of resuscitation attempted	
Avoidable factors	
Airway problems	0
Breathing problems	5.6
Circulation problems	6.9
Drug problems	0
Investigation problems	0
Monitoring problems	2.8

20f. Medical care factors

Description	Community Health Centre	District hospital	Regional hospital	Tertiary hospital / above	Private hospital
Managed at this level	36	35	14	21	1
Lack of information	5	2	2	2	0
No avoidable factor	25	16	5	15	1
Assessable cases	31	33	12	19	1
% no avoidable factors	**80.6**	**48.5**	**41.7**	**78.9**	**100.0**
Avoidable factors	6	17	7	4	0
Initial assessment	3	5	4	0	0
Problem with recognition / diagnosis	3	10	4	1	0
Delay in referring the patient	2	5	0	0	0
Managed at inappropriate level	3	3	2	0	0
Incorrect management (Wrong diagnosis)	0	4	2	0	0
Sub-standard management (Correct diagnosis)	2	5	3	4	0
Not monitored / Infrequently monitored	1	5	3	1	0
Prolonged abnormal monitoring with	0	3	2	1	0

Description	Community Health Centre	District hospital	Regional hospital	Tertiary hospital / above	Private hospital
no action taken					
Proportion of avoidable cases					
Initial assessment	8.3	14.3	28.6	0	0
Problem with recognition / diagnosis	8.3	28.6	28.6	4.8	0
Delay in referring the patient	5.6	14.3	0	0	0
Managed at inappropriate level	8.3	8.6	14.3	0	0
Incorrect management (Wrong diagnosis)	0	11.4	14.3	0	0
Sub-standard management (Correct diagnosis)	5.6	14.3	21.4	19	0
Not monitored / Infrequently monitored	2.8	14.3	21.4	4.8	0
Prolonged abnormal monitoring with no action taken	0	8.6	14.3	4.8	0

Recommendations *(NB: Refer to Appendix for Diagnostic pathways)*

A. *Pulmonary embolism*

- Risk assessment: should be conducted on all pregnant women during the first antenatal visit, and at each hospital admission and discharge followed by appropriate action based on the woman's risk category.
- Early mobilisation of women after caesarean section is strongly recommended and where available, pneumatic compression should be used until a woman is able to mobilise.
- Strongly consider thrombo-prophylaxis for women who are obese (BMI > 30), those who have prolonged hospital stays and those who have had caesarean delivery.
- Education and Awareness: Pregnant women and healthcare providers should be educated about the risk factors and symptoms of thromboembolism, which may include leg pain or swelling, sudden breathlessness, and chest pain and encourage to take appropriate action (consult healthcare providers / appropriate investigations).
- Active Surveillance: All women with factors should be closely monitored for deep vein thrombosis (DVT) and pulmonary embolism (PE), particularly during the postpartum period, which is a critical time for thromboembolism risk.
- Emergency Response Systems: Establish timely diagnosis and management protocols for DVT and PE, ensuring the availability of imaging techniques (e.g., Doppler ultrasound) and rapid initiation of anticoagulation therapy.

C. Amniotic fluid embolism

Healthcare worker awareness, training and emergency preparedness:

- Educate healthcare teams regarding the signs and symptoms of amniotic fluid embolism, such as sudden respiratory distress, hypotension, and coagulopathy.
- Conduct regular emergency drills to prepare staff for managing obstetric emergencies.
- Ensure immediate access to resuscitation equipment and critical care resources, including blood products for the management of coagulopathy.

Develop institutional protocols for the rapid diagnosis and management of suspected amniotic fluid embolism.

- Promptly implement advanced supportive care measures, including oxygenation, blood pressure stabilisation, and the management of disseminated intravascular coagulation (DIC).
- Incorporate a multidisciplinary team approach, involving obstetricians, anaesthesiologists, and critical care specialists, in the management of cases involving amniotic fluid embolism.

D. Acute collapse

- Ensure that in cases of acute collapse of unknown cause and in patients who died during or following a surgical procedure, that a postmortem is requested. More importantly if a postmortem has been done, ensure that at least the gross postmortem results are obtained. This can be done by building relationships with the experts who perform postmortems in your health district.
- Regular training and drills in maternal resuscitation strongly recommended

APPENDIX: Diagnostic work up of embolism and acute collapse

There are many causes of acute collapse during pregnancy and the puerperium (Table 21)

Table 21. Differential diagnosis for acute collapse during pregnancy and the puerperium

Reversible (4H and 4Ts)	**4Hs** Hypoxia Hypovolemia Hypo-/Hyperkalemia Metabolic Hypothermia **4Ts** Thrombosis (coronary or pulmonary) Cardiac Tamponade Toxins Tension Pneumothorax
Others	• Pulmonary embolism (PE) • Amniotic fluid embolism (AFE) • Drug-related issues, including anaesthesia complications (magnesium or local anaesthetic toxicity, high or total spinal anaesthesia **or intrathecal injection of Tranexamic acid**) • Cardiac diseases, such as myocardial infarction, ischemia, aortic dissection, and cardiomyopathy • Hypertension, pre-eclampsia, and eclampsia • Anaphylactic shock • Aspiration pneumonitis • Sepsis • Neurological causes, including stroke and intracerebral haemorrhage (ICH)

Step 1: Maternal resuscitation: Refer ESMOE training modules

Step 2: Clinical suspicion of AFE and PE

Feature	Amniotic Fluid Embolism (AFE)	Pulmonary Embolism (PE)
Onset	Sudden, during labour, caesarean delivery, or immediately postpartum	Sudden, at any stage of pregnancy or puerperium
Symptoms	Hypoxia, hypotension, cardiac arrest, DIC, seizures, altered mental status	Dyspnoea, pleuritic chest pain, tachycardia, hypotension, syncope
Cardiac Arrest	Very common, may be first presentation	Possible especially if massive PE
Respiratory Distress	Severe hypoxia, pulmonary oedema	Acute dyspnoea, often without pulmonary oedema
Neurological Symptoms	Seizures, altered consciousness, confusion	Rare

Feature	Amniotic Fluid Embolism (AFE)	Pulmonary Embolism (PE)
Disseminated Intravascular Coagulation (DIC)	Present (thrombocytopenia, prolonged PT/PTT, low fibrinogen, high D-dimer)	Absent
Haemorrhage	Possible due to DIC	Not a primary feature

It is very important to distinguish between the two as suspicion of PE should be followed by initiation of anticoagulant (e.g. Clexane) until the diagnosis has been excluded. Suspect AFE in a patient who is either in labour or just had a caesarean section who suddenly develops cardiovascular collapse, severe respiratory distress, and coagulopathy. PE on the other hand might present with progressive or sudden dyspnoea, chest pain, and hemodynamic instability.

Step 3: Beside investigations

- **Pulse Oximetry & Arterial Blood Gas (ABG)**
  - Severe **hypoxia** common in both.
  - **Respiratory alkalosis (low CO_2) in PE**.
  - **Metabolic acidosis in severe AFE**.
- **Electrocardiogram (ECG)**
  - **PE:** Tachycardia, right heart strain (S1Q3T3), new-onset right bundle branch block (RBBB).
  - **AFE:** May show bradycardia, asystole, or non-specific ST-T changes.
- **Full blood count (FBC), Coagulation Profile (and Glucose. UKE, electrolytes if suspect hypo or hyperglycaemia and electrolyte problems)**
  - **AFE:** DIC with thrombocytopenia, prolonged PT/PTT, low fibrinogen, high **D-dimer (not very in pregnant or postpartum women**).
  - **PE:** Normal coagulation profile.
- **Cardiac Biomarkers (Troponin, BNP)**
  - **PE:** Elevated in severe cases due to right heart strain.
  - **AFE:** May be elevated due to myocardial dysfunction.

Step 4: Imaging and Specialised Tests

- **Echocardiography (ECG)**
  - **PE:** Right ventricular (RV) dilatation, RV dysfunction, tricuspid regurgitation.
  - **AFE:** Global myocardial depression left ventricular dysfunction, pulmonary hypertension.
- **Chest X-ray**
  - **PE:** Often normal or may show infarction patterns.
  - **AFE:** May show pulmonary edema or bilateral infiltrates.
- **D-dimer**
  - **Elevated in but** less specific in pregnancy.
- **Compression Ultrasound (CUS) for Deep Vein Thrombosis (DVT)**
  - **Confirms underlying DVT in PE**.
- **CT Pulmonary Angiography (CTPA)**
  - **Gold standard for PE** (shows filling defects in pulmonary arteries).
  - **Not useful for AFE**.
- **Ventilation-Perfusion (V/Q) Scan** (if CTPA is contraindicated)
  - **Mismatched defects suggest PE**.

Step 5: Useful tips

- **If sudden collapse with coagulopathy** → AFE is more likely.
- **If collapse preceded by dyspnoea, chest pain, and signs of right heart strain** → PE is more likely.
- **If patient has risk factors for VTE (previous thrombosis, immobility, obesity)** → Consider PE**.**
- **If collapse occurs in labour or postpartum without prior symptoms → Consider AFE.**

Step 6: Immediate Management While Confirming Diagnosis

- Cardiopulmonary Resuscitation (CPR) and Advanced Cardiac Life Support (ACLS) if needed.
- Oxygenation and Mechanical Ventilation for Respiratory Distress.
- Hemodynamic Support with IV Fluids and Vasopressors.
- Empirical Anticoagulation (LMWH) if PE is strongly suspected.
- Massive PE → Consider Thrombolysis.
- AFE → Supportive care, blood products for DIC, and early ICU admission.

Conclusion

Embolism and acute collapse were the 7th commonest cause of maternal mortality in South during the 2020-2022 triennial period, affecting mainly relatively young women who were HIV positive and delivered via caesarean section.

Acute collapse during pregnancy and the puerperium due to **AFE or PE requires urgent differentiation**. **AFE is characterised by sudden cardiovascular collapse with coagulopathy**, while **PE presents with dyspnoea, chest pain, and right heart strain signs**. Immediate resuscitation and targeted investigations (ECG, echocardiography, CTPA) are critical for diagnosis and management.

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7.8 Anaesthetic deaths

Dr Motselisi Mbeki

Abstract *(no full report available*)

This data is derived from the NCCEMD MaMMAS database. A review of the Anaesthesia database (DRAMA) is ongoing, and this will provide additional and more in-depth information about Anaesthetic deaths. The DRAMA database is able to show the cases for which substandard anaesthetic care was contributory to maternal deaths, especially for obstetric causes such as obstetric haemorrhage.

Total Number of Anaesthesia-Related Deaths, and iMMR

The total number of patients who had an anaesthesia-related maternal death was 77. The iMMR for anaesthesia-related maternal deaths in 2020-2022 has improved from other triennial dates and is now 2.55 (Table 1). What is concerning is that within the triennium, the iMMR has risen from 2.2 in 2020 to 4.1 in 2022.

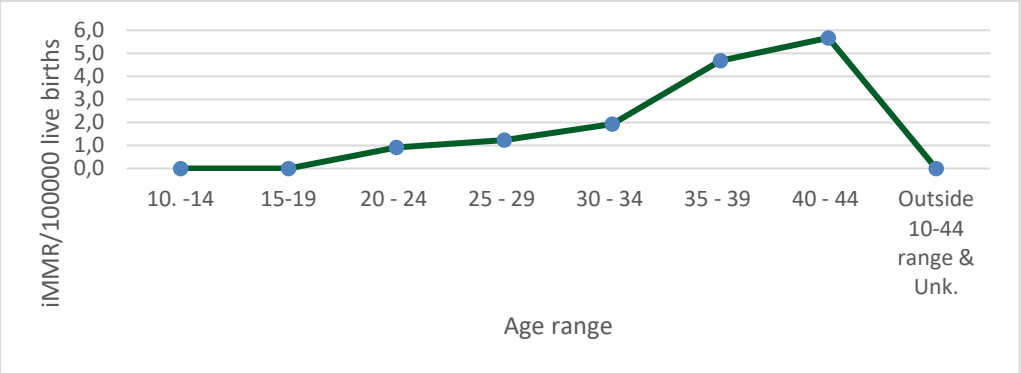
Table 1. Anaesthesia related iMMR 1999-2022

	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019	2020-2022
Hypertensive disorders of pregnancy	22.26	29.43	23.85	24.58	22.75	24.02	20.73	17.85
Obstetric haemorrhage	14.93	20.72	18.82	24.91	24.32	22.67	19.11	19.84
Ectopic pregnancy	1.19	2.2	2.11	2.72	3.63	3.45	4.19	3.41
Miscarriage	5.27	5.34	5.21	6.73	6.58	6	7.18	5.5
Pregnancy-related sepsis	8.74	12.84	8.55	9.34	8.04	7.3	5.99	6.19
Anaesthetic complications	3.34	4.27	4.1	4.38	3.73	3.16	2.72	2.55
Embolism			2.19	3.37	3.63	4.03	3.6	3.84
Acute collapse - cause unknown	7.55	8.01	4.91	5.36	3.77	2.8	2.53	2.38
Non-pregnancy-related infections	33.72	58.4	66.28	71.29	53.47	35.17	27.05	35.21
Medical and surgical disorders	7.51	8.62	9.09	15.57	17.53	16.97	16.91	16.99
Unknown	1.93	4.64	6.67	7.82	6.44	6.14	2.14	5.93
iMMR	**106.42**	**154.48**	**151.77**	**176.22**	**153.88**	**134.33**	**113.77**	**121.06**

Most cases were done under spinal anaesthesia rather than general anaesthesia, despite evidence that spinal anaesthesia is safer than general anaesthesia in obstetrics patients.

There was also an association with an increased iMMR for patients that are of advanced maternal age and anaesthesia-related maternal deaths. The iMMR peaks in the patient age category of 40-44 with an iMMR of 5.7. (Figure 1)

Figure 1. iMMR for Anaesthetic complications per age range *(age range data from Stats SA 2021)*



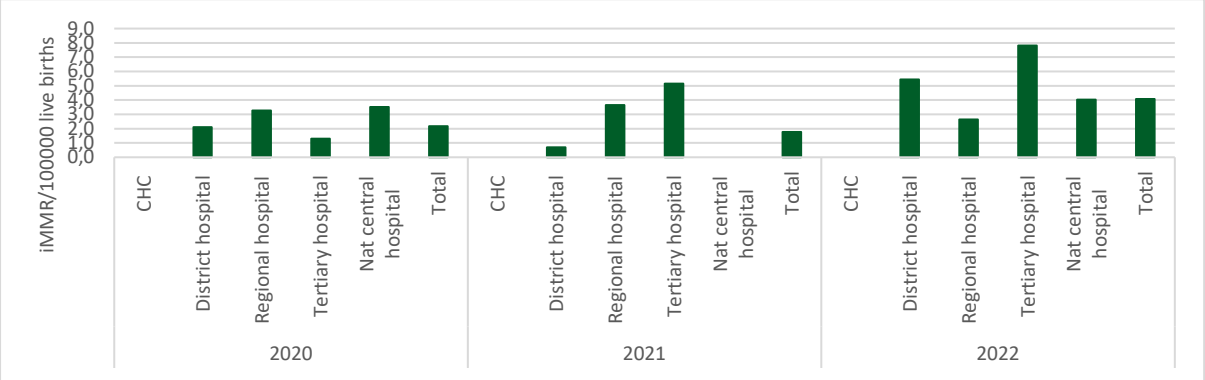
Level of care and anaesthetic mortality

A disproportionate number of the deaths are in District Hospitals (Table 2 and Figure 2).
As in previous triennia, most of the anaesthesia-related maternal deaths occurred in Caesarean Deliveries in the District Hospitals. (Table 2). However, increasingly Regional Hospitals are sites for significant anaesthesia-related maternal mortality. Twenty-nine patients died in District Hospitals versus 26 patients in regional hospitals.

Table 2. Anaesthetic deaths, mode of delivery and level of care

Primary obstetric problems	Vaginal	CD	CD CHC	CD DH	CD RH	CD TH	CD NCH	CD Pvt
Anaesthetic complications	**3**	**70**	**0**	**29**	**26**	**9**	**4**	**2**
General anaesthetic	3	15		5	5	2	2	1
Spinal anaesthetic		55		24	21	7	2	1

Figure 2. iMMR for Anaesthetic complications per level of care from 2020-2022



Final Causes of Death and Avoidability

For the 77 anaesthetic deaths, there were numerous final causes of death:

- Respiratory Failure – 41 (53%)
- Cerebral events – 21 (27.2%). The majority are due to hypoxic events.
- Cardiac Failure – 15 (19.5%)
- Other – 15 (19.5%)

These warrant further analysis when the DRAMA database is interrogated. The categories of causes of death may change after this review.

Potentially 86% of maternal deaths were avoidable.

Recommendations

District hospitals continue to contribute to a disproportionately high number of maternal deaths. Poor training has been repeatedly implicated but inadequate supervision is likely to contribute to the higher iMMR. Strategies are needed to improve and maintain teaching and training in District hospitals, as well as introducing methods to improve onsite supervision for unexpected complications.

Regional hospitals are emerging as sites for significant anaesthesia-related maternal mortality. We wonder whether fluctuating staffing issues and difficulties with retaining medical specialists may contribute to the worsening iMMR.

Age is a factor in anaesthesia-related maternal deaths. The category most affected is the patients who are 40-44 years old. It is not yet clear whether these patients are also being anaesthetised at District hospitals, but they must be considered a high-risk group that has to be referred to regional or tertiary hospitals.

Conclusions

There was an increase in 2022 in anaesthesia-related deaths, which is a concerning trend. The provinces with more significant iMMR are Mpumalanga, Limpopo, Free State and the Eastern Cape. There is also a concern about the underreporting of anaesthesia-related deaths.

The District Hospitals continue to be sites of avoidable anaesthesia-related maternal mortality, but regional hospitals and tertiary hospitals also have significant MMR.

Although it is a few patients, age seems to be a factor in anaesthesia-related maternal mortality. Ensuring that patients of advanced maternal age are delivered in regional hospitals onwards may improve this.

A more in-depth analysis of the Anaesthetic deaths in the MAAMAs and DRAMA databases, with folder review is ongoing and will be published in the expanded Comprehensive report later in 2024.

7.9 Miscellaneous, Adverse Drug Reactions and Coincidental causes

Prof. S Fawcus

Abstract *(no full report available*)

Miscellaneous (Hyperemesis Gravidarum, HMG, and Acute Fatty Liver, AFLS).
There were 15 deaths in this category making up 0.4% of all maternal deaths, with a iMMR of 0.5 maternal deaths per 100,000 live births. They included nine deaths from Hyperemesis Gravidarum (HMG) and six from Acute Fatty Liver Syndrome (AFLS)

Hyperemesis Gravidarum (HMG)There were nine deaths from Hyperemesis gravidarum, with an iMMR of 0.3 per 100,000 live births. This compares with 9 for 2017-2019. They occurred in KwaZulu-Natal (3), Limpopo (2), Free State (2), E. Cape (1) and Mpumalanga (1) There were two deaths at district hospitals, five at Regional and two at Tertiary/national central.

Acute Fatty Liver (AFLS)
There were six deaths from AFLS with an iMMR of 0.2 per 100,000 live births. This compares with 12 in 2017 - 2019 when the iMMR was 0.39. There were four deaths in Western Cape, one in Northern Cape and one in Mpumalanga. There were no death at a district hospital, one at regional, and five at tertiary/national hospitals.

Since numbers are small, HMG and AFLS are analysed together in MAMMAs as Miscellaneous (n =15). Avoidable factors occurred at patient community level for 46.7%, Administrative problems for 53.3% and Resuscitation problems 40%. Assessors thought that 46.6% of cases were possibly or probably avoidable.
Numbers are too small to make Recommendations.

Adverse Drug Reactions (ADR)

There were 26 deaths in this category making up 0.7% of all maternal deaths, with a iMMR of 0.9 maternal deaths per 100,000 live births. They included six deaths associated with ART, two with TB medications, 10 with Herbal Medications and eight with 'other' medications.

There were two in Eastern Cape (iMMR 0.6 ADR deaths per 100,000 live births); two in Free State (iMMR 1.4), seven in Gauteng (iMMR 1.0), five in KwaZulu-Natal (iMMR 0.8); eight in Limpopo (iMMR 2), and two in Mpumalanga (iMMR 0.7). There were no ADR deaths in North West, Northern Cape or Western Cape.

All deaths were in facilities; two in CHCs, four in DHs, nine in RHs,10 in TH/NC and one unknown.
Avoidable factors occurred at patient community level for 57.7%, Administrative problems for 57.7% and Resuscitation problems 57.7%. Assessors thought that 61.5 % of cases were possibly or probably avoidable.
Folders still need to be interrogated. Numbers are too small to make Recommendations.
There is a concern that some deaths from inadvertent intrathecal injection of TXA could be coded separately under Anaesthetic related deaths.

Co-incidental, and inconclusive causes of DDPCP

This section focuses on a group of deaths which are coincidental / fortuitous (non-maternal) and others which are termed 'unknown' and are inconclusive as to whether they were true maternal deaths or coincidental for reasons such as: cause could not be established, or there was lack of available information.

Coincidental deaths

There were 79 of these, accounting for 2.1% of Deaths During Pregnancy, Childbirth and the Puerperium (DDPCP). This is less than the previous triennia; 115 deaths (3.3% of DDPCP in 2017-2019) and 117 deaths (3.1%) in 2014-2016.

Coincidental deaths are not maternal deaths and are excluded from calculations of maternal mortality ratios (MMRs).

Coincidental deaths accounted for 2.1% of DDPCP in Eastern Cape, 3.4% in Free State, 2.2% in Gauteng, 1.5% in KwaZulu-Natal, 1.2% in Limpopo, 1.3% in Mpumalanga, 1.8% in North West, 0% in Northern Cape and 5.7% in Western Cape. The higher proportion in Western Cape is probably due to greater availability of forensic pathology services and involvement in the Maternal Death enquiries.

The causal subcategories were:
Motor vehicle accidents (MVA) - 21 (26.6%)
Other accidents – 10 (12.7%)
Assault – 21 (26.6%).
Other – 27 (34.2%).
Assault cases have doubled compared to the previous triennium.
Postmortems were done for 49.4%

Of the 79 deaths, 21.5% occurred at home/outside a facility, 5.1% in CHCs, 19% at district hospitals, 19% at regional hospitals, 31.6% at tertiary/national central hospitals and 3.8% in private hospitals.

The proportion of deaths with possibly or probable avoidable factors was 20.3% which is lower than for maternal deaths. The largest proportion of avoidable factors (46.8%) was at patient / community level.

Given the concern about gender-based violence in South Africa (the 'second 'epidemic), it would be important to look further into the assault and 'other' subcategories, to see if these were due to femicide. In terms of MVAs, certain countries such as UK, have strict regulations about seat belt use in pregnancy. It is not known to what extent there is such an awareness in South Arica and definitely not in crowded public transport.

Unknown

This is a difficult and varied group of deaths to understand and analyse collectively. It requires further folder reviews. These deaths with unknown causes include those (a) at home and outside facilities with no clinical notes of the final event, (b) those in facilities where no cause could be identified and (c) deaths where there was lack of information. It is obviously unclear how many in this group are maternal deaths and how many could be coincidental. There were 179 deaths in this group, accounting for 4.8% of DDPCP.

If they are reviewed as maternal deaths they accounted for 4.9% with an MMR of 5.9, more than 2.1 in 2017-2019 but similar to 6.14 in 2014-2016.

They accounted for 5.3% of DDPCP in E. Cape, 7.1% in Free State, 3.2% in Gauteng, 7.1% in KwaZulu-Natal, 2.5% in Limpopo, 3% in Mpumalanga, 3.4% in North West, 9.1% in Northern Cape and 5.9% in Western Cape. In terms of subcategories:

94 (52.5%) were deaths at home or outside.

Of the 85 deaths that occurred in facilities, 70 (83%) were in public hospitals and 4 (4.7%) in private hospitals. In terms of avoidability, this is difficult to assess where cause of death is unknown.

The inability to allocate a cause reflects a lack of post-mortems. Only 31 % had post-mortems. Insufficient PMs are being done even when medico-legally indicated such as for home/outside deaths. This reflects a national shortage of forensic pathology services.

Improving accurate classification of deaths and increasing the number and quality of postmortems would aid in reducing the proportion of these coincidental and unknown groups of deaths.

8. PROVINCIAL REPORTS AND ASSESSMENT TEAMS

8.1 Eastern Cape

Executive Summary

The Eastern Cape reported a total of 436 deaths for the 2020 - 2022 triennium with an iMMR of 138.6 maternal deaths per 100,000 live births. This reflects an increase of forty (N=40) women from 396 in the 2017-2019 triennium when the IMMR was 121.24. The leading causes of deaths were non-pregnancy related infections (COVID-19 and HIV, n=155), hypertension (n=67), medical and surgical disorders (n=57), obstetric hemorrhage (n=55) and pregnancy related sepsis (n=21). Embolism (n=20) and miscarriage (n=19) followed closely.

Most maternal deaths were in facility in public hospitals (n=390), however twelve (n=12) women died in transit, and 16 at home. Sixteen women died in private hospitals compared to three in the last triennium.

The most common indirect cause was non-pregnancy related conditions from COVID-19 complications and HIV complicated by TB. Among the direct causes of maternal deaths, the most common subcategory of deaths due to hypertension was **eclampsia**; for medical and surgical disorders it was **cardiac disease,** and for obstetric haemorrhage it was bleeding after caesarean section. Pregnancy related sepsis post caesarean section, septic miscarriage in young patients under 30 years of age and thromboembolism were a concern.

The national central hospitals based in OR Tambo experienced the highest mortality with the majority, (n=104), referred from three districts in their catchment area. Regional hospitals had 118 maternal deaths, tertiary hospitals had 78, followed by 96 at district hospitals.

In national central hospital, NPRI (n=31) was responsible for the highest cause of mortality followed by hypertension (n=22) and Medical and Surgical conditions (n=20).

OR Tambo district had the highest number of maternal deaths (n=156) followed by Buffalo City Municipality and Amathole combined (n=104), Nelson Mandela Bay Metro (n=95), and Chris Hani (n=41). All these districts have L2 and L3 hospitals.

There was slight improvement in deaths among teenagers less than 20 years from 10.8% (n=54) to 8.3% (n=36). This may be due to improved access to antenatal attendance with implementation of the learner pregnancy policy and comprehensive school health policy. Although of note, hypertension is the leading cause of death in 15-19-year age group contributing 25% (n=8) of deaths in this age group.

The highest iMMR (34) was recorded for women in the 35–39 year age category (n=95). This remains a risk group requiring to be prioritised for pregnancy prevention when family is complete.

Patient avoidable factors in the public sector were identified in 52.3% of assessed cases and administrative factors in 45.8%. Patient factors included delay in accessing medical help by patients (27.9%), no antenatal care (22.8%), declined medication/surgery or advice (10.4%), and infrequent antenatal care (7.8%). Resuscitation problems were identified in 40.5% of cases.

Important administrative avoidable factors identified included transport problem from institution to institution (9.1%), lack of ICU facilities (8.8%), lack of appropriate skill onsite or on standby to deal with medical problems (6.2%), delays in initiating critical care as a result of an overburdened service (5.8%), inadequate number of staff on duty (5.3%) and lack of healthcare facilities (3.9 %). The problem of lack of ICU beds increased from 4.6% in the last Triennium to 14.1 in 2020 and 8.6% in 2022 due to COVID-19 patients requiring critical care. Similarly, the contribution of overburdened services increased from 3.8% in 2017-2019 to 7.4% in 2020 and 7.2% in 2021.

Most of the 55 obstetric haemorrhage deaths occurred at facilities (n=45, 81.8%), with 1.4% at home/outside facility and 0.9% in transit. This means optimisation of patients in transit with the use of measures such as the non-pneumatic antishock garment (NASG), should be emphasised. In terms of the outside/ home deaths we would need to ascertain the avoidable factors e.g. look at the duration of wait for medical assistance and the

availability of ambulances, availability of ALS by EMS for escorting unstable patients and availability of Aero medical for doing transfers during day. The shows that emergency medical services remain a great challenge for the province.

Medical care avoidable factors were identified as highest at district hospitals for 61.4% of cases, followed by 53.5% at regional hospitals, 46% at tertiary hospitals and 53.6% in private hospitals. Medical care factors were high in District hospitals due to problems of recognition/diagnosis (31%) compared with other levels, followed by substandard management/correct diagnosis for 23.7% of deaths, delay in patient referral for 16.7% and patients managed at inappropriate level for 13.9%. There is a high attrition of skilled doctors in many district hospitals with better retention and supervision in hospitals with family physicians and registrars like Madwaleni and Zitulele. This strategy needs to be expanded.

Regional hospitals' medical avoidable factors were problem recognition (20%), followed by initial assessment (13.8%) compared to 8.2% for tertiary hospitals and higher levels. Prolonged abnormal monitoring with no action taken was also highest in regional hospitals at 10% vs 2.4% at tertiary level and above, as was substandard monitoring at 25%. These statistics highlight the shortage of specialists.

Employment of specialists will need to be prioritised in regional hospitals to improve quality of care. Having an O&G, Anaesthetist and Paediatrician with a nursery in the same hospital improves outcomes. Arrangements to access to blood and blood products also needs to be addressed. Provision of transitional high care with blood gas analysers and transport ventilators will address the administrative challenges.

Recommendations

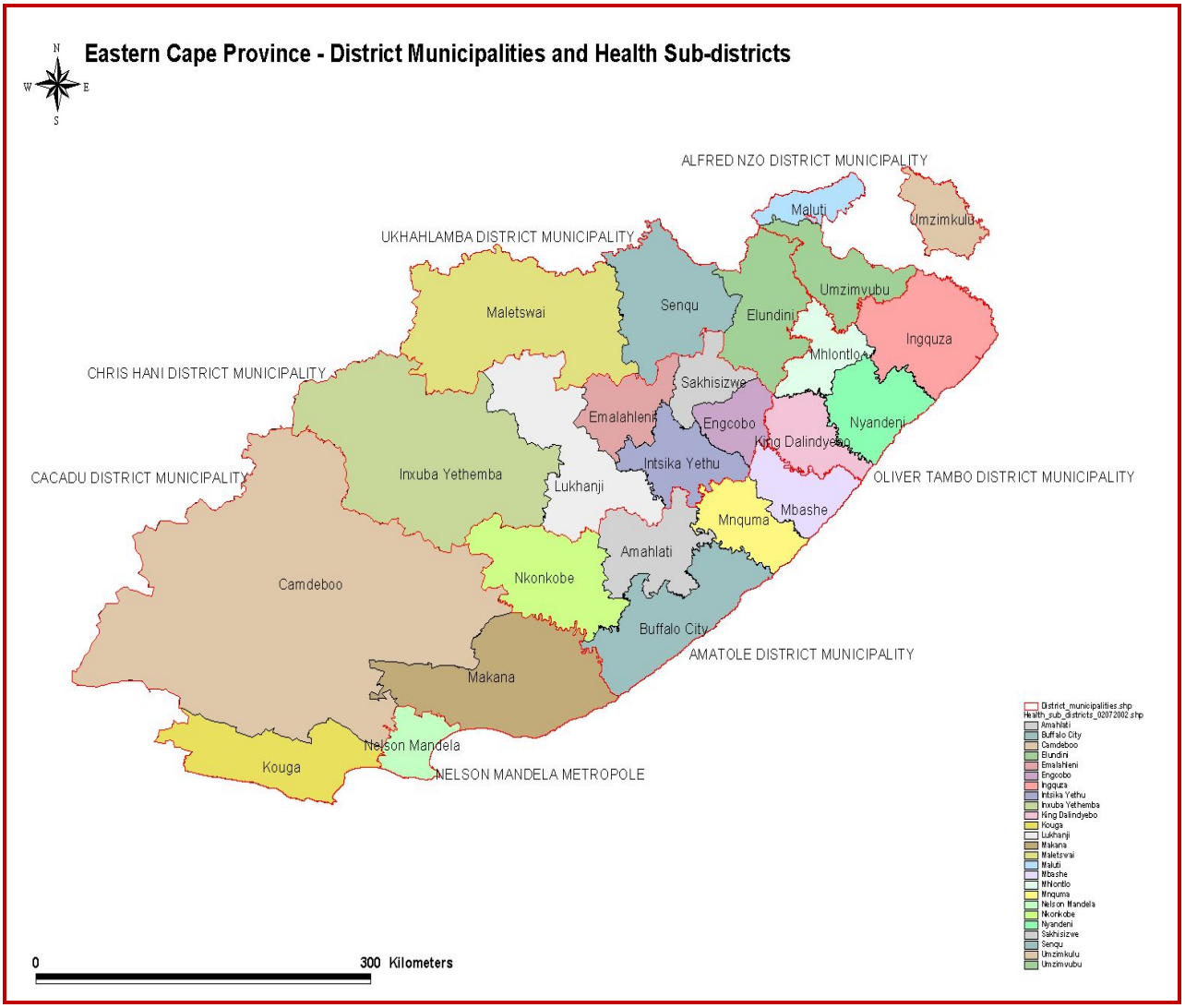
- Facility CEOs and Heads of obstetric departments must ensure that every maternal death that occurs in their facility is promptly reviewed. The review of the death must lead to a practical action plan for preventing a recurrence. Regional perinatal meetings need to be conducted, in addition to district reviews to ensure that relevant role players, HODs of O&G departments and the district clinical specialist teams monitor the implementation of the action plan, and progress presented at provincial quarterly reviews.
- HOD of ECDOH must ensure dissemination of the Sexual Reproductive Health and Rights SOP (2019) to all relevant stakeholders and ensure that the provincial learner pregnancy policy is available and signed by both HODs of Health and Education. Provision of comprehensive SRH services will need to be prioritised. Inter-sectoral collaboration and engagement in the social transformation cluster must be given priority. This will reduce morbidity and mortality related to teenage pregnancy.
- District clinical specialists must ensure that high risk antenatal care clinics are established, and the referral criteria disseminated. Referral criteria should be clear, consistent, and must be available both at the referring site and at the receiving site, and their use monitored. Facility managers must ensure that these referral criteria are followed, and clinical governance forums need to discuss referral challenges and provide solutions.
- The safe caesarean section plan, respectful maternity care plan and Emotive should be implemented in all districts. This will require an adequate number of medical specialists (O&G and anaesthetists) to be available in regional hospitals; and family physician posts need to be created and filled in priority district hospitals.
- The CPD point pilot programme at Amathole should be scaled up to all districts. Ongoing training on the recognition and management of conditions commonly causing maternal deaths must be provided for doctors and midwives and EMS personnel using compulsory fire drills. All staff must complete mandatory training as well as online training and Funda Friday to refresh skills.
- Emergency transport. Dedicated obstetric ICU ambulances need to be available in Amathole, and Alfred Nzo. In the interim a dedicated budget and a mechanism with written SOP should be available to authorise private ambulance for critical patients where state paramedics are not available. The EMS training college needs to ensure that the college has an ESMOE in transit trainer to ensure safe transfer of patients by ILS providers and combat the high number of in transit deaths. Aeromedical services need to be available.
- ALL districts need to ensure the correct version of the maternity case record is budgeted for, available and used in all facilities to mitigate medico-legal risks. Maternity Care Guidelines and BANC plus protocols must be adhered to. Early warning charts both in antenatal and postnatal care must be used and clear discharge summaries and follow up plans provided for all women being discharged.
- The Social mobilisation directorate needs to develop a communication strategy to ensure every woman attends the antenatal clinic at least 8 times, and especially every second week in the third trimester. Women at risk for pre-eclampsia must be informed about the need for receiving and taking low-dose aspirin daily during pregnancy. Messages to counter the risk of unsafe abortion and benefits of

contraception including Emergency contraception posters need to be developed.

- Supply chain and pharmaceutical services directorates need to ensure all drugs, especially contraceptives, and equipment including BP machines, transport CPAP and ventilators are available.
- All State facilities must be able to either offer TOP services or refer eligible clients to a site within the district which offers free TOP services. All sites providing TOP must be able to provide the option of medical TOP for suitable clients.
- Establish OMBU to improve quality of care in regional and tertiary hospitals.
- Strengthen community pregnancy testing, follow up and linkages using ward-based community outreach teams to improve early booking and reduce defaulter rates at ANC which were identified as key patient orientated problems.
- Strengthen the PHC mentoring strategy of allocating clinical nurse mentors per sub-district. Clinical nurse mentors should conduct In-service education on APC, SRH including insertion LARC at PHC facilities. These mentors support clinic supervisors and PHC DCSTs to provide quality care.
- Revive maternity waiting homes and repurpose some of the small hospitals to improve transport availability and costs.

Introduction

The Eastern Cape is the third most populous province in South Africa with a total population of 6,562,053 (Stats SA, Nov 2012). The province is divided into six Districts and two Metropolitan Districts. It has two medical schools: the new Nelson Mandela Medical University in Gqeberha, and Walter Sisulu University in Mthatha with two tertiary hospital complexes, in Mthatha and East London. The province also has 2 regional hospitals, 65 district hospitals, 37 community health centres and 806 clinics. All district hospitals and most CHCs conduct deliveries. The total live births for the triennium were 323133 live births (109077 in 2020, 110909 in 2021, a decreased to 103147 in 2022). There were 14% of the deliveries at CHCs, and 55% at DHs. The levels of poverty and unemployment increased during the COVID-19 pandemic. There is also underdeveloped infrastructure and vast rural districts.



The first part of this report provides an overview of the Eastern Cape maternal deaths for the period 2020–2022 with comparative data from the previous triennial period.

The second part is a detailed discussion on the main primary causes of care with comparison by age group, level of care and district distribution. Condition specific recommendations are outlined for the major primary causes of obstetric deaths. This part was written by individual assessors who each took responsibility for in depth analysis of one particular primary obstetric cause of death.

Part One. Overview of maternal deaths, iMMR, Causes of Death, Demographic and Health System factors and Avoidable factors in Eastern Cape, 2020-2022

Deaths reported and iMMR

The Eastern Cape reported in total 436 deaths for the 2020 - 2022 triennium with an iMMR of 138.6. This reflects an increase of forty (n=40) women from 396 in the 2017 to 2019 triennium when the iMMR was 121.24. However, there is a notable decrease of 69 deaths between the 2014-2016 triennium (505 deaths) as compared to the 2020-2022 triennium (436 deaths). Table 1 shows deaths reported to DHIS and to MAMAAs as well as live births per year; and a calculation of iMMR per year and for the 2020-2022 triennium.

Table 1. Maternal deaths from DHIS and MAMMAs, Live Births and iMMR, 2020-2022

Eastern Cape	Live births	MaMMAS deaths (DDCP)	MaMMAS MD	DHIS MD	MaMMAS MD (corrected)	MaMMAs iMMR	MaMMAs iMMR (corrected)	DHIS iMMR
2020	109077	168	139	160	160	127.43	146.69	146.7
2021	110909	154	153	151	153	137.95	137.95	136.1
2022	103147	134	133	132	133	128.94	128.94	128

Eastern Cape	Live births	MaMMAS MD (corrected)	MaMMAs iMMR (corrected)
2020-2022	323133	446	138.0

A correction was made in 2020 due to suspected underreporting to MaMMAS. The numbers were adjusted to be the same as DHIS reported deaths which usually are less not more than MaMMAS numbers.

Figures I and 2 show trends in numbers of MDs, and iMMR per year over time; and Figure 3 shows triennial trends.

Figure 1. Trends in number maternal deaths 1998-2022

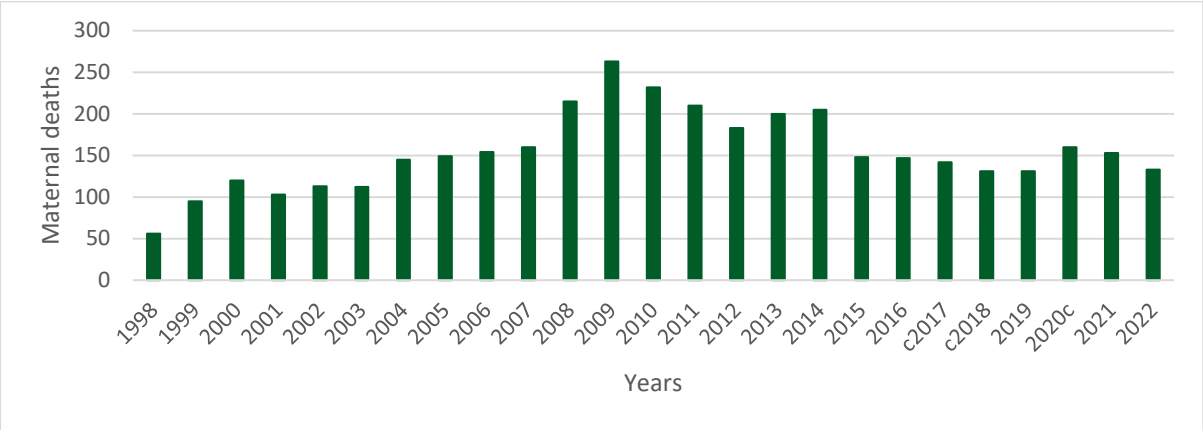


Figure 2. Trends in iMMR 2005-2020

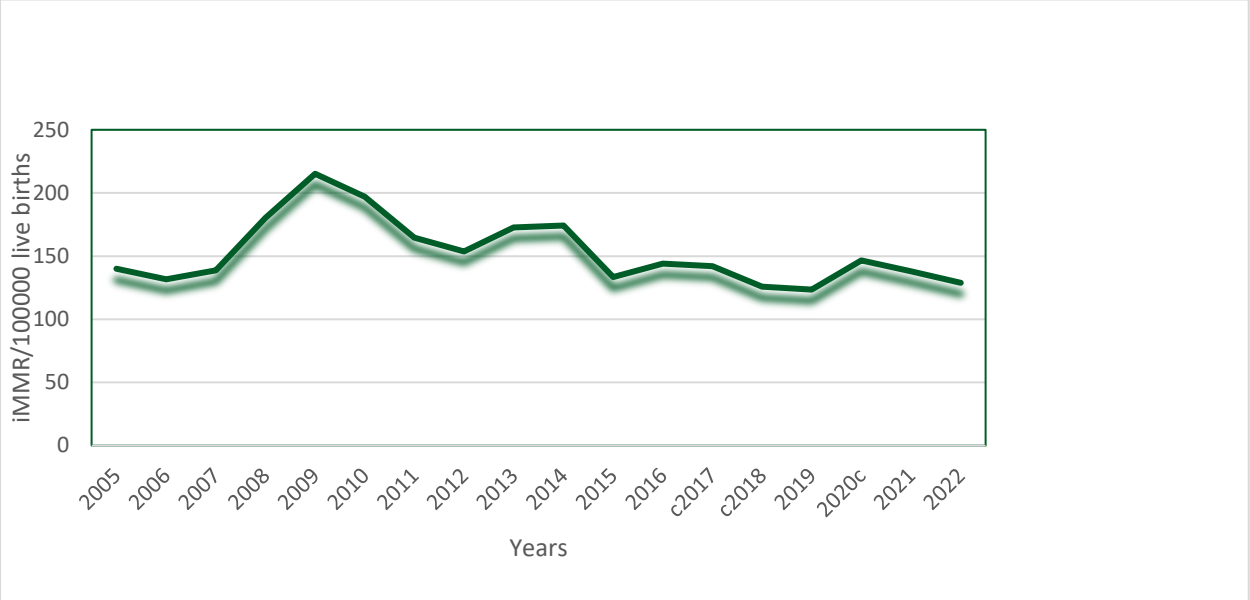
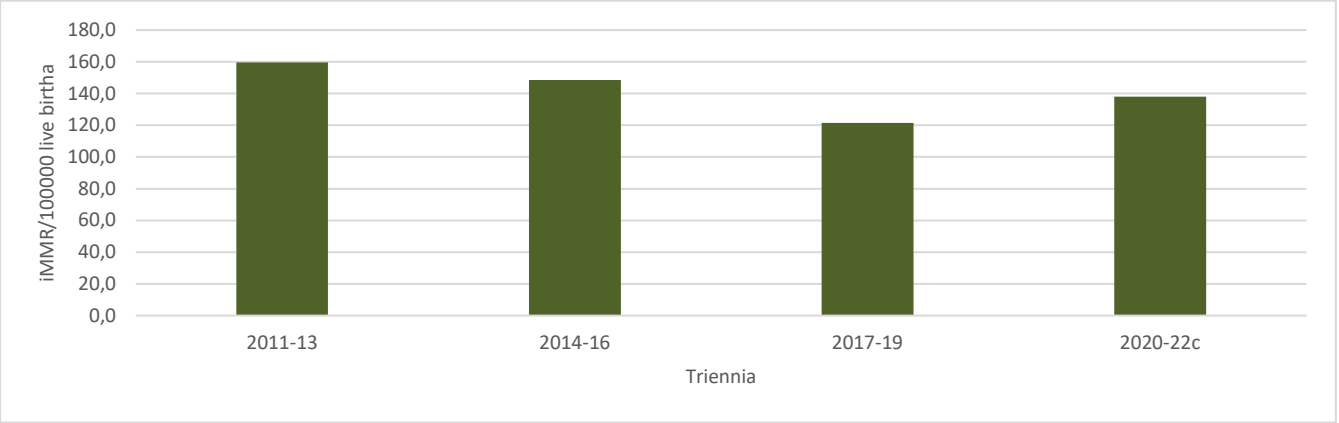


Figure 3. iMMR for Triennia 2011-2022



There has been a consistent decline during the first 3 triennia represented in Figure 3. The iMMR decreased from 160 (2011-2013) to 120 (2017-2019). However, iMMR spiked at the peak of the COVID-19 pandemic from 120 (in 2019) to 146.69 in 2020 and 137.60 in 2021. Th decreased to 128.94 in 2022 as the burden of the pandemic subsided (Table 2).

Table 2. MaMMAS Number of deaths and iMMR 2017-2022

Year	Number reported	iMMR (MDs per 100 000 live births)
2017	142	132.10
2018	134	121.94
2019	120	110.32
2020	160	146.69
2021	153	137.60
2022	133	128.94

Primary obstetric causes of maternal deaths

The leading causes of deaths were non-pregnancy related infections namely COVID-19 and HIV (n=155), hypertension (n=67), medical and surgical disorders (n=57), obstetric haemorrhage (n=55) and Pregnancy related sepsis (n=21). Embolism (n=20) and miscarriage (n=19) followed closely.

Table 3. iMMR, Number of deaths and ranking by primary cause of death 2020-2022

Eastern Cape	No. of deaths	iMMR 2020-2022 (MDs per 100,000 LBs)	Ranking
Medical and surgical disorders	57	17.6	3rd
Non-pregnancy-related infections	155	48.0	1st
Ectopic pregnancy	8	2.5	
Miscarriage	19	5.9	7th

Eastern Cape	No. of deaths	iMMR 2020-2022 (MDs per 100,000 LBs)	Ranking
Pregnancy-related sepsis	21	6.5	5th
Obstetric haemorrhage	55	17.0	4th
Hypertension	67	20.7	2nd
Anaesthetic complications	11	3.4	8th
Adverse drug reactions	2	0.6	
Embolism	20	6.2	6th
Acute collapse - cause unknown	6	1.9	
Miscellaneous	1	0.3	
Unknown	3	0.9	

Table 4. iMMR per Primary obstetric cause per year and for the triennium

Eastern Cape iMMR	2020	2021	2022	2020-2022
Medical and surgical disorders	11.00	20.74	21.33	17.6
Non-pregnancy-related infections	53.17	55.90	33.93	48.0
Ectopic pregnancy	1.83	2.70	2.91	2.5
Miscarriage	5.50	6.31	5.82	5.9
Pregnancy-related sepsis	3.67	6.31	9.69	6.5
Obstetric haemorrhage	19.25	14.43	17.45	17.0
Hypertension	20.17	17.13	25.21	20.7
Anaesthetic complications	4.58	1.80	3.88	3.4
Adverse drug reactions	0.92	0.90	0.00	0.6
Embolism	3.67	9.02	5.82	6.2
Acute collapse - cause unknown	1.83	2.70	0.97	1.9
Miscellaneous	0.00	0.00	0.97	0.3
Unknown	1.83	0.00	0.97	0.9
Maternal deaths	127.43	137.95	128.94	131.5
Coincidental cause	6.42	0.90	0.97	2.8
DDCP	133.85	138.85	129.91	134.3
Live births (2019)	**109077**	**110909**	**103147**	**323133**

Final causes of deaths

In the 2020-2022 triennium, out of 434 patients, the final causes were Respiratory failure (n=167), circulatory failure (n=161), cerebral complications (n=79), hematological failure (n=70), cardiac failure (n=62) immune failure (n=47).

Non-Pregnancy related Infections

Out of 434 deaths, non-pregnancy related Infections (n= 155) were the highest cause with COVID-19 contributing 47% (n = 73) of the total. The resulting iMMR was 48 per 100,00 live births. The number of deaths from NPRI increased from 58 in 2020 to 62 in 2021.

Fifty-two (71%) of the patients who died of COVID-19 were HIV negative. Most of the COVID-19 deaths (n=23) occurred in tertiary hospitals, followed by 11 deaths in district hospitals probably due to overburdened services

and lack of critical care beds at the higher referral level.

HIV also contributed to deaths from NPRI. TB was the leading cause of deaths with forty-three cases making up 9.9 % of the total deaths followed by pneumonia and meningitis each with t 2.5% (n=11).

Of the NPRI deaths, forty-nine deaths (29%) occurred in regional hospitals, followed by 32 deaths (24.5 %) in tertiary hospitals and 31 deaths (20%) in national central hospitals. NPRI were responsible for 62% (n=11) in Private hospitals. There was seven MD in the 10-19-year-old age group with 40 deaths each in the age groups 30-35 and 35-39 years.

The Districts with Metros had the highest number of MDs from NPRI namely Nelson Mandela Bay Municipality, Buffalo City Municipality and Amathole, all with 46 deaths, followed by OR Tambo. In Chris Hani district, out of 44 deaths, NPRI was the leading cause of death at 25% (n=11). Among smaller districts without regional hospitals, such as Sarah Baartman, 45% of maternal deaths were due to NPRI. Tracking and linkage of patients will need to be prioritised. New ART guidelines must be rolled out and nerve centres established.

Hypertension

The second leading cause of death was hypertensive disorders with sixty-seven (n=67, 15.4%). The number of deaths due to hypertension increased from 22 (in 2020) to 26 (in 2022). The iMMR was 20.7MDs per 100,000 LBs for the triennium. Forty-two (n=42) of the patients were HIV negative. Hypertension remains extremely high as a cause of MD, at 30%, in the age group >35 years, followed by 11 percent in teenagers (< 19 years). Out of 67 deaths due to hypertension, the majority of deaths occurred in national central hospitals (n=22), followed by regional hospitals (N=23) and twelve deaths in tertiary hospitals. Patients were mostly appropriately referred however, it was identified that there were multiple missed opportunities at primary care level with the majority of deaths being preventable. Most patients died of eclampsia. A comprehensive hypertension action plan has been developed and presented at the third midwifery congress in August 2022 and a high-risk antenatal care training package rolled out in various districts.

Medical and surgical disorders (M&S)

Medical and surgical disorders (M&S) increased to third position with fifty-seven maternal deaths (N=57) making up 13.1 percent of total deaths. The numbers almost doubled from 12 to 23 (49%) in 2021, which was sustained in 2022 (n=22) deaths. Sixty-one percent (n=35) of patients who died of M & S conditions were under 30 years. Frequently abnormal vitals were not acted on at primary care level. In this triennium, the iMMR from Medical and surgical conditions was 17.6 compared to the national iMMR of 16.99. The leading causes of deaths were cardiac (n=17), suicide (n=7), respiratory problems (n=7) and CNS and neoplasm both with five.

Of the seven suicide deaths, three occurred in district hospitals, three (n=3) in national central hospitals and one in a regional hospital. Cardiac patients were appropriately referred to physicians, though no joint clinics were established. Seven cardiac deaths occurring at national central hospitals with five (n=5) in regional hospital indicating an effective referral system.

Cardiomyopathy peri-partum and post-partum seemed to be the leading cause of death. Several Patients were admitted in general wards in critical condition with advanced respiratory failure without being intubated and ventilated. Use of early warning chart and checklists in post–natal wards will reduce patients being sent home unstable and thus requiring re-admissions. Contraception should be emphasised to prevent pregnancy in cardiac patients.

Obstetric haemorrhage

Obstetric haemorrhage was the fourth leading cause of death with fifty-five deaths making up 12.7% of the total. The IMMR was 17.1 deaths per 100,000 live births, displaying a significant improvement from the last triennium. BLDACD was the leading cause with 13 deaths though a significant improvement was noted when compared to 26 deaths in the last triennium. Forty-five percent (45%) of BLDACD occurred at tertiary hospital, with 6 deaths at the Buffalo City Municipality. This was followed by 5 deaths due to abruptio placentae with hypertension, and ruptured uterus without previous caesarean section. PPH post normal vaginal delivery (NVD) was highest in the 35-39 year age group. The majority of patients died in lower levels of care with 6 deaths outside health facilities, two at CHC and 18 at District Hospitals with transport being a significantly contributor. Non pneumatic anti shock garments have been procured and disseminated but ongoing training of ambulance

personnel needs to be prioritised. Following results from the EMOTIVE trial, the accurate estimation of blood loss and bundle approach with availability of tranexamic acid in all levels of care will be escalated. The safe CS plan needs to be implemented. Lastly, HIV was not a significant risk factor as 30 out of 55 patients (54%) were HIV negative.

Anaesthesia

The number of deaths from Anaesthesia complications were eleven at 2.5% of the total, and the iMMR was 3.4 deaths per 100,000 live births. There was a slight decrease from 11 in the last triennium. Four of these deaths occurred at district hospitals, another 4 at regional hospitals and 2 at national central hospitals. The majority, 10 out of 11 deaths, were related to spinal anaesthetic with 1 being general anaesthesia. Five of the availability of specialist anaesthetists in regional hospitals, and doctors with Diplomas in Anaesthetics in district hospitals is strongly recommended, together with in-reach support and budget for accommodation.

Thirty-one percent (N=134) of the anesthetics were conducted at L2 hospitals (n=43), which increased as compared to the 24% in the last triennium. Tertiary hospitals conducted 16 % (n=22) of anesthetics and district hospitals conducted 15.4% (n=21). Five of the 11 patients were in the 30-34-year age range and 2 were teenagers.

Demographic, obstetric and health system factors for maternal deaths

The proportion of HIV positive women who died was less than in previous triennia. Out of 434 deaths, 41% (N=181) were HIV negative, 43% (N=186) were HIV positive and 15.4% (N=67) had an unknown status. Amongst the pregnancy related sepsis (PRS) deaths, 10 out of 21 deaths were HIV positive, suggesting an association. The majority of patients with PRS, 12 out of 21 patients, were delivered by caesarean section at national central hospital suggesting delays in referral from district hospitals.

Twenty-five percent (N=112) of maternal deaths were unbooked. Forty percent (n= 176) died undelivered during the antenatal period. More patients delivered via caesarean section 28.5 % (n=125) than vaginally 27.2 (n=118).

Of the 434 cases, only 48 postmortems were conducted. Seven out of twenty-one patients with embolism and two out of four patients with acute collapse had postmortems. Only four out of seven anesthetic deaths had postmortems even though this is mandatory for procedure related deaths. The lack of postmortems is due to limited access to forensic pathologists. A budget needs to be available to outsource the service to private for mandatory postmortems.

The pregnancy outcomes were liveborn in 38% (n=165), stillborn in 13.6% (n=59) and the rest were undelivered. Of concern, is the increase in patients with miscarriage from 7.2% in last triennium to 10.1%.

District Distribution of maternal deaths

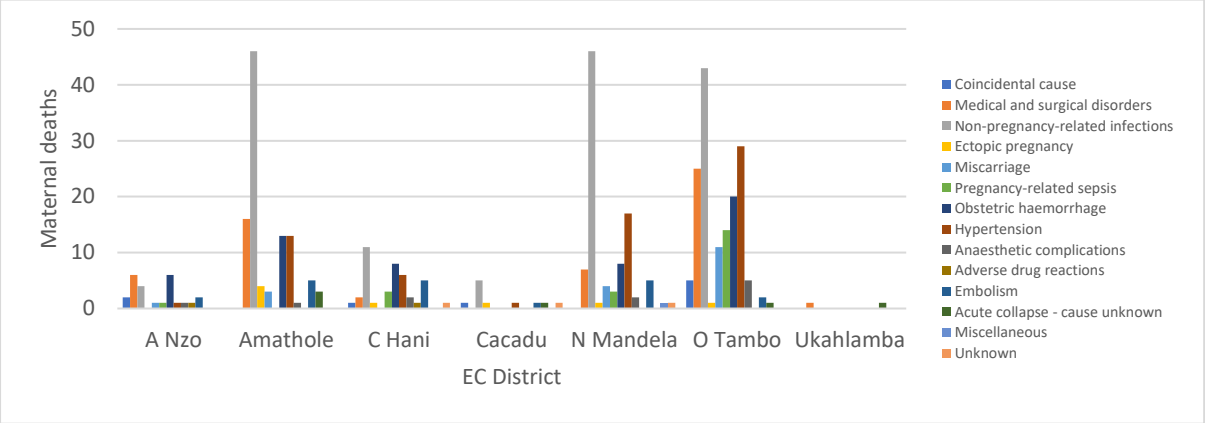
OR Tambo district had the highest number of maternal deaths (n=156) followed by Buffalo City Municipality with Amathole combined (n=104), Nelson Mandela Bay Metro (n=95) and Chris Hani (n=41). All these districts have regional and tertiary/national central hospitals. The figure below shows district distribution by primary cause of death.

Table 5. District distribution of maternal deaths by Primary Obstetric Cause ranked

Primary obstetric problems	A Nzo	Amathole + BCM	C Hani	Cacadu	N Mandela	O Tambo	uKhahlamba	Total
Medical and surgical disorders	**6** 1ST	**16** 2ND	2	0	7	**25** 3RD	1	57
Non-pregnancy-related infections	**4** 2ND	**46** 1ST	**11** 1ST	**5** 1ST	**46** 1ST	**43** 1ST	0	155
Ectopic pregnancy	0	4	1	1	1	1	0	8

Primary obstetric problems	A Nzo	Amathole + BCM	C Hani	Cacadu	N Mandela	O Tambo	uKhahlamba	Total
Miscarriage	1	3	0	0	4	11	0	19
Pregnancy-related sepsis	1	0	3	0	3	14	0	21
Obstetric haemorrhage	**6** 1ST	**13** 3RD	**8** 2ND	0	**8** 3RD	20	0	55
Hypertension	1	**13** 3RD	6	1	**17** 2ND	**29** 2ND	0	67
Anaesthetic complications	1	1	2	0	2	5	0	11
Embolism	2	5	**5** 3RD	1	5	2	0	20
Acute collapse - cause unknown	0	3	0	1	0	1	1	6
Total	**25**	**104**	**41**	**11**	**95**	**156**	**2**	**434**

Figure 4. District distribution of primary causes of death



Maternal Age

The highest iMMR (34) was recorded for women in the 35-39 (n=95) year age category, followed by women between 25-29 years (n=93) and the 30-34-year age group (n=91).

There is slight improvement in deaths among teenagers l (<20 years) from 10.8 % (n=54) to 8.3 % n=36). This may be due to improved access to antenatal attendance with implementation of learner pregnancy policy. Hypertension was the leading cause of death in the 15-19-year age group contributing 25% (n=8) of deaths, followed by NPRI (n=6) and medical and surgical disorders (n=4). Fifty percent of patients with thromboembolism were under 30 years. They died in regional hospitals, therefore thrombo-prophylaxis protocols need to be adhered to. The majority of patients with miscarriage, 13 out of 19, were less than 30 years old.

Maternal deaths by Level of Care

The national central hospitals based in OR Tambo experienced the highest mortality with the majority, (n=104), referred from three districts in their catchment. Regional hospital had 118, tertiary hospitals had 78, followed by 96 at district hospitals.

In national central hospital, NPRI (n=31) was responsible for the highest cause of mortality followed by hypertension (n=22) and Medical and Surgical conditions (n=20). In tertiary hospitals, the leading cause of deaths was NPRI (n=38) followed by hypertension (n=12) and obstetric haemorrhage (n=10).

In district hospitals, the highest cause was NPRI (n=27) followed by obstetric haemorrhage (n=18) and Medical and Surgical conditions (n=11). The increase in NPRI deaths at lower levels of care was due to COVID-19 patients who could not be transferred due to overburdened services and lack of ICU beds.

Table 6. Maternal deaths by Level of care

Primary obstetric problem	Outside	CHC	District hospital	Regional hospital	Tertiary hospital	Nat central hospital	Private hospital	Total
Coincidental cause	1	1	2	1	1	2	1	9
Medical and surgical disorders	2	0	11	16	8	20	0	57
Non-pregnancy-related infections	2	1	27	45	38	31	11	155
Ectopic pregnancy	0	0	2	2	3	1	0	8
Miscarriage	0	0	6	5	2	6	0	19
Pregnancy-related sepsis	0	0	4	4	2	10	1	21
Obstetric haemorrhage	6	2	18	10	10	7	2	55
Hypertension	0	1	9	23	12	22	0	67
Anaesthetic complications	0	0	4	4	0	3	0	11
Adverse drug reactions	0	0	1	1	0	0	0	2
Embolism	1	1	9	5	2	1	1	20
Acute collapse - cause unknown	2	0	1	2	0	1	0	6
Miscellaneous	0	0	1	0	0	0	0	1
Unknown	2	0	1	0	0	0	0	3
Total	**16**	**6**	**96**	**118**	**78**	**104**	**16**	**434**

Avoidable factors

Maternal death assessors believed that medical care was suboptimal in 244 (55.3%) cases and in 34.9% of cases suboptimal care was possibly/probably contributory to the maternal death. The proportion of suboptimal care was similar to the 2017-2019 triennium findings.

Table 7. Avoidability of deaths, 2020-2022

	2020 -2022	
Description	**n**	**n**
No suboptimal care	194	44.7
Suboptimal care, different management would have made no difference to the outcome	45	10.4
Suboptimal care, different management might have made a difference to the outcome	126	29.0
Suboptimal care, different management would reasonably have been expected to have made a difference to the outcome	69	15.9

Patient avoidable factors in the public sector were identified in 52.3% of assessed cases and administrative factors in 45.8%. Patient factors included delay in accessing medical help by patients (27.9%), no antenatal care (22.8%), declined medication/surgery or advice (10.4%), and infrequent antenatal care (7.8%). Resuscitation problems were identified in 40.5% of cases.

Table 8. Percentage of deaths with Avoidable factors related to administrative problems

Description	2021	2020	2020-2022	2017-2019
Lack of information	4.3	3.7	5.2	4.8
No avoidable factor	55.4	39.3	49.1	47.7
Transport Problem Home to Institution	2.9	1.5	2.5	3
Transport Problem from Institution to Institution	7.2	8.1	9.9	9.7
Lack of accessibility Barriers to entry	1.4	2.2	1.4	0.4
Lack of accessibility Other	2.2	1.5	2.3	0
Delay in attending to patient (Overburdened service)	7.2	7.4	5.8	3.8
Delay in attending to patient (reasons unknown)	3.6	1.5	2.3	0
Lack of Healthcare facilities ICU	8.6	14.1	8.8	4.6
Lack of Healthcare Facilities Blood / Blood products	2.2	5.2	2.1	3.8
Lack of Healthcare Facilities Other	2.9	5.9	3.9	3
Inadequate numbers of staff on duty	5	11.1	5.8	0
Appropriate skills not available on site on standby	5	4.4	6.2	0
Communication Problem Technical	0	3	1.4	0,6
Communication Problems Interpersonal	0.7	1.5	1.4	0.8
Other	13.7	18.5	15	13.9

Important administrative avoidable factors identified in the public sector were transport problems between

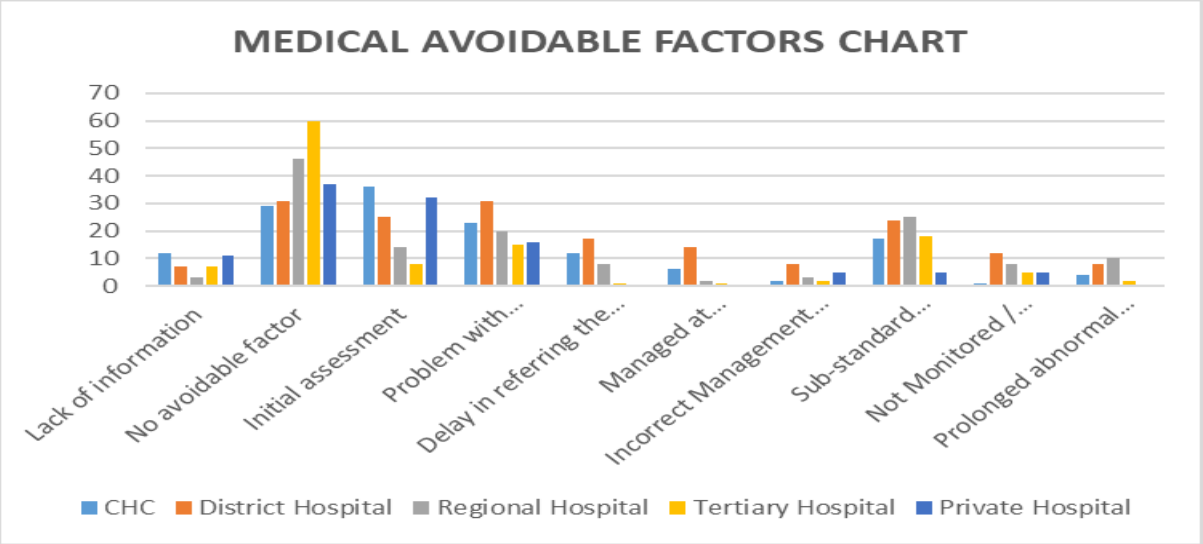
institutions (9.1%), lack of ICU facilities (8.8%), lack of appropriate skill onsite or on standby to deal with medical problems (6.2%), delays in initiating critical care as a result of an overburdened service (5.8%), inadequate number of staff on duty (5.3%) and lack of healthcare facilities (3.9%), Table 8. The problem of lack of ICU beds increased from 4.6% in previous triennium to 14.1% in 2020, mostly accounted for by COVID-19 patients requiring critical care. The contribution of overburdened services increased from 3.8% in 2017-2019 to 7.4% in 2020 and 7.2% in 2021.

Medical care avoidable factors at CHC level were 43.2%. The highest number were at district hospitals at 61.4%, followed by 53.5% at regional hospitals, 46% at tertiary hospitals and 53.6% in private hospitals.

Medical care avoidable factors were assessed by level of care in public sector as demonstrated in Fig 5. Problems with initial assessment were highest in CHCs at 36 %. Medical problems were high in district hospitals due to problems of recognition/diagnosis (31%) compared with other levels, followed by substandard management / correct diagnosis at 23.7%, delay in patient referral at 16.7% and managed at inappropriate level at 13.9%. Regional hospitals' medical avoidable factors were problem recognition (20%), followed by initial assessment at 13.8 % vs 8.2% for tertiary hospitals and higher levels.

Decongesting tertiary hospitals with OMBUs will improve quality of care. Better use of Triage will assist in patient selection, managing at appropriate level and stabilising before referral. Triage training is needed for medical and nursing training curriculum. Inclusion of doctors and nurses in maternity, casualty and gynaecology wards n ESMOE training and Fire drills, will assist reduce health worker related gaps.

Figure 5. Medical avoidable factors by level of care



Private Hospitals

There were 16 patients who died in private hospitals compared to three in the last triennium. The majority sixty-eight % (N=11) died due to COVID-19, two due to obstetric haemorrhage and one due to pregnancy related sepsis. Fifty-three percent of deaths in private institutions were assessed as avoidable. The leading medical factors were poor initial assessment at 31%, followed by poor problem recognition at 15.8%. Substandard management with correct diagnosis, infrequent monitoring and wrong diagnosis /incorrect management were in equal proportion at 5.3%.

Part 2. Detailed analysis of main primary obstetric causes

For Part 2, provincial maternal death assessors divided themselves into groups to further assess the leading primary obstetric causes of death. Each group looked at trends for Eastern Cape from previous triennia, where data was available. Extra tables from MaMMAS for causes by age, level of care for a specific cause were analysed. Due to the demands of the COVID-19 pandemic, the Eastern Cape did not produce a 2017-2019 provincial report, meaning that 2017-2019 data on causes and subcategories of causes was not available for comparison for all Causes.

The team then came up with abstracts and recommendations for each cause and identified districts where these interventions were to be prioritised. Most assessors participated though one person was lead writer for abstracts per topic below.

A list of assessors is provided at the end as acknowledgement of the contribution of the teams to the abstracts.

Table 9. Sub-categories of causes of death 2020-2022 for Ectopic, Miscarriage and Pregnancy related sepsis

	2020-2022	
	N	%
DIRECT		
Ectopic Pregnancy	8	1.8
• Less than 20 weeks	6	1.4
• More than 20 weeks.	2	0.5
Miscarriage	19	4.4
• Septic Miscarriage	15	2.7
• Hemorrhage (non–traumatic)	3	0.7
• Uterine Trauma		
• GTD	1	0.2
• Following Legal TOP		
• Hyperemesis Gravidarum		
Pregnancy–Related Sepsis	21	4.8
• Chorioamnionitis with ruptured membranes		
• Chorioamnionitis without ruptured membranes	1	0.2
• Puerperal Sepsis after NVD	9	2.1
• Puerperal sepsis after Caesarean Section	8	1.8
• Bowel Trauma at Caesarean Section	3	0.7

Ectopic pregnancy

Six women died of ectopic pregnancy prior to 20 weeks' gestation and there were two ectopic pregnancies above 20 weeks' gestation.

Although few patients died from ectopic pregnancy, no women should die of this cause. Routine pregnancy test screening in women of child-bearing age should improve recognition. Currently none of the district hospitals do laparotomy for ectopic; this must be rectified so surgery can be performed at this level. The global surgery collaboration is in place to improve anaesthetic skills at district hospitals which is the main limitation.

Miscarriage (Ms J Pieterson and Ms Ndubaza)

There was a rise in deaths from 2.6% (N=12) to 4.4% (N=19) in this triennium. Septic miscarriages contributed 61% (N=15) to the total deaths followed by 3 haemorrhagic and 1 GTD. There were 9 cases where administrative factors were due to self–induced late illegal abortions. There is reduced reporting of these cases. Most women who died were teenagers. Community education and engagement needs to be done to improve awareness. Currently, second trimester CTOP services are only offered in regional and tertiary hospitals limiting access. An expansion of CTOP services to district hospitals for 2nd trimester TOPs would reduce deaths from this cause.

Table 10. Maternal age and early pregnancy deaths

	20=24	25-29	30-34	35-39	TOTAL
Ectopic	1	6	0	1	8
Miscarriages	6	7	2	4	19

Primary obstetric problems	district hospitals	regional hospital	tertiary hospital	nat. central hospital
Ectopic pregnancy	2	2	3	1
Miscarriages	6	5	2	6

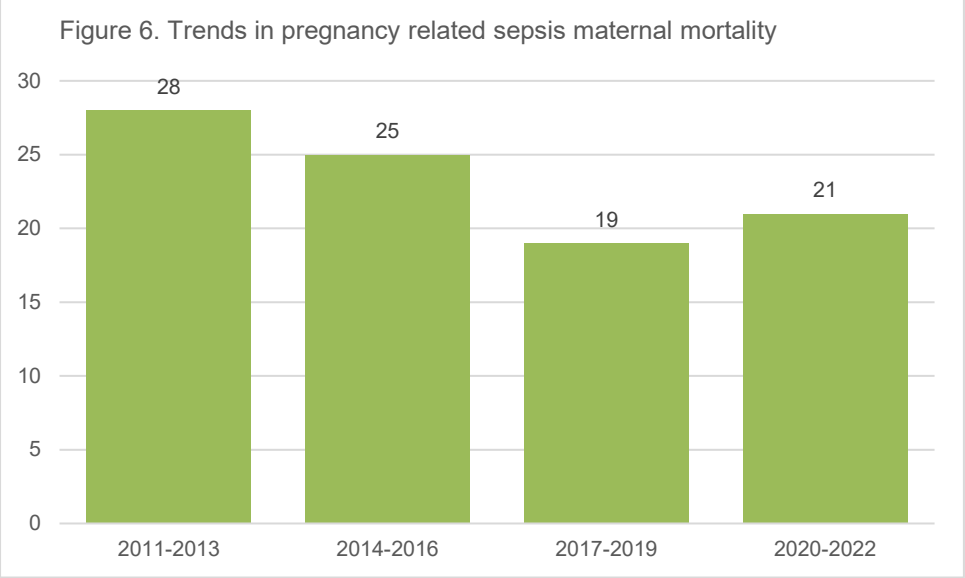
Pregnancy related sepsis (Dr B Mzileni)

Deaths due to pregnancy related sepsis have remained the 5th most common cause of maternal death for the triennium 2020-2022. There were 21 deaths reported for this category and this made up 4.5% of total maternal deaths compared to 5% (N=19) in the previous triennium.

The number of deaths had decreased every triennium since 2011-2013 from 28, to 25 in 2014-2016 and 19 in 2017-2019. This decline was not sustained in 2020-2022 as there is a slight increase in this triennium. This is supported by the institutional maternal mortality rate (maternal deaths per 100,000 live births) which showed the same trends over the last three triennia.

There is a widespread use of prophylactic antibiotics in the Caesarean section (CS). However, this may be given earlier than the recommended one hour before CS. Guidelines for antibiotic use in managing obstructed labour need to be adhered to. CS is a risk factor for PRS. Three maternal deaths were due to bowel trauma at caesarean section. Early warning charts can also assist with early detection of this contributor.

Figure 6. Trends in pregnancy related sepsis maternal mortality



The iMMR increased over three years of this triennium, from 3.67 in 2020, 6.31 in 2021 and 9.67 in 2022 giving an overall iMMR from PRS of 6.5 maternal deaths per 100,000 live births for this triennium. HIV was a risk factor as 10 out of 21 (47.6%) women were HIV positive and status was unknown in 25%. Sixty-six percent (n=13) of these women died in OR Tambo at the National Central hospital with iMMR of 14.91 due to PRS.

Of these 21 deaths, nine women had sepsis after vaginal delivery, eight after caesarean section, three had bowel injury during caesarean section and one death was caused by chorioamnionitis with intact membranes.

There is a 50% reduction in deaths after caesarean, although it has fluctuated from 2.1 percent of all EC maternal deaths in 2011-2013, 2.4 percent in 2014-2016, 3.6% in 2017-2019 and 1.8 percent for this triennium.

There is concern that the cases of bowel trauma were not recognised at CS and not diagnosed post operatively. This also indicates lack of skill in the surgeons, as the caesarean sections were not recorded as difficult in the notes. Caesarean section audits and skill assessment of the surgeons is not routinely done according to the Safe CS plan for Eastern Cape.

The severity of pregnancy related sepsis is often underestimated by the healthcare providers and its management is inadequate. Avoidable factors associated with the healthcare providers were present in district hospitals, regional hospitals and in private 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. The majority of women with PRS died during the postpartum period. Most women who died from complications related to PRS received substandard treatment at the district, national central and tertiary levels of care despite the correct diagnosis. This suggests lack of insight into the treatment of such patients, alongside lack of appropriately trained doctors and nurses.

Key recommendations for PRS

1. Ensure capacity and accessibility of facilities for outpatient postnatal care within six 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, 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 septic shock in ill postpartum women, using forums such as morbidity and mortality meetings, formal ESMOE training or other training platforms.
5. No woman should be discharged from the hospital if any abnormal vital signs are recorded and immediate readmission is advised in women with any symptoms and signs suggestive of sepsis.
6. Proper initial triage of these patients and immediate implementation of maternal ‘sepsis bundles’ must always be done at all levels of care.
7. In district hospital protocols, especially in rural areas, emphasis is needed on the recognition of septic shock, as well as the need for early transfer of these women to higher levels of care, after the immediate implementation of ‘sepsis bundles’ as outlined in the maternity care guidelines.
8. In regional hospitals, audit the capacity of staff and facilities to manage women with septic shock. Recommended norms and standards for staff and facilities, including intensive care units, should be followed.
9. 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.

Obstetric haemorhage (Dr CS Mpehle and Ms T Mangcotywa)

Obstetric haemorrhage was the fourth most common cause of maternal death for the triennium *2020–2022*. There were 55 deaths reported for this category and this made up 12.9% of total maternal deaths compared to 18.9% (N=71) in the last triennium. The three leading contributors in this category are:

1) Bleeding after caesarean section (N=13)
2) Ruptured uterus with previous CS (N=6)
3) Abruptio placentae with hypertension (N=5)

Ruptured uterus without previous CS (N=5) and uterine atony (N=5) all had an incidence of 1.2%. Table 11.

The use of surgical safety checklists and the assessment of facilities using the surgical safety assessments is something that needs ongoing encouragement. Six out of thirteen deaths occurred at the NCH due to late referrals from district hospitals. The use of stabilisation methods such as ability to perform haemostatic sutures such as B-lynch, and the use of the torniquet is likely a contributor in this reduction. Ongoing training on intra-

operative management of bleeding is necessary.

Although bleeding after caesarean section showed the greatest reduction from the previous triennium from twenty-two (5.9%) to thirteen (3.1%), this still remains the greatest contributor of deaths due to obstetric haemorrhage. Six deaths due to bleeding after CS occurred at the tertiary hospital, 3 deaths occurred at district hospitals and 3 at regional hospitals. The importance of the appropriate use of early warning charts should be emphasised, as well as early recourse for re-laparotomy. Surgical techniques may have also been a contributor as adequate haemostasis at the caesarean section may not have occurred. The use of tranexamic acid and prophylactic B-Lynch sutures should also be encouraged when concerned about risk of post-operative bleeding.

Table 11. Sub-categories of causes of death Obstetric haemorrhage

	2020-2022	
	n	%
Obstetric Haemorrhage	55	12.9
• Abruption with hypertension	5	1.2
• Abruption without hypertension	1	0.2
• Placenta Praevia	4	0.9
• Other APH not specified	2	0.5
• Ruptured Uterus with previous C/S	6	1.4
• Ruptured Uterus without previous C/S	5	1.2
• Retained Placenta	3	0.7
• Morbidly Adherent Placenta	1	0.2
• Uterine Atony	5	1.2
• Vaginal Trauma	1	0.2
• Cervical Trauma	2	0.5
• Uterine Inversion	2	0.5
• Bleeding during C/S	1	0.2
• Bleeding after Caesarean Section	13	3.1
• Other PPH not specified	4	0.9

Most obstetric haemorrhage deaths (N=20) occurred from OR Tambo patients, followed by Amathole BCM (N=13), and 8 in both Chris Hani and Nelson Mandela. Of concern is the six out of thirteen maternal deaths in Amathole/BCM that occurred at the tertiary hospital due to bleeding after caesarean section. Alfred Nzo needs to focus on OH interventions as it is the leading cause of death in the district with 25% alongside Medical & Surgical disorders.

Out of 4 cases of younger patients (<20 years), 75% of deaths were due to abruptio placentae with hypertension. Advanced maternal age (> 35 years) was a significant contributor by 40% to deaths of obstetric haemorrhage.

Ruptured uterus with previous CS is the second most common contributor to the deaths in this triennium. These cases increased from 0.3% (N=1) in the previous triennium to 1.4% (N=6). It is necessary to understand where the gap is. Women with Previous CS should be carefully assessed when planning of a trial of labor. The facility of delivery needs to have adequate staff for close monitoring and clinical acumen for recognising impending rupture. Adherence to partogram and continuous CTG monitoring is vital. Patients awaiting theatre and those in labour should be tocolysed and appropriate measure should be taken to date the pregnancy so that elective surgeries are done at the correct time. There is an increasing trend of patients attempting self-induction and the dangers of drugs such as misoprostol and traditional medication such as “umchamo wemfene”, should form part of antenatal education, particularly in patients with a scarred uterus.

Most OH deaths occurred at facilities (N=45) 10.6%, with 1.4% home/outside facility deaths and 0.9% in transit. This means optimisation of patients in transit with the use of measures such as the non-pneumatic antishock garment (NASG), should be emphasised. In terms of the outside/ home deaths we would need to ascertain possible avoidable factors (e.g. look at the duration of wait for medical assistance such as the availability of ambulances, availability of ALS for escorting unstable patients by EMS and availability of Aero medical doing transfers during day. The above mentioned is still a challenge for the province.

Lack of transport from institution-institution was the leading administrative avoidable factor which contributed 9% to total causes.

The mode of delivery did not have an impact as 38% (N=21) of patients had a CS and 42% (N=23) delivered via NVD.

The recent result of the EMOTIVE study emphasises the accurate detection of blood loss and bundle approach for patients with PPH. The most critical element here is recognition and although the measuring devices vary, the awareness of this approach will hopefully assist in rapid and relevant intervention. This critical approach is being emphasised in the ESMOE training. This training session should be mandatory for all healthcare providers working in maternity and facilities should have regular drills.

Recommendations for obstetric haemorrhage:

1. ESMOE training including the use of the NASG should be routinely taught to obstetric units. This includes regular fire drills. The NASG should also be recommended for use by the EMS and they should have an adequate supply.
2. EMOTIVE approach with the emphasis on early recognition of PPH and the bundle approach to management should be introduced.
3. Safe CS checklists and accreditation. ESMOE training must emphasise safe surgical and anaesthetic skills, particularly for the district doctors in managing the airway.
4. Mandatory use of early warning charts and monthly facility audits of their use.
5. Link district doctors to a regional or tertiary hospital for in-reach to improve their skills and to participate in Diploma preparation to write the Diploma in Obstetrics and Anaesthetics. Funding to be secured to reimburse successful candidates.
6. SOP for post-operative monitoring of patients.
7. Institutionalising maternal near miss audits, will allow for more facility/region specific interventions.
8. Special charts for induction of labour: including risk factors, bishop score assessment and misoprostol doses to be designed and distributed provincially.

Table 12. Sub-categories of causes of death 2020-2022, hypertension, anaesthesia, embolism and acute collapse

	2020 - 2022	
	n	%
Hypertension	67	17
• Chronic Hypertension	1	0.2
• Proteinuric Hypertension	2	0.5
• Eclampsia	36	8.3
• HELLP	5	1.2
• Liver Rupture		
• Acute Fatty Liver		
Anaesthetic complications	11	2.5
• General Anaesthetic	1	0.2

	2020 - 2022	
	n	%
• Spinal Anaesthetic	10	2.3
Embolism	20	3.1
• Pulmonary Embolism	18	4.1
Acute Collapse – Cause unknown	6	1.4

Hypertension (Dr GZ Mbambisa, Mrs N Gwiji and F Ngamlana)

Hypertensive disorders are the second leading cause of maternal deaths at 20, 7% (N=67). The most common cause of death in this category remains eclampsia at 8.3% (N=36). This is an improvement from 55 deaths (10.9%) in the previous triennium. The iMMR was 20.7 deaths per 100,000 live births, having dropped to 17.3 in 2021 and increased in 2022. Of the 66 that died in the facilities, most deaths occurred in the regional hospitals (n=23), 22 died in the national central hospitals, 12 died at the tertiary hospitals, nine died at the district hospitals and one at a CHC. No hypertension deaths were reported by the private hospitals. OR Tambo district had the most deaths, 29 out of 156, followed by NMBM with 17 out of 95, both BCM and Amathole had 13 out of 104 and Chris Hani with 6 out of 41.

Hypertension was the leading cause of death contributing 25% (n= 8 between the ages of 15 – 19. The extremes of age were most affected with 10 deaths between the ages of 40 – 44 years, and nine in the age group of 35 – 39. No deaths were reported in the youngest age group (10 – 14 years). Caesarean delivery was the most common delivery route (N=25); 13 were done at the national central hospital. Fifteen women died after vaginal delivery, these also occurred in regional and tertiary hospitals which reported 6 deaths each. Of the 67 deaths due to hypertensive disorders, 42 women were HIV negative, 16 positive and nine had an unknown status. The number of post-mortems conducted was very low with only six done.

Deaths from gestational hypertension improved whilst deaths from HELLP remained the same. This could be related to appropriate referral to tertiary level as well as availability of fresh dried plasma at DH.

Poor management of pre-eclampsia remains a challenge as patients continue to be managed as outpatients despite proteinuria with borderline hypertension. Infrequent follow up of clients at high risk clinics, poor tracing of defaulters, and poor audit of records were avoidable factors. Skilling doctors and nurses and EMS personnel on ESMOE in transit is critical. However, ongoing monitoring of compliance to guidelines needs attention. Availability of contraceptives, Labetolol for control of severe hypertension, and procurement of appropriate BP machines needs attention.

Anaesthesia (Prof. B Mrara)

Primary anaesthetic deaths have increased to 11 contributing 2.5% to the total, with an iMMR of 3.4 deaths per 100,000 live births. These occurred mainly in district hospitals related to poor monitoring of patients under spinal anaesthetic, and insufficient knowledge and skills for managing complications of spinal Anaesthetic. Four patients died at DH and four at RH. Five of the deaths occurred in OR Tambo with two in NMBM and Chris Hani. Five of the 11 patients were in the 30-34-year age range and two were teenagers. Plans include expanding the anaesthetic assessors team with continued in-reach and improved retention of trained doctors. Thematic focused retraining and feedback will be improved. There were also deaths where anaesthesia was contributory to the death but not the primary cause; and for which there was substandard anesthetic care.

Substandard care themes:
1. Results not checked (coagulopathy, renal failure)
2. Failure of post operative care: PPH vigilance is needed.
3. BP monitoring intra-operatively must be adhered to, and appropriate use of vasopressors for spinal hypotension
4. High care and ICU referrals need to be arranged where applicable, with improved availability of such beds.

5. ACLS protocols need to be re-inforced with respect to adrenalin frequency, and use of furosemide
6. Blood product availability (platelets and cryoprecipitate)
7. Management of comorbid illness: TB, HIV, Poisoning, Pulmonary Embolus
8. Vigilance is needed for adverse pregnancy outcomes in patients with severe Preeclampsia post delivery.

Embolism (Prof. M Mdaka and Mrs T Matshoba)

Embolism is the sixth commonest cause of maternal death. There is an increase in deaths from 2.1% (N=16) to 4.6% (N=20). VTE prophylaxis should always be administered in patients with predisposing factors, including after emergency CS. Forty-five percent of patients died in DH, with one in CHC and outside. Only seven out of 20 patients had postmortem. There were two cases of amniotic fluid embolism.

The RCOG VTE score as well as the safe surgical checklist can assist to identify the patients at risk for embolism and their routine use and incorporation in the Maternity Case Record is recommended.

Acute collapse – cause unknown

There were six cases of acute collapse with two occurring outside facilities. Autopsy rate should be improved in both the pulmonary embolus and acute collapse.

Medical and surgical disorders (Dr S Mandondo and Dr Mbongozi)

Table 12. Sub-categories of causes of death 2020-2022 pre-existing medical and surgical disorders

	2020 - 2022	
	n	%
Pre-Existing Medical and Surgical Disorders	57	12.4
• Cardiac disease	17	4.0
• Endocrine		
• GIT	1	0.2
• CNS	5	1.2
• Respiratory	7	1.6
• Haematological	2	0.5
• Skeletal		
• Suicide	7	1.6
• Genito-urinary	1	0.25
• Neoplasm	4	0.9
• Other	13	3

Medical and surgical disorders increased to 3rd position with fifty-seven maternal deaths (N=57) making up 13.1% of the total. The numbers almost doubled from 12 to 23 (45% increase) in 2020. These numbers were sustained in 2021 and 2022 (n=22 deaths). Sixty-one percent (N=35) patients who died of M&S conditions were under 30 years mainly because abnormal vitals were ignored at PHC level. The iMMR from Medical and surgical conditions in EC was 17.6 maternal deaths per 100,000 live births, compared to the national iMMR of 16.99. The most common cause of deaths was cardiac (n=17), suicide (n=7), respiratory problems (n=7), CNS (n=5) and neoplasm (n= 4 deaths).

Of the seven suicide deaths, three occurred in DH, three at NCH and one in RH. Seven of the cardiac deaths

occurred at the NCH with five in regional hospital indicating that the patients are referred appropriately.

Cardiomyopathy and other cardiac disease were the leading cause of death. Patients admitted in critical condition with advanced respiratory failure were admitted to general wards. Use of early warning chart and checklists in post-natal ward will reduce re-admissions of patients who had been sent home in unstable condition.

Recommendations: Hypertension and Pre-existing Medical and Surgical conditions

1. Routine vital signs among pregnant patients should include respiratory rate antenatally in addition to blood pressure, pulse and urine dipstix to triage patients appropriatelly in OPD. The antenatal early warning chart is provided in the maternity case records should be used for all admissions and abnormal vitals escalated and responded to.
2. All registrars in O&G should rotate in ICU, and obtsetric High care units should be adequatelly staffed to improve critical care. All patients admitted in High Care in regional and tertiary hospital should have a high care discharge summary provided to guide follow up at lower levels. This summary should include a delivery plan or postnatal plan review plan.
3. Regional and tertiary hospitals should establish joint clinics involving obstetricians and physcians for the management of women with underlying medical disease. Management of these patients should include a delivery plan and a plan for future contraception.
4. District hospitals should have a transitional highcare area to stabilise and manage women while awaiting transfer to regional and tertiary facilites.
5. Women should be screened for mental health conditions at the first ante-natal visit using the mental health screening tool in the Maternity Case Record, and offered the contact details for online counselling services. Teenagers are vulnerable group and need refferal and linkages for ongoing support. Support group at local clinics or community at subsequent visits need to be established.
6. Gender based violence should be suspected in patients with recurrent admissions and negative findings on investigation after referral to other disciplines. Protocol to manage GBV and patient who screen positive for mental health need to be included in all BANC plus trainings.
7. ESMOE and clinical training needs to include algorithm for managing tachycardia both antenatally and post natally as well as a cardiac module as part of the ESMOE course.
8. Contraception counselling needs to be adhered to and emphasised in patients with extremes of age and access to Long Term Reversible contraception monitored in all primary healthcare clinics . Adolescent and Youth friendly services need to be established where feasible The B WISE app needs to be marketed to youth to improve knowledge about contraceptives. Anonymous tele consulting and information in this app is an effective tool .
9. Conduct Near MISS audit of patients with severe pre-eclampsia complications at tertiary so that DCST and consultant provide feedback to referring facilities during outreach
10. The Nurse mentor strategy needs to be mantained to improve skills at PHC facility level

Non–pregnancy related infections (NPRI) (Dr M Feketshane, Mrs Nwesigye and Mrs N Magingxa*)*

COVID-19 maternal deaths 2020 -2022

2020	37	35%
2021	33	20%
2022	3	5%

Non-pregnancy related infections (NPRI) remained the leading cause of maternal deaths for the triennium 2020-2022. There were 155 deaths reported for this category and this made up 36.5% of total maternal deaths compared to 23.9% (N=90) in the last triennium. Included in this category were the 73 COVID-19 maternal deaths.

The first positive COVID-19 case in South Africa was confirmed in March 2020. The peak impact of the pandemic on maternal deaths was noted in the first two years of the triennium (2020-2021). There were 37 deaths in 2020 (35%), 33 (22%) in 2021 and a drastic drop to 3 (5%) in 2022.

Recommendations

1. Ongoing awareness and safety measures.
2. Ensure vaccination of all pregnant women in the event of future COVID-19 outbreaks.
3. During future COVID-19 outbreaks, mask wearing, social distancing and hand washing will remain the mainstay of infection prevention and control.

Table 13. Sub-categories of causes of death for non-pregnancy Related Infections

	2020-2022	
	N	%
Non–Pregnancy Related Infections	155	62.7
• PCP Pneumonia	4	0.9
• Other Pneumonia	11	2.5
• TB	43	9.9
• Appendicitis		
• Endocarditis		
• UTI	1	0.2
• Cryptococcal meningitis	1	0.2
• Other meningitis	11	2.5
• Kaposi's sarcoma		
• Hepatitis		
• Gastroenteritis	3	0.7
• Wasting syndrome	2	0.5
• Complications of antiretroviral therapy		
• COVID-19	73	16.7

Recommendation NPRI (Dr P Selanto and Mrs N Ngwabeni)

1. Strengthen pregnancy screening at community, TB screening in pregnancy and Gene expert for all clients. CCMDD parcels can be used to insert messages to create demand.
2. Integration of contraceptive services into routine chronic care with promotion of LARC and monitor usage on tier.net. Communication on Emergency contraception needs to be widely disseminated.
3. Implement the New PMTCT guidelines using TLD and focus on VL suppression.
4. Pregnancy testing and linkage of antenatal client to WBOTs to follow up into the Post-natal period. Community engagement on RISKS of not booking, self- induced TOP and marketing of maternity waiting homes is needed.
5. Use nerve center approach to monitor progress.
6. All sub-districts need to continue to allocate clinical nurse mentors who will conduct In-service education on SRH including insertion LARC at PHC facilities. These mentors must have monitored by PHC supervisors and DCST.

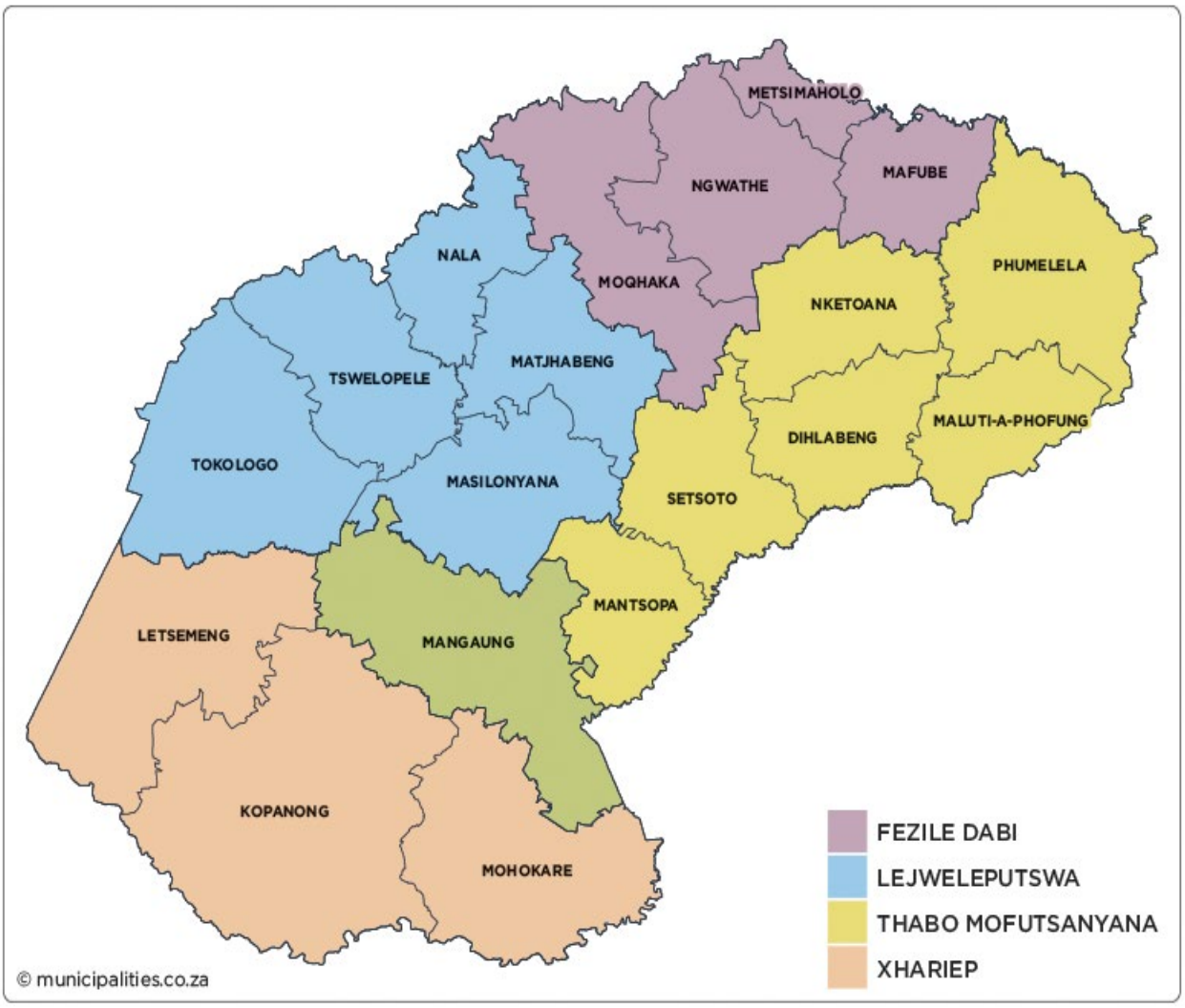
Implementation of recommendations for the major causes of maternal death in EC requires attention to strengthening the health system, improving clinical governance and health worker training.

Eastern Cape Maternal Death Assessors List (2020-2022)

Name and Surname	District	Name Surname	Facility
Dr Sibongile Mandondo	Amathole	Prof. Busisiwe Mrara	NMCH
Ms Cingiswa Qwakanisa	BCM	Dr KAP Bhat	East London Complex
Dr Nonkosi Selanto	BCM	Dr Mihlali Simama	Frontier Hospital
Mrs Ntombizanele Ngwabeni	CMH	Dr Bezile Langa	Frontier Hospital
Dr Zwelidumile Mbambisa	Private r	Ms Noluthando Gwiji	O.R Tambo
Ms Fezeka Ngamlana	Chris Hani	Dr Catherine Bongi Mpehle	CMH/Frere
Prof. Mana Mdaka	NMCH	Dr Yakheka Dyasi	Private
Ms Lulama Sompeta	Private	Ms Julia Pieterson	Dora Nginza Hospital
Ms Ntombizodwa Phokontsi	NMMB	Ms Yolisa Ndubaza	Dora Nginza Hospital
Dr Mfundo Feketshane	East London Complex	Ms Thozeka Mangcotywa	Nontyatyambo MOU
Ms Naomi Mwesigye	Frere Hospital	Dr Lorenzo Borreti	PE Complex
Dr Bulelwa Mzileni	Sarah Baartman	Dr Y Dyasi	Private
Ms Nomthandazo Magingxa	BCM	Dr Nopasika Pinzi	Quuens
Dr Xolani Mbongozi	NMCH	Ms N Dilinga	Dr Malizo Mpehle
Mrs Thandekile Matshoba	NMCH		

8.2 Free State

Overview of the Province



The Free State is situated at the heart of South Africa, surrounded by the Northern Cape, Eastern Cape, North West, Mpumalanga, KwaZulu-Natal, and Gauteng provinces, as well as Lesotho. It is a rural province with farmland, mountains, goldfields, and several small towns scattered throughout.

Despite being the third-largest province in South Africa in terms of land mass, the Free State has the second-smallest population and the second-lowest population density. It spans an area of 129,825 square kilometers and is home to 2.9 million people, which is about 5% of the country's population. The economy of the Free State is mainly driven by agriculture, mining, and manufacturing. The mining industry is a significant employer, with the province being the world's fifth-largest gold producer. The chemicals industry is also a major player, with Sasol, a giant synthetic fuels company, headquartered in the province.

The Free State comprises one metropolitan municipality (Mangaung Metropolitan Municipality) and four district municipalities. These are further divided into 18 local municipalities.

Executive Summary

Introduction

The Saving Mothers report presents an overview of maternal mortality, including underlying causes and trends from 2020-2022, obtained from MAMMAs and District Health Information System (DHIS). The country as part

of the global agenda is expected to reduce maternal mortality to below 70/100 000 live births by 2030. South Africa and the Free State has experienced a downward trend in maternal mortality until 2019. However Free State Province has been one of the provinces with the highest maternal mortality rate since 2017.

Methods

This report contains information about maternal deaths that occurred between 2020-2022 in the Free State Province. The data was collected from all health facilities in the province, including deaths that occurred outside of the facilities if they were reported. However, due to COVID-19 pandemic, data collection faced challenges as the healthcare facilities were overburdened.

Results

Based on the records, there were 258 maternal deaths and nine coincidental deaths in the reporting period. Out of this, 40 deaths occurred in Fezile Dabi, 64 in Lejweleputswa, 93 in Motheo now known as Mangaung Metro, 67 in Thabo Mofutsanyana, and three in Xhariep District. The in-facility maternal mortality ratio (iMMR) during this period was calculated to be **178.1 per 100,000** live births. Out of the total deaths, 37 cases (14.3%) occurred during the Early Pregnancy period, 46 cases (17.8%) occurred during the Antenatal period, 13 cases (5%) occurred during Intrapartum, and the highest number of deaths 170 cases, (65.8% of the total) occurred during Postpartum period. Only one death (0.4% of the total) was anesthesia related, which suggests that either deaths due to anesthesia-related complications are rare or there is a failure to detect such cases. The data also indicate that the department must work on strategies to strengthen postnatal care.

Hypertension is the most common obstetric problem across all districts, followed by non-pregnancy-related infections, Obstetric Hemorrhage, then Medical and surgical disorders. It is concerning that there were 25 deaths where the cause of death was unknown.

Discussion

Submission and assessment of maternal death cases for the Saving Mothers report was hindered by COVID-19. This may have impacted data accuracy. During this period the province experienced an increase in out of facility deaths, which also suggests limited access to healthcare facilities during the pandemic. The joint assessment of maternal death files was not possible due to the limited movement in the province. The provincial office had to distribute the files to the assessors in respective facilities.

An important finding of this report is the increase in maternal mortality during 2020 and 2021 at the height of the pandemic and a remarkable decrease in 2022.

Conclusion

The data shows that maternal mortality in the Free State Province increased to 183.69 in 2020 and further to 232.31 per 100 000 live births in 2021, and substantially decreased to 116.19 per 100 000 live births in 2022. The maternal death rate for the 2020-2022 triennium was 178.1 per 100 000 live births.

Medical and surgical disorder were the leading causes of maternal deaths in 2020, but there was a significant decrease in 2021-2022, with an iMMR of 28.3 maternal deaths per 100,000 live births for the triennium 2020-2022.

There was an increase in deaths due to non-pregnancy-related infections in 2020 and 2021, which decreased in 2022. The iMMR for NPRI for the triennium was 34.5.

Obstetric haemorrhage and hypertension also contributed significantly to the number of deaths, with iMMRs of 31.1 and 35.9 respectively from 2020 to 2022. Most causes of death saw a decrease in 2022 compared to the previous years, which is a positive sign.

The number of live births was relatively stable over the three years, with a slight decrease in 2022.

Overall, these findings suggest that maternal health in the Free State has faced some challenges, but there are also promising signs of improvement. However, more efforts are needed to further reduce maternal mortality rates.

Detailed data on maternal deaths 2020-2022 and comparisons with previous years

Table 1. Maternal deaths, live births and iMMR for 2020-2022

Free State	Live births	MaMMAS deaths (DDCP)	MaMMAS MD	DHIS MD	MaMMAS MD (corrected)	MaMMAs iMMR	MaMMAs iMMR (corrected)	DHIS iMMR
2020	48452	93	89	70	89	183.69	183.69	144.5
2021	49073	115	114	100	114	232.31	232.31	203.8
2022	47336	59	55	50	55	116.19	116.19	105.6

2020-2022	Live births	MaMMAS MD (corrected)	MaMMAs iMMR (corrected)
fs Free State Province	144861	258	178.1

There was an increase in maternal deaths in 2020 and 2021 in the provinces like in the rest of the country. This was due to the contribution of COVID-19 pandemic with the numbers being the lowest in 2022.

In 2020, the iMMR was 183.69. In 2021, it increased to 232.31 but then significantly decreased to 116.2 per 100,000 live births in 2022. It was 178.1 for the whole triennium.

Despite this decrease in 2022, and in previous triennia, the Free State still has the highest values compared to other provinces and was the province with the highest iMMR in 2020-2022.

Figure 1. Maternal deaths in FS, 1998-2022 (corrected)

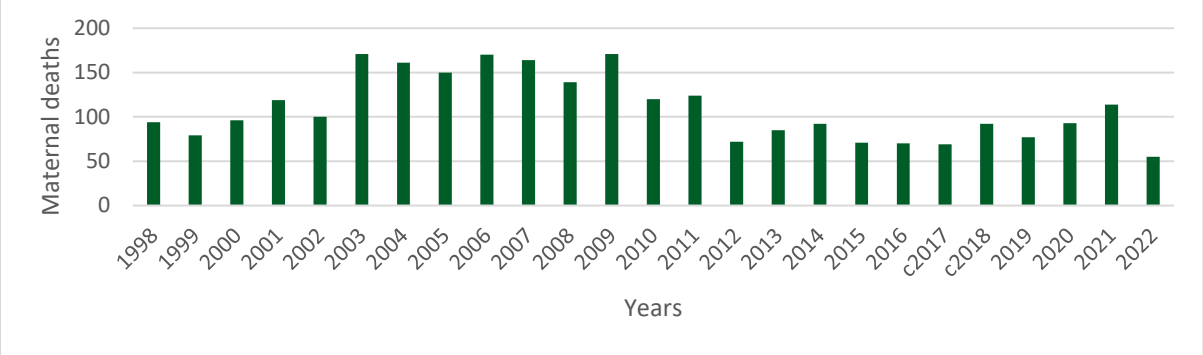
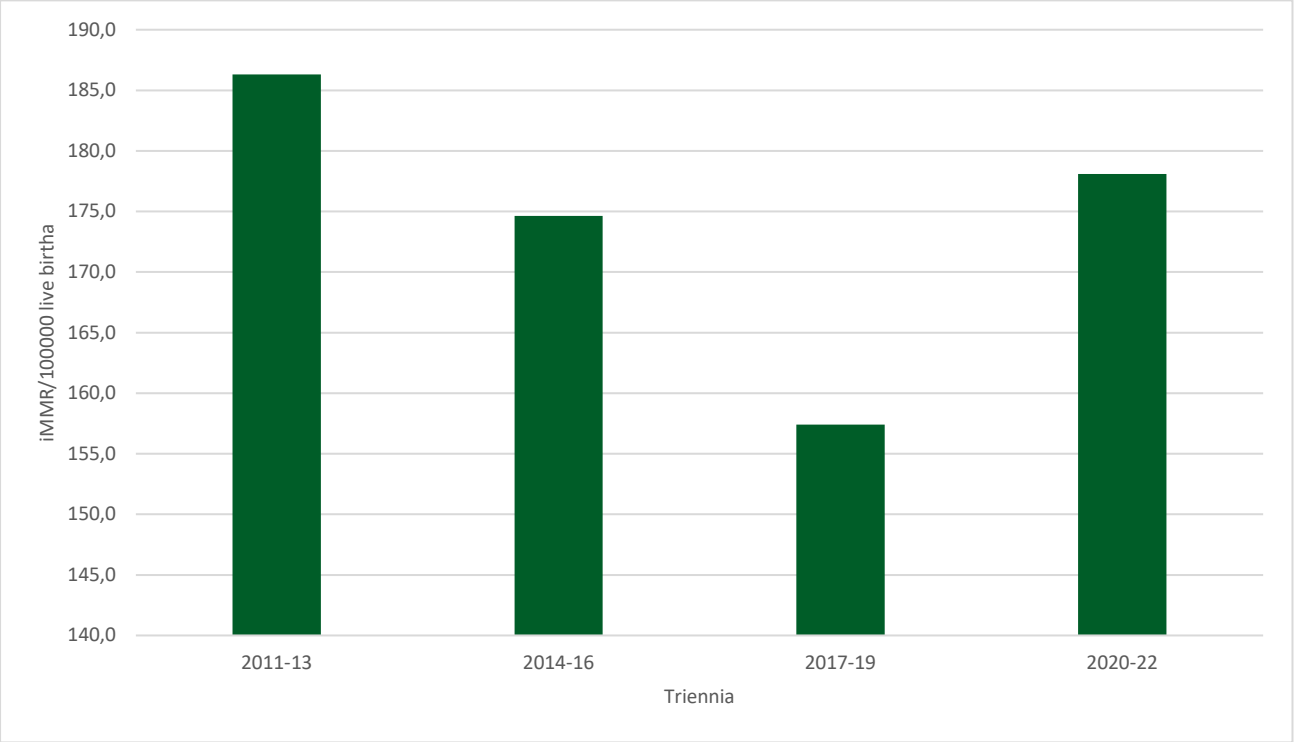
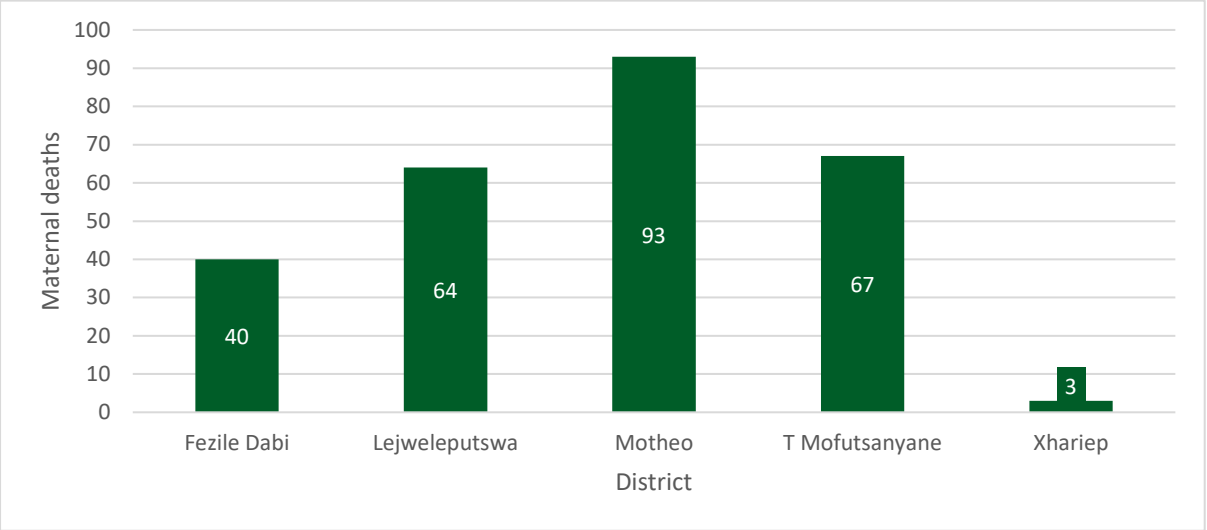


Figure 2. Free State iMMR for 4 triennia from 2011-2022



The iMMR declined from 186.3 in 2011-2013 to 157.4 per 100 000 live births in 2017-2019. However, there was an increase in the maternal mortality ratio during the period of 2020 to 2022, where it rose to 178.1.

Figure 3. Maternal Deaths per District 2020-2022



The district with the highest number of maternal deaths was Motheo (93 deaths) followed by Thabo Mofutsanyana (67 deaths) and Lejweleputswa (64 deaths). The Tertiary and Central Hospitals are in Motheo District and are referral Hospitals for all complicated cases in the province.

Table 2. Primary Obstetric Cause per year and for 2020-2022

Free State	2020	2021	2022	2020-2022
Medical and surgical disorders	22	14	5	41

Free State	2020	2021	2022	2020-2022
Non-pregnancy-related infections	13	29	8	50
Ectopic pregnancy	1	6	2	9
Miscarriage	2	1	1	4
Pregnancy-related sepsis	8	4	3	15
Obstetric haemorrhage	13	23	9	45
Hypertension	14	20	18	52
Anaesthetic complications	1	1	3	5
Adverse drug reactions	2	0	0	2
Embolism	2	5	1	8
Acute collapse - cause unknown	0	0	0	0
Miscellaneous	1	0	1	2
Unknown	10	11	4	25
Maternal deaths	89	114	55	258
Coincidental cause	4	1	4	9
DDCP	93	115	59	267
Live births (2019)	**48452**	**49073**	**47336**	**144861**

Hypertension was the most common obstetric problem across all districts, with a total of 52 deaths (20.1%) for the triennium 2020-2022, followed by non-pregnancy-related infections with 50 deaths (19.3%), Obstetric Hemorrhage at 45 deaths (17.4%), and Medical and surgical disorders at 41 deaths (15.8%). Of concern were the 25 cases (9.6%) deaths where the causes were unknown. Poor feedback from forensic pathology on postmortem results and incomplete clinical records contribute to the unknown causes of death.

Miscarriage and adverse drug reactions are the least common issues, with only four and two cases respectively. Motheo district had the highest number of hypertension cases, followed by Thabo Mofutsanyana, while Xhariep has no hypertension related deaths. A review of cases in Thabo Mofutsanyana revealed poor management of hypertension, delay in referral, delay in commencing emergency management, failure to implement protocols on the use of Magnesium Sulphate, and poor decision-making due to the utilisation of unsupervised medical interns in Thabo Mofutsanyana Hospitals.

Xhariep had the fewest cases, with only three reported. This district does not have a regional hospital or facility that offers Caesarean Section. All high-risk patients and those that need Caesarean section are transferred to Motheo.

Obstetric hemorrhage and hypertension are the two causes with relatively high iMMR throughout the three years, with iMMRs of 31.1 and 35.90 deaths per 100,000 live births respectively.

The iMMR due to medical and surgical disorders has decreased from 45.41 in 2020 to 10.56 in 2022, with an overall iMMR of 28.30 for the triennium.

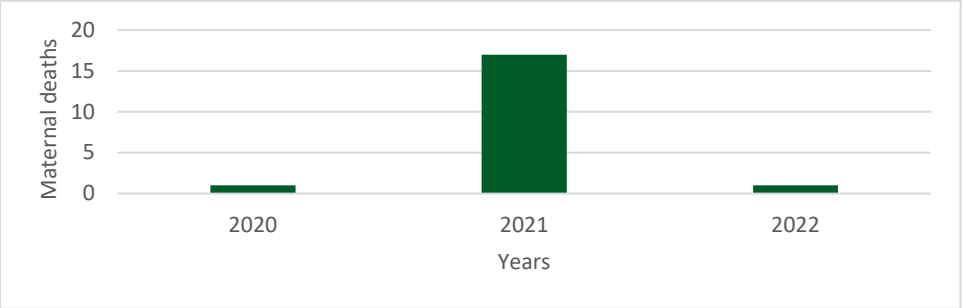
The iMMR due to coincidental causes varied over the three years, with an overall iMMR of 6.21. However, the iMMR due to non-pregnancy-related infections peaked in 2021 at 59.10, which was significantly higher than the rates in 2020 and 2022. The average rate over the three years was 34.52.

The number of live births has slightly decreased from 48 4525 in 2019 to 47 336 in 2022. Despite some progress made in reducing maternal mortality rates, obstetric hemorrhage and hypertension remain significant contributors to maternal mortality. Hence, further efforts should be made to address these issues to continue the downward trend in mortality rates.

There is a category of deaths that is referred to as “Unknown” which accounts for a total of 25 deaths. Out of

these 25, four deaths occurred at a medical facility and 21 occurred outside a medical facility.

Figure 4. COVID-19 Maternal Deaths



The number of COVID-19-related maternal deaths were 19, the highest number was 17 deaths in 2021. The low numbers in 2020 could be due to maternal death assessors not having a good understanding of how and where COVID-19 needs to be classified under non-pregnancy related infections.

During the early stages of the pandemic in 2020, testing capacity might have been limited, which could have led to underreporting of cases. The practices for recording and classifying COVID-19 deaths might have changed over time as our understanding of the virus improved.

If a patient had other health conditions, it might have been challenging to determine the exact causes of death, which could lead to potential misclassification.

Table 3. Location of death (DDPCP)

Primary obstetric problems	Facility	In transit	Home/Outside	Total
Coincidental cause	8	0	1	9
Medical and surgical disorders	41	0	0	41
Non-pregnancy-related infections	48	0	2	50
Ectopic pregnancy	8	1	0	9
Miscarriage	4	0	0	4
Pregnancy-related sepsis	14	0	1	15
Obstetric haemorrhage	43	2	0	45
Hypertension	47	0	5	52
Anaesthetic complications	5	0	0	5
Adverse drug reactions	2	0	0	2
Embolism	6	0	2	8
Acute collapse - cause unknown	0	0	0	0
Miscellaneous	2	0	0	2
Unknown	4	0	21	25
Total	**232**	**3**	**32**	**267**

The majority of the deaths happened within a healthcare facility, indicating that most women had access to healthcare. However, this also raises concerns about the quality of care provided. Very few deaths occurred while in transit.

Table. Primary obstetric cause of death per Level of care (DDPCP)

Primary obstetric problem	Outside	CHC	District hospital	Regional hospital	Tertiary/ Nat central hospital	Private hospital	Total
Coincidental cause	1	1	0	3	4	0	9
Medical and surgical disorders	0	0	4	12	17	8	41
Non-pregnancy-related infections	2	0	7	20	12	9	50
Ectopic pregnancy	0	0	4	4	1	0	9
Miscarriage	0	0	1	3	0	0	4
Pregnancy-related sepsis	1	0	0	6	8	0	15
Obstetric haemorrhage	0	0	12	23	7	3	45
Hypertension	5	0	3	26	15	3	52
Anaesthetic complications	0	0	1	4	0	0	5
Adverse drug reactions	0	0	0	1	1	0	2
Embolism	2	0	1	3	1	1	8
Acute collapse - cause unknown	0	0	0	0	0	0	0
Miscellaneous	0	0	0	2	0	0	2
Unknown	21	0	0	3	1	0	25
Total	**32**	**1**	**33**	**110**	**67**	**24**	**267**

The majority of deaths occurred in regional hospitals (110 out of 267). This could be due to a higher number of complicated cases being referred to these hospitals. However, it remains a concern that some of the Regional Hospitals do not have full-time obstetricians.

Hypertension was the leading cause of death in regional hospitals accounting for 26 deaths while tertiary/central hospitals accounted for 15. This indicates a need for improved management of hypertension across all levels of care.

Non-pregnancy-related infections were the second leading cause of death in regional hospitals (20) and the leading cause in private hospitals (9).

Obstetric hemorrhage was the third leading cause of death in regional hospitals (23). Improved management of obstetric hemorrhage could significantly reduce maternal mortality.

A significant number of deaths occurred outside of healthcare facilities (32), most of which were due to unknown causes (21). This highlights the need for community education and improved access to care.

Most deaths (69 out of 267) occurred in the age group 35-39. The leading causes were hypertension (17), non-pregnancy-related infections (11), and obstetric hemorrhage (16). This indicates the importance of strengthening sexual and reproductive health services in this group Table 5.

The second highest number of total deaths (68 out of 267) was in the age group of 30-34. The leading causes of deaths were non-pregnancy-related infections (17), obstetric hemorrhage (16) and hypertension (6).

Age Group 25-29 accounted for the third highest number of deaths (53 out of 267). The leading causes were non-pregnancy-related infections (10) hypertension accounted for (8).

Eighteen deaths (18 out of 267) occurred between the ages of 40-44 years and hypertension was the leading cause. The province should improve access to sterilisation.

The Free State like other provinces has a challenge of deliveries to teenagers. In the current reporting period, few deaths were reported from this age group (10-19) years.

Table 5. Primary obstetric cause of death and Maternal age (DDPCP)

Primary obstetric problem	10-14	15-19	20-24	25-29	30-34	35-39	40-44	Outside 10-44 range & Unknown	Total
Coincidental cause		1	1	2	3	2	0	0	9
Medical and surgical disorders		3	7	10	14	6	1	0	41
Non-pregnancy-related infections		0	6	10	17	11	6	0	50
Ectopic pregnancy		0	1	4	1	3	0	0	9
Miscarriage		0	0	1	1	2	0	0	4
Pregnancy-related sepsis		1	3	4	4	2	1	0	15
Obstetric haemorrhage		4	3	3	16	16	3	0	45
Hypertension		4	14	8	6	17	3	0	52
Anaesthetic complications		0	1	3	0	1	0	0	5
Adverse drug reactions		0	0	1	0	1	0	0	2
Embolism		1	1	2	2	2	0	0	8
Acute collapse - cause unknown		0	0	0	0	0	0	0	0
Miscellaneous		0	1	1	0	0	0	0	2
Unknown		1	3	4	4	6	4	3	25
Total	**0**	**15**	**41**	**53**	**68**	**69**	**18**	**3**	**267**

Table 6. Primary Obstetric cause and Mode of delivery (DDPCP)

Primary obstetric problems	Vaginal	CD	CHC CD	DH CD	RH CD	TH/NCH CD	PvT CD
Coincidental cause	1	0	0	0	0	0	0
Medical and surgical disorders	10	13	0	0	4	5	4
Non-pregnancy-related infections	15	18	0	1	7	5	5
Ectopic pregnancy	7	7	0	3	4	0	0
Miscarriage	0	0	0	0	0	0	0
Pregnancy-related sepsis	7	7	0	0	2	5	0
Obstetric haemorrhage	24	16	0	3	8	3	2
Hypertension	7	32	1	3	20	9	3

Primary obstetric problems	Vaginal	CD	CHC CD	DH CD	RH CD	TH/NCH CD	PvT CD
Anaesthetic complications	0	5	0	1	4	0	0
Adverse drug reactions	0	1	0	0	1	0	0
Embolism	2	4	1	1	2	2	2
Acute collapse - cause unknown	0	0	0	0	0	0	0
Miscellaneous	0	0	0	0	0	0	0
Unknown	12	5	5	5	5	5	5
Total	**85**	**108**	**7**	**17**	**57**	**34**	**21**

Table 6 shows the mode of delivery for each primary obstetric cause of deaths.

In the reporting period, there were **46746** Caesarean deliveries, and out of 267 deaths, 108 were delivered through CD, which accounts for 41.8% of maternal deaths.

The primary causes of death for caesarean deliveries were hypertension (32), non-pregnancy-related infections (18), and Obstetric hemorrhage (16).

Meanwhile, vaginal delivery had the second-highest number of total deaths at 85. Obstetric hemorrhage accounted for 24 deaths followed by non-pregnancy-related infections (15 deaths), and Medical and surgical disorders (10 deaths).

Table 7. Primary Obstetric cause and HIV status (DDPCP)

Primary obstetric problems	Negative	Positive	Declined test	Unknown	Total
Coincidental cause	0	3	0	6	9
Medical and surgical disorders	19	15	0	7	41
Non-pregnancy-related infections	8	38	0	4	50
Ectopic pregnancy	2	3	0	4	9
Miscarriage	1	2	0	1	4
Pregnancy-related sepsis	8	5	0	2	15
Obstetric haemorrhage	18	23	0	4	45
Hypertension	31	17	0	4	52
Anaesthetic complications	5	0	0	0	5
Adverse drug reactions	1	1	0	0	2
Embolism	4	3	0	1	8
Acute collapse - cause unknown	0	0	0	0	0
Miscellaneous	2	0	0	0	2
Unknown	13	6	0	6	25
Total	**112**	**116**	**0**	**39**	**267**

Among the total deaths of 267 individuals, the HIV-positive group accounted for 116 deaths. Non-pregnancy-related infections (38), obstetric hemorrhage (23), and hypertension (17) were the leading causes of death among HIV-positive individuals. Similarly, the HIV-negative group had 112 deaths, with hypertension (31),

obstetric hemorrhage (18), and medical and surgical disorders (19) being the leading causes of death. It was reported that no pregnant women declined the HIV status group, and the cause of death was often unknown as well, which has already been identified as a matter of concern.

This calls for continuation in health promotion by providing education to the communities to “know your Status” and ensure that the 95,95,95 strategy is implemented as all levels of care by enhancing access to care, ensuring linkage and retention in care, and a functional referral system.

Table 8. Primary Obstetric cause and Postmortems (DDPCP)

Primary obstetric problems	Postmortem	Not Done
Coincidental cause	3	6
Medical and surgical disorders	1	40
Non-pregnancy-related infections	0	50
Ectopic pregnancy	1	8
Miscarriage	0	4
Pregnancy-related sepsis	2	13
Obstetric haemorrhage	3	42
Hypertension	7	45
Anaesthetic complications	1	4
Adverse drug reactions	1	1
Embolism	3	5
Acute collapse - cause unknown	0	0
Miscellaneous	0	2
Unknown	6	19
Total	**28**	**239**

- The total number of postmortems conducted was 28, while the number of cases where postmortem was not done was 239. In some cases, postmortem was not indicated.
- The highest number of postmortems were conducted for cases related to hypertension (7), followed by Obstetric hemorrhage (3), Embolism (3), and Coincidental cause (3).
- The highest number of cases where a postmortem was not done was related to non-pregnancy-related infections (50), followed by hypertension (45), and Obstetric hemorrhage (42).
- There were six cases where the cause was unknown and a postmortem was conducted, while there were 19 such cases where a postmortem was not done.

Table 9 shows the final cause of death for maternal deaths.

- Circulatory system issues were the leading final cause of death, accounting for 40.4% of the total. This category includes hypovolemic shock (25.8) and septic shock (14.6%).
- The second leading final cause was respiratory failure, which accounted for 34.5% of the deaths.
- Cardiac failure and cerebral complications were also significant causes, contributing to 16.5% and 15.4% of the deaths respectively.
- Other notable causes include renal failure (10.5%), hematological issues (13.5%), and immune system failure (9.4%).
- The final cause of death was unknown in 11.6% of the cases.

Table 9. Final cause of maternal death

Cause of death	Number	% of total
Circulatory system	108	40.4
- Hypovolaemic shock	69	25.8
- Septic shock	39	14.6
Respiratory failure	92	34.5
- Respiratory failure	92	34.5
Cardiac failure	44	16.5
- Pulmonary oedema	44	16.5
Embolism	14	5.2
- Acute collapse due to embolism	14	5.2
Renal failure	28	10.5
- Renal failure	28	10.5
Liver failure	8	3
- Liver failure	8	3
Cerebral complications	41	15.4
- Intracranial haemorrhage	17	6.4
- Cerebral oedema resulting in coning	3	1.1
- Meningitis	5	1.9
- Brain death following hypoxic event	11	4.1
- Unspecified	5	1.9
Metabolic	18	6.7
- Maternal ketoacidosis	5	1.9
- Electrolyte imbalance	9	3.4
- Thyroid crisis	1	0.4
- Lactic acidosis	2	0.7
- Other	1	0.4
Haematological	36	13.5
- DIC	27	10.1
- Severe anaemia	9	3.4
Immune system	25	9.4
- Immune system failure	25	9.4
Unknown	31	11.6
- Home death	19	7.1
- Unknown	12	4.5
Other	19	7.1
- Other	19	7.1
Total deaths	**267**	

Table 10. Timing of Emergency and Timing of death

Timing of emergency		
- Early pregnancy	40	15.0
- Antenatal period: 20w +	76	28.5
- Intrapartum period	27	10.1
- Postpartum period	123	46.1
- Anaesthesia	1	0.4
Timing of death		
- Early pregnancy	37	13.9
- Antenatal period: 20w +	46	17.2
- Intrapartum period	13	4.9
- Postpartum period	170	63.7
- Anaesthesia	1	0.4

The timing of the emergency was mostly in the postpartum period which accounted for the highest percentage (46.1%). Similar to the timing of the emergency, the timing of the death was mostly in the postpartum period (63.7%).

The following Tables focus on the **Avoidability** of maternal deaths in Free State

Table 11. Avoidability of deaths

No suboptimal care identified	66	24.7
Suboptimal care, no impact on outcome	21	7.9
Suboptimal care, possible impact on outcome	122	45.7
Suboptimal care, probable impact on outcome	58	21.7
Total:	**267**	

Suboptimal care was identified in 201 out of 267 cases. This includes cases where suboptimal care had no impact, possible impact, or probable impact on the outcome. Approximately **75.3%** of patients received suboptimal care.

In 24.7% of the cases (66 cases), no suboptimal care was identified. This suggests that in these cases, the standard of care met or exceeded expectations, but the patient still died.

In 7.9% if the cases (21 cases), suboptimal care was identified but it did not impact the outcome. This means that while the care provided was not up to the standard, it did not adversely affect the patient's health outcome. In 45.7% of the cases (122 cases), suboptimal care was identified and it possibly impacted the outcome. This is a significant percentage and suggests that improvements in care could potentially lead to better health outcomes. In 21.7% of the cases (58 cases), suboptimal care was identified and it probably impacted the outcome. This indicates a strong likelihood that the substandard care directly contributed to the adverse health outcome.

Table 12. Classification of Avoidable Factors

	Number	% of total	% of cases at this level
Patient oriented problems			

	Number	% of total	% of cases at this level
- Avoidable factors identified	123	46.1	
- No avoidable factors	114	42.7	
- Lack of information	37	13.9	
Administrative problems			
- Avoidable factors identified	146	54.7	
- No avoidable factors	98	36.7	
- Lack of information	28	10.5	
Resuscitation problems			
- Avoidable factors identified	173	64.8	
- No avoidable factors	72	27.0	
- Lack of information	23	8.6	
Medical care – CHC			
- Managed at this level	145	54.3	
- Avoidable factors identified	37		25.5
- No avoidable factors	93		64.1
- Lack of information	16		11.0
Medical care - district hospital			
- Managed at this level	157	58.8	
- Avoidable factors identified	92		58.6
- No avoidable factors	57		36.3
- Lack of information	15		9.6
Medical care - Regional hospital			
- Managed at this level	154	57.7	
- Avoidable factors identified	95		61.7
- No avoidable factors	47		30.5
- Lack of information	18		11.7
Medical care - Tertiary & above			
- Managed at this level	72	27.0	
- Avoidable factors identified	34		47.2
- No avoidable factors	36		50.0
- Lack of information	2		2.8
Medical care – Private hospital			
- Managed at this level	31	11.6	
- Avoidable factors identified	14		45.2
- No avoidable factors	14		45.2
- Lack of information	3		9.7

Patient-Oriented Avoidable factors were identified in 46.1% of cases, while no avoidable factors were found in 42.7% of cases. In 13.9% of cases, there was lack of information.

Administrative related Avoidable factors were identified in 54.7% of cases, while no avoidable factors were found in 36.7% of cases. In 10.5% of cases, there was a lack of information.

Medical care related Avoidable factors, are broken down by level of care.

Community Health Centre (CHC):

145 cases were managed at this level, which is 54.3% of the total cases.
37 cases (2535%) had avoidable factors identified.
93 cases (64.1%) had no avoidable factors.
In 16 cases (11.0), there was a lack of information.

District Hospitals:

157 cases were managed at this level, which is 58.8% of the total cases.
92 cases (58.6) had avoidable factors identified.
57 cases (36.3%) had no avoidable factors.
In 15 cases (9.6%), there was a lack of information.

Regional Hospital:

154 cases were managed at this level, which is 57.7% of the total cases.
95 cases (61.7%) had avoidable factors identified.
47 cases (30.5%) had no avoidable factors.
In 18 cases (11.7%), there was a lack of information.

Tertiary and above:

72 cases were managed at this level, which is 27.0% of the total cases.
34 cases (47.2%) had no avoidable factors identified.
36 cases (50.0) had no avoidable factors.
In 2 cases (2.8%), there was a lack of information.

Table 13. Patient Orientated Care avoidable factors

Description	Number	% of cases
Lack of information	37	13.9
No avoidable factor	114	42.7
No antenatal care	37	13.9
Infrequent antenatal care	2	0.7
Delay in accessing medical help	77	28.8
Declined medication/surgery/advice	15	5.6
Family problem	4	1.5
Community problem	1	0.4
Unsafe abortion	2	0.7
Other	14	5.2
Total cases	**267**	

No patient oriented avoidable factor was identified in 42.7% of cases. This suggest that in nearly half of the cases, the deaths occurred despite the standard patient care measures in place, indicating that these were likely due to severe medical complications or other factors outside of patient-oriented care.

There were 28.8% of cases which involved a delay in accessing medical help. This indicates that s significant number of patients experienced delays in receiving medical help, which could have been due to various reasons such as transportation issues, lack of awareness, or systemic delays in the healthcare system.

Lack of information and no antenatal care were significant factors in 13.9% of cases each.

In 5.6% of cases, patients declined recommended treatments or advice, which could have led to adverse outcomes.

Infrequent antenatal care, family problems, community problems, unsafe abortion, and other issues combined, represented 10.4% of cases. These issues form part of there pre-hospital avoidable factors even though they represent a smaller proportion of the cases but are still important areas to address.

The data suggests that while some maternal deaths were unavoidable, there is still an important need for a community focus on health promotion activities for early identification through community-based screening and testing of all child bearing women.

Table 14. Administrative related avoidable factors

Description	Number	% of cases
Lack of information	28	10.5
No avoidable factor	98	36.7
Transport problem: Home to institution	8	3
Transport problem: Institution to institution	8	3
Lack of accessibility: Barriers to entry	6	2.2
Lack of accessibility: Other	6	2.2
Delay in attending to patient (Overburdened service)	20	7.5
Delay in attending to patient (Reason unknown)	5	1.9
Lack of healthcare facilities: ICU	15	5.6
Lack of healthcare facilities: Blood/blood products	7	2.6
Lack of healthcare facilities: Other	9	3.4
Inadequate numbers of staff on duty	34	12.7
Appropriate skill not available on site / on standby	43	16.1
Communication problems: Technical	3	1.1
Communication problems: Interpersonal	1	0.4
Other	26	9.7
Total cases	**267**	

According to the data, in 36.7% of cases, there were no avoidable factors, meaning that the deaths occurred despite the existing administrative measures in place. This suggests that medical complications or other factors outside of administrative control were likely the cause of these deaths.

In 16.1% of cases, the appropriate skills were not available on-site or on standby. This indicates a significant issue with the availability of skilled, knowledgeable, and competent healthcare professionals, which could have a direct impact on patient outcomes.

Inadequate numbers of staff on duty were a contributing factor in 12.7% of cases, potentially leading to delays and or substandard care.

10.5% of cases were associated with a lack of information. This could refer to a lack of patient records, communication gaps, or missing data, which could hinder effective patient management.

7.5% of cases were due to delays in attending to the patient, which could be attributed to overburdened services and subsequent delays in patient care.

11.6% of cases were due to a lack of healthcare facilities, including a shortage of ICU facilities, blood/blood products, etc. indicating infrastructure or resource limitations.

6% of cases were related to transport problems, which include issues with transport from home to institution and between institutions, indicating potential issues with emergency transport services.

4.4% of cases were due to a lack of accessibility, including barriers to early entry into healthcare system.
1.5% of cases were associated with communication problems, both technical and interpersonal communication issues, indicating potential areas for improvement in communication strategies.

Overall, the data suggests that while some maternal deaths were unavoidable, many were associated with administrative issues such as staffing, skills availability, facility limitations, and communication problems. Removing barriers to early entry into health services by creating a responsive healthcare system and addressing these issues could potentially reduce the number of maternal deaths in the Free State.

Table 15. Medical Care related avoidable factors by level of care

Description	Number	% of all cases	% of cases at level
Community health centre			
Managed at this level	145	54.3	100
Lack of information	16	6	11
No avoidable factor	93	34.8	64.1
Initial assessment	11	4.1	7.6
Problem with recognition / diagnosis	17	6.4	11.7
Delay in referring the patient	9	3.4	6.2
Managed at inappropriate level	1	0.4	0.7
Incorrect management (Wrong diagnosis)	6	2.2	4.1
Sub-standard management (Correct diagnosis)	7	2.6	4.8
Not monitored / Infrequently monitored	2	0.7	1.4
Prolonged abnormal monitoring with no action taken	0	0	0
District hospital			
Managed at this level	157	58.8	100
Lack of information	15	5.6	9.6
No avoidable factor	57	21.3	36.3
Initial assessment	28	10.5	17.8
Problem with recognition / diagnosis	48	18	30.6
Delay in referring the patient	34	12.7	21.7
Managed at inappropriate level	20	7.5	12.7

Description	Number	% of all cases	% of cases at level
Incorrect management (Wrong diagnosis)	14	5.2	8.9
Sub-standard management (Correct diagnosis)	25	9.4	15.9
Not monitored / Infrequently monitored	9	3.4	5.7
Prolonged abnormal monitoring with no action taken	9	3.4	5.7
Regional hospital			
Managed at this level	154	57.7	100
Lack of information	18	6.7	11.7
No avoidable factor	47	17.6	30.5
Initial assessment	13	4.9	8.4
Problem with recognition / diagnosis	35	13.1	22.7
Delay in referring the patient	20	7.5	13
Managed at inappropriate level	12	4.5	7.8
Incorrect management (Wrong diagnosis)	13	4.9	8.4
Sub-standard management (Correct diagnosis)	52	19.5	33.8
Not monitored / Infrequently monitored	14	5.2	9.1
Prolonged abnormal monitoring with no action taken	12	4.5	7.8
Tertiary hospital / above			
Managed at this level	72	27	100
Lack of information	2	0.7	2.8
No avoidable factor	36	13.5	50
Initial assessment	7	2.6	9.7
Problem with recognition / diagnosis	10	3.7	13.9
Delay in referring the patient	1	0.4	1.4
Managed at inappropriate level	0	0	0
Incorrect management (Wrong diagnosis)	4	1.5	5.6
Sub-standard management (Correct diagnosis)	18	6.7	25
Not monitored / Infrequently monitored	5	1.9	6.9
Prolonged abnormal monitoring with no action taken	4	1.5	5.6
Private hospital			
Managed at this level	31	11.6	100
Lack of information	3	1.1	9.7
No avoidable factor	14	5.2	45.2

Description	Number	% of all cases	% of cases at level
Initial assessment	2	0.7	6.5
Problem with recognition / diagnosis	11	4.1	35.5
Delay in referring the patient	0	0	0
Managed at inappropriate level	0	0	0
Incorrect management (Wrong diagnosis)	4	1.5	12.9
Sub-standard management (Correct diagnosis)	5	1.9	16.1
Not monitored / Infrequently monitored	1	0.4	3.2
Prolonged abnormal monitoring with no action taken	2	0.7	6.5
Total cases	**267**		

According to the data, 54.3% of all cases were managed by community health centers, and the most common issue was 'Problem with recognition/diagnosis' (11.7%). Meanwhile, district hospitals managed 58.8% of all cases, and the most prevalent issue here was also a 'Problem with recognition/diagnosis' (30.6%).

Regional Hospitals managed 57.7% of all cases, and 'No avoidable factor' (30.5%) and 'Sub-standard management/Correct diagnosis' (33.8%) were the most common issues.

Tertiary hospitals and those above managed 27% of all cases, and half of the cases at this level had 'No avoidable factor', while 'sub-standard management /Correct diagnosis) was a problem in 25% of cases.

Private Hospitals managed 11.6% of all cases, and the most common issue was 'Problem with recognition/diagnosis' (35.5%).

It appears that 'Problem with recognition/diagnosis' is the most common issue across all levels of care. This suggests that improving diagnostic accuracy and management of cases could potentially reduce maternal mortality rates.

It's also worth noting that the percentage of cases managed at each level does not necessarily reflect the quality of care at that level, as the complexity and severity of cases may vary.

The lack of information mainly was from incomplete clinical notes or files not found.

Table 16. Resuscitation related avoidable factors

Description	Number	% of cases
Lack of information	23	8.6
No avoidable factor	72	27
Airway problems	23	8.6
Breathing problems	33	12.4
Circulation problems	53	19.9
Drug problems	2	0.7
Investigation problems	4	1.5

Description	Number	% of cases
Monitoring problems	13	4.9
Not attempted	65	24.3
Total cases	**267**	

Out of all the cases, resuscitation efforts were not assessable in 23 cases (8.6%) due to the unavailability of resuscitation information. In 72 cases (27%), despite the resuscitation efforts, the outcome could not be avoided, indicating that the situations were too critical to be reversed. In 65 cases (24%), resuscitation was not attempted, possibly due to failure to recognise the need for resuscitation or that the patient's condition was thought to be terminal.

This data suggests that while resuscitation was attempted in many cases, there were various obstacles to its success. These obstacles, such as lack of information or inherent health problems (airway, breathing, and circulation issues), highlight areas where improvements could potentially increase the success rate of resuscitation in maternal death cases. It also underscores the importance of presentative measures and early intervention to reduce the severity of complications leading to maternal deaths.

Recommendations

1. The previous recommendations from the NCCEMD Executive Summary 2017-2019 and 2020-2022 remain relevant including the following which are specific to the Free State Province. It is crucial to promptly establish a system for implementing and overseeing these recommendations. Direct engagement with Districts is necessary, to develop strategies to facilitate the execution of NCCEMD Recommendations.
2. In the realm of maternal health leadership, regional hospitals need to employ a minimum of two full-time obstetricians per hospital. Departments should not be managed by interns and community service doctors. Instead, full-time senior medical officers, who have passion and interest in gynecology and obstetrics, should be appointed.
3. Enhancements are needed in the infrastructure of all hospitals, with particular attention to Dihlabeng, Manapo, and Boitumelong Regional hospitals.
4. The health system should be fortified by improving data collection and ensuring the synchronisation and accuracy of data systems including patient records.
5. Existing resources should be reallocated based on necessity. The provision of 24 hour Caesarean Section services at district hospitals, specifically at Tokollo, Albert Nzula, and Senorita Ntlabathi, is of utmost importance. This could significantly improve the health results for both mothers and their newborns.
6. It is necessary to set up outreach programmes.
7. EMS should be accessible for immediate transportation of complicated cases especially from Eastern Free State e.g. Manapo, Phumelela and the Northern Free State hospitals to Central Hospitals.
8. Primary Healthcare (PHC) in the province requires reinforcement in terms of Human Resources for Health (HRM), particularly the issue of appropriate skills mix and provision of basic essential equipment. Equitable allocation of resources should be prioritised.
9. The staff structures in all facilities must be reassessed. Norms and standards centered on Maternal health should be integrated into the Ideal Clinic and Ideal hospital Project.
10. Capacity building for all medical officers, especially for ultrasound training to prevent incorrect diagnosis of extrauterine pregnancy. There are skills deficit among medical officers. The National Department of Health (NDoH) should assist the Provincial Department of Health (DoH) by collaborating with academic Obstetrics and Gynecology and the Health Professionals Council of South Africa (HPCSA) for Exit Competency in priority programmes.
11. It is crucial to build capacity, which involves training healthcare workers on maternal healthcare and skills enhancement and creating a supportive environment for their work. The focus should be on quality care and not just quantity. ESMOE training, including the anesthesia module and ESMOE drills, is necessary.
12. Enhance the capabilities of midwives in the area of mental health. Implement mental health screenings and establish support groups for high-risk patients, as well as debriefing sessions for staff.
13. Develop province-wide protocols for dealing with organophosphate exposure during pregnancy.
14. It is important to involve EMS and pathologists to determine the accurate cause of death specifically for out-of-facility deaths. EMS training should be implemented to ensure timely reporting and avoid late

reporting where someone gets buried before case investigation. Doctors should not write a notification of death without properly assessing the patient/the body.

15. Enhance collaborations with stakeholders, including General Practitioners (GPs), traditional health practitioners, and developmental supporting partners, as maternal healthcare is intricate.
16. Establish peer review evaluation teams to ensure safe Caesarean Sections and safe deliveries.
17. Keep track of the World Health Organization (WHO) Signal functions within the province.
18. At community level, establishing a connection to care is essential, and maternal health should be a central concern of an effective community healthcare programme.
19. Antenatal clients who are high risk should give birth at specified hospitals and go to high-risk postnatal clinics when necessary (Medical Obstetric Clinics).
20. Make sure that mothers and babies are given a suitable discharge plan as part of continuous care when they are discharged from any health facility. It is recommended that postnatal care should be carried out at least three times: on day three, between days seven to 14, and at six weeks after birth as recommended by WHO (2).
21. The establishment of OMBU at Boitumelo, Bongani, and Pelonomi hospitals should be fast-tracked.

References

1. Municipalities of South Africa. Free State Province Overview. municipalities.co.za. Accessed [2023]. Available from: https://municipalities.co.za/
2. World Health Organization. WHO recommendations on postnatal care of the mother and newborn. World Health Organization, 2024.

Free State provincial assessors

No	Name	Position
1.	Ms M. Msasa	Advanced midwife
2.	Dr Selloane Phakisi	Advanced Midwife
3.	Dr Victor Akeke	Family physician
4.	Ms Desriee Mofokeng	Advanced Midwife
5.	Dr Kelebogile Finger- Motsepe	Medical Officer
6.	Dr Janine Lemmer-Malherbe	Specialist Anaesthetist
7.	Dr Palesa Ntaitsane	Medical Officer
8.	Ms Lulu Radebe	Advanced Midwife
9.	Ms Nanki Mpembe	Advanced Midwife
10.	Ms Sebakeng Mphirime	Advanced Midwife
11.	Ms Nokufa Nkhame	Advanced Midwife
12.	Ms Portia Ramalitse	Advanced Midwife
13.	Ms Lungile Juleka	Advanced Midwife
14.	Ms Thuliswa Sithole	Advanced Midwife
15	Ms Mpho Mofedi	Advanced Midwife
16	Ms Nelly Sebusi	Advanced Midwife
17	Dr Thando Nondabula	Obstetrician
18	Dr Matshidiso Duiker	Obstetrician
19	Mookho Kumpi	Advanced Midwife
20	Ms Emma Moloi	Advanced Midwife
21	Ms Maria Mbelekane	Advanced Midwife

No	Name	Position
22	NosimiloTowa	Advanced Midwife

8.3 Gauteng

Overview of the Province

Gauteng (Figure 1) with a population of 16 098 571 people approximately 16 million, is the smallest in land size but it is a densely populated province, followed by KwaZulu-Natal (11 million) and Western Cape (7 million). It stretches over an area of 18 178 km² or approximately 1.4% of the total surface area of South Africa, bordered by the Free State, North West, Limpopo and Mpumalanga provinces. It is situated on the highveld and comprises of five Health Districts, ie three metropolitan municipalities and two district municipalities populated as follows: Sedibeng (966 230), West Rand (969 545), City of Ekurhuleni (4 080 699), Johannesburg (6 121 323) and Tshwane (3 860 013). Gauteng renders healthcare services to 84% of the population in the public sector and 16% in the private sector.

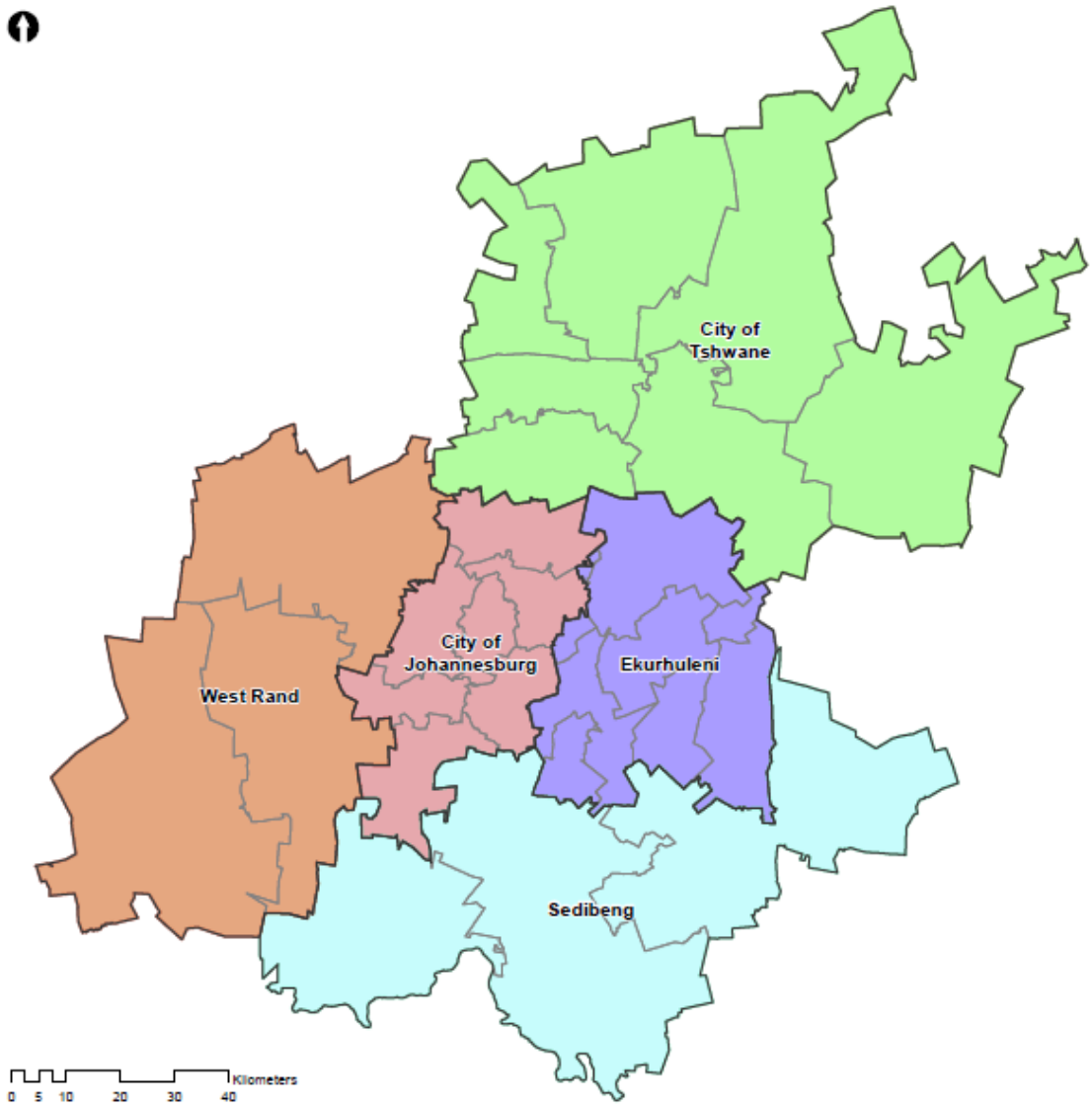


Figure 1: Map of Gauteng Province, source DHIS, 2023

Gauteng is considered the economic hub, wealthiest and highly urbanised province in the country. It is the financial hub of not only South Africa but the entire African continent. It contributes more than 35% to South Africa's Gross Domestic Product (GDP), the provincial economy grew by 7.4% in the first half of 2021 compared to the same period last year. It is home to the Johannesburg Stock Exchange, the largest stock exchange in Africa. Some of the largest companies in Africa and abroad are based in Gauteng, it also includes Pretoria, the administrative capital. It contributes heavily in the financial, manufacturing, transport, technology, and telecommunications sectors, among others. It also plays host to a large number of overseas companies

requiring a commercial base in and gateway to Africa.

Validity of data and Corrections by NCCEMD

In tables 1a and 1b, corrections are noted taking into consideration that more deaths were captured on DHIS than MAMMAs which suggest underreporting to NCCEMD, especially as the latter should include deaths outside of facilities and private deaths, which are not reported to DHIS. The correction increased the number of maternal deaths to be equivalent to those reported to DHIS, see numbers in red print. In the 2005-2027 triennium report a concern was raised about possible under reporting of maternal deaths[1]. In the 2008-2010 triennium report improved reporting was noted[2]. However, it is noted that there is misinterpretation of the definition of maternal deaths in some facilities which needs to be addressed for capturing on DHIS, eg entering of maternal deaths beyond the cutoff of 42 days postpartum.

Table 1a. Numbers of Maternal deaths (corrected)

Gauteng	Live births	MaMMAS deaths (DDCP)	MaMMAS MD	DHIS MD	MaMMAS MD (corrected)	MaMMAs iMMR	MaMMAs iMMR (corrected)	DHIS iMMR
2020	240270	260(c276)	255	271	271	106.13	112.79	112.8
2021	227182	331(c349)	323	341	341	142.18	150.10	150.1
2022	218619	216(c272)	211	266	266	96.51	121.67	121.7

Table 1b: iMMR for 32020-2022 (corrected)

2020-2022	Live births	MaMMAS MD (corrected)	MaMMAs iMMR (corrected)
gp Gauteng Province	686071	878	128.0

Numbers of Maternal deaths, iMMR and trends

Figure 1a. Trends in Gauteng maternal deaths from 1998-2022

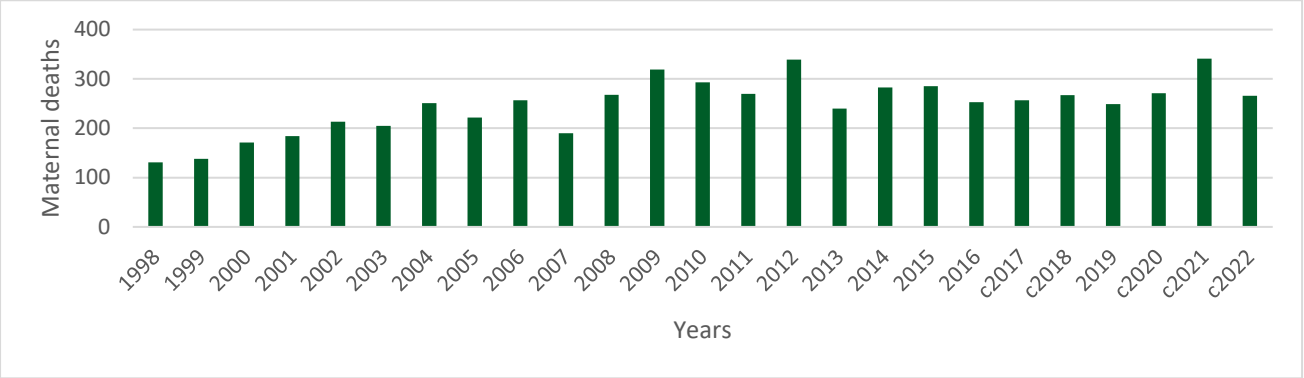
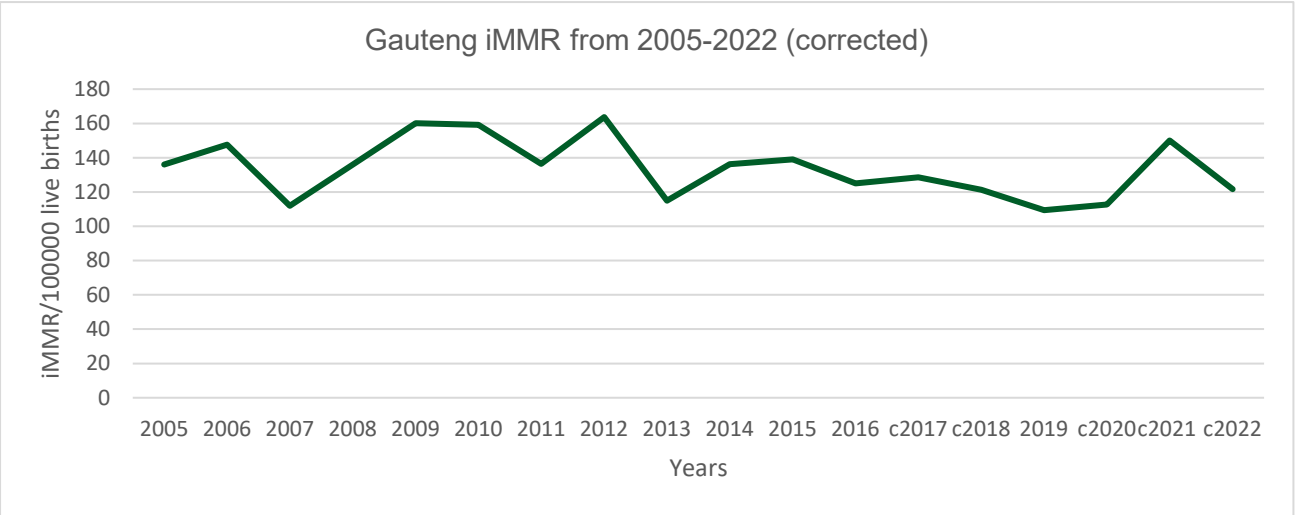


Figure 1b. Trends in Gauteng iMMR from 1998 – 2022



In Figures 1a and 1b, striking spikes in maternal deaths and iMMR are noted in 2009, 2012 and 2021 and during the 2020 – 2022 triennium. The latter increase was due to the COVID-19 pandemic which was severe in Gauteng in 2021.

Figure 2. Gauteng iMMR for 2020 – 2022 (corrected)

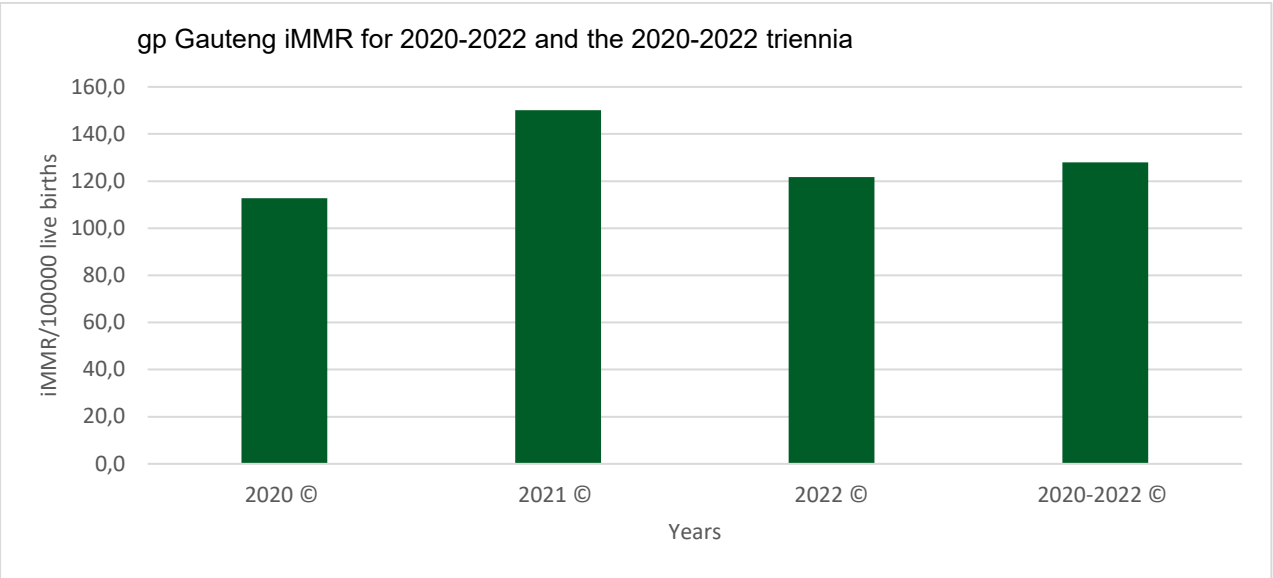
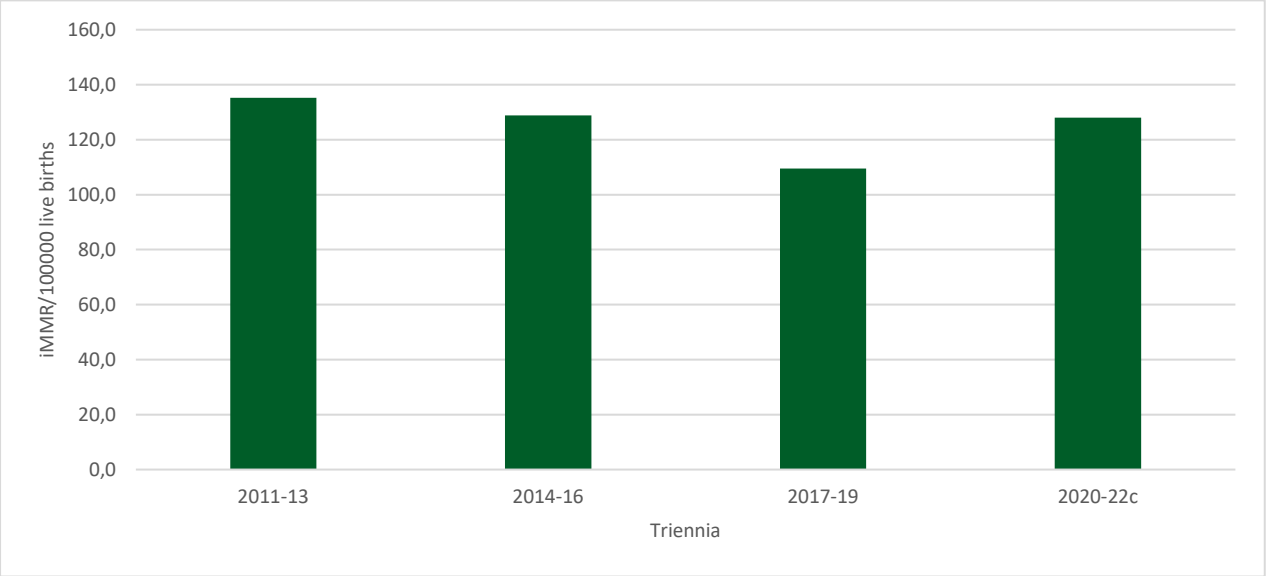


Figure 3. Comparison of iMMR over four triennia (corrected)



In the above graph comparing the four triennia, there was a significant reduction in iMMR from 2011-2013 to 2017-2019 following specific interventions in reducing maternal deaths due to non-pregnancy related infection and obstetric haemorrhage. Implementations of Saving Mothers Report recommendations contributed to the significant reduction in iMMR. A spike in maternal deaths is observed in 2020-2022 triennium due to COVID-19 pandemic and healthcare services disruption.

Causes of Maternal death, 2020-2022

The leading causes of maternal deaths were non-pregnancy relate infections (187), obstetric haemorrhage (137), hypertension (120), medical and surgical disorders (118), unknown (55) and miscarriage (49). The increase in non-pregnancy related infection was attributed to COVID-19 deaths. Tables 2 and 3.

Table 2. Primary Obstetric Causes of Maternal Deaths (uncorrected data)

Gauteng	2020	2021	2022	2020-2022
Medical and surgical disorders	37	48	33	118
Non-pregnancy-related infections	45	110	32	187
Ectopic pregnancy	9	6	11	26
Miscarriage	16	16	17	49
Pregnancy-related sepsis	15	14	11	40
Obstetric haemorrhage	50	55	32	137
Hypertension	50	38	32	120
Anaesthetic complications	2	0	5	7
Adverse drug reactions	3	1	3	7
Embolism	3	4	9	16
Acute collapse - cause unknown	5	13	9	27
Miscellaneous	0	0	0	0
Unknown	20	18	17	55
Maternal deaths	255	323	211	789
Coincidental cause	5	8	5	18

Gauteng	2020	2021	2022	2020-2022
DDCP	260	331	216	807
Live births (2019)	**240270**	**227182**	**218619**	**686071**

Table 3. iMMR per causes of death per year, 2020-2022, and for the triennium

Gauteng iMMR	2020	2021	2022	2020-2022
Medical and surgical disorders	15.40	21.13	15.09	17.20
Non-pregnancy-related infections	18.73	48.42	14.64	27.26
Ectopic pregnancy	3.75	2.64	5.03	3.79
Miscarriage	6.66	7.04	7.78	7.14
Pregnancy-related sepsis	6.24	6.16	5.03	5.83
Obstetric haemorrhage	20.81	24.21	14.64	19.97
Hypertension	20.81	16.73	14.64	17.49
Anaesthetic complications	0.83	0.00	2.29	1.02
Adverse drug reactions	1.25	0.44	1.37	1.02
Embolism	1.25	1.76	4.12	2.33
Acute collapse - cause unknown	2.08	5.72	4.12	3.94
Miscellaneous	0.00	0.00	0.00	0.00
Unknown	8.32	7.92	7.78	8.02
Maternal deaths	106.13	142.18	96.51	115.00
Coincidental cause	2.08	3.52	2.29	2.62
DDCP	108.21	145.70	98.80	117.63
Live births (2019)	**240270**	**227182**	**218619**	**686071**

In Figures 4a and 4b and table 4, there is a marked increase of deaths due to non-pregnancy related infections in 2021 as compared to 2020 and a further decline to pre-COVID-19 period in 2022. A similar trend is observed for obstetric haemorrhage and medical and surgical disorders which also peaked in 2021 due to lack of access to healthcare services and overwhelmed healthcare system during the COVID-19 pandemic.

Figure 4a. iMMR per cause of death for 2020, 2021, 2022 and the whole triennium

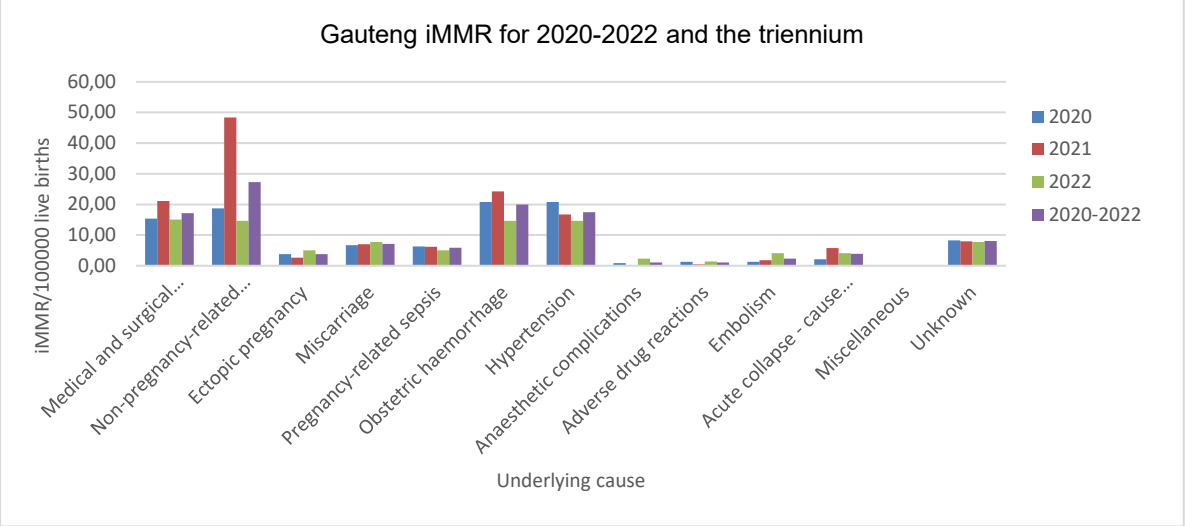
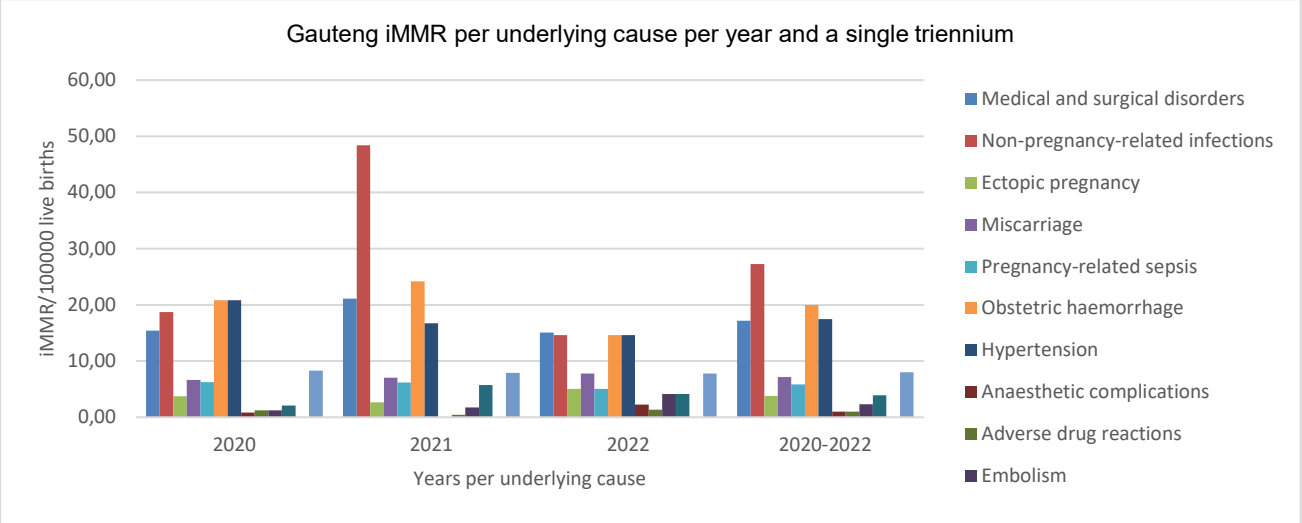


Figure 4b. Comparison of iMMR per underlying cause per year and the whole triennium



Figures 4a and b show that for the whole triennium, non-pregnancy related infections remain the leading cause of maternal deaths followed by obstetric haemorrhage and hypertension.

Table 4. Breakdown of Primary Obstetric Causes by subcategory 2020-2022

Primary obstetric problems	Gauteng
Coincidental cause	**18**
- MVA	2
- Other accidents	1
- Assault	15
- Other	
Medical and surgical disorders	**118**
- Cardiomyopathy	19
- Rheumatic heart disease	5
- Other cardiac disease	5
- Endocrine	9
- GIT	5
- CNS	9
- Respiratory	12

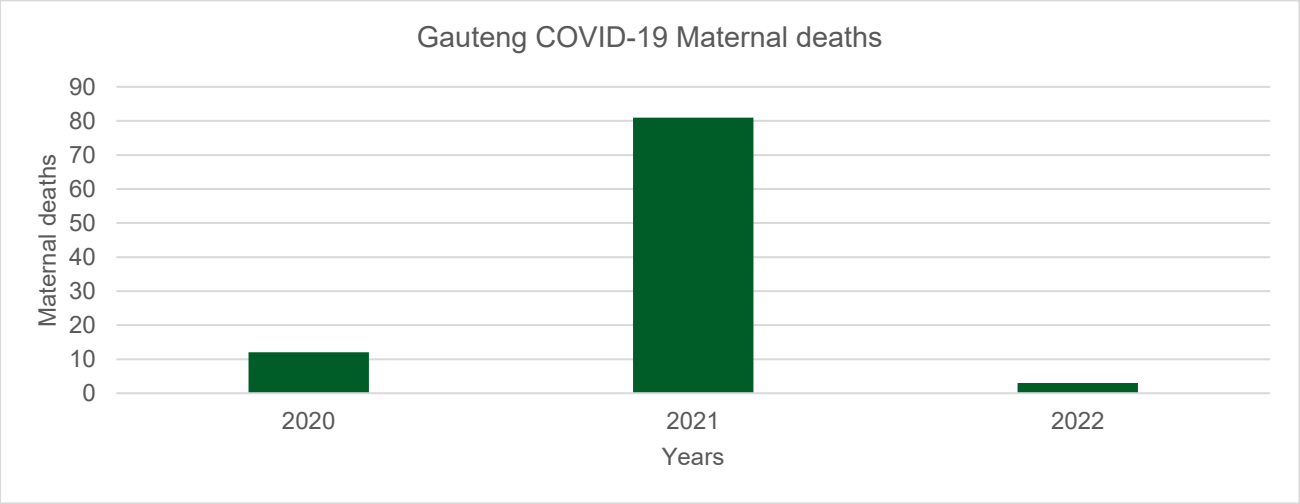
Primary obstetric problems	Gauteng
- Haematological	2
- Genito-urinary	1
- Suicide	4
- Substance abuse	
- Other psychiatric disease	1
- Neoplasm	15
- Auto-immune	2
- Other	29
Non-pregnancy-related infections	**187**
- PCP pneumonia	25
- Other pneumonia	21
- TB	20
- UTI	
- Appendicitis	3
- Malaria	
- Cryptococcal meningitis	1
- Other meningitis	4
- Kaposi's sarcoma	2
- Toxoplasmosis	
- Hepatitis	1
- Gastroenteritis	
- Wasting syndrome	4
- Other	106
Ectopic pregnancy	**26**
- Less than 20 weeks	22
- More than 20 weeks (extrauterine pregnancy)	4
Miscarriage	**49**
- Septic miscarriage	29
- Haemorrhage (non-traumatic)	8
- Uterine trauma	4
- GTD	7
- Following legal TOP	1
Pregnancy-related sepsis	**40**
- Chorioamnionitis (ruptured membranes)	3
- Chorioamnionitis (intact membranes)	1
- Puerperal sepsis after NVD	13
- Puerperal sepsis after CD	21
- Bowel trauma at CD	2
Obstetric haemorrhage	**137**
- Abruption with hypertension	12
- Abruption without hypertension	5
- Placenta praevia	6
- Other APH not specified	2
- Ruptured uterus with previous CD	9
- Ruptured uterus without previous CD	11
- Uterine atony after vaginal delivery	15
- Vaginal trauma after vaginal delivery	4
- Cervical trauma after vaginal delivery	4
- Retained placenta after NVD (morb adherent)	2
- Retained placenta after NVD (not adherent)	5
- Inverted uterus after vaginal delivery	

Primary obstetric problems	Gauteng
- Other PPH not specified after vaginal delivery	5
- Bleeding during CD (morbidly adherent placenta)	10
- Bleeding during CD (not adherent placenta)	11
- Bleeding after Caesarean delivery	36
Hypertension	**120**
- Chronic hypertension	6
- Gestational hypertension	5
- Pre-eclampsia with severe features	25
- Pre-eclampsia without severe features	6
- Eclampsia	61
- HELLP	14
- Liver rupture	3
Anaesthetic complications	**7**
- General anaesthetic	2
- Spinal anaesthetic	5
Adverse drug reactions	**7**
- ARV medication	2
- TB medication	
- Other medication	3
- Herbal medication	2
Embolism	**16**
- Pulmonary embolism	14
- Amniotic fluid embolism	2
Acute collapse - cause unknown	**27**
Miscellaneous	0
- Hyperemesis gravidarum	
- Acute fatty liver	
Unknown	**55**
- Death at home or outside health services	29
- No primary cause found	6
- Lack of information	20
Total	**807**

Table 5. Gauteng COVID-19 maternal deaths

COVID-19 maternal deaths	Gauteng
2020	12
2021	81
2022	3
2020-2022	**96**

Figure 5. Gauteng COVID-19 maternal deaths in 2020, 2021 and 2022



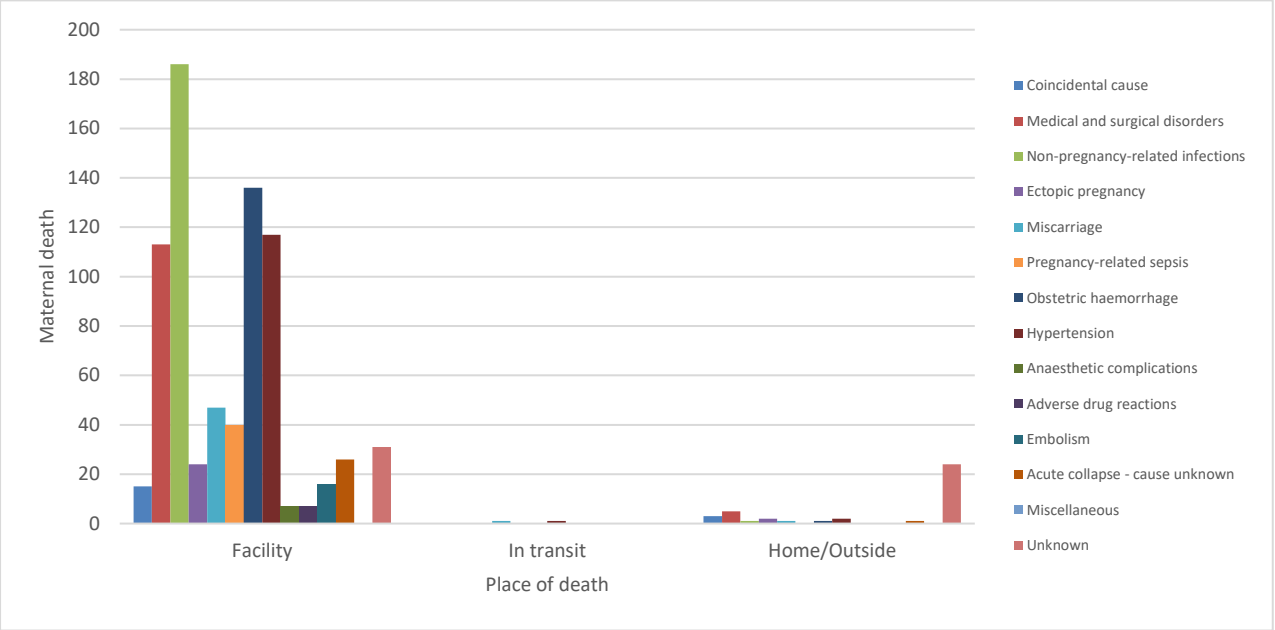
In Table 4 COVID-19 contributed to most deaths from non-pregnancy related infections (classified as 'other'), and caesarean delivery contributed the most to obstetric haemorrhage category. It is noted that eclampsia remains the leading cause of death in hypertensive disorders of pregnancy. Tables 5 and Figure 5, show that there was a rise in COVID-19 related deaths in 2021 as COVID-19 infections increased.

Table 6. Place of death and level of care

Primary obstetric problems	Facility	In transit	Home/Outside	Total
Coincidental cause	15	0	3	18
Medical and surgical disorders	113	0	5	118
Non-pregnancy-related infections	186	0	1	187
Ectopic pregnancy	24	0	2	26
Miscarriage	47	1	1	49
Pregnancy-related sepsis	40	0	0	40
Obstetric haemorrhage	136	0	1	137
Hypertension	117	1	2	120
Anaesthetic complications	7	0	0	7
Adverse drug reactions	7	0	0	7
Embolism	16	0	0	16
Acute collapse - cause unknown	26	0	1	27
Miscellaneous	0	0	0	0
Unknown	31	0	24	55
Total	**765**	**2**	**40**	**807**

Table 6 shows that the greatest number of deaths occurred in health facilities.

Figure 6. Number of Maternal deaths per place of death and underlying cause



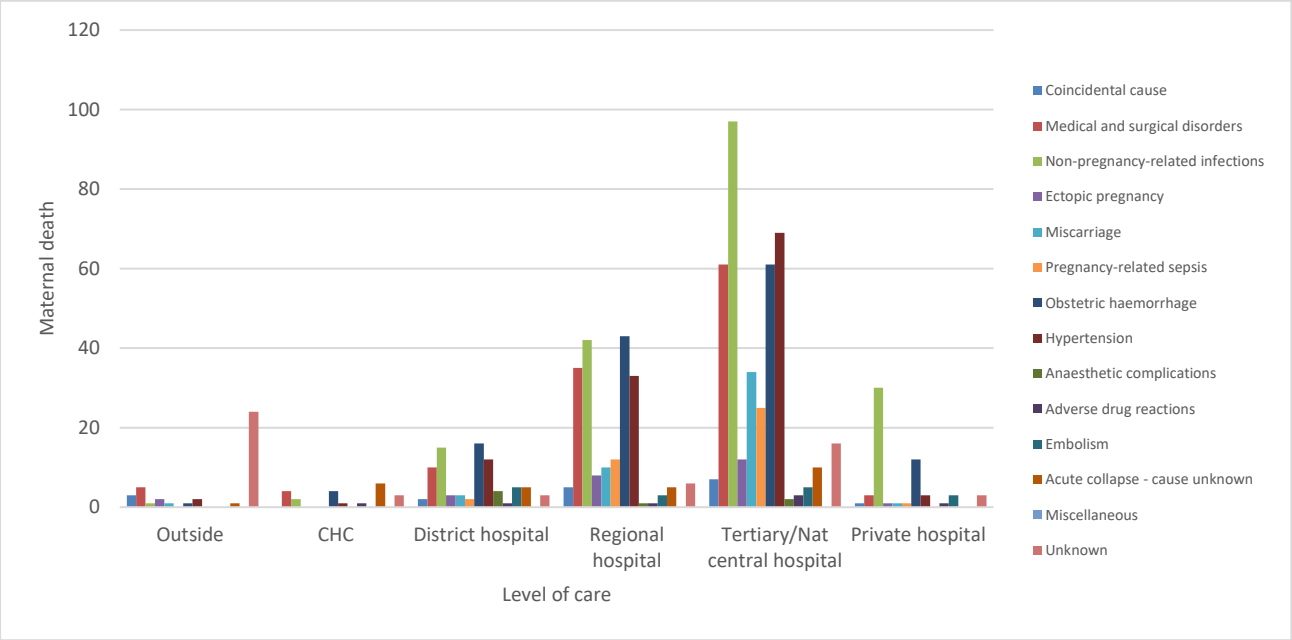
In the above graph, most deaths occurred at the health facility and the main cause of death was non-pregnancy related infections related to COVID-19 pneumonia.

Table 7. Maternal deaths per level of care and underlying cause

Primary obstetric problem	Outside	CHC	District hospital	Regional hospital	Tertiary/Nat central hospital	Private hospital	Total
Coincidental cause	3	0	2	5	7	1	18
Medical and surgical disorders	5	4	10	35	61	3	118
Non-pregnancy-related infections	1	2	15	42	97	30	187
Ectopic pregnancy	2	0	3	8	12	1	26
Miscarriage	1	0	3	10	34	1	49
Pregnancy-related sepsis	0	0	2	12	25	1	40
Obstetric haemorrhage	1	4	16	43	61	12	137
Hypertension	2	1	12	33	69	3	120
Anaesthetic complications	0	0	4	1	2	0	7
Adverse drug reactions	0	1	1	1	3	1	7
Embolism	0	0	5	3	5	3	16
Acute collapse - cause unknown	1	6	5	5	10	0	27
Miscellaneous	0	0	0	0	0	0	0
Unknown	24	3	3	6	16	3	55
Total	**40**	**21**	**81**	**204**	**402**	**59**	**807**

In Table 7 and Figure 7, the majority of women died from non-pregnancy related infections, mainly COVID-19 pneumonia and that the deaths occurred at the appropriate level of care.

Figure 7. Maternal deaths per level of care, per underlying cause for the 2020 – 2022 triennia



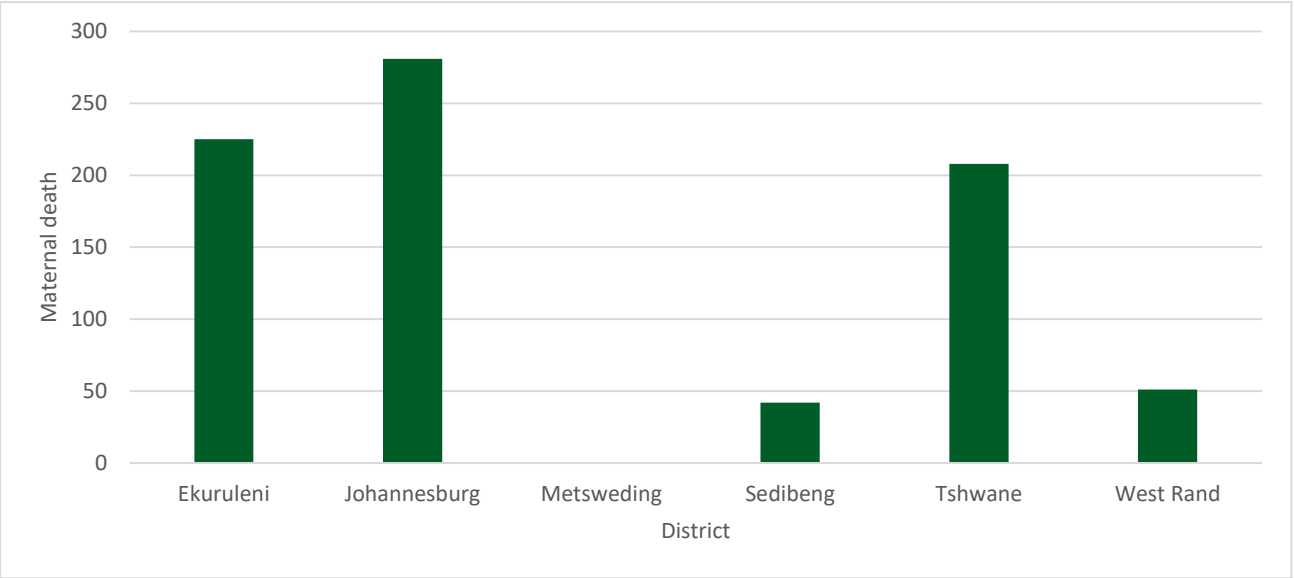
The greatest number of women died at the appropriate level of care but there was shortage of staff as the doctors and nurses became sick, some died due to COVID-19 pandemic; and the healthcare system was overwhelmed and overburdened. No staffing norms are available for Obstetrics and Gynaecology departments. There were transport challenges for mothers due to lock down as permits were needed for travelling due to COVID-19 restrictions.

Table 8. Primary obstetric causes per Health District for 2020-2022

Primary obstetric problems	Ekurhuleni	Johannesburg	Metsweding	Sedibeng	Tshwane	West Rand	Total
Coincidental cause	6	5	0	1	4	2	18
Medical and surgical disorders	32	50	0	5	28	3	118
Non-pregnancy-related infections	44	68	0	7	59	9	187
Ectopic pregnancy	8	5	0	4	9	0	26
Miscarriage	27	14	0	0	7	1	49
Pregnancy-related sepsis	8	19	0	1	8	4	40
Obstetric haemorrhage	38	38	0	9	41	11	137
Hypertension	33	37	0	8	31	11	120
Anaesthetic complications	1	2	0	1	1	2	7
Adverse drug reactions	1	5	0	0	0	1	7
Embolism	7	2	0	2	4	1	16
Acute collapse	8	14	0	2	1	2	27
Miscellaneous	0	0	0	0	0	0	0
Unknown	12	22	0	2	15	4	55
Total	**225**	**281**	**0**	**42**	**208**	**51**	**807**

In the above table, most deaths occurred in the three metropolitan areas, namely Ekurhuleni, Johannesburg and Tshwane Health District with Johannesburg taking the lead followed by Ekurhuleni and Tshwane. All these three Health Districts are metropolitan areas and highly populated providing quaternary level of care to the rest of the province and to the other bordering provinces. The causes of deaths are related to non-pregnancy related deaths in all three respectively.

Figure 8. Total maternal deaths per Health District for the 2020 – 2022 triennium



In the above graph, the three metropolitan areas, which are also Health District in the province, namely Johannesburg, Ekurhuleni and Tshwane have recorded the greatest number of deaths respectively. Figure 9 shows that the most frequent cause of death in these three metropoles were non-pregnancy related infections.

Figure 9. Gauteng maternal deaths per Health District and per underlying cause for the 2020 – 2022 triennium

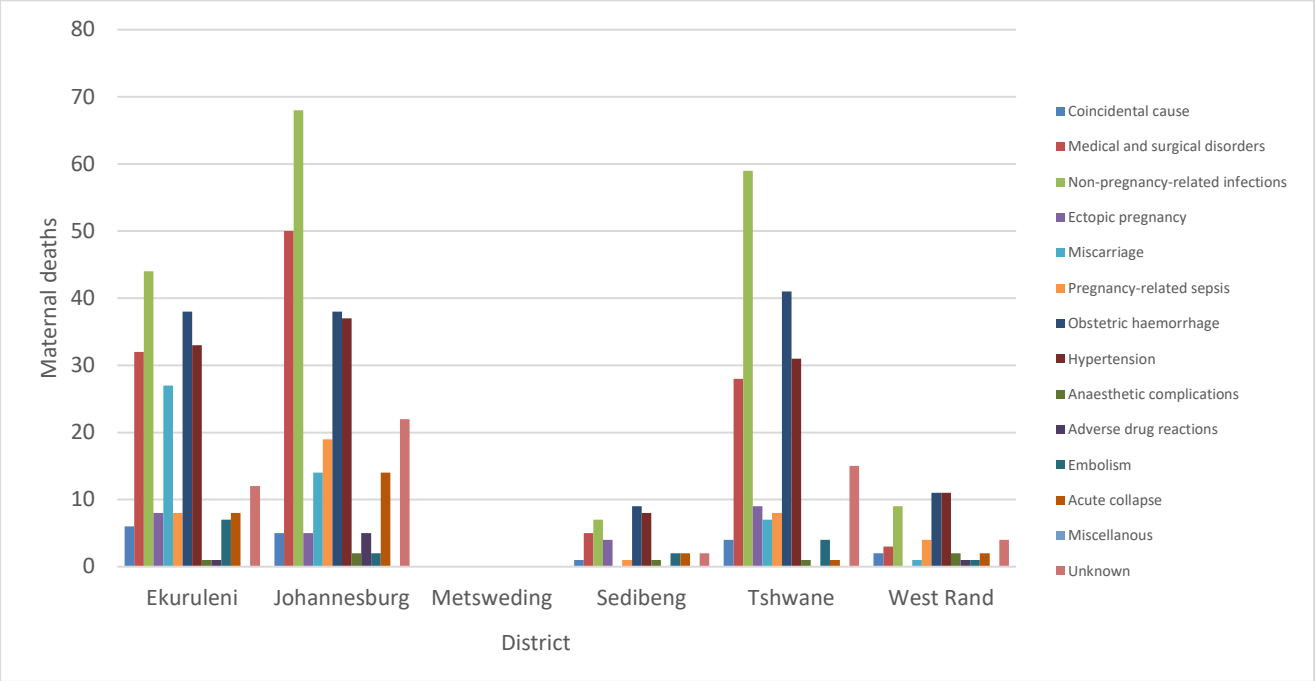


Table 9. Primary obstetric problem per maternal age

Primary obstetric problem	10-14	15-19	20-24	25-29	30-34	35-39	40-44	Outside 10-44 range & unknown	Total
Coincidental cause		3	7	2	5	1	0	0	18
Medical and surgical disorders		8	14	28	27	29	11	1	118
Non-pregnancy-related infections		4	21	35	66	47	13	1	187
Ectopic pregnancy		1	0	8	8	4	4	1	26
Miscarriage		5	6	14	15	5	4	0	49
Pregnancy-related sepsis		1	7	10	5	14	3	0	40
Obstetric haemorrhage	1	4	8	33	42	39	7	3	137
Hypertension		8	14	30	30	27	9	2	120
Anaesthetic complications		1	1	2	2	1	0	0	7
Adverse drug reactions		1	0	1	1	2	2	0	7
Embolism		1	2	1	6	5	1	0	16
Acute collapse - cause unknown		1	3	8	8	4	3	0	27
Miscellaneous		0	0	0	0	0	0	0	0
Unknown		2	14	6	15	13	5	0	55
Total	**1**	**40**	**97**	**178**	**230**	**191**	**62**	**8**	**807**

In Tables 9 and Figure 10, the greatest number of women that are dying are between the ages 30 – 34 and the

leading causes of deaths being non-pregnancy related, followed by obstetric hemorrhage and hypertension.

Figure 10. Gauteng maternal deaths per age and underlying cause for the 2020 – 2022 triennium

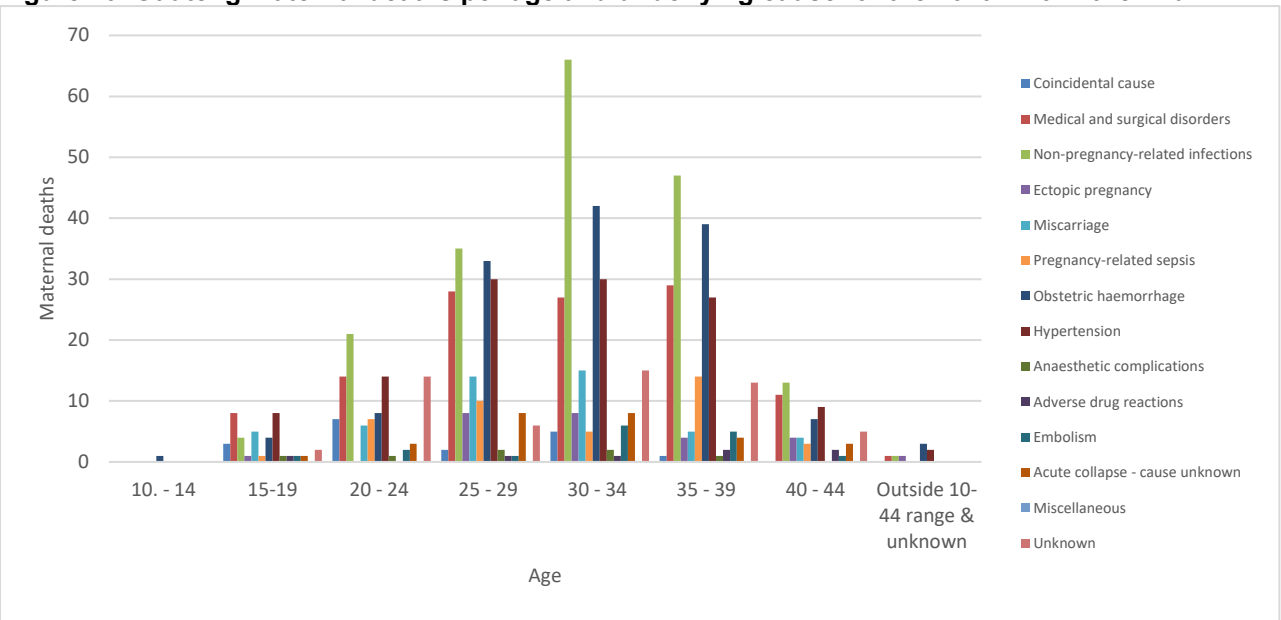


Table 10. Primary obstetric problems per delivery route

Primary obstetric problems	Vaginal	CD	CHC CD	DH CD	RH CD	TH/NCH CD	Pvt CD
Coincidental cause	1	3	0	0	0	3	0
Medical and surgical disorders	28	44	1	2	13	29	3
Non-pregnancy-related infections	34	67	1	4	11	35	20
Ectopic pregnancy	18	19	1	4	7	9	2
Miscarriage	3	2	0	0	1	1	0
Pregnancy-related sepsis	14	26	0	0	8	17	1
Obstetric haemorrhage	45	83	0	6	29	37	11
Hypertension	16	69	2	7	23	40	5
Anaesthetic complications	0	7	0	4	1	2	0
Adverse drug reactions	1	3	0	1	0	1	1
Embolism	3	7	0	1	1	3	2
Acute collapse - cause unknown	5	10	0	2	3	5	0
Miscellaneous	0	0	0	0	0	0	0
Unknown	18	12	2	2	5	4	3
Total	**186**	**352**	**7**	**33**	**102**	**186**	**48**

In the above table, the greatest number of women died post caesarean delivery.

Table 11. Primary obstetric problems per HIV status

Primary obstetric problems	Negative	Positive	Declined test	Unknown	Total
Coincidental cause	4	5	0	9	18
Medical and surgical disorders	65	37	0	16	118

Primary obstetric problems	Negative	Positive	Declined test	Unknown	Total
Non-pregnancy-related infections	67	103	0	17	187
Ectopic pregnancy	5	11	0	10	26
Miscarriage	15	12	0	22	49
Pregnancy-related sepsis	11	24	0	5	40
Obstetric haemorrhage	82	45	0	10	137
Hypertension	77	22	0	21	120
Anaesthetic complications	6	1	0	0	7
Adverse drug reactions	2	5	0	0	7
Embolism	8	4	0	4	16
Acute collapse - cause unknown	15	6	0	6	27
Miscellaneous	0	0	0	0	0
Unknown	26	14	0	15	55
Total:	**383**	**289**	**0**	**135**	**807**

In the above table, the greatest number of women that died were HIV negative.

Table 12. Primary obstetric problems per postmortem results

Primary obstetric problems	Postmortem	Not done
Coincidental cause	10	8
Medical and surgical disorders	38	80
Non-pregnancy-related infections	30	157
Ectopic pregnancy	10	16
Miscarriage	12	37
Pregnancy-related sepsis	14	26
Obstetric haemorrhage	63	74
Hypertension	43	77
Anaesthetic complications	4	3
Adverse drug reactions	2	5
Embolism	8	8
Acute collapse - cause unknown	19	8
Miscellaneous	0	0
Unknown	24	31
Total:	**277**	**530**

This table shows that most maternal deaths did not have a postmortem; this was in part due to the COVID-19 pandemic restrictions on performing them.

Table 13. Final cause of death

Cause of death	Number	% of total
Circulatory system	311	38.9
- Hypovolaemic shock	187	23.4
- Septic shock	124	15.5
Respiratory failure	266	33.3
- Respiratory failure	266	33.3
Cardiac failure	90	11.3
- Pulmonary oedema	90	11.3
Embolism	41	5.1
- Acute collapse due to embolism	41	5.1
Renal failure	85	10.6
- Renal failure	85	10.6
Liver failure	47	5.9
- Liver failure	47	5.9
Cerebral complications	118	14.8
- Intracranial haemorrhage	51	6.4
- Cerebral oedema resulting in coning	11	1.4
- Meningitis	7	0.9
- Cerebral emboli	4	0.5
- Brain death following hypoxic event	33	4.1
- Unspecified	12	1.5
Metabolic	165	20.6
- Maternal ketoacidosis	34	4.3
- Electrolyte imbalance	33	4.1
- Thyroid crisis	5	0.6
- Lactic acidosis	83	10.4
- Other	10	1.3
Haematological	180	22.5
- DIC	103	12.9
- Severe anaemia	77	9.6
Immune system	75	9.4
- Immune system failure	75	9.4
Unknown	82	10.3
- Home death	36	4.5
- Unknown	46	5.8
Other	92	11.5

Cause of death	Number	% of total
- Other	92	11.5
Total deaths	**800**	

Respiratory problems were the leading and final cause in the greatest number of maternal deaths, related to COVID-19 related infections, mainly pneumonia.

Avoidable Factors

Table 14. Patient related avoidable factors

	Number	% of total	% of cases at this level
Patient oriented problems			
- Avoidable factors identified	329	40.8	
- No avoidable factors	389	48.2	
- Lack of information	109	13.5	
Administrative problems			
- Avoidable factors identified	310	38.4	
- No avoidable factors	418	51.8	
- Lack of information	95	11.8	
Resuscitation problems			
- Avoidable factors identified	281	34.8	
- No avoidable factors	454	56.3	
- Lack of information	78	9.7	
Medical care - CHC			
- Managed at this level	253	31.4	
- Avoidable factors identified	55		21.7
- No avoidable factors	177		70.0
- Lack of information	23		9.1
Medical care - District hospital			
- Managed at this level	164	20.3	
- Avoidable factors identified	77		47.0
- No avoidable factors	71		43.3
- Lack of information	23		14.0
Medical care - Regional hospital			
- Managed at this level	256	31.7	
- Avoidable factors identified	113		44.1
- No avoidable factors	124		48.4
- Lack of information	24		9.4
Medical care - Tertiary and above			
- Managed at this level	402	49.8	
- Avoidable factors identified	177		44.0
- No avoidable factors	200		49.8
- Lack of information	37		9.2
Medical care - Private hospital			
- Managed at this level	78	9.7	
- Avoidable factors identified	28		35.9
- No avoidable factors	40		51.3
- Lack of information	12		15.4
Timing of emergency			

	Number	% of total	% of cases at this level
- Early pregnancy	130	16.1	
- Antenatal period: 20w +	327	40.5	
- Intrapartum period	66	8.2	
- Postpartum period	284	35.2	
- Anaesthesia	21	2.6	
Timing of death			
- Early pregnancy	101	12.5	
- Antenatal period: 20w +	150	18.6	
- Intrapartum period	25	3.1	
- Postpartum period	508	62.9	
- Anaesthesia	23	2.9	
Impact of suboptimal care			
- No suboptimal care identified	372	46.1	
- Suboptimal care, no impact on outcome	47	5.8	
- Suboptimal care, possible impact on outcome	232	28.7	
- Suboptimal care, probable impact on outcome	156	19.3	
Total:	**807**		

In the above table, it is demonstrated that 48% of maternal deaths were potentially preventable by the health system.

Patient related factors were present for 40.8% and administrative factors for 38.4% of maternal deaths.

Table 15. Patient /Community Orientated avoidable factors

Description	Number	% of cases
Lack of information	109	13.5
No avoidable factor	389	48.2
No antenatal care	110	13.6
Infrequent antenatal care	35	4.3
Delay in accessing medical help	185	22.9
Declined medication/surgery/advice	34	4.2
Family problem	5	0.6
Community problem	1	0.1
Unsafe abortion	12	1.5
Other	39	4.8
Total cases	**807**	

In the above table, delayed in accessing care was the most common problem, which suggests delay in the decision to seek care.

Table 16. Administrative related avoidable factors

Description	Number	% of cases
Lack of information	95	11.8

Description	Number	% of cases
No avoidable factor	418	51.8
Transport problem: Home to institution	4	0.5
Transport problem: Institution to institution	19	2.4
Lack of accessibility: Barriers to entry	3	0.4
Lack of accessibility: Other	1	0.1
Delay in attending to patient (Overburdened service)	50	6.2
Delay in attending to patient (Reason unknown)	25	3.1
Lack of healthcare facilities: ICU	104	12.9
Lack of healthcare facilities: Blood/blood products	18	2.2
Lack of healthcare facilities: Other	23	2.9
Inadequate numbers of staff on duty	25	3.1
Appropriate skill not available on site / on standby	28	3.5
Communication problems: Technical	8	1
Communication problems: Interpersonal	9	1.1
Other	60	7.4
Total cases	**807**	

In the above table, no avoidable administrative factors were found for 418 deaths, but of note 104 were related to lack of healthcare facilities.

Table 17. Medical Care related avoidable factors

Description	Number	% of all cases	% of cases at level
Community health centre			
Managed at this level	253	31.4	100
Lack of information	23	2.9	9.1
No avoidable factor	177	21.9	70
Initial assessment	23	2.9	9.1
Problem with recognition / diagnosis	23	2.9	9.1
Delay in referring the patient	11	1.4	4.3
Managed at inappropriate level	2	0.2	0.8
Incorrect management (Wrong diagnosis)	6	0.7	2.4
Sub-standard management (Correct diagnosis)	9	1.1	3.6
Not monitored / Infrequently monitored	3	0.4	1.2
Prolonged abnormal monitoring with no action taken	4	0.5	1.6
District hospital			
Managed at this level	164	20.3	100
Lack of information	23	2.9	14
No avoidable factor	71	8.8	43.3
Initial assessment	17	2.1	10.4
Problem with recognition / diagnosis	33	4.1	20.1
Delay in referring the patient	16	2	9.8
Managed at inappropriate level	14	1.7	8.5
Incorrect management (Wrong diagnosis)	7	0.9	4.3

Description	Number	% of all cases	% of cases at level
Sub-standard management (Correct diagnosis)	31	3.8	18.9
Not monitored / Infrequently monitored	11	1.4	6.7
Prolonged abnormal monitoring with no action taken	5	0.6	3
Regional hospital			
Managed at this level	256	31.7	100
Lack of information	24	3	9.4
No avoidable factor	124	15.4	48.4
Initial assessment	23	2.9	9
Problem with recognition / diagnosis	48	5.9	18.8
Delay in referring the patient	5	0.6	2
Managed at inappropriate level	4	0.5	1.6
Incorrect management (Wrong diagnosis)	16	2	6.3
Sub-standard management (Correct diagnosis)	44	5.5	17.2
Not monitored / Infrequently monitored	21	2.6	8.2
Prolonged abnormal monitoring with no action taken	23	2.9	9
Tertiary hospital and above			
Managed at this level	402	49.8	100
Lack of information	37	4.6	9.2
No avoidable factor	200	24.8	49.8
Initial assessment	25	3.1	6.2
Problem with recognition / diagnosis	59	7.3	14.7
Delay in referring the patient	4	0.5	1
Managed at inappropriate level	1	0.1	0.2
Incorrect management (Wrong diagnosis)	16	2	4
Sub-standard management (Correct diagnosis)	95	11.8	23.6
Not monitored / Infrequently monitored	19	2.4	4.7
Prolonged abnormal monitoring with no action taken	16	2	4
Private hospital			
Managed at this level	78	9.7	100
Lack of information	12	1.5	15.4
No avoidable factor	40	5	51.3
Initial assessment	7	0.9	9
Problem with recognition / diagnosis	16	2	20.5
Delay in referring the patient	1	0.1	1.3
Managed at inappropriate level	1	0.1	1.3
Incorrect management (Wrong diagnosis)	3	0.4	3.8
Sub-standard management (Correct diagnosis)	16	2	20.5
Not monitored / Infrequently monitored	1	0.1	1.3
Prolonged abnormal monitoring with no action taken	5	0.6	6.4
Total cases	**807**		

In the above table, problem recognition and substandard care remain the most commonly cited factors at all levels of care.

Table 18. Resuscitation related avoidable factors

Description	Number	% of cases
Lack of information	78	9.7
No avoidable factor	454	56.3

Description	Number	% of cases
Airway problems	44	5.5
Breathing problems	77	9.5
Circulation problems	93	11.5
Drug problems	4	0.5
Investigation problems	5	0.6
Monitoring problems	12	1.5
Not attempted	73	9
Total cases	**807**	

In the above table, the greatest number of maternal deaths (454) had no avoidable factors suggesting that they were admitted already in a serious medical condition. In seventy-three of these deaths resuscitation was not attempted.

Conclusion and Recommendation

The department has established a Task Team to develop the **policy on the establishment of Onsite Midwife-led Birthing Units (OMBUs)** and conducted the provincial health summit to address skills gap on management of the top two causes of maternal death, **obstetric haemorrhage** and **hypertensive disorders of pregnancy with introduction of the Maternal Quality Standards (MQS) for management of hypertension in pregnancy at the primary healthcare level**. In increasing awareness on the availability of and as a strategy in social mobilisation, the province developed a **poster on the addresses of all termination of pregnancy healthcare facilities**. In efforts to reduce the number of low-risk deliveries at the national central hospitals a consultative workshop on the functionality of **Midwife-Obstetric Units (MOUs)** was held with **Operational Managers**. The health-soft-cross-border areas as a challenge is being addressed by the introduction of the **Health-Soft-Cross-Border Forums**.

It has been recommended that increase in access to safe termination of pregnancy will contribute reduced number of maternal deaths due to septic abortion and all **Community Health Centres (CHCs)** must be able to provide **medical abortion.** Also, strengthening the maternal death reporting system will improve the notification of maternal deaths as per the definition for the purpose of recording to the DHIS and NCCEMD. A report on hospitals' compliance with Minimum Standards for Safe Caesarean Delivery is being finalised. It is also recommended that the province must continue to implement the **16+ WHO key interventions**.

References

1. Saving Mothers: Fourth Report on Confidential Enquiries into Maternal Deaths in South Africa; 2005-2007 p259
2. Saving Mothers: Fifth Report on Confidential Enquiries into Maternal Deaths in South Africa; 2008 - 2010 p220

Gauteng provincial assessors

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8.4 KwaZulu-Natal

Note: this report includes information from a few maternal death assessments which were entered into the MAMMAS database after the KwaZulu-Natal database was sent to the NCCEMD for compiling the overall Saving mothers 2020-22 Report. In the overall report, a correction (estimate) was made to account for the missing 2022 cases from KwaZulu-Natal. This summary includes the data from all these missing cases and will therefore differ slightly from the figures seen in the overall report.

Maternal Mortality Data with Comments

724 maternal deaths were notified in KwaZulu-Natal in the triennium 2020-2022. This is a 14% increase compared to the previous triennium (see table 1)

Table 1. Number of maternal deaths notified, and number entered into MaMMAS per year:

	Maternal deaths notified and entered into MaMMAS
2017-2019	637 (2014-2016: 746)
2020	252
2021	280
2022	192
2020-2022	724

Coincidental deaths in pregnancy included:

- The institutional maternal mortality ratio (iMMR) for KwaZulu-Natal which dropped from 130 per 100,000 in 2014-16 to 100 in 2017-19, rose back up to 108 per 100,000 in 2020-22. Despite this rise, the KwaZulu-Natal iMMR was 12% below the National average iMMR (126). KwaZulu-Natal has the second lowest iMMR of all Provinces in South Africa, the lowest being in the Western Cape.
- The rise in number of maternal deaths in the 2020-22 triennium was due to the COVID-19 pandemic, which contributed 135 maternal deaths directly due to COVID-19 infection, the majority being in early 2021.
- The number of deaths in KwaZulu-Natal in the final year of the triennium, 2022, fell to 192, which was similar to the number of maternal deaths that occurred in 2019 (185). This demonstrated a resilient maternal healthcare service which was able to recover from the COVID-19 pandemic and re-establish a downward trend in maternal mortality.
- The iMMR in KwaZulu-Natal in 2022 was 84,5 per 100,000. It is feasible that with continuing downward trends in maternal mortality, that the SDG target of 70 will be achieved by 2030.
- 49% of maternal deaths in KwaZulu-Natal occurred in regional hospitals, by far the most common site for maternal deaths to occur. An increasing proportion of notified deaths (10.6%) occurred outside the State health facilities (in private health facilities or outside a health facility)
- There was an increase in the number and proportion of maternal deaths which followed delivery by caesarean section (CS). There were 243 deaths at or after CS in 2020-22 (54% of all deaths excluding deaths early in pregnancy and undelivered cases), compared to 183 in 2017-19 (50%). This partly reflects the fact that many pregnant women who were in respiratory failure due to COVID-19 were intubated and taken for caesarean section, in an unsuccessful attempt to alleviate the respiratory failure. However, it also highlights the need for renewed emphasis on ensuring facilities conducting caesarean section are complying with minimum safety standards.
- There was a smaller increase in the number of deaths that occurred after vaginal delivery: 203 in 2020-22 (46%) compared to 184 in 2017-19 (50%).
- 64% of maternal deaths occurred in the post-partum period.
- The most common category of maternal death by far remains non-pregnancy-related infections (NPRI), which accounted for 36% of all deaths. Over half of these were deaths due to COVID-19 infection. NPRI deaths due to other causes (mostly due to HIV-related infections) decreased from 164 in 2017-19 to 125 in 2020-22, which demonstrated that the benefits of increased coverage of antiretroviral therapy continued despite the pandemic. Apart from COVID-19, the most common sub-category was tuberculosis (whose numbers also decreased from 61 deaths in 2017-19 to 45 in 2020-22)
- The next most common causes of death in order were medical and surgical disorders (biggest contributor: cardiac disease), obstetric haemorrhage (biggest contributor: bleeding during or after caesarean section), hypertensive disorders of pregnancy (biggest contributor: eclampsia), and miscarriage (biggest contributor: septic miscarriage).
- Compared to the last triennium, there were significant decreases in the number of deaths due to hypertensive disorders of pregnancy, miscarriage, and anaesthetic deaths, but an increase in deaths from obstetric haemorrhage. Deaths due to medical and surgical disorders, remained similar in number as did deaths from pregnancy-related sepsis and ectopic pregnancy.
- In the last year of the triennium (2022), when COVID-19 deaths were no longer a significant contributor, the most notable trend was a continued increase in obstetric haemorrhage deaths (35 deaths), the number being only slightly lower than NPRI deaths (37 deaths) which had decreased markedly. Of the 35 haemorrhage deaths, 30 were due to PPH, an equal number following vaginal delivery, and following caesarean section (15 cases each). This highlights the need to focus on the early detection and management of PPH, as the haemorrhage deaths were the biggest contributor to avoidable deaths (see below).
- 94% of the maternal deaths had known HIV status. Of these 54.6% were HIV positive, which is a lower proportion than in 2017-19 (59.4%).
- 152 deaths (21%) were assessed as being <u>probably</u> avoidable within the healthcare system, a 31% decrease compared to 2017-19 (221 definitely avoidable deaths). It is difficult to know what to make of this apparent improvement in the quality of care, because deaths assessed as being <u>possibly</u> avoidable were far more in 2020-22 compared to 2017-19.
- The most common causes of definitely avoidable death were obstetric haemorrhage (58 deaths) followed by NPRI (19 deaths) and medical and surgical conditions (17 deaths), with the following causes also contributing significant numbers: hypertensive disorders (13), ectopic pregnancy (11), miscarriage (8), anaesthetic deaths (7), and pregnancy-related sepsis (7). A detailed breakdown of definitely avoidable deaths according to cause of death is presented in table 2 below.

- It is notable that the number of definitely avoidable deaths due to hypertensive disorders of pregnancy decreased greatly from 42 cases in 2017-19 to 13 cases in 2020-22. This is reflected in the overall decrease in hypertension deaths during this triennium and suggests a positive effect of implementation of the new national guidelines on management of hypertensive disorders which were introduced during the last triennium. There is perceived improvement at PHC level in the early detection of hypertension (including borderline hypertension) and prompt referral to high-risk clinics. There is also a perceived improvement in the management of hypertension after referral to the high-risk clinic, including recognition of severe features and decision for delivery being made at an earlier stage of the disease.
- The total numbers of anaesthetic deaths decreased from 19 in 2017-19 to 12 in 2020-22, and the probably avoidable anaesthetic deaths decreased from 16 to 7. This encouraging trend occurred despite three deaths in 2022 due to an avoidable anaesthetic drug error, whereby tranexamic acid was mistakenly injected intrathecally instead of bupivacaine at the time of administration of a spinal anaesthetic for caesarean section. These fatal drug errors led to various measures being taken to prevent future recurrence, spreading the information about the drug error and how to prevent it. The decrease in anaesthetic deaths may have been related to the introduction of a system in 2021 at all district hospitals in KwaZulu-Natal of designating one medical officer as the “Lead Anaesthetic Doctor”, responsible, with support from the outreach anaesthetist, for ensuring a safe anaesthetic service.
- The most common patient-related avoidable factor was delay in accessing medical help, which in many cases probably indicates that the patient had a transport problem. No antenatal care or infrequent antenatal care were also common avoidable factors.
- The most common administrative avoidable factors within the healthcare system were: delay in attending to the patient due to overburdened service or other reasons, 97 cases (13.4% of maternal deaths); inter-facility transport problems, 52 cases (7.2%); lack of ICU access, 49 cases (6.8%) and inadequate staff on duty, 49 cases (6.8%)
- The most common medical personnel-related avoidable factors within the healthcare system were: failure to recognise the problem or make the diagnosis, often related to inadequate initial assessment of the patient (all levels of care except tertiary); substandard management despite correct diagnosis -ie failure to follow protocols (all levels of care including tertiary and private); delay in referring or failure to refer the patient to a higher level of care (mainly at primary or district hospital level). In many of these cases this must imply that the doctors and nurses managing the patient were incompetent or lacking in commitment to quality care
- Resuscitation was substandard in 35% of maternal deaths, including 20% of deaths where resuscitation was not even attempted.

Table 2. Clearly avoidable deaths within the healthcare system according to primary cause of death 2020-2022

Cause of death	Total number of deaths 2020-22	Number of avoidable deaths			Number (%) of deaths avoidable per cause 2020-22
		2020	2021	2022	
Obstetric haemorrhage	96	15	15	28	58(60%)
Non-pregnancy-related infections	260	6	10	3	19(7%)
Medical and surgical disorders	113	9	6	2	17(15%)
Hypertensive disorders	65	6	3	4	13(20%)
Ectopic pregnancy	20	6	2	3	11(55%)
Miscarriage	32	3	1	4	8(40%)
Anaesthetic complications	12	2	0	5	7(58%)
Pregnancy-related sepsis	31	5	1	1	7(23%)
Embolus	19	1	2	3	6(32%)
Unknown cause	43	0	1	2	3(7%)

Cause of death	Total number of deaths 2020-22	Number of avoidable deaths			Number (%) of deaths avoidable per cause 2020-22
		2020	2021	2022	
Coincidental causes	11	1	0	0	1(9%)
Adverse drug reactions	5	1	0	0	1(20%)
Acute collapse	13	0	1	0	1(8%)
Miscellaneous	4	0	0	0	0
Total	**724**	**55**	**42**	**55**	**152(21%)**

Recommendations

- Facility CEOs and Heads of obstetric departments must be made aware of every maternal death that occurs in their facility and ensure that every case is promptly reviewed. The review of the death must lead to a practical action plan for preventing a recurrence. Relevant role players, including those involved in the management of the case, facility senior management and the district clinical specialist team should be involved in the review, and together agree on the plan. Implementation of the plan must be monitored and reviewed for example at the facility or District perinatal meetings, or by the facility patient safety incident (PSI) committee.
- Emphasis must be put on making appropriate contraception and family planning methods available to vulnerable groups to prevent unwanted or unplanned pregnancy. These groups include teenagers, over 35s, and those with chronic medical conditions including HIV infection and cardiac disease. Innovative strategies are needed to achieve this, for example taking family planning services to high schools, tertiary education institutions and workplaces, and using community care givers to improve uptake of and compliance with family planning methods. Family planning must be integrated into all levels of healthcare which encounter women of reproductive age including specialist medical clinics (eg cardiology clinics and HIV clinics). Long-acting reversible contraceptives, particularly the intra-uterine contraceptive device and the progesterone implant, must be promoted as they are highly effective contraceptive methods. All family planning providers must be trained in their insertion and removal including all doctors working at District hospitals and in specialist obstetrics and gynaecology departments. Emergency contraception must be accessible from all health facilities every day of the week, and this must be effectively communicated to the community.
- Obstetric care at regional hospitals across the province needs to be supported and improved. This will require prioritisation of the filling of specialist obstetrics and gynaecology (O+G) posts and O+G medical officer posts at regional hospitals so that a functional regional level service can be provided. This is essential for supporting the service at District level (outreach) as well as for providing quality training for medical students, interns, and registrars.
- Plans should be made to set up On-site midwife-run delivery units (OMBUs) at those hospitals whose labour wards are currently overcrowded with large numbers of low-risk women. In KwaZulu-Natal this situation mainly applies to the regional hospitals, but plans should also be made for the busiest of the large District hospitals. This will ease the burden on the hospital labour ward and allow appropriate care to be given to both the high-risk and low-risk women. New midwife posts need to be created for this, and priority put on filling them. This is a preferred model, compared to having multiple small midwife-run units at the community clinics referring to the regional or district hospital. Two OMBUs were successfully established during the 2020-22 triennium in KwaZulu-Natal, and these should be supported in terms of staff recruitment to ensure their functioning can be sustained.
- Hospital CEOs must ensure that the caesarean section (CS) service in their hospital complies with South African guidelines for safe CS[1]. The minimum standards include the requirement that audits of caesarean section are conducted, which may reduce the numbers of unnecessary CS while ensuring that CS are performed timeously when indicated. A recently added minimum standard is that the drug Tranexamic acid must be stored outside the operating room in the theatre complex, to ensure that it cannot be mistakenly administered instead of spinal anaesthetic drug.
- Facility CEOs and operational managers must ensure that the Minimum standards for safe and respectful care during labour, as listed in a 2023 provincial circular (G56/23), are complied with by all designated delivery sites.
- Post-natal care in general needs to be intensified. The new national Maternity Case Record must be used in KwaZulu-Natal from 2024, including the pre-discharge checklist and discharge summary. Pregnant

women need to be linked to their community care giver who must be involved in providing post-natal care to strengthen the facility-based post-natal care.

- The scope of duties of community care givers with respect to pregnant women must include diagnosis of pregnancy (urine pregnancy tests), encouraging early antenatal booking and compliance with antenatal visits, encouraging compliance with medications and supplements, and post-natal home visits.
- Maternity waiting homes should be available at all delivery sites where pregnant women experience transport difficulties in accessing the delivery site when in labour.
- There must be a focus at all delivery sites on improving the early detection and management of post-partum haemorrhage (PPH). The EMOTIVE study was conducted in KwaZulu-Natal amongst other sites during the 2020-22 triennium and the EMOTIVE protocol was shown to be highly effective in reducing severe PPH. Training must be conducted to introduce the EMOTIVE protocol at all delivery sites, so that it becomes standard practice.
- Facility managers must ensure that HIV care of pregnant women is integrated into maternity care, including initiation and management of ARVs, and screening for, diagnosis and management of opportunistic infections including TB. This requires all midwives and doctors managing maternity care to be trained in the latest National ARV/VTP guidelines and to be competent in all aspects of the routine care of HIV positive pregnant women, including recognising and appropriately managing ARV treatment failure.
- Every District hospital must have amongst its medical officers, a designated Lead Anaesthetic doctor who, with support from the medical manager, and the outreach anaesthetist from the referral centre, has a responsibility to ensure a safe anaesthetic service is provided at the hospital.
- District clinical specialists must ensure that clear and consistent referral patterns and referral criteria for risk factors and problems in pregnancy are available to all healthcare practitioners caring for pregnant women. These criteria must be available both at the referring site and at the receiving site. Facility managers must ensure that they are followed.
- Ongoing training on the recognition and management of conditions commonly causing avoidable maternal deaths must be provided for doctors and midwives working at all levels of care. Facility managers must ensure that regular ESMOE fire drills are conducted (at least monthly) for all relevant staff. This implies that every hospital and CHC must have amongst their staff active ESMOE master trainers, who are given the opportunity to conduct the fire drills. District Clinical specialists must support this process. The Provincial and/or District Health departments must provide ESMOE train-the trainer courses to train doctors and midwives to be ESMOE trainers, so the gap can be filled at any maternity facility without an ESMOE trainer.
- The ESMOE programme includes a module on Respectful and humane care during labour. All labour ward staff must participate in this module to promote a culture of respect for women using our maternity services as well as respect amongst the healthcare workers. Respect for women in labour includes allowing companions for women in labour which is one of the minimum standards for safe and respectful care during labour.
- All State facilities in KwaZulu-Natal must be able to either offer TOP services or refer eligible clients to a site within the district which offers free TOP services. All sites providing TOP must be able to provide the option of medical TOP for suitable clients.
- 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.

KwaZulu-Natal Provincial assessors past and present who assessed cases from the 2020-22 triennium

No	Name	Name of Institution	Comment
1.	Prof. J Moodley	UKZN	Quality Assurance Assessor-
2.	Dr N Moran	KZN DOH Head office	O+G Specialist Member of NCCEMD
3.	R Roopchand	Mahatma Gandhi Memorial Hospital	Advanced Midwife
4.	Prof. D Bishop	uMgungundlovu DCST	Specialist Anaesthetist
5.	Dr B Hira	Mahatma Gandhi Memorial Hospital	O&G Specialist

No	Name	Name of Institution	Comment
6.	Dr TL Khumalo	UGu DCST	O&G Specialist
7.	Dr T Ibrahim	eThekwini DCST	O&G Specialist
8.	Dr M Naidoo	UKZN and Wentworth Hospital	Family Physician
9.	A Ngema	iLembe DCST	Advanced Midwife
10.	Dr N Mayat	Queen Nandi Hospital	O&G Specialist
11.	P Phungula	KZN DOH Head Office	Advanced midwife, Provincial Maternal Health Manager
12.	Dr Z Moyce	Pixley Ka Isaka Seme Memorial Hospital:	Specialist Anaesthetist
13.	S Mnqayi	DCST: King Cetshwayo DCST	Advanced Midwife
14.	J Tobo	Ugu DCST	Advanced Midwife
15.	Dr I Popov	Port Shepstone Hospital	O&G Specialist
16.	Dr CL Chellan	King Edward VIII Hospital	Specialist Anaesthetist
17.	Dr L Naidoo	iLembe DCST	O&G Specialist
18.	K Makhathini	uMgungundlovu DCST	Advanced Midwife
19.	Dr K Govender	General Justice Gizenga Mpanza Regional Hospital	O&G Specialist
20.	N Kubheka	Prince Mshiyeni Memorial Hospital	Advanced Midwife
21.	S Pillay	Osindisweni Hospital	Advanced Midwife
22	Prof TD Naidoo	Greys Hospital	O&G Specialist
23	Dr J Titus	Retired	O+G Specialist
24	L Scott	Retired	Advanced Midwife
23.	Dr U Wessels	Retired	O&G Specialist
24	Dr U Singh	Addington Hospital	Specialist anaesthetist

8.5 Limpopo

Introduction

Limpopo, South Africa's northern most province, borders onto Mozambique, Zimbabwe, and Botswana. It also borders the Mpumalanga, Gauteng, and North West provinces. Named after the Limpopo River, which flows along its northern border, it is a region of contrasts, from true Bushveld country to majestic mountains, primeval indigenous forests, unspoiled wilderness, and patchworks of farmland. In the eastern region lies the northern half of the magnificent Kruger National Park.

Limpopo ranks fifth in South Africa in both surface area and population, covering an area of 125 754km² and being home to a population of 6 124 446.

The capital city is Polokwane (Formerly known as Pietersburg). Other major towns include Bela-Bela (Formerly Warmbad), Lephalale (formerly Ellisras), Makhado (Formerly Louis Trichardt), Musina (Messina), Mokopane (formerly known as Potgietersrus) (Thabazimbi and Tzaneen (see the Limpopo map).

Agriculture and Mining are the primary driver of economic activity. Limpopo is rich in mineral deposits, including platinum-group metals, iron ore, chromium, high and middle-grade cooking coal, diamonds, antimony, phosphate, and copper, as well as mineral reserves such as gold, emeralds, scheelite, magnetite, vermiculite, silicon and mica. The province is a typical developing Province, exporting primary products and importing manufactured goods and services.

The climatic conditions in the province allow for double harvesting seasons, which results in it being the one of the largest producers of various agricultural products. Sunflowers, cotton, maize and peanuts are cultivated in the Bela-Bela–Modimolle area. Bananas, Avocados, litchis, pineapples, mangoes and pawpaw's, as well as a variety of nuts, are grown in the Tzaneen and Makhado areas.

The vast land caters for grazing and game farming also offers hunting and ranching.

Limpopo is divided into five district municipalities, which are further subdivided into 22 local municipalities.

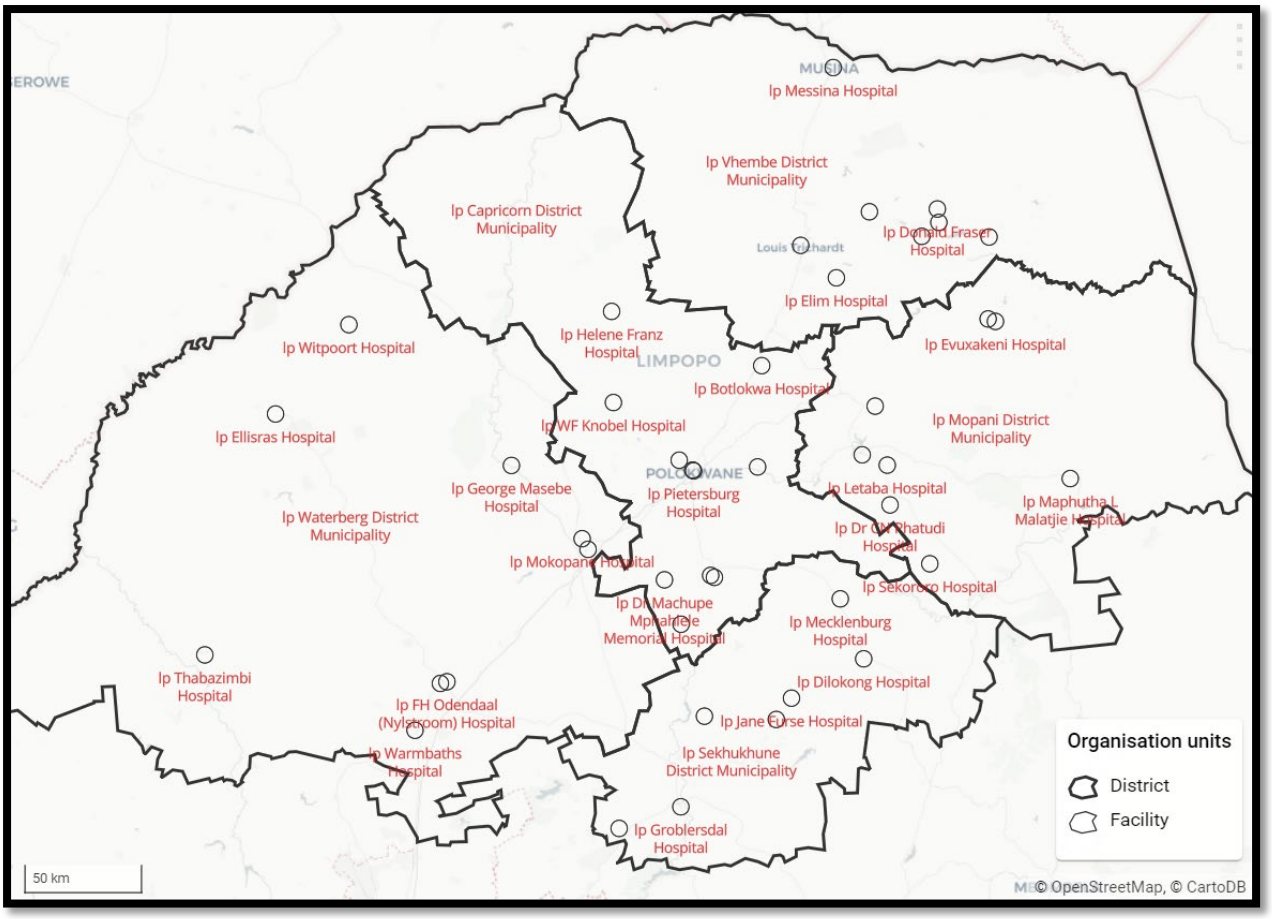
Approximately 80% of the population in Limpopo province resides in the rural part of the province which has an impact on the access to education with a subsequent negative impact on economic sector development.

The province consists of five districts with 451 clinics, 21 gateway clinics, 160 mobile 25 Community Health Centres, 30 district hospitals, 5 regional hospitals and two tertiary hospitals.

Despite the increase in the number of clinics providing a full package of Primary Healthcare services the department still experience challenges in shortage of Human resource to supporting the clinics.

Maternal death notification process has improved because deaths taking place at home and in the private sector are reported, however there is a need to strengthen the flow of files.

Previous reports reflected non - pregnancy related infections as the leading cause of indirect maternal deaths. HIV and AIDS still pose a challenge to the whole country which is also seen in Limpopo province. However, there are there were many women in the 2020-2022 triennium who died from non - pregnancy related infection in the triennium due to COVID-19. Post-Partum Haemorrhage is the leading direct cause of maternal deaths followed by hypertensive diseases in pregnancy.



Maternal deaths numbers, rates and trends

Limpopo Province reported 166, 196 and 143 maternal deaths in 2020, 2021 and 2022 respectively adding up to 505, and 486 files for the triennium were entered in the national data base. The number of maternal deaths reported over the triennium has declined slightly compared to the last triennium (2017 -2019).

Figure 1. Limpopo maternal deaths from 1998 to 2022

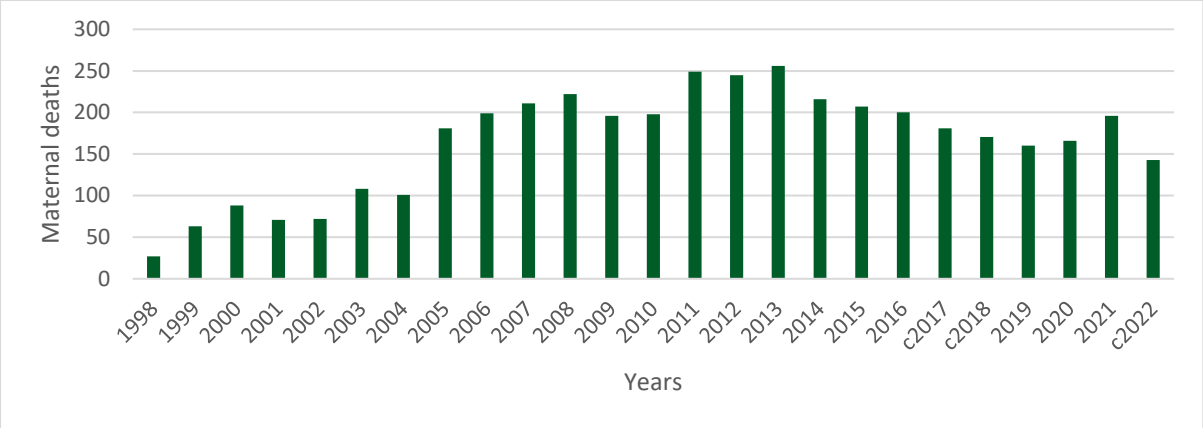


Figure 2. Trends in iMMR 2005-2022

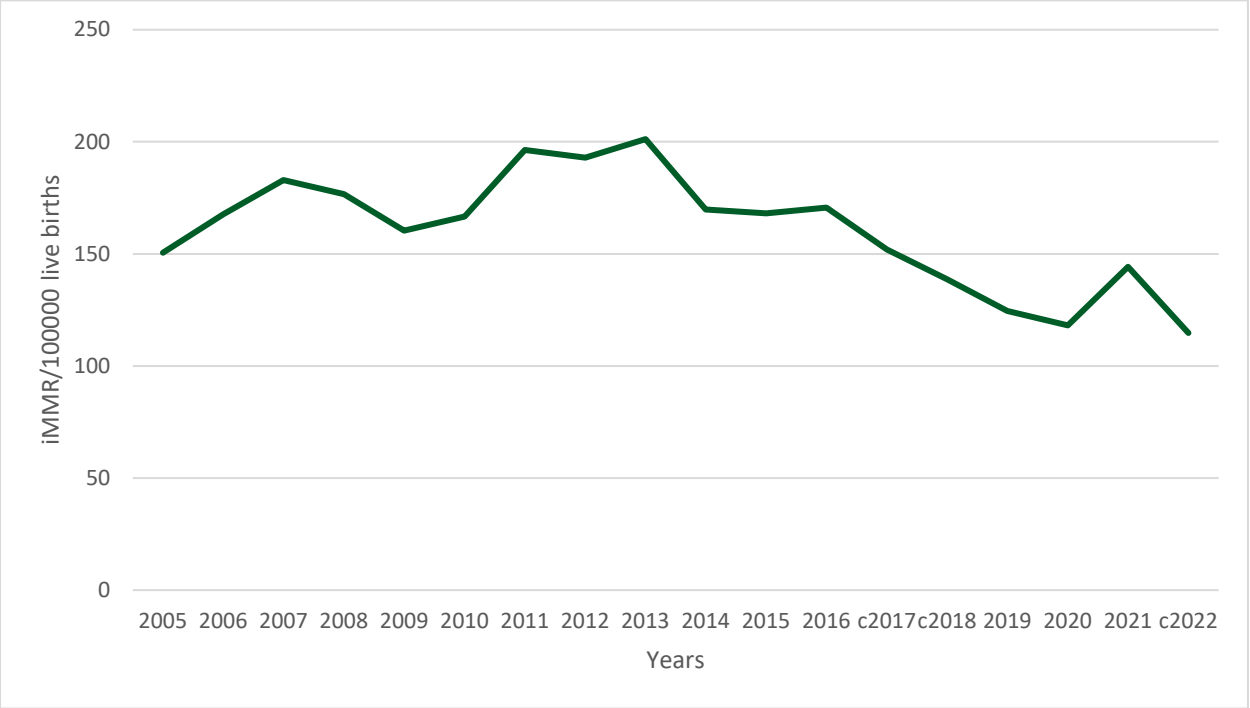


Figure 3. iMMR for 2020,2021,2022 and the whole triennium

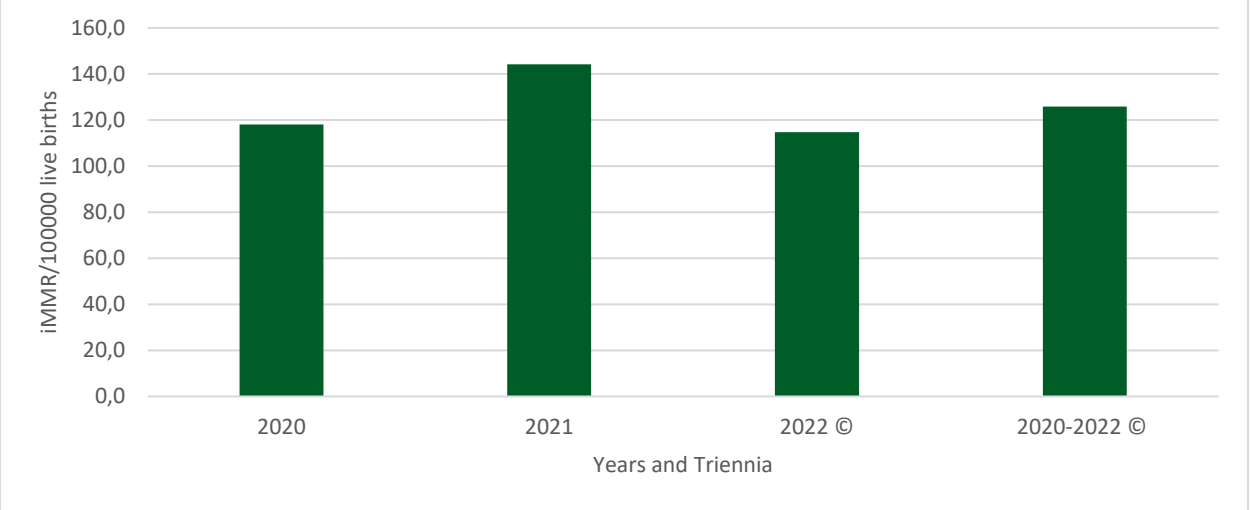
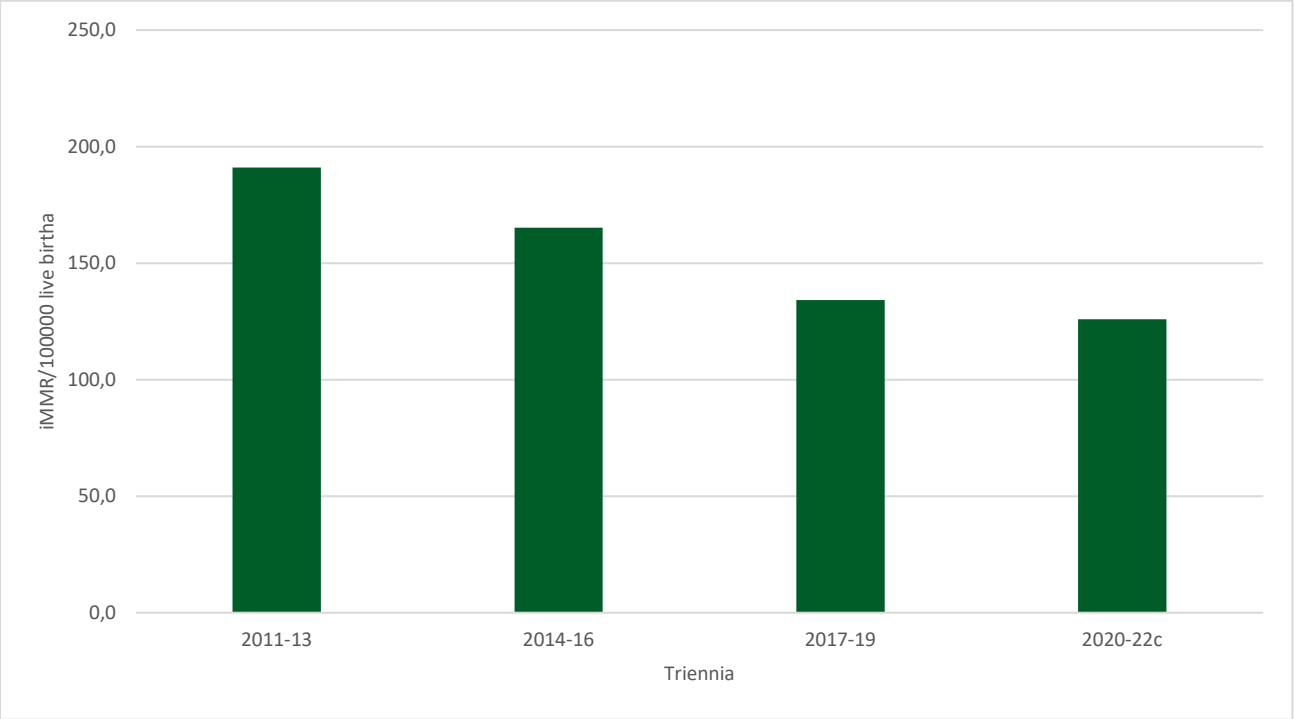
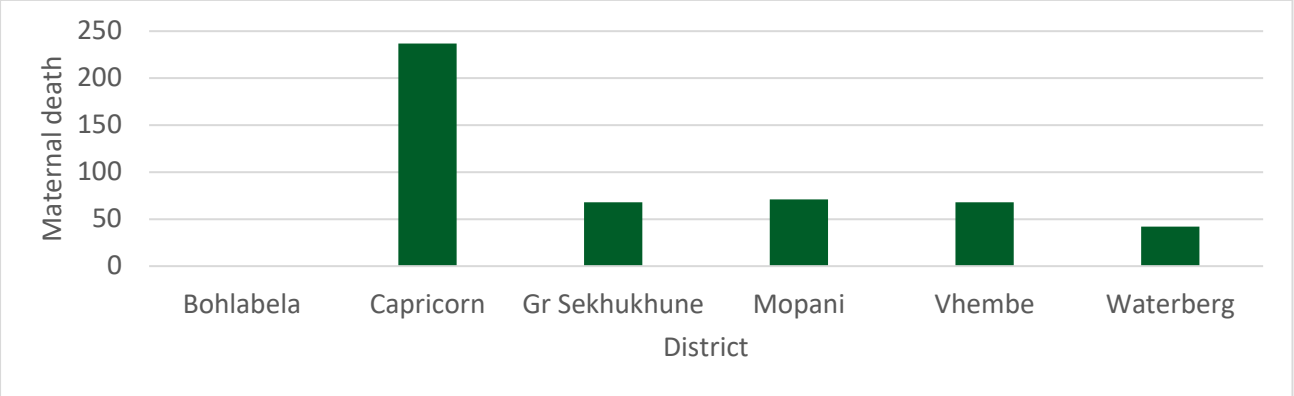


Figure 4. Trends in iMMR for four triennia



Limpopo is the only province in SA where iMMR declined in this triennium; and it now ranks third lowest iMMR after Western Cape and KwaZulu-Natal, with an iMMR of 125.9 deaths per 100,000 live births.

Figure 5. Maternal deaths per district, 2020-2022



Detailed data for the triennium will be presented as Figures and Tables, and then discussed.

Primary Obstetric Causes of Death

Figure 6. Comparison of Causes of death, 2020-2022

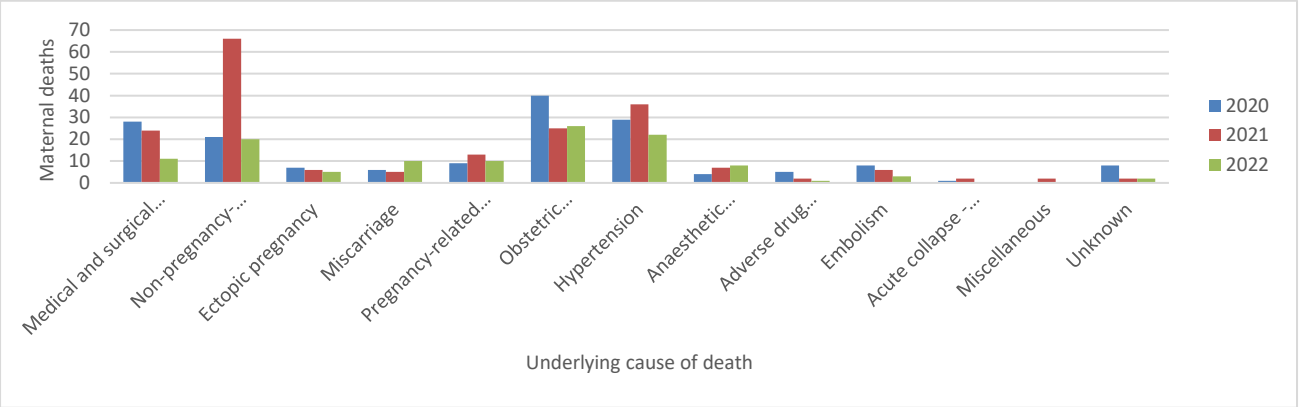


Table 1. Primary Obstetric causes, 2020-2022

Limpopo	2020	2021	2022	2020-2022
Medical and surgical disorders	28	24	11	63
Non-pregnancy-related infections	21	66	20	107
Ectopic pregnancy	7	6	5	18
Miscarriage	6	5	10	21
Pregnancy-related sepsis	9	13	10	32
Obstetric haemorrhage	40	25	26	91
Hypertension	29	36	22	87
Anaesthetic complications	4	7	8	19
Adverse drug reactions	5	2	1	8
Embolism	8	6	3	17
Acute collapse - cause unknown	1	2	0	3
Miscellaneous	0	2	0	2
Unknown	8	2	2	12
Maternal deaths	166	196	118	480
Coincidental cause	1	4	1	6
DDCP	167	200	119	486
Live births (2019)	**140542**	**135892**	**124648**	**401082**

Figure 7. Comparison of Causes of death, 2020-2022

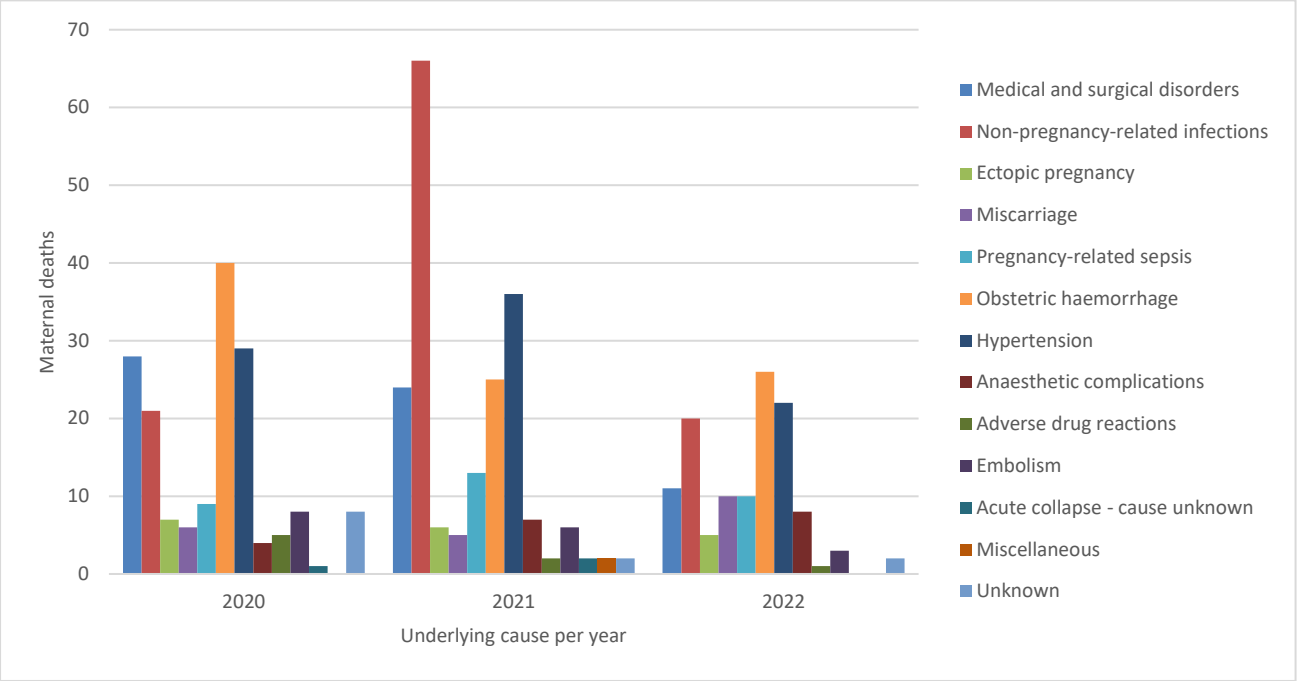


Figure 8. IMMR per Cause of death, 2020-2022

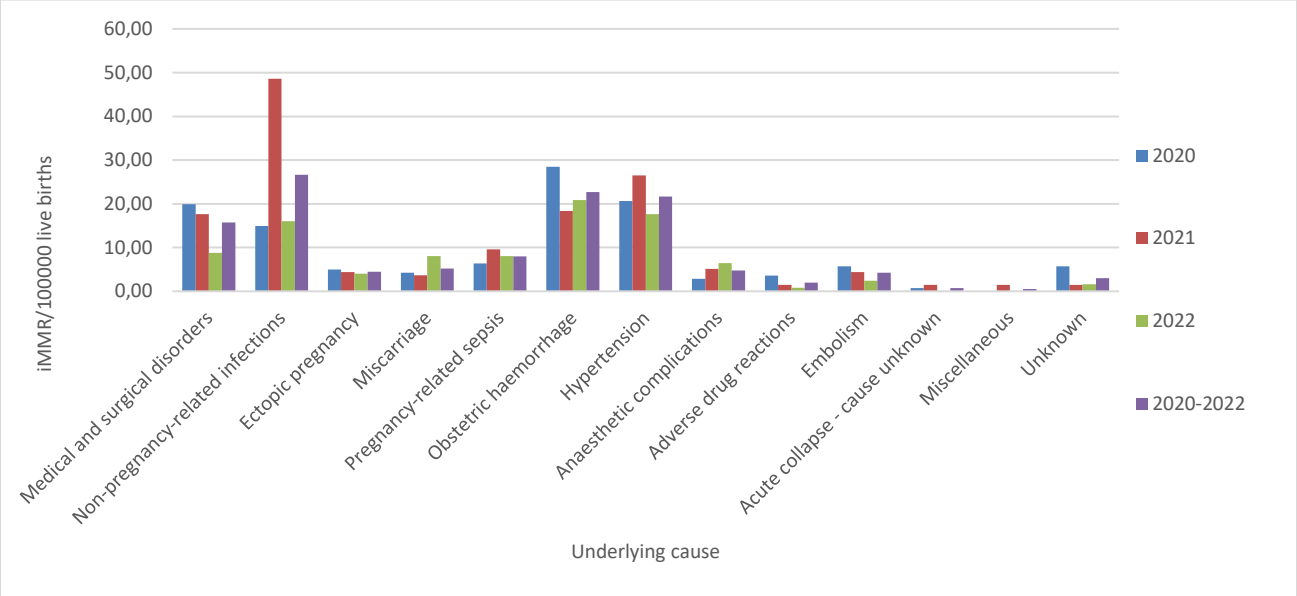


Table 2. IMMR per Cause of death, 2020-2022

Limpopo iMMR	2020	2021	2022	2020-2022
Medical and surgical disorders	19.92	17.66	8.82	15.71
Non-pregnancy-related infections	14.94	48.57	16.05	26.68
Ectopic pregnancy	4.98	4.42	4.01	4.49
Miscarriage	4.27	3.68	8.02	5.24

Limpopo iMMR	2020	2021	2022	2020-2022
Pregnancy-related sepsis	6.40	9.57	8.02	7.98
Obstetric haemorrhage	28.46	18.40	20.86	22.69
Hypertension	20.63	26.49	17.65	21.69
Anaesthetic complications	2.85	5.15	6.42	4.74
Adverse drug reactions	3.56	1.47	0.80	1.99
Embolism	5.69	4.42	2.41	4.24
Acute collapse - cause unknown	0.71	1.47	0.00	0.75
Miscellaneous	0.00	1.47	0.00	0.50
Unknown	5.69	1.47	1.60	2.99
Maternal deaths	118.11	144.23	94.67	119.68
Coincidental cause	0.71	2.94	0.80	1.50
DDCP	118.83	147.18	95.47	121.17
Live births (2019)	**140542**	**135892**	**124648**	**401082**

Figure 9. iMMR for Obstetric cause in each year of the triennium

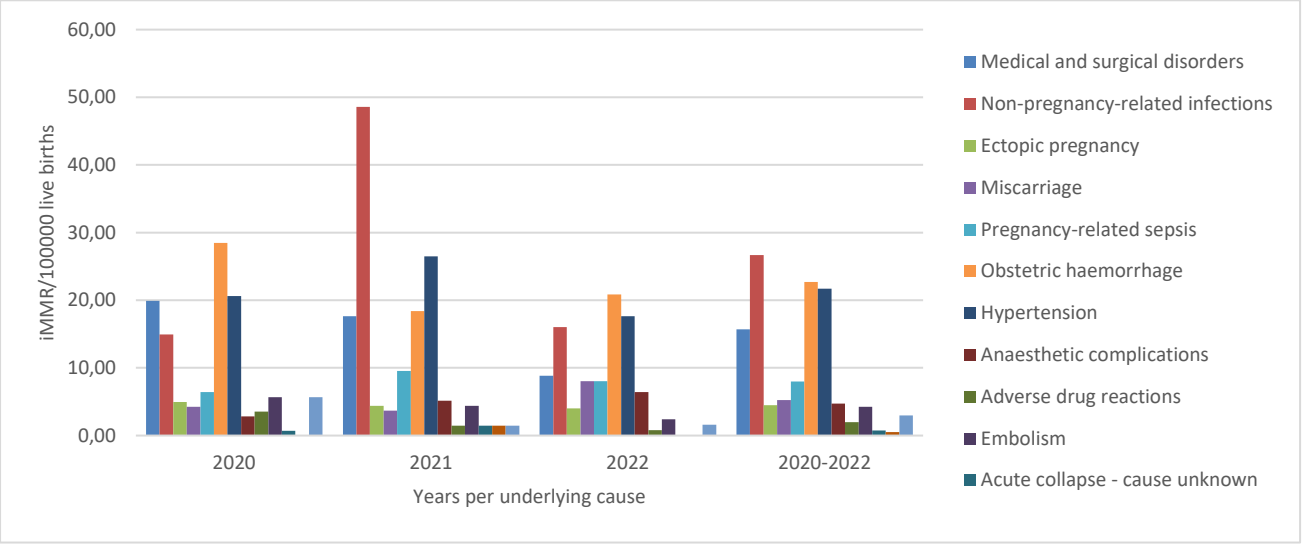


Table 3. Subcategories of Obstetric Causes of death, 2020-2022

Primary obstetric problems	Limpopo
Coincidental cause	**6**
- MVA	3

Primary obstetric problems	Limpopo
- Other accidents	1
- Assault	
- Other	2
Medical and surgical disorders	**63**
- Cardiomyopathy	18
- Rheumatic heart disease	
- Other cardiac disease	
- Endocrine	6
- GIT	6
- CNS	4
- Respiratory	7
- Haematological	5
- Genito-urinary	1
- Suicide	
- Substance abuse	
- Other psychiatric disease	
- Neoplasm	
- Auto-immune	2
- Other	14
Non-pregnancy-related infections	**107**
- PCP pneumonia	14
- Other pneumonia	5
- TB	17
- UTI	
- Appendicitis	
- Malaria	1
- Cryptococcal meningitis	9
- Other meningitis	6
- Kaposi's sarcoma	1
- Toxoplasmosis	
- Hepatitis	1
- Gastroenteritis	4
- Wasting syndrome	1
- Other	48
Ectopic pregnancy	**18**
- Less than 20 weeks	18
- More than 20 weeks (extrauterine pregnancy)	
Miscarriage	**21**

Primary obstetric problems	Limpopo
- Septic miscarriage	16
- Haemorrhage (non-traumatic)	2
- Uterine trauma	1
- GTD	
- Following legal TOP	2
Pregnancy-related sepsis	**32**
- Chorioamnionitis (ruptured membranes)	
- Chorioamnionitis (intact membranes)	1
- Puerperal sepsis after NVD	17
- Puerperal sepsis after CD	11
- Bowel trauma at CD	3
Obstetric haemorrhage	**91**
- Abruption with hypertension	1
- Abruption without hypertension	8
- Placenta praevia	1
- Other APH not specified	4
- Ruptured uterus with previous CD	5
- Ruptured uterus without previous CD	9
- Uterine atony after vaginal delivery	11
- Vaginal trauma after vaginal delivery	1
- Cervical trauma after vaginal delivery	6
- Retained placenta after NVD (morb adherent)	1
- Retained placenta after NVD (not adherent)	
- Inverted uterus after vaginal delivery	
- Other PPH not specified after vaginal delivery	8
- Bleeding during CD (morbidly adherent placenta)	2
- Bleeding during CD (not adherent placenta)	8
- Bleeding after Caesarean delivery	26
Hypertension	**87**
- Chronic hypertension	4
- Gestational hypertension	13
- Pre-eclampsia with severe features	4
- Pre-eclampsia without severe features	2
- Eclampsia	38
- HELLP	26
- Liver rupture	
Anaesthetic complications	**19**
- General anaesthetic	6

Primary obstetric problems	Limpopo
- Spinal anaesthetic	13
Adverse drug reactions	**8**
- ARV medication	4
- TB medication	
- Other medication	1
- Herbal medication	3
Embolism	**17**
- Pulmonary embolism	15
- Amniotic fluid embolism	2
Acute collapse - cause unknown	**3**
Miscellaneous	2
- Hyperemesis gravidarum	2
- Acute fatty liver	
Unknown	**12**
- Death at home or outside health services	11
- No primary cause found	
- Lack of information	1
Total:	**486**

COVID-19 deaths

COVID-19 maternal deaths	Limpopo
2020	1
2021	43
2022	0
2020-2022	**44**

Table 4. Primary Cause of Death and Location of death

Primary obstetric problems	Facility	In transit	Home/Outside
Coincidental cause	6	0	0
Medical and surgical disorders	63	0	0
Non-pregnancy-related infections	104	1	2
Ectopic pregnancy	18	0	0
Miscarriage	21	0	0
Pregnancy-related sepsis	32	0	0
Obstetric haemorrhage	89	2	0

Primary obstetric problems	Facility	In transit	Home/Outside
Hypertension	83	2	2
Anaesthetic complications	19	0	0
Adverse drug reactions	8	0	0
Embolism	16	0	1
Acute collapse - cause unknown	2	0	1
Miscellaneous	2	0	0
Unknown	2	0	10
Total	**465**	**5**	**16**

Table 5. Primary Cause of Death and level of care

Primary obstetric problem	Outside	CHC	District hospital	Regional hospital	Tertiary/Nat central hospital	Private hospital	Total
Coincidental cause	0	0	3	1	2	0	6
Medical and surgical disorders	0	0	11	13	31	8	63
Non-pregnancy-related infections	2	2	27	28	38	10	107
Ectopic pregnancy	0	0	9	6	3	0	18
Miscarriage	0	0	7	4	9	1	21
Pregnancy-related sepsis	0	0	5	10	14	3	32
Obstetric haemorrhage	0	2	32	26	27	4	91
Hypertension	2	2	22	16	41	4	87
Anaesthetic complications	0	0	5	9	5	0	19
Adverse drug reactions	0	0	2	3	3	0	8
Embolism	1	0	6	3	4	3	17
Acute collapse - cause unknown	1	0	1	0	1	0	3
Miscellaneous	0	0	0	2	0	0	2
Unknown	10	0	1	1	0	0	12
Total	**16**	**6**	**131**	**122**	**178**	**33**	**486**

Table 6. Primary Obstetric Causes per district in Limpopo province, 2020-2022

Primary obstetric problems	Bohlabela	Capricorn	Gr Sekhukhune	Mopani	Vhembe	Waterberg	Total
Coincidental cause	0	3	3	0	0	0	6
Medical and surgical disorders	0	40	7	3	9	4	63

Primary obstetric problems	Bohlabela	Capricorn	Gr Sekhukhune	Mopani	Vhembe	Waterberg	Total
Non-pregnancy-related infections	0	55	12	16	13	11	107
Ectopic pregnancy	0	4	3	5	4	2	18
Miscarriage	0	12	3	1	3	2	21
Pregnancy-related sepsis	0	18	2	5	4	3	32
Obstetric haemorrhage	0	36	12	18	19	6	91
Hypertension	0	48	13	10	10	6	87
Anaesthetic complications	0	5	7	2	3	2	19
Adverse drug reactions	0	3	2	0	2	1	8
Embolism	0	7	1	6	1	2	17
Acute collapse - cause unknown	0	2	0	1	0	0	3
Miscellaneous	0	0	0	1	0	1	2
Unknown	0	4	3	3	0	2	12
Total	**0**	**237**	**68**	**71**	**68**	**42**	**486**

Figure 10. Maternal deaths per Primary Obstetric Cause per district 2020-2022

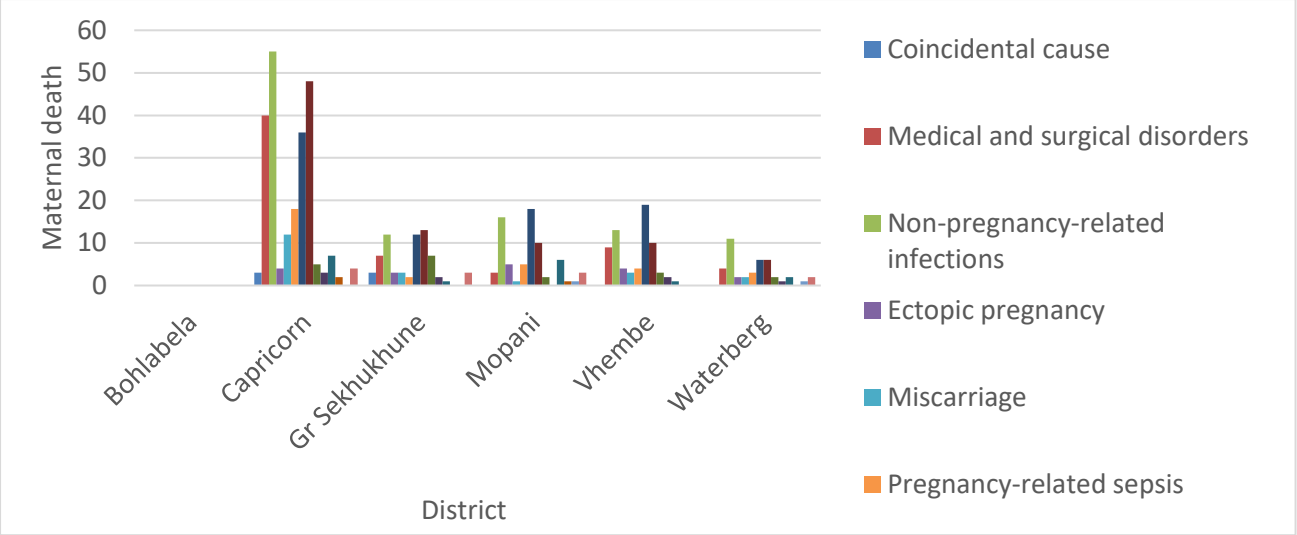


Table 7. Primary Obstetric Cause and Age

Primary obstetric problem	10-14	15-19	20-24	25-29	30-34	35-39	40-44	Outside 10-44 range & unknown	Total
Coincidental cause	0	2	0	2	2	0	0	0	6
Medical and surgical disorders		4	9	9	18	18	4	1	63
Non-pregnancy-related infections		8	11	20	31	25	11	1	107
Ectopic pregnancy		0	1	7	6	3	1	0	18
Miscarriage		3	3	1	7	4	3	0	21

Primary obstetric problem	10-14	15-19	20-24	25-29	30-34	35-39	40-44	Outside 10-44 range & unknown	Total
Pregnancy-related sepsis		2	4	7	8	8	3	0	32
Obstetric haemorrhage		1	9	20	18	22	18	3	91
Hypertension		6	17	16	17	26	4	1	87
Anaesthetic complications		1	3	4	3	7	1	0	19
Adverse drug reactions		0	1	2	3	1	1	0	8
Embolism		0	2	2	4	4	4	1	17
Acute collapse - cause unknown		1	0	0	2	0	0	0	3
Miscellaneous		0	0	1	0	1	0	0	2
Unknown		1	4	3	0	1	3	0	12
Total	**0**	**29**	**64**	**94**	**119**	**120**	**53**	**7**	**486**

Table 8. Primary Obstetric Cause and Mode of Delivery

Primary obstetric problems	Vaginal	CD	CD CHC	CD DH	CD RH	TH/NCH	Pvt
Coincidental cause	2	0	0	0	0	0	0
Medical and surgical disorders	18	15	0	4	2	5	4
Non-pregnancy-related infections	34	26	1	5	5	11	8
Miscarriage	1	1	0	1	0	0	0
Pregnancy-related sepsis	17	14	0	0	5	6	3
Obstetric haemorrhage	27	50	0	19	15	12	4
Hypertension	21	42	2	9	6	27	6
Anaesthetic complications	1	18	0	4	9	5	0
Adverse drug reactions	3	2	0	0	0	2	0
Embolism	7	7	0	3	1	1	2
Acute collapse - cause unknown	0	1	1	1	1	1	1
Miscellaneous	0	0	0	0	0	0	0
Unknown	3	0	0	0	0	0	0
Total:	**134**	**176**	**4**	**46**	**44**	**70**	**28**

Table 9. Final cause of Death

Cause of death	Number	% of total
Circulatory system	198	40.7
- Hypovolaemic shock	128	26.3

Cause of death	Number	% of total
- Septic shock	70	14.4
Respiratory failure	122	25.1
- Respiratory failure	122	25.1
Cardiac failure	100	20.6
- Pulmonary oedema	100	20.6
Embolism	40	8.2
- Acute collapse due to embolism	40	8.2
Renal failure	70	14.4
- Renal failure	70	14.4
Liver failure	49	10.1
- Liver failure	49	10.1
Cerebral complications	69	14.2
- Intracranial haemorrhage	26	5.3
- Cerebral oedema resulting in coning	11	2.3
- Meningitis	9	1.9
- Cerebral emboli	1	0.2
- Brain death following hypoxic event	14	2.9
- Unspecified	8	1.6
Metabolic	62	12.8
- Maternal ketoacidosis	17	3.5
- Electrolyte imbalance	33	6.8
- Thyroid crisis	3	0.6
- Lactic acidosis	8	1.6
- Other	1	0.2
Haematological	100	20.6
- DIC	72	14.8
- Severe anaemia	28	5.8
Immune system	60	12.3
- Immune system failure	60	12.3
Unknown	18	3.7
- Home death	12	2.5
- Unknown	6	1.2
Other	20	4.1
- Other	20	4.1
Total deaths:	**486**	

Avoidable factors

Table 10. Overview of Avoidable factors, 2020-2022

	Number	% of total	% of cases at this level
Patient oriented problems			

	Number	% of total	% of cases at this level
- Avoidable factors identified	224	46.1	
- No avoidable factors	221	45.5	
- Lack of information	43	8.8	
Administrative problems			
- Avoidable factors identified	296	60.9	
- No avoidable factors	142	29.2	
- Lack of information	50	10.3	
Resuscitation problems			
- Avoidable factors identified	291	59.9	
- No avoidable factors	137	28.2	
- Lack of information	61	12.6	
Medical care – CHC			
- Managed at this level	142	29.2	
- Avoidable factors identified	78		54.9
- No avoidable factors	56		39.4
- Lack of information	14		9.9
Medical care - District hospital			
- Managed at this level	245	50.4	
- Avoidable factors identified	167		68.2
- No avoidable factors	62		25.3
- Lack of information	21		8.6
Medical care - Regional hospital			
- Managed at this level	150	30.9	
- Avoidable factors identified	87		58.0
- No avoidable factors	46		30.7
- Lack of information	18		12.0
Medical care - Tertiary and above			
- Managed at this level	182	37.4	
- Avoidable factors identified	75		41.2
- No avoidable factors	79		43.4
- Lack of information	31		17.0
Medical care - Private hospital			
- Managed at this level	35	7.2	
- Avoidable factors identified	16		45.7
- No avoidable factors	17		48.6
- Lack of information	2		5.7
Timing of emergency			
- Early pregnancy	91	18.7	
- Antenatal period: 20w +	148	30.5	
- Intrapartum period	61	12.6	

	Number	% of total	% of cases at this level
- Postpartum period	178	36.6	
- Anaesthesia	11	2.3	
Timing of death			
- Early pregnancy	71	14.6	
- Antenatal period: 20w +	91	18.7	
- Intrapartum period	39	8.0	
- Postpartum period	274	56.4	
- Anaesthesia	11	2.3	
Impact of suboptimal care			
- No suboptimal care identified	130	26.7	
- Suboptimal care, no impact on outcome	44	9.1	
- Suboptimal care, possible impact on outcome	163	33.5	
- Suboptimal care, probable impact on outcome	149	30.7	
Total:	**486**		

Discussion

Limpopo reported 486 DDPCP, of these six were coincidental resulting in 480 maternal deaths for the triennium 2020-2022 and all files were captured on MaMMAS. In 2022, under reporting was suspected because MAMMAs numbers were less than DHIS, and the total maternal deaths for the triennium were corrected up to 505 for all provincial iMMR calculations. Reporting of maternal deaths that occurred outside facility were eight in the 2020-2022 triennium and maternal deaths in early pregnancy were also reported (<13weeks).

Demographic data indicates that deaths between the ages 20-24 have decreased by 7% whereas for the ages 25-29 have increased by 5.4% for the triennium 2020-2022 with more maternal deaths in age groups 30-34 and 35-39 over the three-triennium compared to other age groups indicating a need to strengthen contraception services. Deaths in women with Parity 2 and 0 remain high at 25% and 22% respectively.

Most of the maternal deaths take place at tertiary hospital accounting for 37.1% of the deaths. This could be due late referrals. District hospital account for 28.1% of the deaths for the triennium 2020-2022 with a decrease of 8.1% as compared with the previous triennium indicating improvement in skills and implementation of protocols and guidelines.

The five major causes of maternal deaths in Limpopo in the triennium 2020-2022 are:
1. Non-Pregnancy related infections 107 (22.2%)
2. Obstetric haemorrhage 91 (18.9%)
3. Hypertensive disorders 87 (18.12%)
4. Pre - existing Medical and Surgical disorders 63 (13.1%)
5. Pregnancy related sepsis 32 (6.6%)

Obstetric haemorrhage remains the highest direct cause of maternal deaths at 22.2% in the triennium 2020-2022 reflecting the challenge faced by the province in respect of availability of skilled health workers leading to substandard care with the correct diagnosis which is at 24.4%. There is also inconsistence supply of medications at primary healthcare facilities. The avoidable deaths for this category were 93%.

Deaths of mothers with a positive HIV status have decreased from 43.1% in 2017- 2019 triennium to 34.2%, a decrease of 8.9%. Deaths of women with an unknown HIV status increased by 5.9% in 2020-2022 as compared to 2017 – 2019 triennium.

Shortage of skilled midwives and doctors including specialists continue to be a challenge faced by the province in the reduction of maternal deaths as evidenced by health worker related avoidable factors due to problems in medical management of cases. This lack of core of clinical competence affects the quality of management of clients.

Recommendations

COMPONENT	ACTIVITIES
HIV and AIDS and TB COVID-19	• Increase the testing rate for HIV and screening for TB among women of childbearing age for early initiation of treatment and care. • Initiate all HIV positive TB negative pregnant women on IPT. • Correct implementation of protocols and guidelines on the management of HIV positive women should be encouraged for all health professionals at all levels of care. • Consistent availability of drugs to manage HIV and AIDS and TB. • Conduct follow up on defaulters and monitor adherence to treatment. • COVID-19 vaccination for pregnant women
Obstetric Haemorrhage	• Implement E Motive approach to early detection and management of PPH after vaginal delivery. • Strengthen the Implementation of training on Essential Steps in Managing Obstetric Emergencies and Emergency Obstetric Simulation Training. (ESMOE-EOST). • Encourage correct use and interpretation of the partogram for early intervention. • Active Management of the Third Stage of Labour to be practised with each delivery by all health professionals conducting deliveries. • Improve the skills of doctors in providing safe caesarean section. • Haematinics to be consistently available at all levels of care. • Drills on management of obstetric emergencies to be conducted at all levels of care to improve the skills in the management of obstetric haemorrhage. • Post-Partum Haemorrhage box to be available at levels of care for emergency management of the patient. • Fourth stage of labour monitoring to be done for all women post-delivery to exclude Post-Partum Haemorrhage and other complications. • Post- natal care to be encouraged within 6 days and women should be examined for any complications and be treated. • Promote the use of maternal health standards, protocols and guidelines in the management of obstetric haemorrhage.
Hypertension	• Promote early detection of hypertension and improve early detection of women who are at risk. • Promote the use of Hypertension guidelines during training of doctors and midwives. • Consistent Availability of calcium and low dose aspirin in all facilities providing maternal healthcare services to reduce the incidence of hypertensive disorders of pregnancy. • Encourage early booking for early identification of problems and intervention especially for hypertension in pregnancy. • Early referral of patients with signs of hypertensive disorders of pregnancy. • Monitor blood pressure and test the urine at every visit and provide appropriate intervention to the client. • Eclampsia box to be available at all levels of care for emergency management of pregnant women with eclampsia.
Health worker training	• Disseminate the maternal health standards to all doctors and midwives. • Training of health professionals in Sexual Reproductive Health

COMPONENT	ACTIVITIES
	• Training on Basic Antenatal Care Plus including Prevention of Mother to Child Transmission of HIV. • Training of Medical Officers in Diplomas of Obstetrics and Gynaecology; and Anaesthesia • Training Essential Steps in Managing Obstetric Emergencies (ESMOE-EOST). • Conduct monthly ESMOE-EOST drills at all levels of care. • Conduct support and mentorship for trained personnel to maintain the skill. • Onsite mentoring of healthcare workers should be implemented continuously. • In reach and Outreach services should be conducted to the district hospitals by specialists at regional and tertiary hospitals
Health system strengthening	• Allocate appropriately trained staff with relevant skills and knowledge to maternal healthcare services and avoid rotation of staff. • Provide equipment and consumables at all levels of care. • Consistent supply of medicine. • Availability of blood and blood products • Improve the audit of implementation of Basic Ante Natal Care (BANC) and labour records. • Conduct audit of the antenatal and maternity case record to improve quality of care. • Cluster clinics to conduct deliveries and establish MOUs at district hospitals where the infrastructure is available. • Dedicated Emergency obstetric ambulances to be made available to facilitate inter-facility transfer. • Strengthen contraception services. • Essential equipment and surgical supplies to be consistently available at all levels of care. • Tertiary and regional hospitals to conduct in reach and outreach programmes to support doctors at district level. • Doctors visiting Primary Healthcare facilities to also take care of pregnant women. • Hospitals to conduct monthly perinatal review meetings to discuss cases and implement recommendations made in the meeting.

Limpopo provincial assessors

No	Surname and initials	District	Institution	Job title
1.	Mathetha M	Capricorn	Capricorn district office	Acting Deputy director MCWH&N
2.	Lebogo SJ	Capricorn	Hellen Franz hospital	Nursing service manager
3.	Setumo LJ	Capricorn	Seshego hospital	Advanced midwife
4.	Moremi DR	Capricorn	Sovenga campus	Tutor
5.	Phalane MD	Capricorn	Pietersburg hospital	Advance midwife
6.	DR K Baloyi	Capricorn	Polokwane /Mankweng complex	O&G Specialist
7.	Khumalo J	Capricorn	Seshego hospital	Advance midwife

No	Surname and initials	District	Institution	Job title
8.	Mohlake K	Capricorn	Pietersburg hospital	Area manager maternity
9.	Mashele LX	Provincial office	Maternal health	Deputy Director
10	Dr Marumo	Sekhune	Phladelphia hospital	Medical offiger maternity
11	Malapane MF	Sekhukhune	Phladelphia hospital nursing school	Tutor
12	Ramontsho MG	Sekhukhune	District office	Deputy director MCWH
13.	Motsanani B	Waterberg	Warm baths hospital	Advanced midwife
14.	Rhvhedzani MS	Vhembe	PHC	Assistant manager
15.	Nyakana M	Mopani	Letaba hospital	Advanced midwife
16.	Machavani M	Mopani	District office	Deputy director MCWH
17.	Singo T	Vhembe	Donald Frazer hospital	Advanced midwife

8.6 Mpumalanga

Introduction

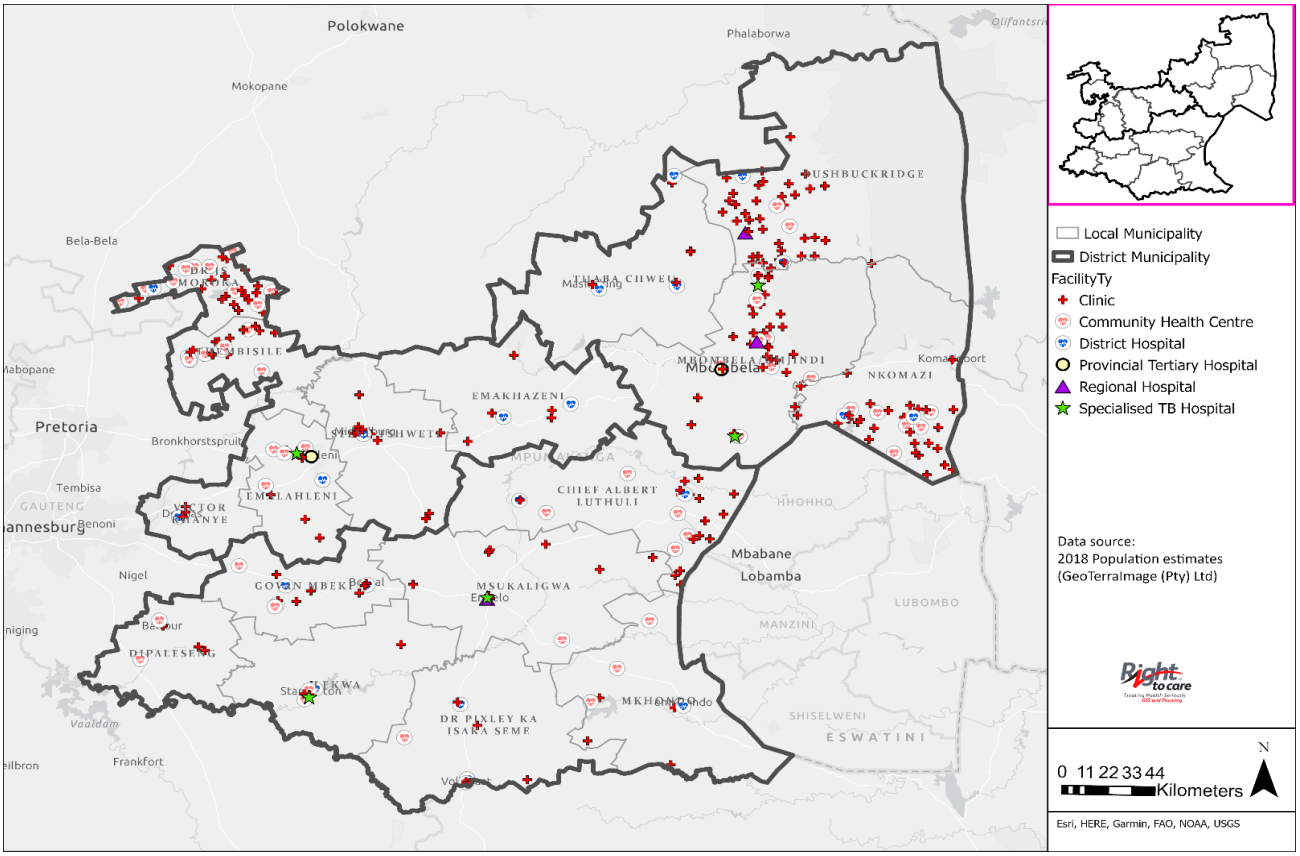
Mpumalanga Province is divided into three districts, namely Ehlanzeni, Gert Sibande and Nkangala. There are 17 sub-districts, with a recent population of about 5 143 324 (2022 Census). The province is committed to the achievement of SDG, by the year 2030. The confidential enquiry into Maternal Mortality helps in achieving these goals.

Mpumalanga province does not have a medical school; therefore, this poses a challenge in delivery of tertiary and quaternary (central hospital) services. The province has two tertiary, three regional, 23 district hospitals, 60 CHCs, and 232 clinics. None of the three districts within the province has a fully functional District Clinical Specialist Team (DCST). One of the two tertiary hospitals (Witbank hospital) also offer regional hospital services with only one full time Obstetrician and one full time anesthesiologist. Both tertiary hospitals (Rob Ferreira hospital and Witbank hospital) are not affiliated to any medical school. None of the regional hospitals has an anesthesiologist.

The COVID-19 pandemic adversely affected maternal mortality in the province, both directly and indirectly.

DHIS data on maternal mortality is collected and reported by the facility to the district MCWH coordinator. The death reports from the three districts are collated by the Assistant Director Maternal Health, and together with the District MCWYH coordinators organise the assessment of files. The assessed files are then captured into MaMMAS by the Deputy Director Maternal Health.

Service Delivery Platform/Public Health Facilities map



Source: Right To Care

Maternal deaths reported 2020-2022

Trends in maternal deaths

Mpumalanga province maternal deaths increased from 299 in the last triennium (2017-19) to 375 in this triennium (2020-22).

Table 1. Trends in Maternal deaths 2017 to 2022

YEAR	NUMBER OF MD	% OF DEATHS IN SA
2017	117	9.94%
2018	112	9.73%
2019	70	6.85%
2020	95	7.69%
2021	167	11.08
2022	113	10.64%

Figure 1. Mpumalanga maternal deaths from 1998-2022

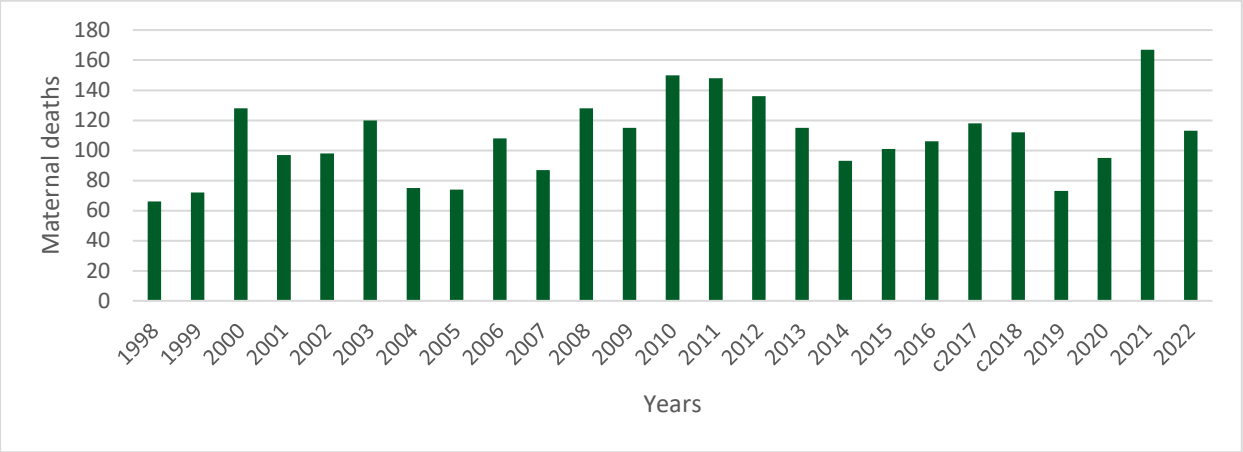
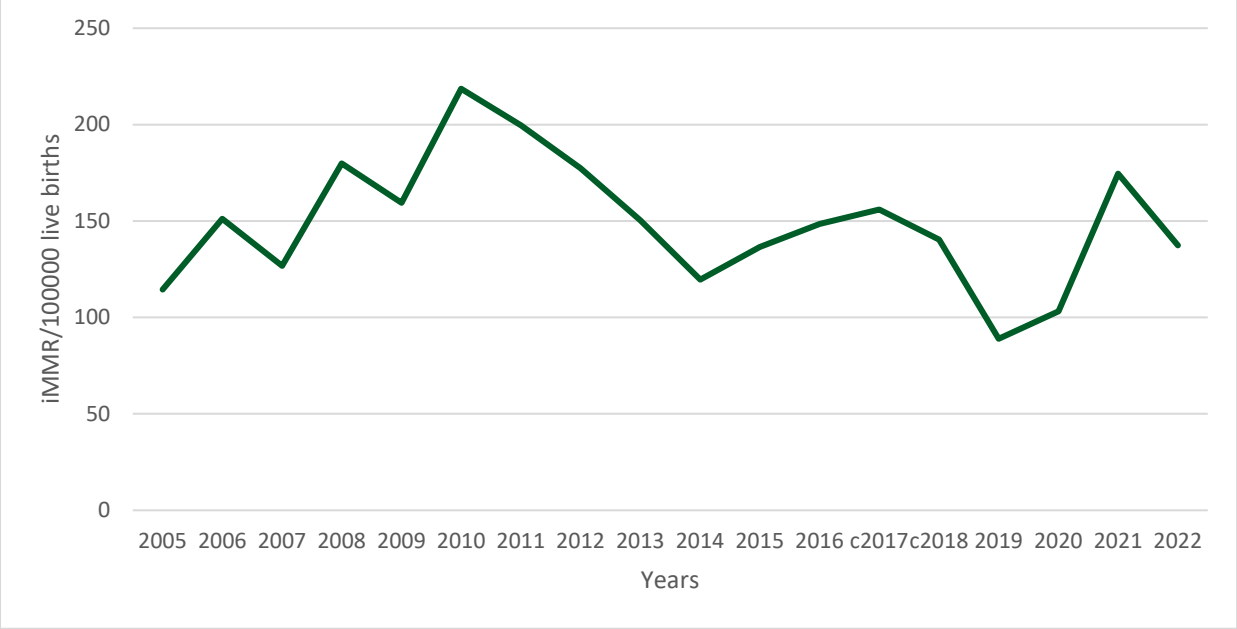


Figure 2. Mpumalanga iMMR from 2005-2022



There was a steady increase in institutional maternal mortality ratio (iMMR) from 2005-2010. This was followed by a steady decrease between 2011 to 2019 which could be attributed to antiretroviral treatment for HIV as well as district support provided by the DCST as documented in the previous reports. Within the last triennium (2020—2022), there was a sharp increase in iMMR, in 2021 mainly due to direct and indirect effects of the COVID-19 pandemic on maternity services. This was followed by a small decline in 2022. This decline was mainly due to achievements in reduction on COVID-19 deaths, but further decline may be achieved if the indirect effect of COVID-19 pandemic on maternity services is fully reversed.

Figure 3. Mpumalanga iMMR for 2020-2022 and the 2020-2022 triennia

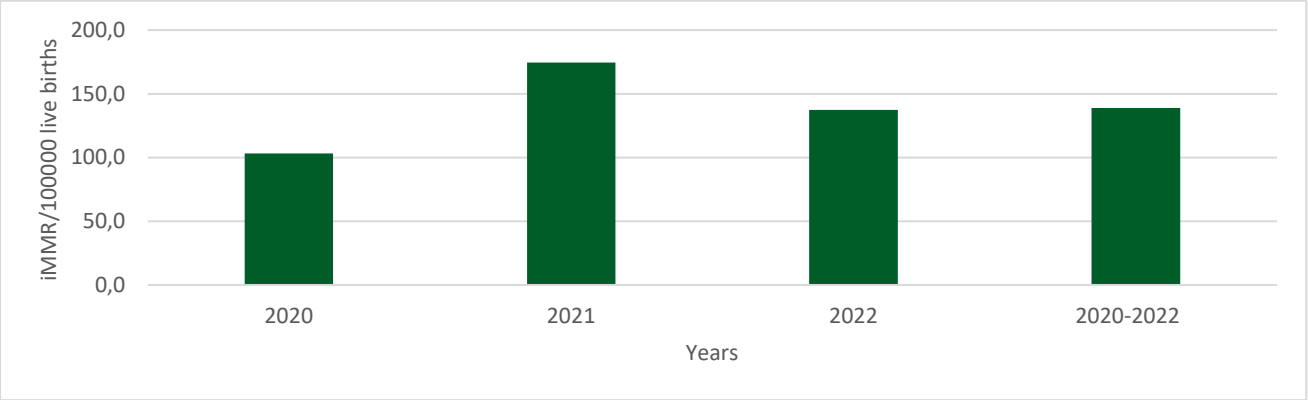


Figure 4. Mpumalanga iMMR for 4 triennia from 2011-2022

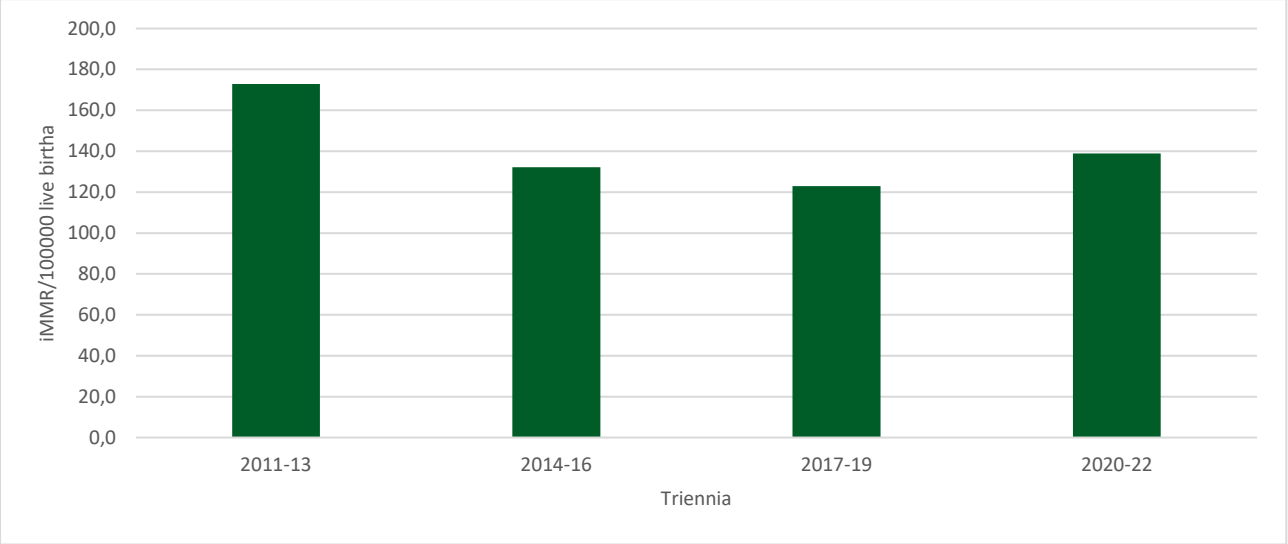


Table 2 shows the number of deaths reported to NCCEMD (MAMMAs database) and to DHIS. No corrections were required since, as expected MAMMAs numbers exceeded DHIs numbers. Live birth data was obtained from the DHIS database.

Table 2. DHIS and MaMMAS data

Mpumalanga	Live births	MaMMAS deaths (DDCP)	MaMMAS MD	DHIS MD	MaMMAS MD	MaMMAs iMMR	DHIS iMMR
2020	92094	99	95	77	95	103.16	83.6
2021	95700	168	167	142	167	174.50	148.4
2022	82270	113	113	105	113	137.35	127.6

2020-2022	Live births	MaMMAS MD	MaMMAs iMMR
Mpumalanga Province	270 064	375	138,86

Causes of maternal deaths

Figure 5. Mpumalanga Maternal deaths for 2020,2021 and 2022

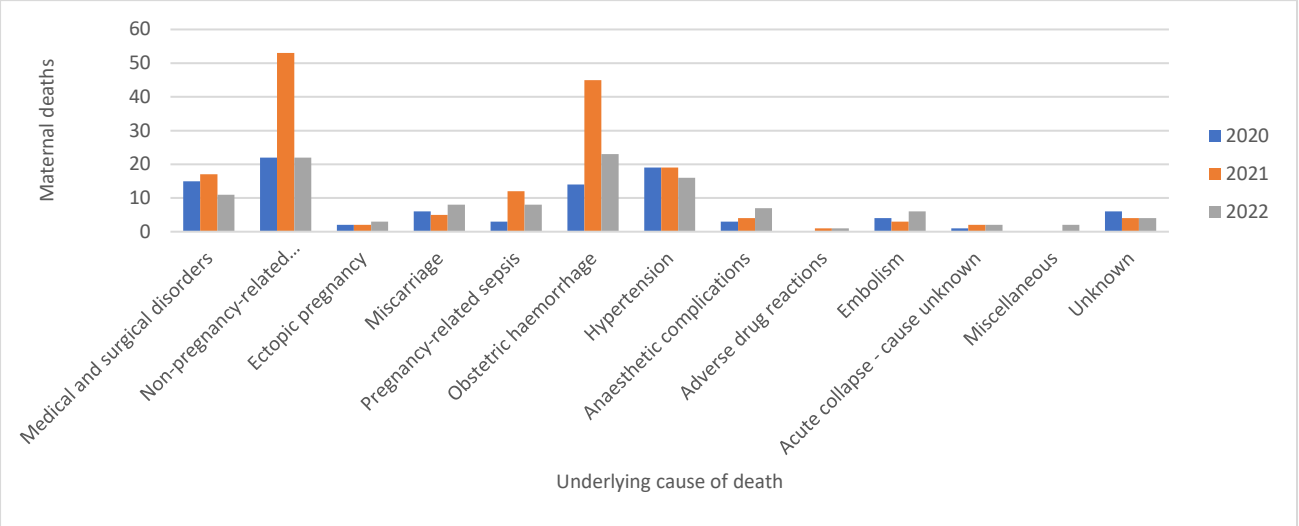


Table 3. TOP 5 Primary Obstetric Causes (numbers of maternal deaths)

Mpumalanga	2020	2021	2022	2020-2022	2020-2022 %	2017-2019 %
1. Non-pregnancy related infections	22	53	22	97	25.9% ↑	25.68%
2. Obstetric haemorrhage	14	45	23	82	21.9% ↓	26.95%
3. Hypertension	19	19	16	54	13.9% ↓	23.58%
4. Medical and surgical disorders	15	17	11	43	11.5% ↓	13.05%
5. Pregnancy-related sepsis	3	12	8	23	6.1% ↑	4.21%
Miscarriage	6	5	8	19	5.1% ↓	13.05%
Anaesthetic complications	3	4	7	14	3.7% ↑	1.26%
Embolism	4	3	6	13	3.5% ↓	4.21
Ectopic pregnancy	2	2	3	7	1.9% ↓	6.32

Mpumalanga	2020	2021	2022	2020-2022	2020-2022 %	2017-2019 %
Acute collapse	1	2	2	5	1.3%	
Adverse drug reactions	0	1	1	2	0.5% ⇩	3.37
Miscellaneous	0	0	2	2	0.5%	
Unknown	6	4	4	14	3.7%	
Maternal deaths	**95**	**167**	**113**	**375**	**100%**	
Coincidental cause	4	1	0	5		
DDCP	99	168	113	380		
Live births (2019)	92094	95700	82270	270064		

- There was a notable increase in non-pregnancy related Infections in 2021, mostly accounted for by COVID-19 related deaths
- There was a sharp increase in Obstetric Haemorrhage related deaths from 14 in 2020 to 45 in 2022 and then a subsequent decrease to 23 in 2022.
- Obstetric Haemorrhage has decreased from the last triennium (26.95% to 21.09%)
- Deaths from hypertensive disease in pregnancy decreased in the last triennium (2020-2022) by 9.68% compared with previous triennium (2017-2019).
- Anaesthetic deaths have increased from 1.26% in the last triennium to 3.7% currently.

Table 4. iMMR per primary obstetric cause 2020-2022

Mpumalanga iMMR	2020	2021	2022	2020-2022
Non-pregnancy-related infections	23.89	55.38	26.74	35.92
Obstetric haemorrhage	15.20	47.02	27.96	30.36
Hypertension	20.63	19.85	19.45	20.00
Medical and surgical disorders	16.29	17.76	13.37	15.92
Pregnancy-related sepsis	3.26	12.54	9.72	8.52
Miscarriage	6.52	5.22	9.72	7.04
Anaesthetic complications	3.26	4.18	8.51	5.18
Embolism	4.34	3.13	7.29	4.81
Ectopic pregnancy	2.17	2.09	3.65	2.59
Acute collapse - cause unknown	1.09	2.09	2.43	1.85
Adverse drug reactions	0.00	1.04	1.22	0.74

Mpumalanga iMMR	2020	2021	2022	2020-2022
Miscellaneous	0.00	0.00	2.43	0.74
Unknown	6.52	4.18	4.86	5.18
Maternal deaths	**103.16**	**174.50**	**137.35**	**138.86**
Coincidental cause	4.34	1.04	0.00	1.85
DDCP	107.50	175.55	137.35	140.71

Anaesthetic deaths are on the increase due to logistic problems and insufficient skills.

Figure 6. iMMR per primary cause per year, and for the triennium 2020-2022

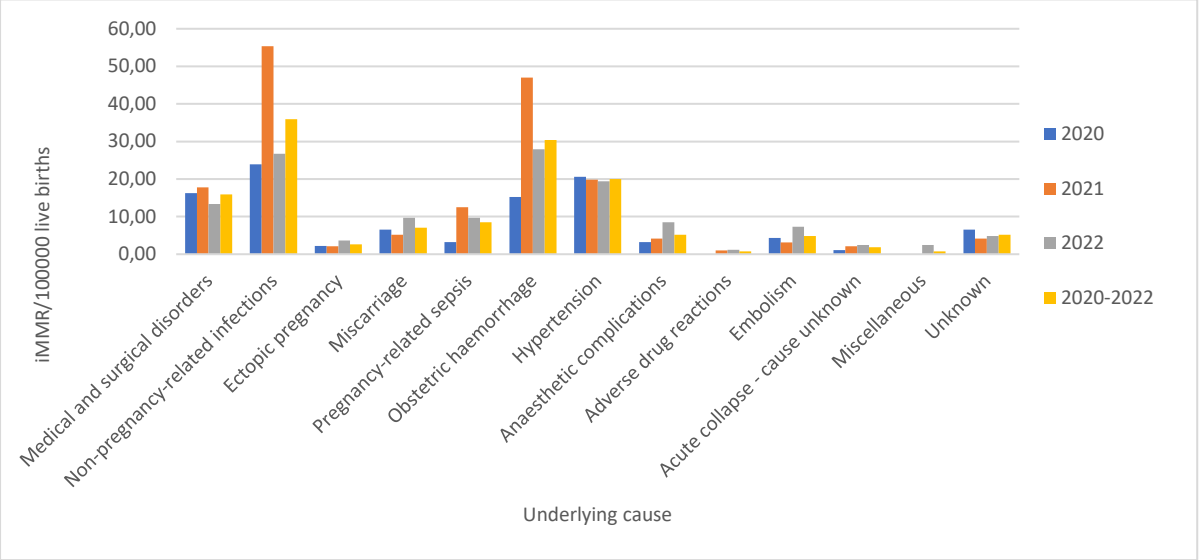


Figure 7. Pattern of iMMR per underlying cause per year and for the triennium

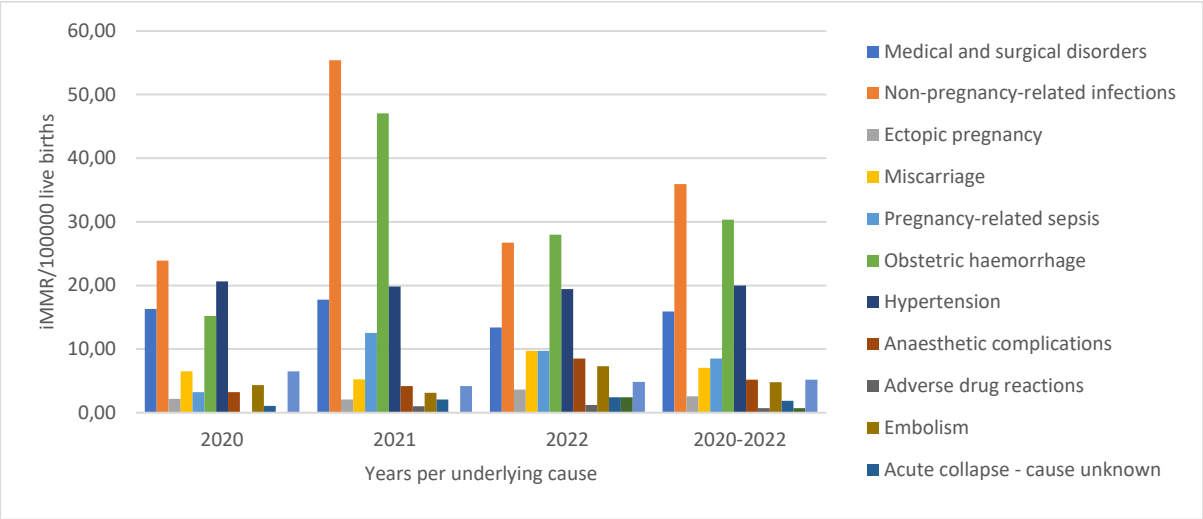


Table 5. Effect of COVID-19

COVID-19 maternal deaths	MP
2020	7
2021	33
2022	1
2020-2022	**41**

Figure 8. Mpumalanga COVID-19 Maternal deaths

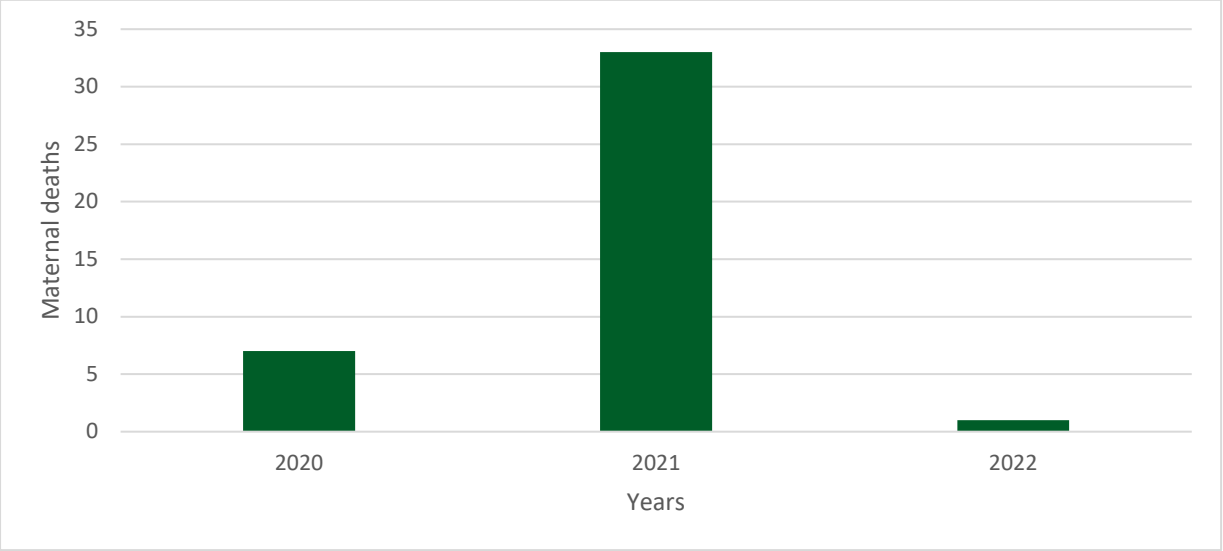


Table 6. Effect of HIV infection

Primary obstetric problems	Negative	Positive	Declined test	Unknown	Total
Non-pregnancy-related infections	33	59	0	5	97
Obstetric haemorrhage	45	31	0	6	82
Hypertension	29	16	0	9	54
Medical and surgical disorders	20	17	0	6	43
Pregnancy-related sepsis	10	10	0	3	23
Miscarriage	4	5	0	10	19
Anaesthetic complications	9	4	0	1	14
Embolism	8	4	0	1	13
Coincidental cause	0	2	0	3	5
Acute collapse - cause unknown	0	5	0	0	5

Primary obstetric problems	Negative	Positive	Declined test	Unknown	Total
Adverse drug reactions	1	1	0	0	2
Miscellaneous	1	0	0	1	2
Unknown	7	5	0	2	14
Total	**167**	**160**	**0**	**53**	**380**

Table 7. Place of death

Primary obstetric problem	Outside	CHC	District hospital	Regional hospital	Tertiary hospital	Private hospital	Total
Non-pregnancy-related infections	3	0	32	27	23	12	97
Coincidental cause	0	0	2	2	1	0	5
Medical and surgical disorders	1	0	16	11	15	0	43
Obstetric haemorrhage	2	3	34	17	24	2	82
Hypertension	1	2	19	16	15	1	54
Pregnancy-related sepsis	0	0	4	9	10	0	23
Miscarriage	0	0	6	6	6	1	19
Anaesthetic complications	0	0	10	4	0	0	14
Embolism	1	1	8	3	0	0	13
Acute collapse - cause unknown	0	0	4	1	0	0	5
Adverse drug reactions	0	0	0	1	1	0	2
Miscellaneous	0	0	0	2	0	0	2
Unknown	9	0	2	3	0	0	14
Total	**17**	**6**	**137**	**102**	**95**	**16**	**373**

Table 8. Maternal Deaths per district

Primary obstetric problems	Ehlanzeni	Gert Sibande	Nkangala	Total
Non-pregnancy related infections	54	18	25	97
Obstetric haemorrhage	32	27	23	82
Hypertension	24	14	16	54
Medical and surgical disorders	18	9	16	43
Pregnancy-related sepsis	11	4	8	23
Miscarriage	8	4	7	19

Primary obstetric problems	Ehlanzeni	Gert Sibande	Nkangala	Total
Anaesthetic complications	6	3	5	14
Embolism	8	4	1	13
Ectopic pregnancy	3	0	4	7
Coincidental cause	2	2	1	5
Acute collapse - cause unknown	3	2	0	5
Miscellaneous	2	0	0	2
Unknown	7	4	3	14
Total	**180**	**91**	**109**	**380**

Figure 9. Mpumalanga maternal deaths per district

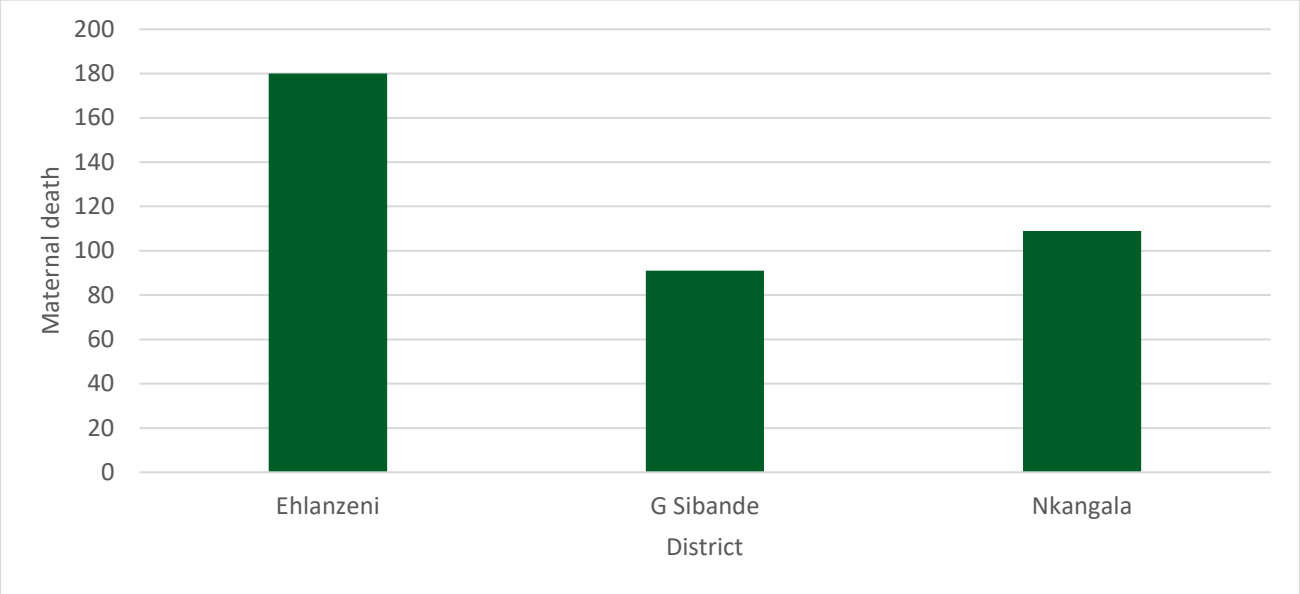


Table 9. Route of delivery

Primary obstetric problems	Vaginal	CD	CD CHC	CD DH	CD RH	CD TH/NCH	CD Pvt
Coincidental cause	0	1	0	0	1	0	0
Medical and surgical disorders	13	9	0	3	3	3	0
Non-pregnancy-related infections	33	24	1	9	7	9	2
Ectopic pregnancy	6	6	0	4	1	1	0
Miscarriage	1	0	0	0	0	0	0
Pregnancy-related sepsis	7	15	0	2	5	8	0
Obstetric haemorrhage	27	45	0	18	13	12	2

Primary obstetric problems	Vaginal	CD	CD CHC	CD DH	CD RH	CD TH/NCH	CD Pvt
Hypertension	13	19	0	2	7	9	1
Anaesthetic complications	1	13	0	9	4	0	0
Adverse drug reactions	1	1	0	0	0	1	0
Embolism	3	4	0	3	1	0	0
Acute collapse - cause unknown	0	1	0	1	0	0	0
Miscellaneous	0	0	0	0	0	0	0
Unknown	5	5	1	4	2	1	1
Total	**110**	**143**	**2**	**55**	**44**	**44**	**6**

Table 10. Post-mortem Services

Primary obstetric problems	Post-mortem	Not done
Coincidental cause	2	3
Medical and surgical disorders	15	28
Non-pregnancy-related infections	6	91
Ectopic pregnancy	2	5
Miscarriage	5	14
Pregnancy-related sepsis	9	14
Obstetric haemorrhage	39	43
Hypertension	13	41
Anaesthetic complications	9	5
Adverse drug reactions	0	2
Embolism	7	6
Acute collapse - cause unknown	3	2
Miscellaneous	1	1
Unknown	4	10
Total	**115**	**265**

The province depends on the Forensic service for postmortem. The post-mortems are not always performed by a pathologist, and so the quality of the post- mortems is sometimes a challenge.

Table 11. Resuscitation

Description	Number	% of cases
Lack of information	59	15.5

Description	Number	% of cases
No avoidable factor	161	42.4
Airway problems	10	2.6
Breathing problems	17	4.5
Circulation problems	29	7.6
Drug problems	16	4.2
Investigation problems	3	0.8
Monitoring problems	14	3.7
Not attempted	100	26.3
Total cases	**380**	

Discussion

- The number of maternal deaths reported in this triennium increased by 76 from 299 (2017-2019) to 375 (2020-2022) in this triennium.
- There was a sharp increase in Obstetric Haemorrhage related deaths from 14 in 2020 to 45 in 2021. This is multi-factorial but probably related to adverse effects of the COVID-19 pandemic on maternity services, as well as inexperienced junior medical officers and community servers in the rural district hospitals who carry after hour responsibilities. In recent years, more and more community service medical officers come into our service without having even completed the required 10 caesarean sections during their internship training. There was a decrease to 23 in 2022 as the COVID-19 pandemic became contained.
- During the pandemic, district support by the DCST team was affected due to a re-focus of their skill and clinical inputs into pandemic related matters.
- The COVID-19 pandemic adversely affected maternal mortality in the province, both directly and indirectly.
- HIV infection was associated with increased deaths from non-pregnancy related infections.
- Deaths from obstetric haemorrhage are more common following caesarean section delivery.
- There was a steady increase in Anaesthetic related deaths. This might be a reflection of poor Anaesthetic skills in the district hospitals and regional hospitals coupled with inadequate Anaesthetic nursing support. The province has invested in providing the Safe Obstetric Anaesthetic course in conjunction with the University of the Free State. Improvement in Anaesthetic skills may impact positively on provision of resuscitation following cardiopulmonary arrest since resuscitation was not attempted in about 25% of maternal deaths.
- Deaths related to hypertension in pregnancy decreased in the last triennium by 9.68% (2020-2022= 13.9% and 2017-2019=23.58%).
- More deaths occurred in the district hospitals compared with the regional and tertiary institutions in all the top five causes of maternal deaths. This is probably a reflection of dysfunctional referral system and a lack of skills amongst medical officers in these facilities.
- Deaths from miscarriages decreased from 13.05% in the previous triennium to 5.1% in this triennium.

Recommendations

- To decrease deaths due to OH, the province should implement the recently developed E-Motive approach for early detection and first response for PPH, aiming to decrease OH deaths by at least 60%. Safe caesarean section delivery must be ensured especially at the district hospitals.
- To strengthen the prevention and management of hypertension during antenatal care in PHC facilities.
- HIV infection prevention and contraception services must be strengthened among women of reproductive age group.
- The availability of all basic resources should be improved.

- Availability of a medical school in Mpumalanga should be motivated and actioned.
- Improvement in Anaesthetic skills is highly recommended, and provision of Anaesthetic nurses need to be addressed.
- The province needs to sustain the good practices.

Mpumalanga Provincial assessors

Ehlanzeni District - Maternal death assessors

No	Name	Category	Health facility
1.	Dr G Goosen	DCST	Ehlanzeni District
2.	Sr D Dlamini	Sub district MCWH	BBR sub-district
3.	Dr Orie	Obstetrician	Themba Hospital
4.	Sr D Ngoma	Advanced Midwife	Themba hospital (Retired in 2022)
5.	Dr BG Ndubane	Doctor	Mapulaneng Hospital
6.	Sr J Maboi	Advanced Midwife	Mapulaneng Hospital
7.	Sr G Mnisi	Advanced Midwife	Tintswalo hospital (Retired)
8.	Dr Walzl	Doctor	Tonga Hospital (Retired)
9.	Sr K Shongwe	Advanced Midwife	Shongwe Hospital
10.	Sr Mabel Sibiya	Advanced Midwife	Matikwane Hospital
11.	Sr Z Mhlongo	Sub district MCWH	Nkomazi sub-district

Gert Sibande district - Maternal death assessors

No	Name	Category	Health facility
1.	Dr R Ndlovu	Doctor	Ermelo Hospital
2.	Sr Y Mvambo	Advanced Midwife	Ermelo Hospital
3.	Dr Okoka	Doctor	Carolina Hospital
4.	Sr V Ncongwane	Advanced Midwife	Carolina Hospital
5.	Dr AR Anyawo	Doctor	Evander Hospital
6.	Sr L Lidzadze	Advanced Midwife	Evander Hospital
7.	Dr E Shabalala	Doctor	Piet Retief hospital
8.	Sr Nomsa Sibeko	Advanced Midwife	DCST Gert Sibande (Retired)
9.	Sizakele Nxumalo	Advanced Midwife	Embhuleni Hospital
10.	Dr S Mpombwa	Doctor	Embhuleni hospital
11.	Sr BK Vilakazi	Advanced Midwife	Standerton hospital
12.	Dr S Sivuyile	Doctor	Standerton hospital
13.	Dr EB Mthethwa	Doctor	Bethal hospital
14.	Ms Kholekile Mabunda	MCWYH Coordinator	District (Retired)

No	Name	Category	Health facility
15.	Mr Thando Ngwenya	MCWYH Coordinator	District Office
16.	Dr J Mahlangu	Doctor	Standerton Hospital

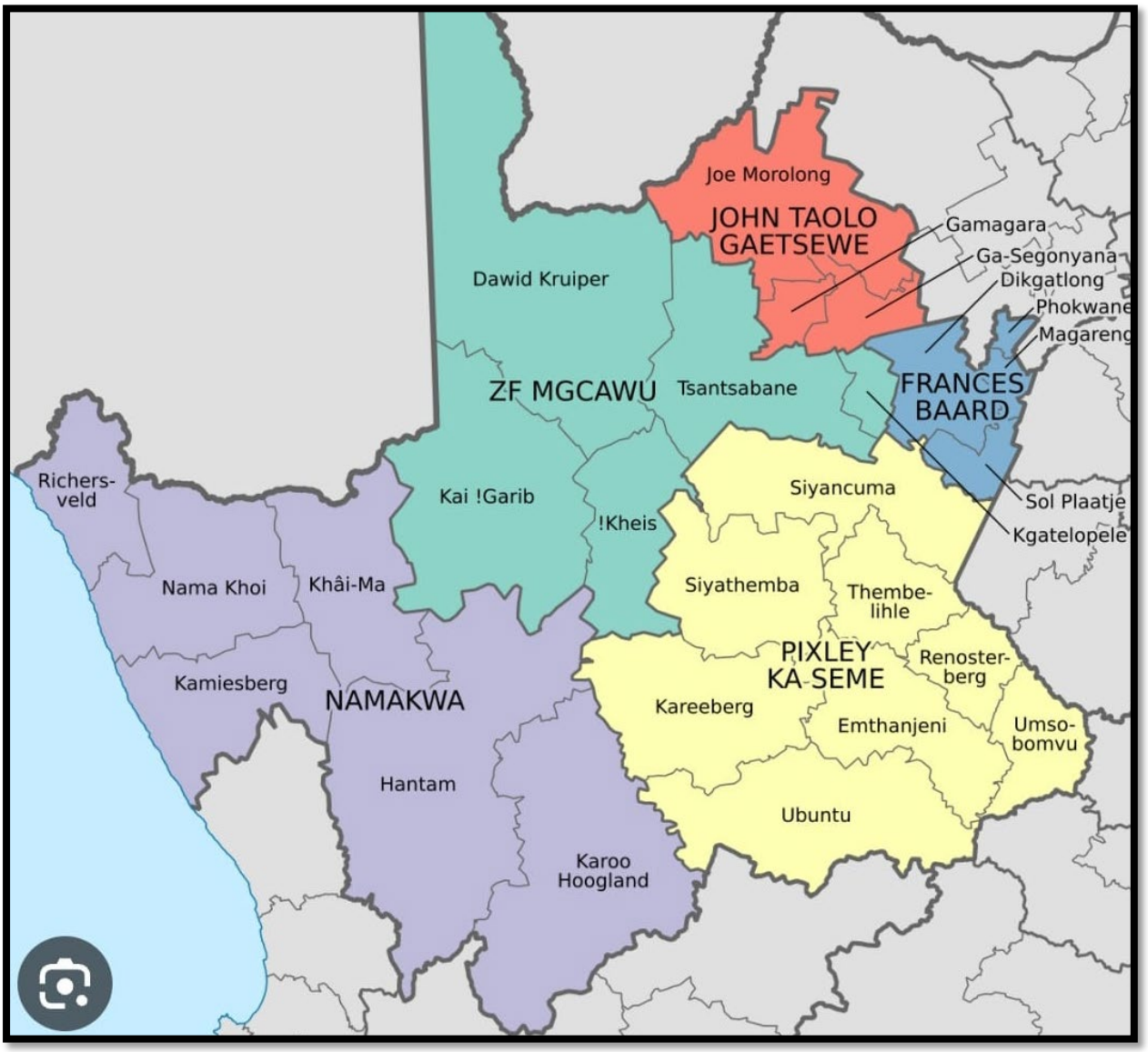
Nkangala district - Maternal death assessors

No	Name	Category	Health facility
1.	Dr S Motsweni	Doctor	Bernice Samuel Hospital
2.	Sr NM Mabena	Advanced Midwife	Bernice Samuel Hospital
3.	Dr Sibanyoni	Doctor	Kwamhlanga Hospital
4.	Sr K Mtshaisa	MCWYH co-ordinator	Thembisile Hani sub-district
5.	Sr RD Mishele	Advanced Midwife	Mmamethlake hospital
6.	Sr MV Lepaku	Advanced Midwife	Mmamethlake hospital
7.	Dr Tibamwenda	Doctor	Mmamethlake hospital
8.	Sr S Canda	Advanced Midwife	Witbank Hospital (RIP)
9.	Dr Mwamba	Doctor	Middleburg Hospital
10.	Ms A Viljoen	District MCWYH	Nkangala District

Provincial officials

No	Name	Category
1.	Ms Marie Muller	MaMMAS data capturer (Retired)
2.	Ms Annsie Mashele	MaMMAS data capturer
3.	Ms Victoria Mokoena	Deputy Manager Maternal Health, MD Assessor
4.	Dr Kekane	Anaesthetic Assessor
5.	Dr M Makhinde	Quality Assessor and NCCEMD member

8.7 Northern Cape



Introduction

Northern Cape is the largest province in the country with the smallest population of 1,36 million as reported in the (Stats SA Mid –Year Population Estimates 2020). It constitutes 2.2% of the population of South Africa and covers 372 889 square kilometres which is 30.5% of the country's land area. It is largely rural with vast distances to travel.

The province is divided into five districts namely: Frances Baard (FB), John Taolo Gaetsewe (JTG), Zwelintlanga Fatman Mgcawu (ZFM), Namakwa (NMK) and Pixley Ka Seme (PKS).

Frances Baard is the smallest district but with the highest population and Namakwa is the largest district with the smallest population and John Taolo Gaetsewe is the most rural district.

The province comprises of the following health institutions: One level three (Tertiary) hospital in FB, one regional hospital in ZFM and eleven district hospitals, 130 clinics, 46 Satellite clinics, 29 mobiles and 33 Community Health Centres.

During the 2020-2022 triennium a total of 92 maternal deaths were notified with the total of 66 723 livebirths giving an iMMR of 137.9/100 000 livebirths.

The major causes of deaths for this triennium were non-pregnancy related infections, Hypertension and Obstetric haemorrhage.

Mining and agriculture are the main source of employment thus resulting in high influx to respective areas. This impacts negatively on Antenatal care services, e.g. late booking, and unbooked cases.

The low socio -economic status, high transport costs, poor road conditions as well as lack of emergency medical transport result in the delay of patients reaching health service points timeously.

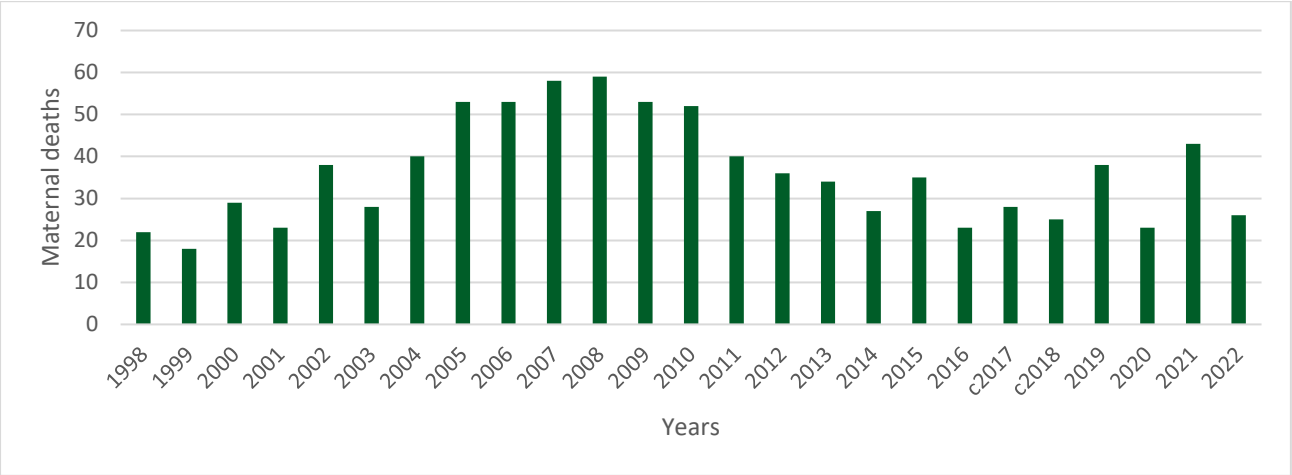
Community healthcare centres render services between eight to 24 hours depending on staff compliment. Only six of eleven district hospitals function at capacity. Lack of essential equipment, non-functional theatres, infrastructural challenges and competent staff at level 1 hospitals are the main challenges and impact negatively on quality of care.

The Tertiary institution, Robert Mangaliso Sobukwe hospital, also renders both level 1 and level 2 care because Sol Plaatjie and Magareng sub districts do not have district hospitals. Two district hospitals in FB not fully functional. The Regional hospital (Dr Harry Surtie: ZFM) renders service for both ZF Mgcawu and Namakwa districts.

There is no Obstetrics and Gynaecology specialist for the District Clinical Specialist Teams throughout the province; this is only available at the Tertiary hospital.

Trends in maternal deaths and MMR

Figure 1. Maternal deaths 1998 to 2022



A decrease in numbers of maternal deaths was noted in 2020 possibly due to underreporting as consequence of fear with the start of the COVID-19 pandemic. In 2021 a large increase in maternal deaths was noted with 14 out of 43 deaths due to COVID-19. In 2022 no COVID-19 deaths were reported and maternal mortality decreased to pre- COVID-19 levels. During the 2020-2022 triennium a total of 92 maternal deaths were notified with a total of 66 723 livebirths giving an iMMR of 137.9/100 000 livebirths.

Figure 2. Trends in iMMR 2005 to 2022

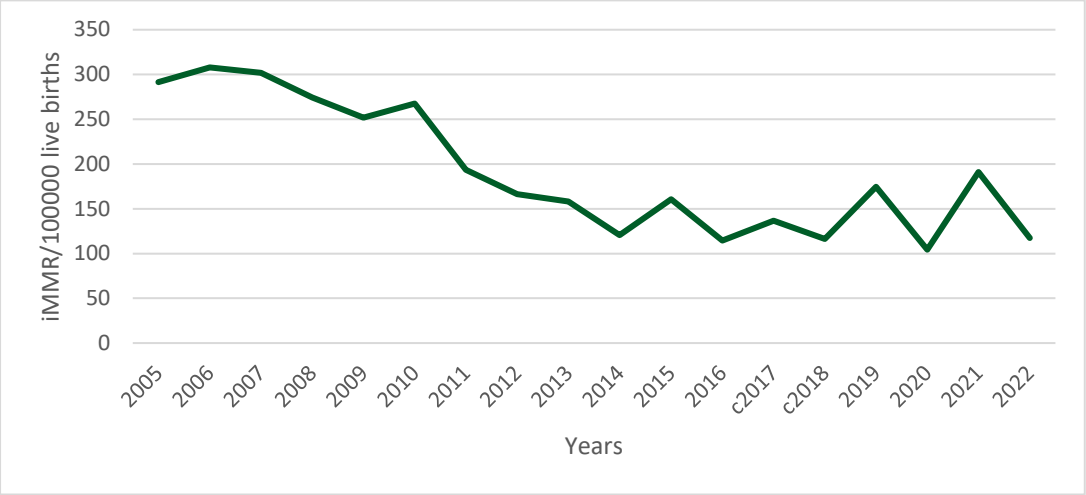
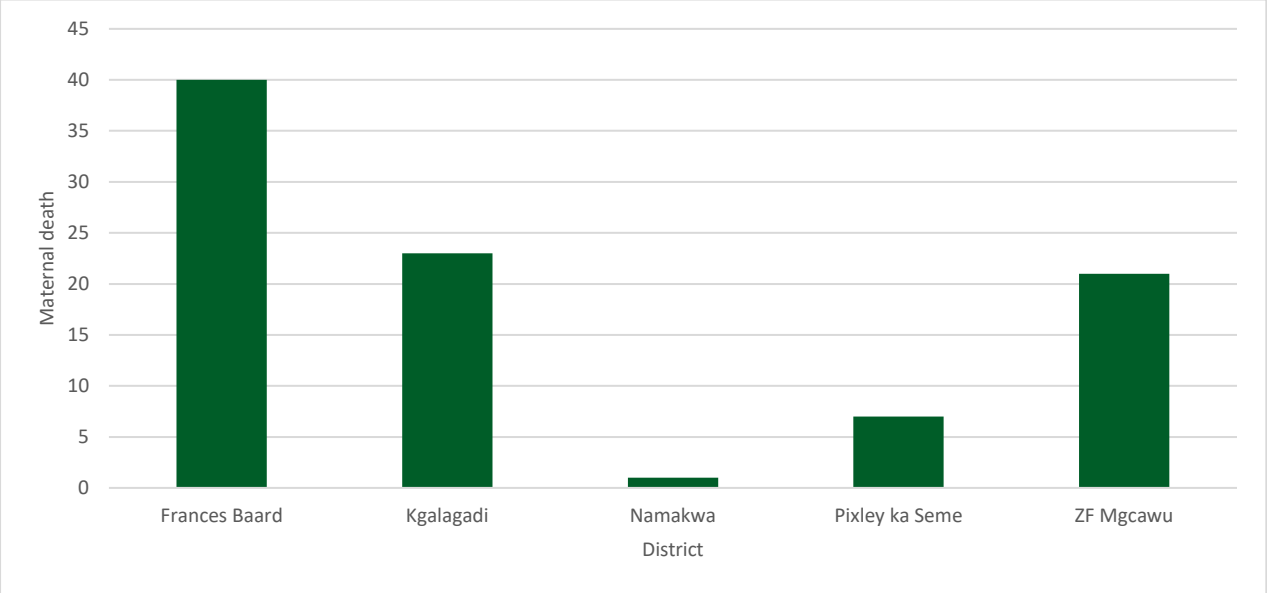


Figure 3. Maternal deaths per district, 2020-2022



Frances Baard district has the highest number of maternal deaths in the province due to all complicated cases requiring specialist care being referred to the Tertiary level. It is followed by John Taolo Gaetsewe and ZF Mgcawu district, which were less hit by COVID-19 related deaths in 2021.

CAUSES OF MATERNAL DEATH

NPRI was the leading cause of maternal deaths for the triennium. NPRI deaths due to COVID-19 were highest in 2021 with 14 COVID-19 deaths.

The number of HDP deaths was similar for 2020 and 2022. Although it might appear that there was a decrease in 2021, many of the patients who died of COVID-19 also had HDP.

OH was highest in 2021. This might have been a secondary effect of COVID-19, as more staff were mobilised to other areas and transport was also negatively affected, etc.

Table 1. Primary Obstetric Causes of Maternal death with Causal subcategories, 2020-2022

Primary Cause of death	2020	2021	2022	2020-2022
Coincidental cause	**0**	**0**	**0**	**0**
MVA	0	0	0	
Other	0	0	0	
Medical and surgical disorders	**2**	**2**	**6**	**10**
Cardiomyopathy	1	0	1	2
Haematological	0	0	1	1
Endocrine	0	1	0	1
Respiratory	0	0	3	3
GIT	0	0	0	0
CNS	0	0	0	0
Rheumatic heart disease	0	1	0	1
Other	1	0	1	2
Non-pregnancy-related infections	**5**	**20**	**1**	**26**
PCP pneumonia	1	0	0	1
Other pneumonia	2	4	0	6
TB	0	2	1	3
Other	2	14	0	16
Ectopic pregnancy	**1**	**1**	**2**	**3**
Less than 20 weeks	1	1	2	3
Miscarriage	**2**	**1**	**0**	**3**
Haemorrhage non-traumatic	1	1	0	2
Following Legal TOP	1	0	0	1
Pregnancy-related sepsis	**0**	**3**	**1**	**4**
Chorioamnionitis (Ruptured membranes)	0	0	0	0
Chorioamnionitis (intact membranes)	0	0	0	0
Bowel trauma at caesarean delivery	0	1	0	1
Puerperal sepsis after NVD	0	2	1	3
Puerperal sepsis after C/S	0	0	0	0
Obstetric haemorrhage	**4**	**7**	**3**	**14**
Abruption with hypertension	1	1	0	2
Abruption without Hypertension	0	1	1	2
Placenta Praevia	0	0	0	0
Other APH not specified	0	0	0	0
Ruptured uterus with C/S	0	0	0	0
Ruptured uterus without C/S	0	0	1	1
Retained Placenta after NVD (not adherent)	0	0	0	0
Retained Placenta after NVD (morbidly adherent)	1	1	0	2
Uterine atony after vaginal delivery	0	2	0	2

Primary Cause of death	2020	2021	2022	2020-2022
Bleeding during Caesarean delivery (morbidly adherent placenta)	0	0	0	0
Bleeding during Caesarean delivery (not adherent placenta)	0	0	0	0
Bleeding after Caesarean delivery	1	1	0	2
Other PPH not specified after vaginal delivery	0	0	0	
Cervical trauma with severe features	0	0	1	1
Vaginal trauma after vaginal delivery	0	1		1
Hypertension	**7**	**3**	**8**	**18**
Chronic Hypertension	0	0	1	1
Gestational hypertension	0	0	1	1
Pre-Eclampsia with severe features	2	1	2	5
Pre-Eclampsia without severe features	0	1	0	1
Eclampsia	4	1	1	6
HELLP	1	0	1	2
Liver rupture	0	0	2	2
Anaesthetic complications	**0**	**1**	**0**	**1**
Spinal Anaesthetic	0	1	0	1
General Anaesthesia	0	0	0	0
Adverse Drug reaction	0	0	0	0
Embolism	**0**	**3**	**1**	**4**
Pulmonary embolism	0	3	1	4
Acute collapse - cause unknown	**0**	**1**	**0**	**1**
Unknown	**2**	**1**	**3**	**6**
Death at home or outside health services	2	1	0	3
No primary cause found	0	0	0	0
Lack of Information	0	0	3	3
Miscellaneous	**0**	**0**	**1**	**1**
Acute fatty liver	0	0	1	1

Figure 4. IMMR per underlying cause per year and for the 2020-2022 triennium

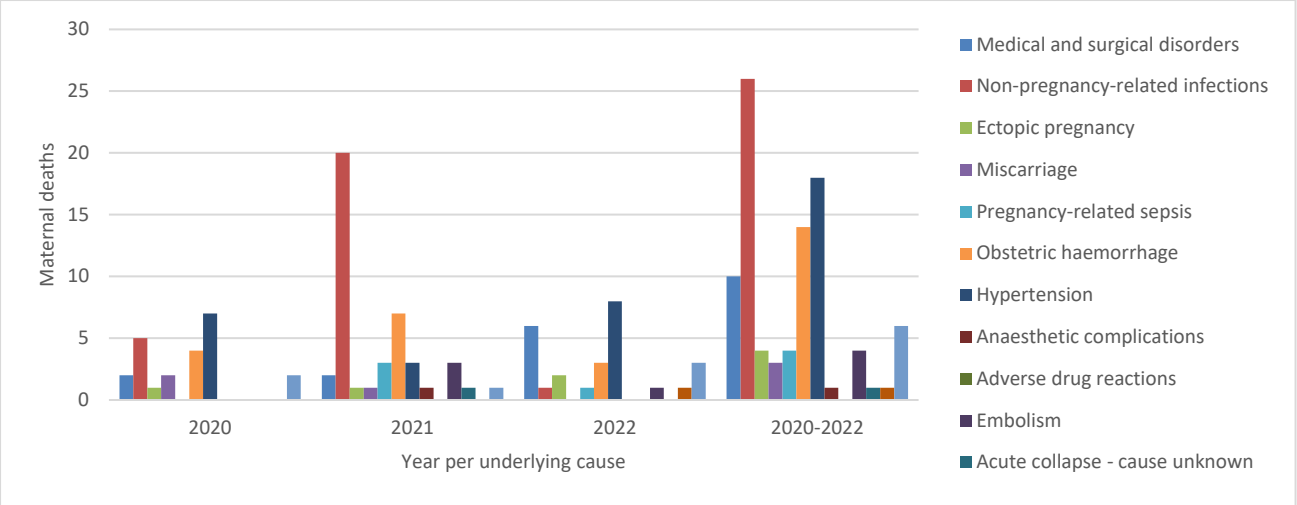


Table 2. COVID-19 Maternal deaths

COVID-19 maternal deaths	NC
2020	2
2021	14
2022	0
2020-2022	**16**

The numbers of maternal deaths due to COVID-19 was much lower than in other provinces with only 16 COVID-19 cases. This might be attributed to less dense population and not being a travel destination.

Of concern:

- None of the patients received the vaccine, although the roll out of the vaccine was towards the end of 2021.
- Unbooked cases.
- Indirect consequence of COVID-19 pandemic, increase in loss to follow up for chronic treatment.
- Other obstetric cases not managed optimally due to COVID-19.
- Overburdened service e.g. no ICU bed available, ventilators, shortage of staff.

Table 3. Maternal deaths per district per the underlying cause 2020-2022

Primary obstetric problems	Frances Baard	Kgalagadi	Namakwa	Pixley ka Seme	ZF Mgcawu	Total
Coincidental cause	0	0	0	0	0	0
Medical and surgical disorders	4	1	0	0	5	10
Non-pregnancy-related infections	13	4	0	3	6	26
Ectopic pregnancy	1	2	0	0	1	4
Miscarriage	1	1	0	0	1	3

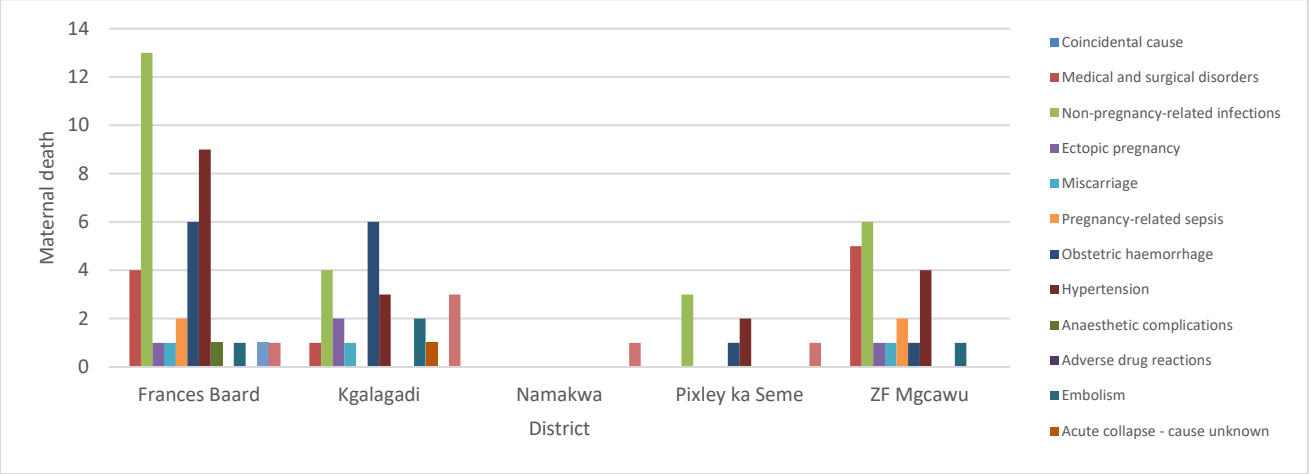
Primary obstetric problems	Frances Baard	Kgalagadi	Namakwa	Pixley ka Seme	ZF Mgcawu	Total
Pregnancy-related sepsis	2	0	0	0	2	4
Obstetric haemorrhage	6	6	0	1	1	14
Hypertension	9	3	0	2	4	18
Anaesthetic complications	1	0	0	0	0	1
Adverse drug reactions	0	0	0	0	0	0
Embolism	1	2	0	0	1	4
Acute collapse - cause unknown	0	1	0	0	0	1
Miscellaneous	1	0	0	0	0	1
Unknown	1	3	1	1	0	6
Total	**40**	**23**	**1**	**7**	**21**	**92**

Thirteen patients who died of NPRI were in FB. The tertiary hospital and two private hospitals are in FB and therefore explain the high number.

Nine out of 18 HDP deaths are from FB with the Tertiary hospital as the receiving institution for the district. ZF Mgcawu had four deaths where the regional hospital is situated and receives patients from the district and from Namakwa.

The six deaths due to OH in Kgalagadi (JTG) is of concern.

Figure 5. Maternal death per district per underlying cause, 2020-2022



Non-pregnancy related infections (NPRI) were the leading causes of deaths in FB district, followed by hypertensive disorders in pregnancy and by Obstetric haemorrhage.

OH was the leading cause of death in JTG (Kgalagadi), followed by NPRI, HDP and Medical and Surgical disorders. In ZF Mgcawu district NPRI deaths were most common, followed by Medical and Surgical disorders and HDP.

Table 4. Final causes of death, 2020-2022

Final cause of death	2020	2021	2022	2020-2022
Circulatory system	**6**	**13**	**7**	**26**
Hypovolaemic	2	9	5	
Septic shock	4	4	2	
Respiratory failure	**8**	**22**	**5**	**35**
Respiratory failure	8	22	5	
Cardiac failure	3	3	4	
Pulmonary oedema	3	3	4	
Embolism	**0**	**4**	**2**	**6**
Acute collapse due to embolism		4	2	
Renal failure	**2**	**6**	**9**	**17**
Renal failure	2	6	9	
Liver failure	**1**	**4**	**2**	**7**
Liver failure	1	4	2	
Cerebral complications	**8**	**6**	**3**	**17**
Intracranial haemorrhage	2	0		
Cerebral oedema resulting in coning	1	1	1	
Brain death following hypoxic event	4	0	0	
Unspecified	1	1	1	
Metabolic	**2**	**7**	**4**	**13**
Maternal ketoacidosis	1	3	3	
Lactic acidosis	0	2	1	
Electrolyte imbalance	1	1	0	
other	0	1	0	
Haematological	**7**	**4**	**8**	**19**
DIC	4	2	2	
Severe anaemia	3	2	6	
Immune system	**4**	**1**	**3**	**7**
Immune system failure	**4**	**1**	**3**	
Unknown	**2**	**3**	**3**	**8**

Final cause of death	2020	2021	2022	2020-2022
Death at home or outside health services	1	2	1	
Unknown	1	1	2	
Other	**1**	**4**	**6**	**11**

Respiratory and circulatory cause resulted in most maternal deaths due to complications of COVID-19.

Demographic, obstetric and health system data

Table 5. Age and Maternal deaths, 2020-2022

Age	2020	2021	2022	2020-2022
<20	2	5	2	9
20-24	3	4	2	9
25-29	3	12	4	19
30-34	3	9	10	22
35-39	5	11	6	22
40-44	7	2	2	11
45+	0	0	0	0
Unknown	0	0	0	0

The majority of deaths occurred amongst women aged 25 to 44 years, with most deaths occurring in the age group 30-39 years.

Family planning services and health education were negatively affected by the COVID-19 pandemic.
In the age groups < 20yrs, pregnancy could be avoided, with better Health Education and Contraception.

Table 6. Maternal age and Primary Obstetric Cause of death, 2020-2022

Primary obstetric problem	15-19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	Outside 10-44 range & unknown	Total
Coincidental cause	0	0	0	0	0	0	0	0
Medical and surgical disorders	0	3	2	1	3	1	0	10
Non-pregnancy-related infections	2	2	5	5	8	4	0	26
Ectopic pregnancy	1	0	0	1	2	0	0	4
Miscarriage	0	1	2	0	0	0	0	3
Pregnancy-related sepsis	0	1	3	0	0	0	0	4
Obstetric haemorrhage	3	1	2	3	3	2	0	14
Hypertension	1	0	3	8	2	4	0	18
Anaesthetic complications	0	0	1	0	0	0	0	1

Primary obstetric problem	15-19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	Outside 10-44 range & unknown	Total
Adverse drug reactions	0	0	0	0	0	0	0	0
Embolism	0	0	0	2	2	0	0	4
Acute collapse - cause unknown	1	0	0	0	0	0	0	1
Miscellaneous	0	1	0	0	0	0	0	1
Unknown	1	0	1	2	2	0	0	6
Total	**9**	**9**	**19**	**22**	**22**	**11**	**0**	**92**

NPRI affected all age groups with 16 COVID-19 deaths.

HDP was highest in age group 30-34 followed by 40-44. The management of HPD at primary health remains sub-optimal with conditions not identified or managed incorrectly.

OH affected all age groups with management being sub-optimal where protocols were not implemented. Medical and surgical disorders increased in the age group 25-44. Pre-existing conditions might have been missed during the ANC period.

Figure 6. Maternal age and Primary Obstetric cause of death, 2020-2022

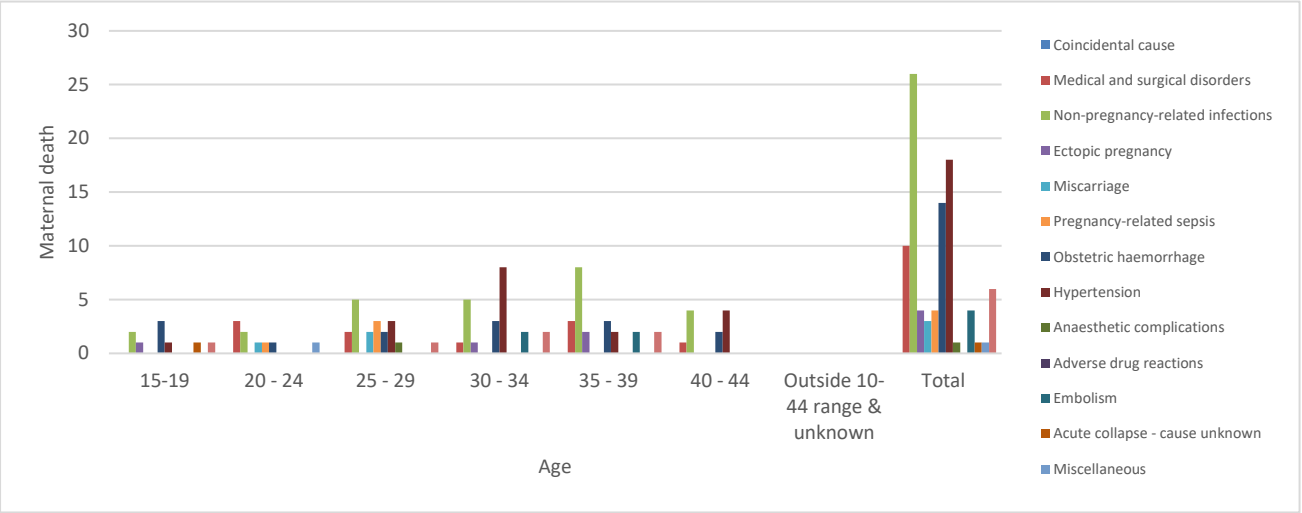


Table 7. Maternal deaths and parity, 2020-2022

Parity	2020	2021	2022	2020-2022
0	4	10	3	17
1	4	12	6	22
2	7	9	7	23
3	5	6	4	15
4	2	0	5	7
5	0	2	1	3
6+	1	1	0	2
Unknown	0	3	0	3

Most deaths are in the multipara groups and their obstetric history with possible risk factors should be known and therefore their management should have been planned accordingly. The high number of deaths in nulliparous women is of concern.

Table 8. Maternal deaths and Antenatal Care Attendance, 2020-2022

Antenatal Care Attendance	2020	2021	2022	2020-2022
Received ANC	18	29	16	63
No Antenatal Care	3	9	9	21
Unknown	2	5	1	8

Table 8 shows that most women who died had attended the ANC clinic (61.5%). There is concern about the quality of care provided. Although the reasons for not attending the ANC are mostly unknown, this still reflects on a failing system directly or indirectly.

Table 9. Maternal deaths and Gestational Age at booking, 2020-2022

Gestational Age at Booking	2020	2021	2022	2020-2022
Booked before 20 weeks	9	17	9	35
Did not book before 20 weeks	8	11	6	25
Unknown	1	1	1	3

Most women booked for ANC before 20 weeks, and this seemed not to have been affected by the effects of COVID-19 in 2021

Table 10 shows that more deaths occurred amongst women who were HIV negative, followed by those who were HIV positive and not virally suppressed. Of concern are those who were never tested for HIV and those with CD4 count of less than 350/mm³. The majority of HIV positive women who died of NPRI had unsuppressed viral loads of above 1000 copies/Ml.

Table 10. Maternal deaths and HIV Status, 2020-2022

HIV Status	2020	2021	2022	2020-2022
Positive	8	11	8	27
Negative	13	25	14	52
Unknown	2	7	4	13
Declined	0	0	0	0

Table 11. HIV status and Primary Obstetric Cause of death

Primary obstetric problems	Negative	Positive	Declined test	Unknown	Total
Coincidental cause	0	0	0	0	0
Medical and surgical disorders	5	3	0	2	10
Non-pregnancy-related infections	12	8	0	6	26
Ectopic pregnancy	1	2	0	1	4

Primary obstetric problems	Negative	Positive	Declined test	Unknown	Total
Miscarriage	1	2	0	0	3
Pregnancy-related sepsis	1	2	0	1	4
Obstetric haemorrhage	10	3	0	1	14
Hypertension	13	3	0	2	18
Anaesthetic complications	1	0	0	0	1
Adverse drug reactions	0	0	0	0	0
Embolism	3	1	0	0	4
Acute collapse - cause unknown	1	0	0	0	1
Miscellaneous	1	0	0	0	1
Unknown	3	3	0	0	6
Total	**52**	**27**	**0**	**13**	**92**

Eight patients who died from NPRI were HIV positive, 12 were HIV negative, and for six their status was unknown.

Table 12. Maternal deaths in HIV positive women and CD 4 counts, 2020-2022

Type of Therapy	2020	2021	2022	2020-2022
500+/mm³	2	4	2	8
350-499/mm³	0	1	2	3
200-349/mm³	1	0	1	2
Less than 200/mm³	4	3	3	10
Unknown	1	3	0	4

Deaths occurred amongst women with CD4 count of less than 350/mm³. Adherence counselling to be emphasised and disclosure encouraged.

Table 13. Maternal deaths in HIV positive women and HIV Viral Load, 2020-2022

HIV VIRAL LOAD	2020	2021	2022	2020-2022
LDL and less than 50	1	4	2	7
50 - 999	1	0	0	1
≥1000	3	2	6	11
Unknown	3	5	0	8

Deaths occurred amongst women with unsuppressed viral loads and viral loads unknown. Adherence counselling needs to be emphasised, disclosure encouraged, and guidelines implemented.

Table 14. Maternal deaths in HIV positive women and antiretroviral treatment, 2020-2022

Type of Therapy	2020	2021	2022	2020-2022
None	2	3	1	6
TLD	0	3	2	5
TEE	6	5	3	14
Other ART	0	0	2	2

It is concerning that some women were not initiated on the TLD, though there is a decline on those who were never initiated on treatment.

Table 15. Maternal deaths and Pregnancy Outcome, 2020-2022

Pregnancy outcome	2020	2021	2022	2020-2022
Live-born	10	17	10	37
Stillborn	6	9	9	24
Neonatal Death	0	2	0	2
Miscarriage	2	2	1	5
Ectopic Pregnancy	1	1	1	3
Undelivered	4	9	5	18
Unknown	0	3	0	3

Most women who died (40%) had delivered live babies, followed by stillbirths and those who died undelivered.

Table 16. Maternal deaths and Route of Delivery, 2020-2022

Route of delivery	2020	2021	2022	2020-2022
Vaginal	9	12	11	32
Assisted delivery	0	2	0	2
Caesarean section	7	16	7	30
Laparotomy	0	0	1	18
Miscarriage	0	0	0	0
Undelivered	6	11	2	19
Not applicable	0	1	4	5

Similar numbers of maternal deaths had Caesarean sections as had vaginal delivery.

Table 17. Primary cause of death and route of delivery, 2020-2022

Primary obstetric problems	Vaginal	CD	CD CHC	CD DH	CD RH	CD TH/NCH	CD Pvt
Coincidental cause	0	0	0	0	0	0	0
Medical and surgical disorders	5	0	0	0	0	0	0
Non-pregnancy-related infections	6	11	0	1	1	2	7
Ectopic pregnancy	3	3	0	1	1	1	0
Miscarriage	0	0	0	0	0	0	0
Pregnancy-related sepsis	2	2	0	0	1	0	1
Obstetric haemorrhage	8	5	0	3	0	1	1
Hypertension	6	9	1	3	2	5	2
Anaesthetic complications	0	1	0	0	0	1	0
Adverse drug reactions	0	0	0	0	0	0	0

Primary obstetric problems	Vaginal	CD	CD CHC	CD DH	CD RH	CD TH/NCH	CD Pvt
Embolism	1	2	0	0	0	1	1
Acute collapse - cause unknown	1	0	0	0	0	0	0
Miscellaneous	1	0	0	0	0	0	0
Unknown	2	0	0	0	0	0	0
Total	**35**	**33**	**1**	**8**	**5**	**11**	**12**

There was a high number of caesarean sections done on patients with NPRI. The medical condition of the mother prior to delivery e.g. the intubated COVID-19 patients most probably played the biggest role.
All patients who delivered in private facilities had caesarean sections.

For the three OH deaths where CS were performed at district level, lack of skill, transport, and lack of blood products might have contributed to the deaths.

For the eight OH patients who delivered vaginally, routine observations were not done due to poor monitoring, vital signs were not interpreted correctly, and protocols were not implemented.

Unfortunately, the NASG was not used to manage OH in all patients who died despite it being available.

Table 18. Level of care where maternal deaths occurred, 2020-2022

Level of care	2020	2021	2022	2020-2022
Home/ outside facility	3	4	2	9
CHC	1	1	0	2
District	7	11	7	25
Regional	1	7	7	15
Tertiary	7	13	8	28
Private	4	7	2	13

Most deaths occurred at tertiary hospital for all three years as expected, followed by district hospitals and regional hospital for the province (Table 18). An increase in deaths in Private facilities in 2021 was noted due to COVID-19 infections. The number of deaths occurring at district level remain a concern. Contributing factors are a delay in referring patients, lack of equipped and reliable transport and lack of skilled staff at these facilities.

Table 19. Level of care from which maternal deaths were referred, 2020-2022

Level of Care from which patients were referred	2020	2021	2022	2020-2022
Community Health Centre	4	7	4	15
District Hospital	3	6	6	15
Regional Hospital	0	0	1	1
Tertiary Hospital	0	1	0	1
Private Hospital	1	4	0	5

16% of patients were referred from the Community Health Centre and 16% from district hospitals.

Table 20. Level of Care where anaesthetics were performed, 2020-2022

Level of Care	2020	2021	2022	2020-2022
Community Health Centre	0	0	0	0
District Hospital	3	0	5	8
Regional Hospital	1	3	2	6
Tertiary Hospital	3	7	5	15
Private Hospital	3	9	1	13

Most patient received anaesthesia at Tertiary Hospital followed by private facilities where most caesarean deliveries are conducted.

Table 21. Primary Obstetric Cause of Death and location of death, 2020-2022

Primary obstetric problems	Facility	In transit	Home/ Outside	Total
Coincidental cause	0	0	0	0
Medical and surgical disorders	9	0	1	10
Non-pregnancy-related infections	25	0	1	26
Ectopic pregnancy	4	0	0	4
Miscarriage	3	0	0	3
Pregnancy-related sepsis	4	0	0	4
Obstetric haemorrhage	14	0	0	14
Hypertension	15	1	2	18
Anaesthetic complications	1	0	0	1
Adverse drug reactions	0	0	0	0
Embolism	3	0	1	4
Acute collapse - cause unknown	1	0	0	1
Miscellaneous	1	0	0	1
Unknown	2	0	4	6
Total	**82**	**1**	**9**	**92**

Nine per cent of deaths died out of the facility and almost 90% died at facility level. Ideally no patients should die outside facilities.

Table 22 shows Primary obstetric cause of death at each level of care. The six patients who died from NPRI (COVID-19) at district level, could not be transferred due to overburdened services at the next level of care.

There were seven OH deaths at district hospital. Of concern is the sub-optimal care provided at that level and non- use of NASG.

HDP remains a challenge to manage, with poor implementation of guidelines, problem recognition and loss to follow-up being the main problems.
Several patients who died at Tertiary hospital were received in critical condition.

Table 22. Primary Obstetric Cause and level of care, 2020-2022

Primary obstetric problem	Outside	CHC	DH	RH	T/NC	PRIV	Total
Coincidental cause	0	0	0	0	0	0	0
Medical and surgical disorders	1	0	1	4	4	0	10
Non-pregnancy-related infections	1	1	6	4	7	7	26
Ectopic pregnancy	0	0	2	1	1	0	4
Miscarriage	0	0	1	1	1	0	3
Pregnancy-related sepsis	0	0	1	1	1	1	4
Obstetric haemorrhage	0	0	7	1	4	2	14
Hypertension	2	1	4	3	7	1	18
Anaesthetic complications	0	0	0	0	1	0	1
Adverse drug reactions	0	0	0	0	0	0	0
Embolism	1	0	1	0	1	1	4
Acute collapse - cause unknown	0	0	1	0	0	0	1
Miscellaneous	0	0	0	0	1	0	1
Unknown	4	0	1	0	0	1	6
Total	**9**	**2**	**25**	**15**	**28**	**13**	**92**

Table 23. Primary cause of death and Postmortems

Primary obstetric problems	Postmortem	Not done
Coincidental cause	0	0
Medical and surgical disorders	0	10
Non-pregnancy-related infections	0	26
Ectopic pregnancy	0	4
Miscarriage	0	3
Pregnancy-related sepsis	0	4
Obstetric haemorrhage	2	12
Hypertension	2	16
Anaesthetic complications	0	1
Adverse drug reactions	0	0
Embolism	2	2
Acute collapse - cause unknown	0	1
Miscellaneous	0	1

Primary obstetric problems	Postmortem	Not done
Unknown	0	6
Total	**6**	**86**

There were 93% of maternal deaths that did not have postmortems. It is a challenge as there is no anatomical pathologist in the province. Forensic pathology has limited resources with staff shortages and lack of transport in the province.

Avoidable factors

Table 24. Classification of Avoidable factors for maternal deaths, 2020-2022

	Number	% of total	% of cases at this level
Patient oriented problems			
- Avoidable factors identified	57	62.0	
- No avoidable factors	27	29.3	
- Lack of information	14	15.2	
Administrative problems			
- Avoidable factors identified	42	45.7	
- No avoidable factors	36	39.1	
- Lack of information	24	26.1	
Resuscitation problems			
- Avoidable factors identified	25	27.2	
- No avoidable factors	55	59.8	
- Lack of information	14	15.2	
Medical care - CHC			
- Managed at this level	29	31.5	
- Avoidable factors identified	16		55.2
- No avoidable factors	13		44.8
- Lack of information	3		10.3
Medical care - District hospital			
- Managed at this level	39	42.4	
- Avoidable factors identified	30		76.9
- No avoidable factors	9		23.1
- Lack of information	10		25.6
Medical care - Regional hospital			
- Managed at this level	16	17.4	
- Avoidable factors identified	14		87.5
- No avoidable factors	2		12.5
- Lack of information	5		31.3
Medical care - Tertiary and above			
- Managed at this level	29	31.5	
- Avoidable factors identified	10		34.5
- No avoidable factors	17		58.6
- Lack of information	3		10.3
Medical care - Private hospital			
- Managed at this level	15	16.3	
- Avoidable factors identified	5		33.3
- No avoidable factors	4		26.7
- Lack of information	10		66.7
Timing of emergency			

	Number	% of total	% of cases at this level
- Early pregnancy	12	13.0	
- Antenatal period: 20w +	38	41.3	
- Intrapartum period	9	9.8	
- Postpartum period	33	35.9	
- Anaesthesia	0	0.0	
Timing of death			
- Early pregnancy	12	13.0	
- Antenatal period: 20w +	13	14.1	
- Intrapartum period	0	0.0	
- Postpartum period	67	72.8	
- Anaesthesia	0	0.0	
Impact of suboptimal care			
- No suboptimal care identified	29	31.5	
- Suboptimal care, no impact on outcome	4	4.3	
- Suboptimal care, possible impact on outcome	36	39.1	
- Suboptimal care, probable impact on outcome	23	25.0	
Total	**92**		

Patient related avoidable factors are the largest group of avoidable factors, which might be due to lack of awareness on danger signs, delay in seeking help (43.5%) and unbooked cases (18.5%). Focus should be directed to public health awareness campaigns and strengthening the WBOT system for tracking and tracing of patients.

Administrative problems were identified in 45,7% of deaths, where emphasise and focus should be directed towards ensuring well-resourced facilities for provision of service packages, mostly at district level.

Lack of information in 26% of deaths, and poor record keeping was a major problem. Transport delays, delay in attending to the patient, inadequate number of staff on duty and appropriate skill not being available are the main factors.

Avoidable factors during **resuscitation** were identified in 27.2% of patients, ESMOE/EOST needs to be prioritised at all levels of care.

Medical care:

Avoidable factors were identified at CHC level 55.2% with initial assessment and problem recognition being the main problem.

At district level, 76.9% had medical related avoidable factors which included sub-standard management /correct diagnosis, poor problem recognition, poor initial assessment, no monitoring and infrequent monitoring, prolonged abnormal monitoring with no action and delay in referring. Thes factors occurred, despite all these facilities having doctors.

At Regional level, 87.5% of deaths had medical care avoidable factors identified. Poor Problem recognition, sub-standard management, poor initial assessment, no monitoring/infrequent monitoring and prolonged abnormal monitoring with no action were the main reasons identified.

Medical care related avoidable factors occurred in 34.5% of deaths at Tertiary hospitals, and 33,3% in Private hospitals.

Most emergencies and deaths occurred during the post-partum period. Monitoring is sub-optimal with early warning signs not recognised and no action on prolonged abnormal observations. Training of staff on BANC plus and ESMOE/EOST to be prioritised.

Only 35.1% of maternal deaths in Northern Cape had no sub-optimal care. In 39.1%, there was sub-optimal care with a possible impact on the outcome and on 25% there was sub-optimal care with a probable impact on outcome. Overall, 64.1% of deaths were potentially preventable by the health system.

This should be a priority for the province in the next triennium and KPA's of CEO's should include maternal health services.

Table 25. Patient orientated avoidable factors, 2020-2022

Description	2020	2021	2022	2020-2022
Avoidable factors identified	15	25	17	57
Lack of information	3	8	3	14
No avoidable factor	6	13	8	27
No antenatal care	1	7	9	17
Infrequent antenatal care	3	2	1	6
Delay in seeking help	9	19	12	41
Declined medication/surgery/advice	4	5	4	13
Family problem	0	0	0	0
Community problem	0	0	0	0
Unsafe abortion	0	1	0	1
Other	10	7	7	24

Delay in seeking medical care remains a challenge. Public awareness on the importance of early ANC booking to be emphasised. Fear to access health services due to COVID-19 might have contributed to high numbers in 2021.

Table 26. Administrative avoidable factors, 2020- 2022

Description	2020	2021	2022	2020-2022
Avoidable factors identified	9	18	15	42
Lack of information	7	10	7	24
No avoidable factor	10	19	7	36
Transport problem: Home to institution	1	1	0	2
Transport problem: Institution to institution	2	1	5	8
Lack of accessibility: Barriers to entry	0	0	0	0
Lack of accessibility: other	0	0	0	0
Delay in attending to patient (Overburdened service)	2	2	2	6
Delay in attending to patient (reason unknown)	1	1	3	5

Description	2020	2021	2022	2020-2022
Lack of healthcare facilities: ICU	1	3	0	4
Lack of healthcare facilities: Blood/blood products	0	0	1	1
Lack of healthcare facilities: Other	0	0	0	0
Inadequate numbers of staff on duty	3	2	3	8
Appropriately skill not available on site/on standby	2	7	0	9
Communication problems: Technical	0	0	0	0
Communication problem: Interpersonal	0	1	0	1
Other	2	2	9	13

Appropriately skill not available on site/on standby was highest in 2021 due to COVID-19 and limited staff available to manage Obstetric cases.

Table 27. Emergency Care avoidable factors, 2020-2022

Description	2020	2021	2022	2020-2022
Lack of information	5	7	2	14
No avoidable factor	14	27	14	55
Airway problems	0	2	0	2
Breathing problems	0	2	1	3
Circulation problems	1	1	2	4
Drug problems	2	0	1	3
Investigation problems	0	1	0	1
Monitoring problems	2	3	1	6
Resuscitation not attempted	2	5	8	15

Emphasis must be directed towards monitoring of problems at all levels of care and improving management of patients from referring facilities.

Summary of Northern Cape maternal mortality data

- There was an increase of maternal deaths due to NPRIs in 2021 as a result of the pandemic COVID-19.
- In all the three years, (2020, 2021 and 2022) NPRI was the leading cause of maternal deaths followed by Hypertension, Obstetric Haemorrhage and Medical and Surgical conditions.
- 2022 showed that deaths occurred more at tertiary Hospitals followed by regional, then district Hospitals respectively with less deaths occurring at CHCs.
- There was an increase in deaths occurring outside facilities and during the post-partum period where focus should be directed towards intrapartum care and use of the checklist before discharge.
- More deaths occurred amongst women of age 20 to 39 years.
- Most of the women who died had tested negative for the retroviral disease but of concern was the large percentage of HIV positive women whose viral load was > 1000 copies/ml.
- Most women who died, delivered live births and stillbirths.
- Most women were referred from the Community Health Centre to District hospitals and upward to Regional and Tertiary Hospitals which is a good practice that needs to be sustained.

- Most women died during the post-partum period, WBOTs system for track and tracing needs to be improved.
- There was suboptimal care with possible/probable impact on outcome in 64.1% of the deaths.

Recommendations

Policy:
- Establishment adequately resourced facilities to manage the obstetric emergencies in the district.
- Improve inter-facility transport to prevent delay between facilities.
- Implement policy on accreditation of delivery sites and caesarean section sites.

Healthcare promotion:
- All facilities to be provided with IEC material on maternal health services covering:
- Risk factors during pregnancy and after delivery.
- Value of early booking at ANC.
- Importance of knowing HIV status and the value of VTP and ART during pregnancy.
- Value of family spacing /contraception.
- Campaigns to inform the local communities of maternity related issues.

Collaboration:
Collaboration with private sector on maternal health services

Training:
- Knowledge and skills of healthcare provider.
- Establish ESMOE maintenance training schedules.
- Emergency obstetric simulation training policy to be developed, monitored and implemented at all levels of care.
- Implement prioritisation of training in obstetric surgery and delivery services.
- Improve supervision of junior and newly appointed medical officers
- Establish multidisciplinary team approach in the management of medical diseases in pregnancy

Consultation skills:
- Clinical outreach and in-reach for training

Monitoring and evaluation:
- Interrogate data submitted by hospitals and clinics to DHIS at district level to identify areas that is problematic.
- Routine audit of files at all levels of care for compliance with protocols.

The following three key aspects of a health system are essential:
- Knowledgeable and skilled healthcare providers
- Appropriately resourced and accessible healthcare facilities (including equipment and human resources)
- Rapid inter-facility emergency transport system

The Northern Cape province will adopt and will continue with the implementation and monitoring of the Saving mothers report national recommendations.

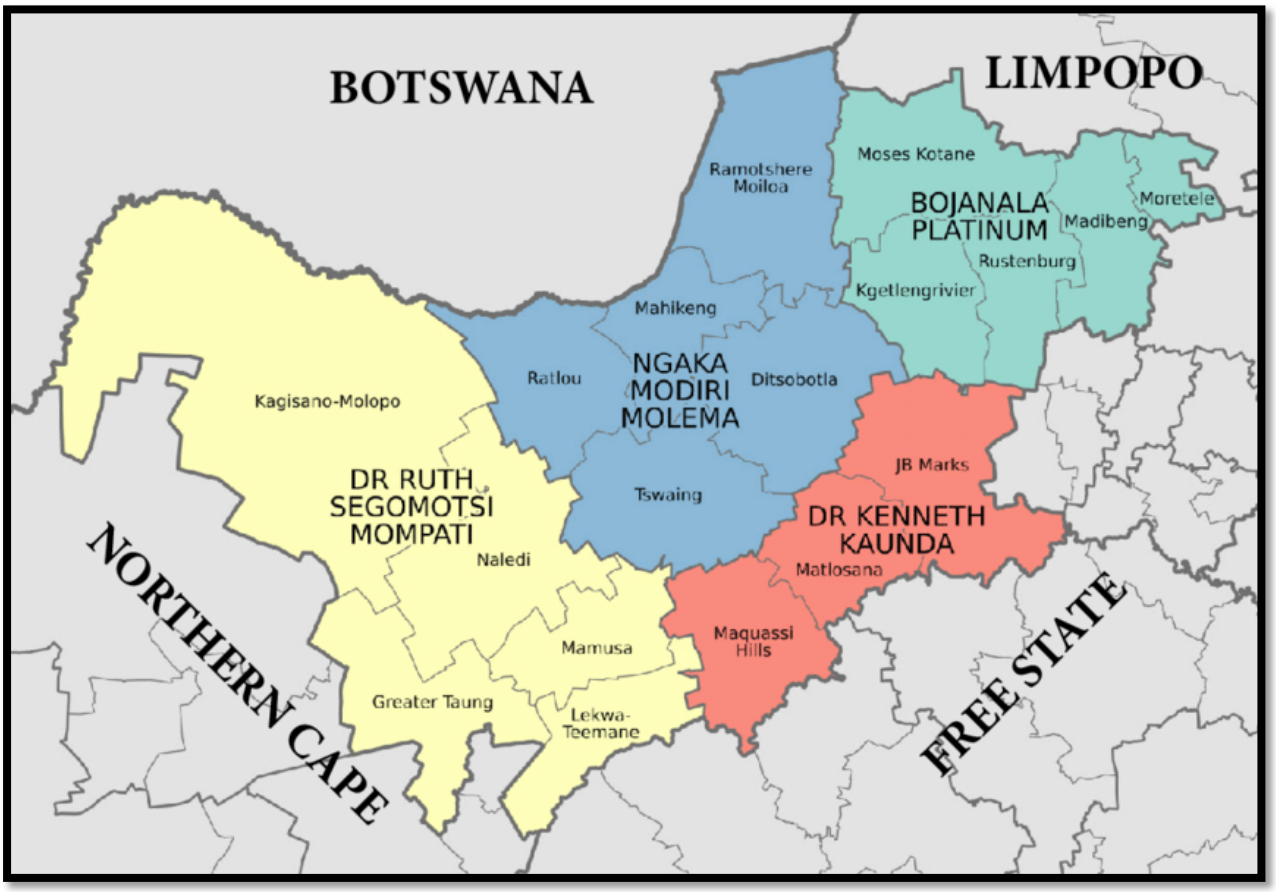
Northern Cape Assessors

No	Name	Position
1.	Ms MJ Diphoko	Assistant Director: Maternal health
2.	Dr LV Valdez Munoz	Consultant O&G: RMSH Provincial quality assurer
3.	Dr P Anderson	Head clinical unit medical: RMSH (Anaesthetist)

No	Name	Position
4.	Dr S Wessels	Acting Consultant: O&G: RMSH Provincial NCCEMD representative
5.	Dr G Torres	DCST: family physician: PKS
6.	Ms B Maramba	District clinical coordinator: Maternal: PKS
7.	Dr L Romero	DCST: family physician: NAM
8.	Dr S Lukuugi	DCST: family physician: ZFM
9.	Dr C Ifebuzor	DCST: family physician: JTG
10.	Dr JM Ngundu	DCST: family physician: FB
11.	Ms P Langa	Advanced midwife: RMSH
12.	Ms L Vakele	DCST: Advanced midwife: JTG
13.	Ms L Mocumi	Advanced midwife: FB
14.	Ms M Shushu	District clinical coordinator: FB
15.	Ms Seretse	Advanced midwife: JTG
16.	Ms Micaela De Wet	District clinical coordinator: Maternal: Namakwa
17.	Ms F Witbooi	Advanced midwife: DHSH
18.	Ms G Du Toit	Advance midwife: PKS
19.	Dr Lopez	DCST: Anaesthesiologist: PKS

8.8 North West

North West Map



Introduction

The North West Province has an estimated population size of 4,169,094 (DHIS 2023). The total female population is estimated at 2,052,922 of which 1,056,373 represent the number of women of reproductive age group (15-49). The largest number of the population lives mainly in rural areas of North West Province. The province is divided into four Health Districts with 11 District Hospitals, 47 Community Health Centres and 266 clinics. It also provides tertiary services at Klerksdorp/Tshepong Hospital Complex and Job Shimankane Tabane Hospital and has no medical schools. There are three Regional Hospitals namely Mahikeng Provincial, Joe Morolong Memorial and Potchefstroom. These three Regional Hospitals provide some specialised services with Obstetricians and Anaesthesiologists appointed at these Hospitals.

Deaths reported and MMR

DDPCP reported to the province in the triennium 2020-2022 were 272, of which 267 were maternal, and total deliveries in the province were 183505. Maternal Mortality Ratio (MMR) was 145.5 per 100 000. In 2020 MMR was 130.59 per 100 00 live births, in 2021 MMR was 188.53 per 100 000 live births and in 2022 MMR was 116.76 per 100 000 live births. This reflects a drastic increase in maternal mortality in 2021 during the COVID-19 pandemic and a decrease thereof in 2022.

The indicators below were calculated using the information from the 267 maternal death files which were captured into MaMMAS programme from 2020 to 2022.

Table 1. MaMMAs, DHIS and iMMR data 2020-2022

North West	Live births	MaMMAS deaths (DDCP)	MaMMAS MD	DHIS MD	MaMMAS MD	MaMMAs iMMR	MaMMAs iMMR	DHIS iMMR
2020	62026	83	81	72	81	130.59	130.59	116.1
2021	61528	117	116	97	116	188.53	188.53	157.7
2022	59951	72	70	65	70	116.76	116.76	108.4

2020-2022	Live births	MaMMAS MD	MaMMAs iMMR
North West Province	183505	267	145.5

There was a decrease in the total number of live births, and this is because of the decline in total deliveries in general in the province possibly due to intensive marketing of LARC for couple year protection rate to reduce unwanted pregnancy in the province. Figure one shows that the MMR increased to 188,53 in 2021 due to COVID-19 pandemic and decreased to 116.76 in 2022 as there was no COVID-19 case reported in that year.

Figure 1. iMMR for 2020,2021,2022 and the triennium

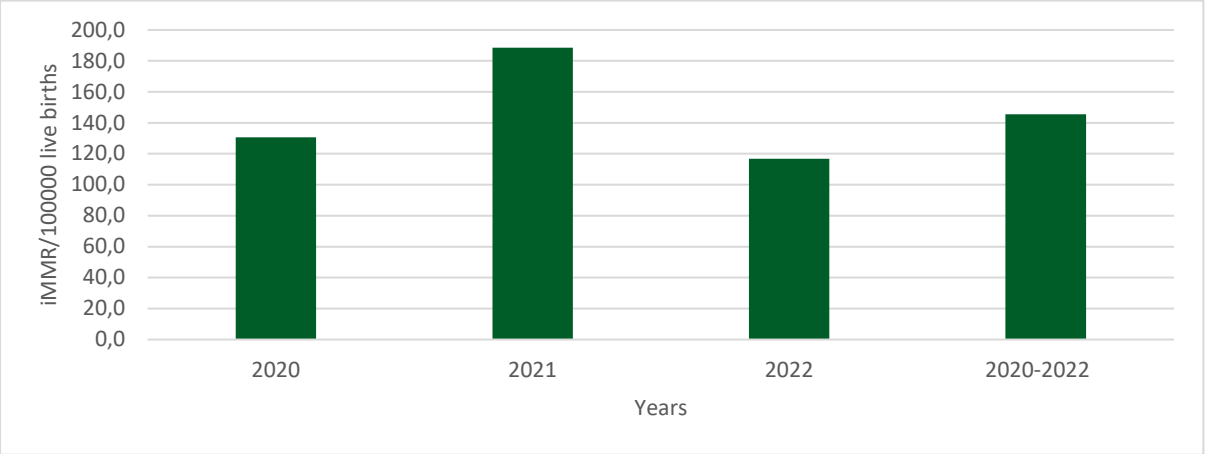
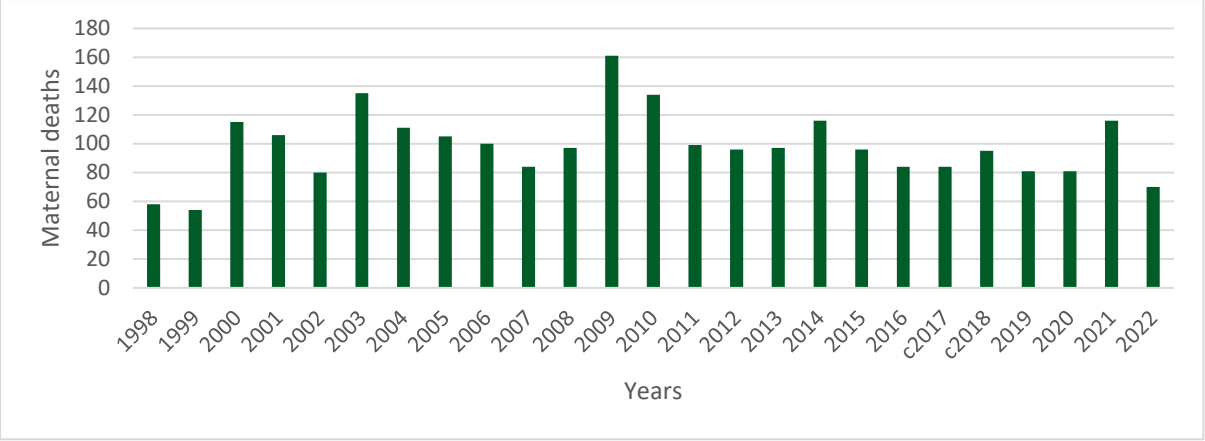


Figure two provides trends in number of North West maternal deaths from 1998 to 2022.

Figure 2. Trends in number maternal deaths, 1998-2022



The table above shows that deaths reported to the province were consistent in every year with fluctuations from year to year, the maximum number of deaths reported being 161 in 2009. A downward trend was observed over the years with a recent peak in 2021 due to the COVID-19 pandemic.
A similar trend is shown in iMMR (Figure 3)

Figure 3. Trends in iMMR, 2005 to 2022

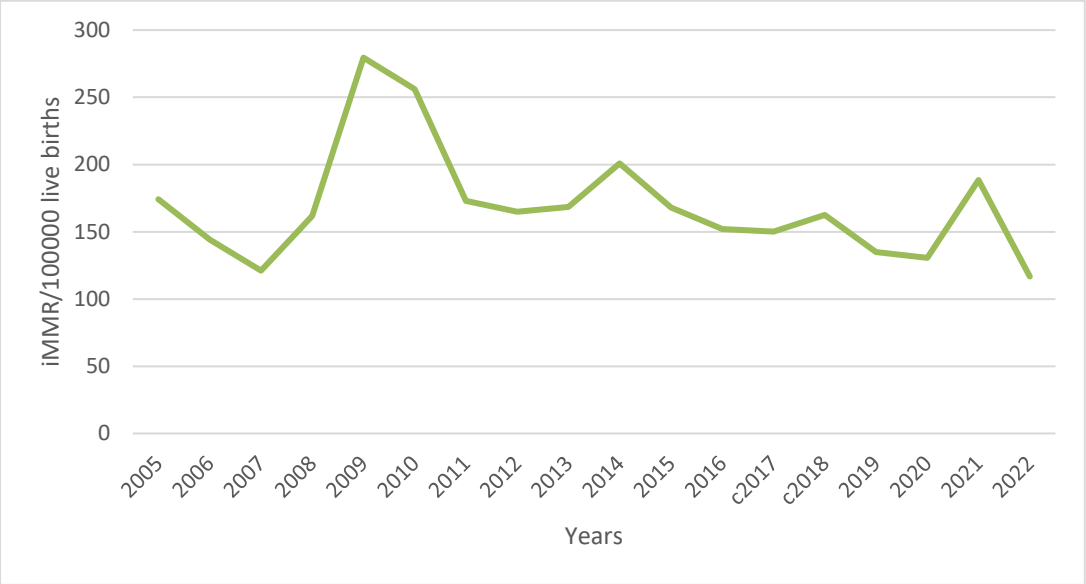
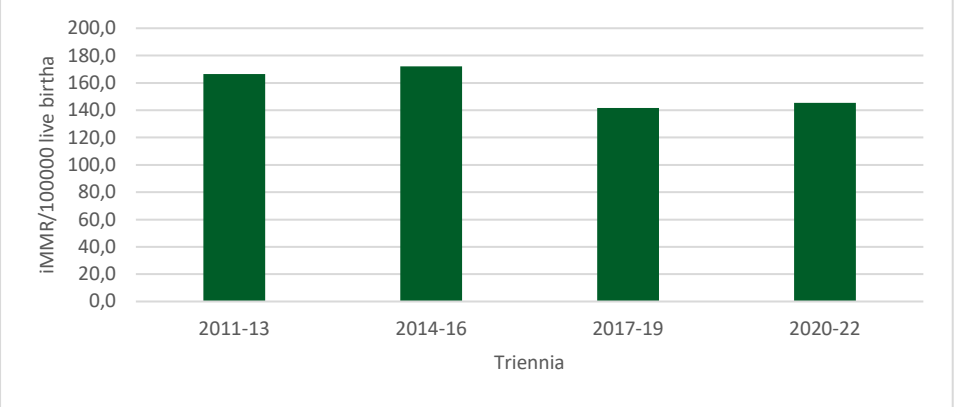
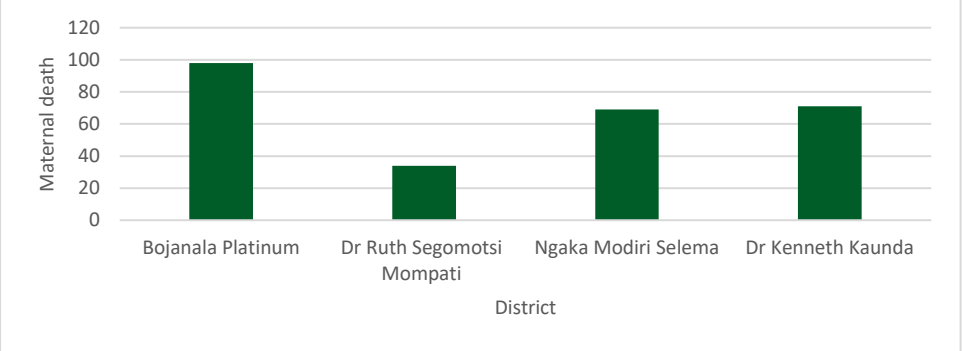


Figure 4. Trends in IMMR for four triennia, 2022-2022



The above table shows fluctuation of deaths in the 4 triennia, the downward trend in 2017-2019 being slightly reversed in 2020-2002.

Figure 5. Number Maternal deaths per district, 2020-2022



Bojanala District had the highest number of maternal deaths in this triennium, followed by Dr Kenneth Kaunda, Ngaka Modiri Molema then Dr Ruth Segomotsi Mompati District in that order.

Causes of maternal deaths

Table 2. Primary Obstetric Causes of Maternal death, 2020-2022

North West	2020	2021	2022	2020-2022
Medical and surgical disorders	13	15	7	35
Non-pregnancy-related infections	18	41	15	74
Ectopic pregnancy	4	1	1	6
Miscarriage	2	9	6	17
Pregnancy-related sepsis	4	2	3	9
Obstetric haemorrhage	16	24	12	52
Hypertension	17	14	15	46
Anaesthetic complications	1	0	4	5
Adverse drug reactions	0	0	0	0
Embolism	0	2	2	4
Acute collapse - cause unknown	1	4	2	7
Miscellaneous	0	0	0	0
Unknown	5	4	3	12
Maternal deaths	81	116	70	267
Coincidental cause	2	1	2	5
DDCP	83	117	72	272
Live births	62026	61528	59951	183505

Non-Pregnancy Related Infections is still the leading cause of maternal deaths in all the years 2020 to 2022, followed by Obstetric Haemorrhage then Hypertension, and Medical and Surgical disorders. COVID-19 deaths were classified as NPRI/other.

Table 3. COVID-19 maternal deaths, 2020-2022

COVID-19 maternal deaths	NW
2020	4
2021	20
2022	0
2020-2022	**24**

Table 3 Shows that COVID-19 deaths were high in 2021 as compared to 2020 when it started. COVID-19 was at the peak in 2021 in the province with more death as a result.

Figure 6. Trends in Primary Obstetric causes per year; 2020, 2021 and 2022

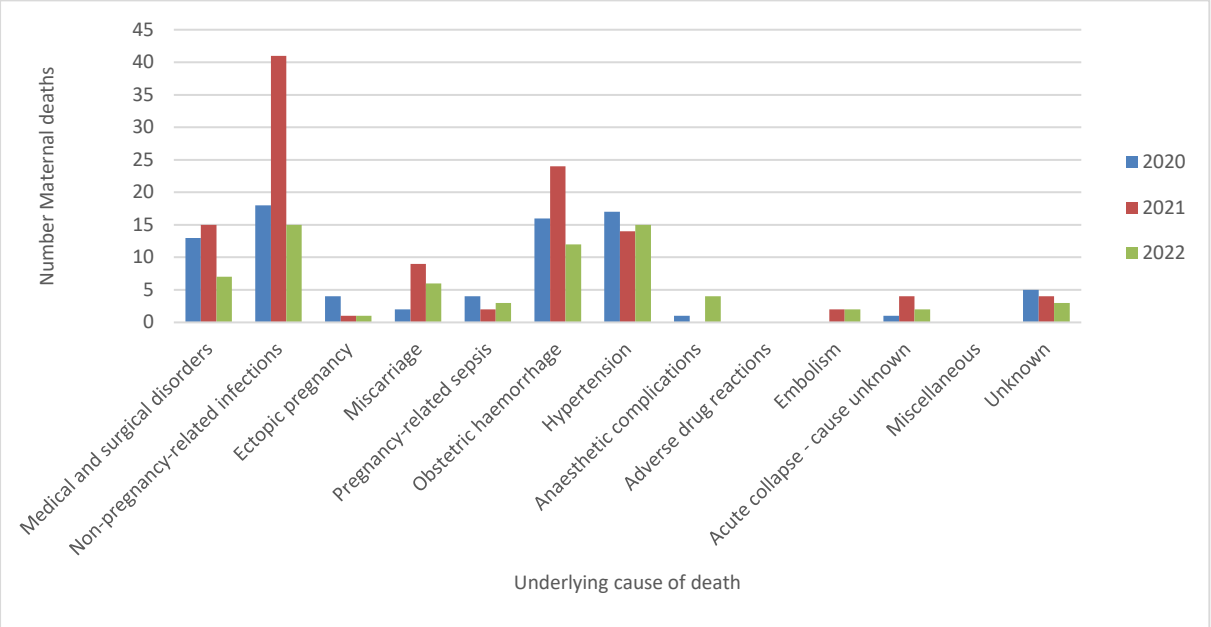


Figure 7. Pattern of Primary Obstetric causes per year; 2020,2021 and 2022

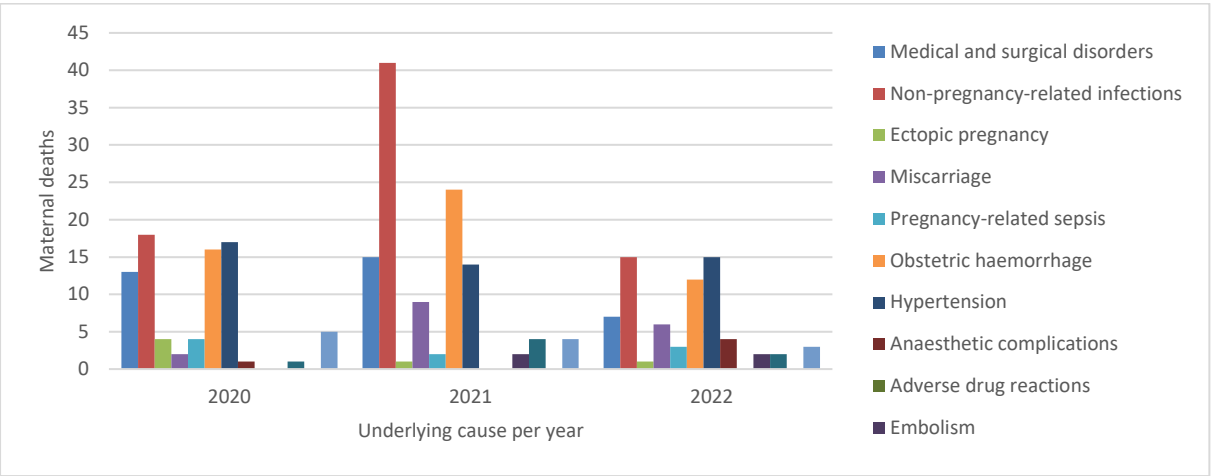


Figure 8. Trends in iMMR per cause per year during 2020-2022

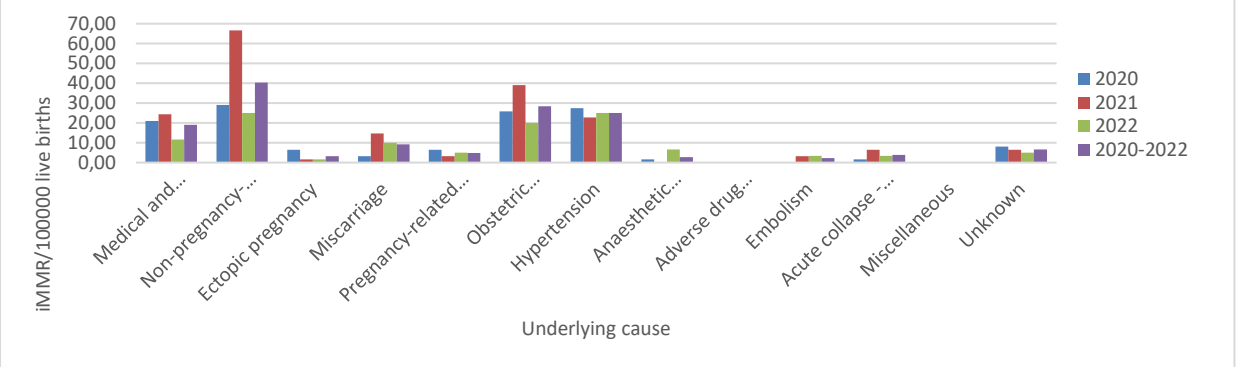


Figure 8 and Table 4 show that iMMR from NPRI, OH and M&S disorders all increased in 2021.

Table 4. iMMR for each Primary Obstetric Cause, 2020-2022

North West iMMR	2020	2021	2022	2020-2022
Medical and surgical disorders	20.96	24.38	11.68	19.07
Non-pregnancy-related infections	29.02	66.64	25.02	40.33
Ectopic pregnancy	6.45	1.63	1.67	3.27
Miscarriage	3.22	14.63	10.01	9.26
Pregnancy-related sepsis	6.45	3.25	5.00	4.90
Obstetric haemorrhage	25.80	39.01	20.02	28.34
Hypertension	27.41	22.75	25.02	25.07
Anaesthetic complications	1.61	0.00	6.67	2.72
Adverse drug reactions	0.00	0.00	0.00	0.00
Embolism	0.00	3.25	3.34	2.18
Acute collapse - cause unknown	1.61	6.50	3.34	3.81
Miscellaneous	0.00	0.00	0.00	0.00
Unknown	8.06	6.50	5.00	6.54
Maternal deaths	130.59	188.53	116.76	145.50
Coincidental cause	3.22	1.63	3.34	2.72
DDCP	133.81	190.16	120.10	148.22
Live births (2019)	**62026**	**61528**	**59951**	**183505**

Figure 9. Patterns of Primary Obstetric Causes per year, 2020-2022

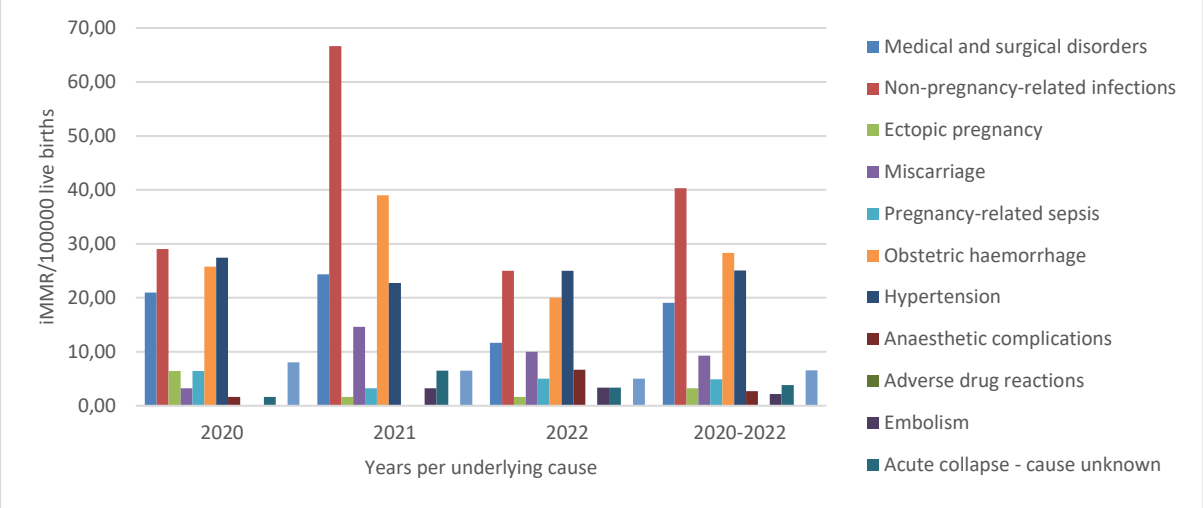


Table 5. Primary Obstetric Causes of death with Subcategories, 2020-2022

Primary obstetric problems	Number deaths
Coincidental cause	**5**
- MVA	1
- Other accidents	1

Primary obstetric problems	Number deaths
- Assault	1
- Other	2
Medical and surgical disorders	**35**
- Cardiomyopathy	6
- Rheumatic heart disease	
- Other cardiac disease	1
- Endocrine	3
- GIT	3
- CNS	3
- Respiratory	9
- Haematological	1
- Genito-urinary	
- Suicide	
- Substance abuse	
- Other psychiatric disease	
- Neoplasm	
- Auto-immune	
- Other	9
Non-pregnancy-related infections	**74**
- PCP pneumonia	12
- Other pneumonia	13
- TB	20
- UTI	
- Appendicitis	
- Malaria	
- Cryptococcal meningitis	
- Other meningitis	2
- Kaposi's sarcoma	
- Toxoplasmosis	1
- Hepatitis	
- Gastroenteritis	
- Wasting syndrome	
- Other	26
Ectopic pregnancy	**6**
- Less than 20 weeks	4
- More than 20 weeks (extrauterine pregnancy)	2
Miscarriage	**17**
- Septic miscarriage	10
- Haemorrhage (non-traumatic)	4
- Uterine trauma	
- GTD	
- Following legal TOP	3
Pregnancy-related sepsis	**9**

Primary obstetric problems	Number deaths
- Chorioamnionitis (ruptured membranes)	1
- Chorioamnionitis (intact membranes)	1
- Puerperal sepsis after NVD	3
- Puerperal sepsis after CD	3
- Bowel trauma at CD	1
Obstetric haemorrhage	**52**
- Abruption with hypertension	7
- Abruption without hypertension	3
- Placenta praevia	2
- Other APH not specified	2
- Ruptured uterus with previous CD	6
- Ruptured uterus without previous CD	3
- Uterine atony after vaginal delivery	5
- Vaginal trauma after vaginal delivery	
- Cervical trauma after vaginal delivery	
- Retained placenta after NVD (morb adherent)	2
- Retained placenta after NVD (not adherent)	6
- Inverted uterus after vaginal delivery	
- Other PPH not specified after vaginal delivery	3
- Bleeding during CD (morbidly adherent placenta)	2
- Bleeding during CD (not adherent placenta)	1
- Bleeding after Caesarean delivery	10
Hypertension	**46**
- Chronic hypertension	1
- Gestational hypertension	
- Pre-eclampsia with severe features	6
- Pre-eclampsia without severe features	2
- Eclampsia	28
- HELLP	9
- Liver rupture	
Anaesthetic complications	**5**
- General anaesthetic	1
- Spinal anaesthetic	4
Adverse drug reactions	**0**
- ARV medication	
- TB medication	
- Other medication	
- Herbal medication	
Embolism	**4**
- Pulmonary embolism	4
- Amniotic fluid embolism	
Acute collapse - cause unknown	**7**
Miscellaneous	0

Primary obstetric problems	Number deaths
- Hyperemesis gravidarum	
- Acute fatty liver	
Unknown	**12**
- Death at home or outside health services	8
- No primary cause found	3
- Lack of information	1
Total:	**272**

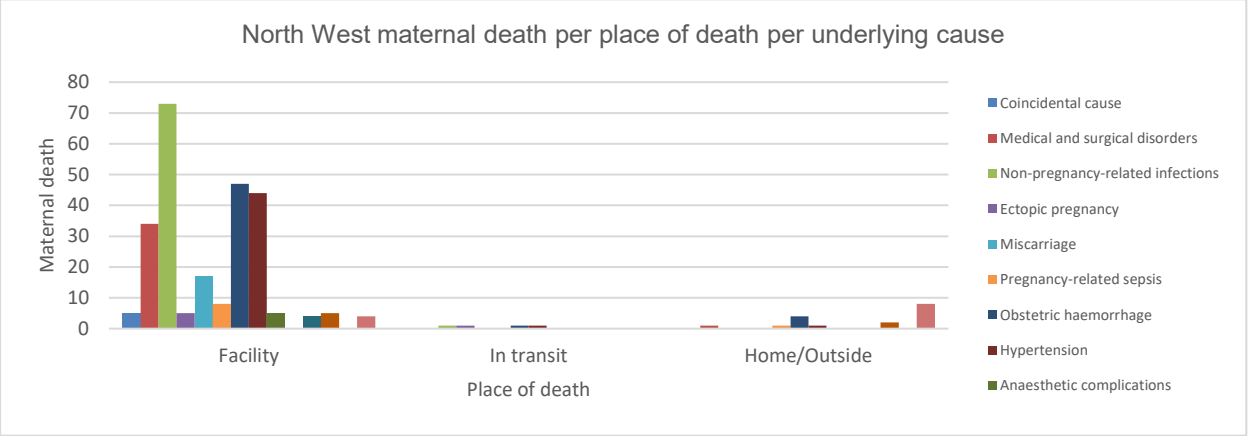
Table 6. Final cause(s) of Maternal deaths, 2020-2022

Cause of death	Number	% of total
Circulatory system	111	40.8
- Hypovolaemic shock	66	24.3
- Septic shock	45	16.5
Respiratory failure	96	35.3
- Respiratory failure	96	35.3
Cardiac failure	48	17.6
- Pulmonary oedema	48	17.6
Embolism	9	3.3
- Acute collapse due to embolism	9	3.3
Renal failure	37	13.6
- Renal failure	37	13.6
Liver failure	16	5.9
- Liver failure	16	5.9
Cerebral complications	46	16.9
- Intracranial haemorrhage	23	8.5
- Cerebral oedema resulting in coning	6	2.2
- Meningitis	2	0.7
- Cerebral emboli	1	0.4
- Brain death following hypoxic event	11	4
- Unspecified	3	1.1
Metabolic	21	7.7
- Maternal ketoacidosis	4	1.5
- Electrolyte imbalance	9	3.3
- Lactic acidosis	6	2.2
- Other	2	0.7
Haematological	66	24.3
- DIC	42	15.4
- Severe anaemia	24	8.8
Immune system	33	12.1
- Immune system failure	33	12.1
Unknown	20	7.4
- Home death	10	3.7

- Unknown	10	3.7
Other	24	8.8
- Other	24	8.8
Total deaths:	**272**	

Figure 10 shows that more women died at the facility and few from outside the facility, then followed by those died in transit. That shows that our women are aware of the importance of seeking medical help although it might have been too late for them to be assisted when arriving at the facilities.

Figure 10. Primary Obstetric Cause and Location of death, 2020-2022



Tables 7 shows that Non-Pregnancy Related Infections is the leading cause of all the deaths that occurred at facility level, followed by Obstetric Haemorrhage, then Hypertension, Medical and Surgical Disorders and miscarriages respectively.

Table 7. Primary Obstetric Cause and Location of death, 2020-2022

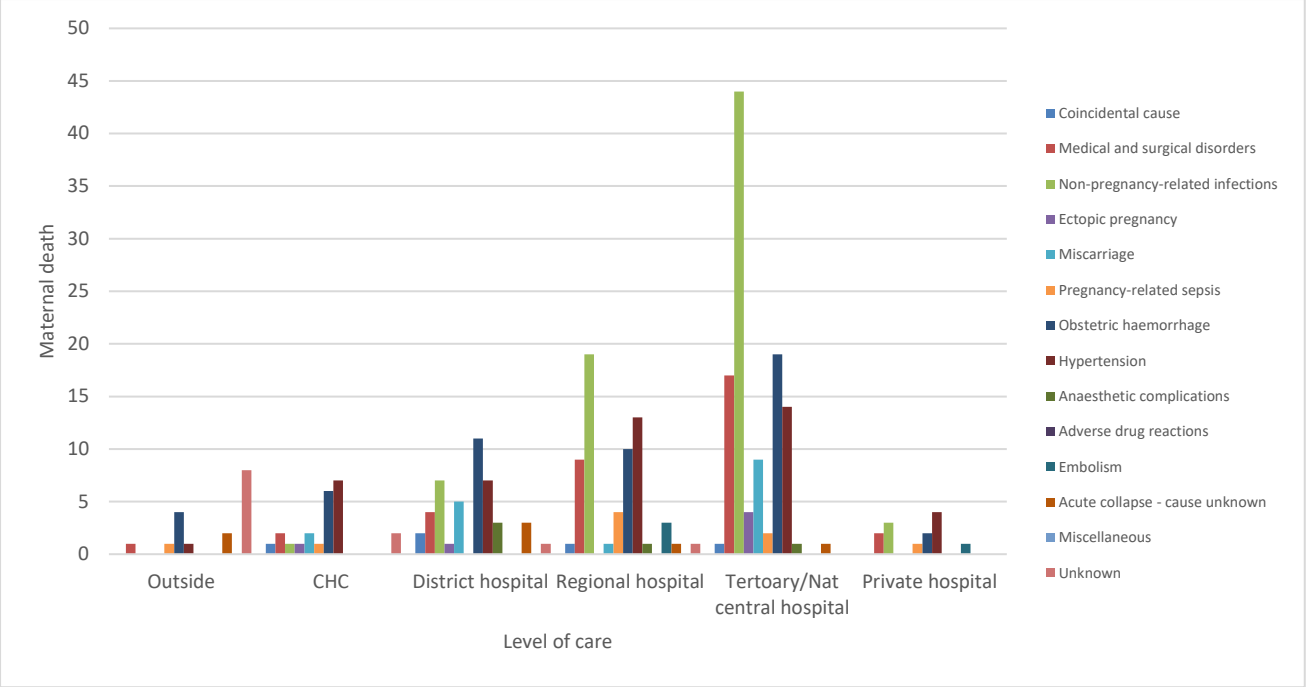
Primary obstetric problems	Facility	In transit	Home/Outside	Total
Coincidental cause	5	0	0	5
Medical and surgical disorders	34	0	1	35
Non-pregnancy-related infections	73	1	0	74
Ectopic pregnancy	5	1	0	6
Miscarriage	17	0	0	17
Pregnancy-related sepsis	8	0	1	9
Obstetric haemorrhage	47	1	4	52
Hypertension	44	1	1	46
Anaesthetic complications	5	0	0	5
Adverse drug reactions	0	0	0	0
Embolism	4	0	0	4
Acute collapse - cause unknown	5	0	2	7
Miscellaneous	0	0	0	0
Unknown	4	0	8	12
Total	**251**	**4**	**17**	**272**

Table 8. Primary Obstetric Cause and Level of Care, 2020-2022

Primary obstetric problem	Outside	CHC	District hospital	Regional hospital	Tertiary/Nat central hospital	Private hospital	Total
Coincidental cause	0	1	2	1	1	0	5
Medical and surgical disorders	1	2	4	9	17	2	35
Non-pregnancy-related infections	0	1	7	19	44	3	74
Ectopic pregnancy	0	1	1	0	4	0	6
Miscarriage	0	2	5	1	9	0	17
Pregnancy-related sepsis	1	1	0	4	2	1	9
Obstetric haemorrhage	4	6	11	10	19	2	52
Hypertension	1	7	7	13	14	4	46
Anaesthetic complications	0	0	3	1	1	0	5
Adverse drug reactions	0	0	0	0	0	0	0
Embolism	0	0	0	3	0	1	4
Acute collapse - cause unknown	2	0	3	1	1	0	7
Miscellaneous	0	0	0	0	0	0	0
Unknown	8	2	1	1	0	0	12
Total	**17**	**23**	**44**	**63**	**112**	**13**	**272**

Table 8 and Figure 10 show that most deaths occurred at tertiary Hospital followed by regional and district hospitals.

Figure 11. Primary Obstetric Cause and Level of Care, 2020-2022



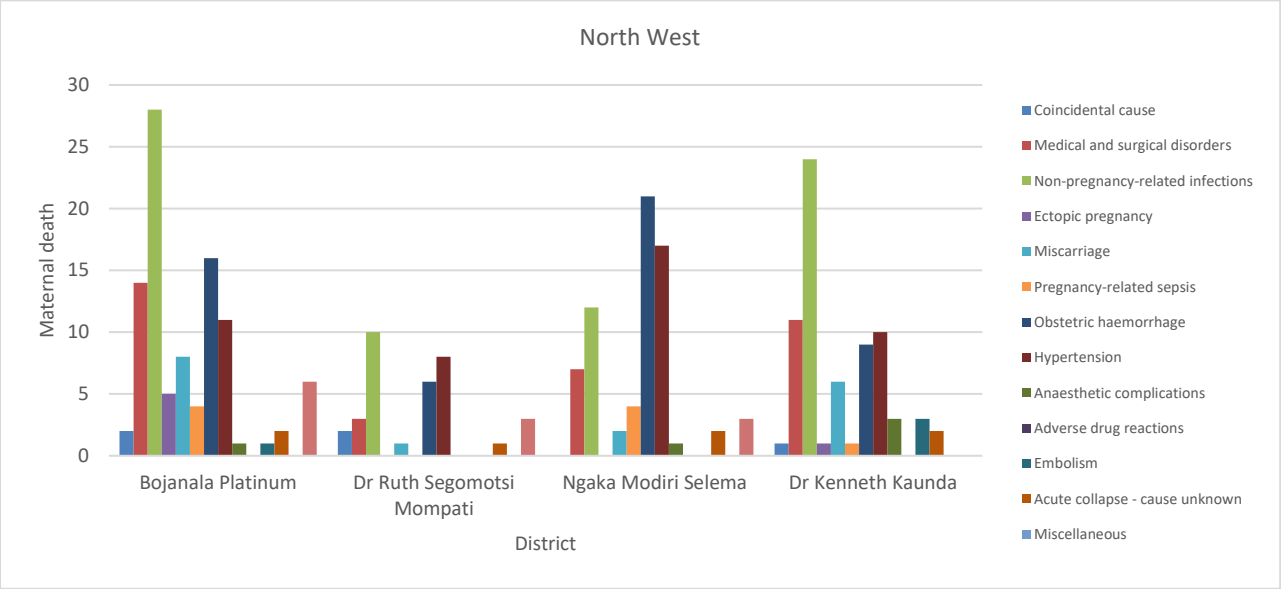
The above table shows that more women with Non-Pregnancy Related Infections died at Tertiary Hospital followed by Regional Hospital then District Hospital.

Table 9. Primary Obstetric Causes by District in North West, 2020-2022

Primary obstetric Cause	Bojanala Platinum	Dr Ruth Segomotsi Mompati	Ngaka Modiri Molema	Dr Kenneth Kaunda	Total Numbers
Coincidental cause	2	2	0	1	5
Medical and surgical disorders	14	3	7	11	35
Non-pregnancy-related infections	28	10	12	24	74
Ectopic pregnancy	5	0	0	1	6
Miscarriage	8	1	2	6	17
Pregnancy-related sepsis	4	0	4	1	9
Obstetric haemorrhage	16	6	21	9	52
Hypertension	11	8	17	10	46
Anaesthetic complications	1	0	1	3	5
Adverse drug reactions	0	0	0	0	0
Embolism	1	0	0	3	4
Acute collapse - cause unknown	2	1	2	2	7
Miscellaneous	0	0	0	0	0
Unknown	6	3	3	0	12
Total	**98**	**34**	**69**	**71**	**272**

Non-Pregnancy Related Infections is the leading cause of maternal deaths at Bojanala and Dr Kenneth Kaunda Districts; Obstetric Haemorrhage is a leading cause in Ngaka Modiri Molema followed by Bojanala District. Hypertension followed Obstetric Haemorrhage in Ngaka Modiri Molema and Bojanala, then Dr Kenneth Kaunda District.

Figure 12. Numbers of maternal death per district per Primary obstetric cause, 2020-2022



For the triennium, Non-Pregnancy Related Infections were the leading cause of death in Bojanala District, followed by Dr Kenneth Kaunda, Ngaka Modiri Molema then Dr Ruth Segomotsi Mompati in that order. Non-Pregnancy Related Infections were followed by Hypertension being the highest in Ngaka Modiri Molema District, Bojanala, Dr Kenneth Kaunda and Dr Ruth Segomotsi Mompati respectively.

Table 10. Primary Obstetric Cause and Maternal age, 2020-2022

Primary obstetric problem	15-19	20-24	25-29	30-34	35-39	40-44	Outside 10-44 range & unknown	Total
Coincidental cause	1	2	1	1	0	0	0	5
Medical and surgical disorders	4	4	11	6	8	2	0	35
Non-pregnancy-related infections	1	6	19	23	18	7	0	74
Ectopic pregnancy	0	1	1	4	0	0	0	6
Miscarriage	1	5	2	6	3	0	0	17
Pregnancy-related sepsis	2	3	0	3	1	0	0	9
Obstetric haemorrhage	2	15	4	10	19	2	0	52
Hypertension	4	9	9	9	10	5	0	46
Anaesthetic complications	1	1	0	2	1	0	0	5
Adverse drug reactions	0	0	0	0	0	0	0	0
Embolism	0	2	1	1	0	0	0	4
Acute collapse - cause unknown	0	1	3	3	0	0	0	7
Miscellaneous	0	0	0	0	0	0	0	0
Unknown	1	2	2	3	4	0	0	12
Total	**17**	**51**	**53**	**71**	**64**	**16**	**0**	**272**

The above table shows that more deaths occurred amongst women aged 30 to 34 years followed by those in 35 to 39yrs, 25 to 29yrs then 20 to 24yrs respectively. The leading causes of death in those years were Non-Pregnancy Related Infections, Obstetric Haemorrhage and then Hypertension.

Figure 13. Primary Obstetric Cause and Maternal age, 2020-2022

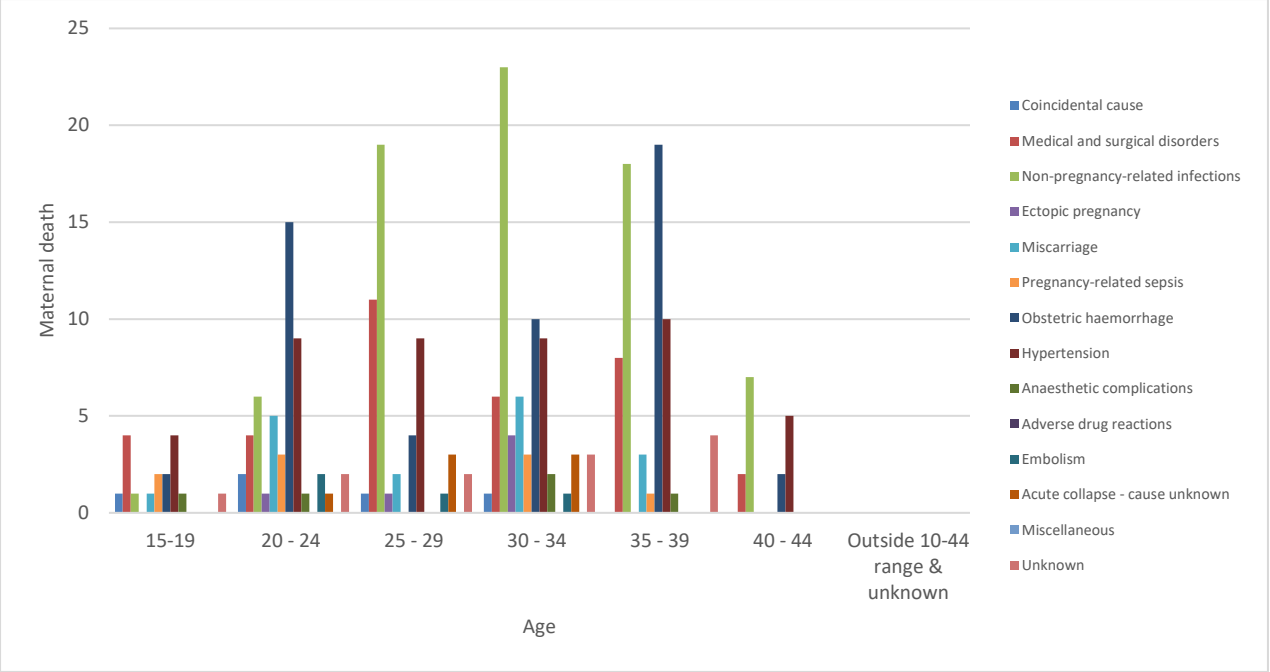


Table 11. Primary Obstetric Cause and Delivery Route, 2020-2022

Primary obstetric problems	Vaginal	CD	CD CHC	CD DH	CD RH	CD TH/NCH	CD Pvt
Coincidental cause	1	1	0	0	0	1	0
Medical and surgical disorders	8	9	0	0	4	4	1
Non-pregnancy-related infections	26	21	0	0	6	14	1
Miscarriage	0	0	0	0	0	0	0
Pregnancy-related sepsis	2	6	2	1	2	3	2
Obstetric haemorrhage	21	17	0	3	5	8	1
Hypertension	11	21	1	2	5	10	3
Anaesthetic complications	0	3	0	2	1	0	0
Adverse drug reactions	0	0	0	0	0	0	0
Embolism	2	2	0	0	2	0	0
Acute collapse - cause unknown	2	2	0	0	1	1	0
Miscellaneous	0	0	0	0	0	0	0
Unknown	2	1	0	0	1	0	0
Total	**75**	**83**	**3**	**8**	**27**	**41**	**8**

The highest number of women died were those who had Caesarean Delivery (CD) followed by vaginal delivery, with the highest number of CDs being at tertiary Hospital and followed by regional Hospital.

Table 12. Primary Obstetric Cause and HIV Status, 2020-2022

Primary obstetric problems	Negative	Positive	Declined test	Unknown	Total
Coincidental cause	3	0	0	2	5
Medical and surgical disorders	23	9	0	3	35
Non-pregnancy-related infections	24	48	0	2	74
Ectopic pregnancy	0	3	0	3	6
Miscarriage	5	6	0	6	17
Pregnancy-related sepsis	6	3	0	0	9
Obstetric haemorrhage	32	14	0	6	52
Hypertension	29	12	0	5	46
Anaesthetic complications	4	1	0	0	5
Adverse drug reactions	0	0	0	0	0
Embolism	4	0	0	0	4
Acute collapse - cause unknown	6	0	0	1	7
Miscellaneous	0	0	0	0	0
Unknown	6	3	0	3	12
Total	**142**	**99**	**0**	**31**	**272**

The above table shows that more deaths occurred amongst women who were HIV negative, and the positivity rate had decreased amongst maternal deaths, but there were 31 with unknown HIV status.

Postmortems are done in the province, but more needs to be done for the unknown, acute collapse and embolism categories.

Table 13. Primary Obstetric Causes and Postmortems, 2020-2022

Primary obstetric problems	Post mortem	Not done
Coincidental cause	1	4
Medical and surgical disorders	8	27
Non-pregnancy-related infections	3	71
Ectopic pregnancy	2	4
Miscarriage	2	15
Pregnancy-related sepsis	2	7
Obstetric haemorrhage	12	40
Hypertension	3	43
Anaesthetic complications	3	2
Adverse drug reactions	0	0
Embolism	1	3

Primary obstetric problems	Post mortem	Not done
Acute collapse - cause unknown	3	4
Miscellaneous	0	0
Unknown	3	9
Total	**43**	**229**

AVOIDABLE FACTORS FOR MATERNAL DEATHS

Table 14. Classification of Avoidable factors, 2020-2022

	Number	% of total	% of cases at this level
Patient oriented problems			
- Avoidable factors identified	144	52.9	
- No avoidable factors	121	44.5	
- Lack of information	8	2.9	
Administrative problems			
- Avoidable factors identified	147	54.0	
- No avoidable factors	113	41.5	
- Lack of information	15	5.5	
Resuscitation problems			
- Avoidable factors identified	158	58.1	
- No avoidable factors	80	29.4	
- Lack of information	34	12.5	
Medical care - CHC			
- Managed at this level	168	61.8	
- Avoidable factors identified	117		69.6
- No avoidable factors	46		27.4
- Lack of information	6		3.6
Medical care - district hospital			
- Managed at this level	107	39.3	
- Avoidable factors identified	76		71.0
- No avoidable factors	28		26.2
- Lack of information	6		5.6
Medical care - regional hospital			
- Managed at this level	81	29.8	
- Avoidable factors identified	62		76.5
- No avoidable factors	16		19.8
- Lack of information	5		6.2
Medical care - tertiary & above			
- Managed at this level	113	41.5	
- Avoidable factors identified	70		61.9
- No avoidable factors	37		32.7
- Lack of information	7		6.2
Medical care - private hospital			
- Managed at this level	25	9.2	
- Avoidable factors identified	12		48.0
- No avoidable factors	12		48.0
- Lack of information	2		8.0
Timing of emergency			

	Number	% of total	% of cases at this level
- Early pregnancy	35	12.9	
- Antenatal period: 20w +	119	43.8	
- Intrapartum period	23	8.5	
- Postpartum period	92	33.8	
- Anaesthesia	3	1.1	
Timing of death			
- Early pregnancy	26	9.6	
- Antenatal period: 20w +	65	23.9	
- Intrapartum period	6	2.2	
- Postpartum period	173	63.6	
- Anaesthesia	2	0.7	
Impact of suboptimal care			
- No suboptimal care identified	70	25.7	
- Suboptimal care, no impact on outcome	15	5.5	
- Suboptimal care, possible impact on outcome	126	46.3	
- Suboptimal care, probable impact on outcome	61	22.4	
Total:	**272**		

There were 68,7% of maternal deaths which were possible or probably preventable by better care within the health system; this needs to be attended to.

Table 15. Patient Orientated Avoidable factors, 2020-2022

Description	Number	% of cases
Lack of information	8	2.9
No avoidable factor	121	44.5
No antenatal care	53	19.5
Infrequent antenatal care	8	2.9
Delay in accessing medical help	88	32.4
Declined medication/surgery/advice	22	8.1
Family problem	2	0.7
Community problem	0	0
Unsafe abortion	5	1.8
Other	20	7.4
Total cases	**272**	

Delay in accessing medical help at 32,4% of patient related avoidable factors shows that more emphasis should be made on patient education to gain patient's cooperation.

Table 16. Administrative related avoidable factors, 2020-2022

Description	Number	% of cases
Lack of information	15	5.5
No avoidable factor	113	41.5
Transport problem: Home to institution	4	1.5

Description	Number	% of cases
Transport problem: Institution to institution	10	3.7
Lack of accessibility: Barriers to entry	2	0.7
Lack of accessibility: Other	4	1.5
Delay in attending to patient (Overburdened service)	22	8.1
Delay in attending to patient (Reason unknown)	13	4.8
Lack of healthcare facilities: ICU	16	5.9
Lack of healthcare facilities: Blood/blood products	3	1.1
Lack of healthcare facilities: Other	3	1.1
Inadequate numbers of staff on duty	9	3.3
Appropriate skill not available on site / on standby	45	16.5
Communication problems: Technical	2	0.7
Communication problems: Interpersonal	7	2.6
Other	54	19.9
Total cases	**272**	

Appropriate skill not available on site/ on standby was the highest in the administrative avoidable factors category, which showed that our facilities should appoint more killed personnel.

Table 17. Medical Care related avoidable factors, 2020-2022

Description	Number	% of all cases	% of cases at level
Community health centre			
Managed at this level	168	61.8	100
Lack of information	6	2.2	3.6
No avoidable factor	46	16.9	27.4
Initial assessment	84	30.9	50
Problem with recognition / diagnosis	57	21	33.9
Delay in referring the patient	26	9.6	15.5
Managed at inappropriate level	16	5.9	9.5
Incorrect management (Wrong diagnosis)	5	1.8	3
Sub-standard management (Correct diagnosis)	27	9.9	16.1
Not monitored / Infrequently monitored	2	0.7	1.2
Prolonged abnormal monitoring with no action taken	4	1.5	2.4
District hospital			
Managed at this level	107	39.3	100
Lack of information	6	2.2	5.6
No avoidable factor	28	10.3	26.2
Initial assessment	35	12.9	32.7
Problem with recognition / diagnosis	44	16.2	41.1

Description	Number	% of all cases	% of cases at level
Delay in referring the patient	21	7.7	19.6
Managed at inappropriate level	20	7.4	18.7
Incorrect management (Wrong diagnosis)	9	3.3	8.4
Sub-standard management (Correct diagnosis)	29	10.7	27.1
Not monitored / Infrequently monitored	8	2.9	7.5
Prolonged abnormal monitoring with no action taken	5	1.8	4.7
Regional hospital			
Managed at this level	81	29.8	100
Lack of information	5	1.8	6.2
No avoidable factor	16	5.9	19.8
Initial assessment	25	9.2	30.9
Problem with recognition / diagnosis	26	9.6	32.1
Delay in referring the patient	3	1.1	3.7
Managed at inappropriate level	5	1.8	6.2
Incorrect management (Wrong diagnosis)	5	1.8	6.2
Sub-standard management (Correct diagnosis)	34	12.5	42
Not monitored / Infrequently monitored	11	4	13.6
Prolonged abnormal monitoring with no action taken	8	2.9	9.9
Tertiary hospital / above			
Managed at this level	113	41.5	100
Lack of information	7	2.6	6.2
No avoidable factor	37	13.6	32.7
Initial assessment	22	8.1	19.5
Problem with recognition / diagnosis	28	10.3	24.8
Delay in referring the patient	0	0	0
Managed at inappropriate level	0	0	0
Incorrect management (Wrong diagnosis)	10	3.7	8.8
Sub-standard management (Correct diagnosis)	37	13.6	32.7
Not monitored / Infrequently monitored	1	0.4	0.9
Prolonged abnormal monitoring with no action taken	11	4	9.7
Private hospital			
Managed at this level	25	9.2	100
Lack of information	2	0.7	8
No avoidable factor	12	4.4	48
Initial assessment	7	2.6	28
Problem with recognition / diagnosis	7	2.6	28
Delay in referring the patient	0	0	0
Managed at inappropriate level	0	0	0
Incorrect management (Wrong diagnosis)	3	1.1	12

Description	Number	% of all cases	% of cases at level
Sub-standard management (Correct diagnosis)	2	0.7	8
Not monitored / Infrequently monitored	1	0.4	4
Prolonged abnormal monitoring with no action taken	0	0	0
Total cases	**272**		

Initial assessment and problem recognition/diagnosis are still high in almost all levels of care, more intervention needs to be done for this. Substandard care occurred more at regional and tertiary hospitals, which is a cause of concern as there are specialist at those levels.

Table 18. Resuscitation related avoidable factors, 2020-2022

Description	Number	% of cases
Lack of information	34	12.5
No avoidable factor	80	29.4
Airway problems	18	6.6
Breathing problems	29	10.7
Circulation problems	47	17.3
Drug problems	9	3.3
Investigation problems	2	0.7
Monitoring problems	10	3.7
Not attempted	64	23.5
Total cases	**272**	

Summary and discussion of key findings on maternal deaths reported to MAMMAS

- Deaths reported to Province showed consistency in reporting every year with fluctuations from year to year, the maximum number of deaths reported being 161 in 2009. A downward trend in maternal deaths was however observed over the years up to 2019, until the recent triennium when there was an overall increase, due to the COVID-19 pandemic.
- The iMMR was 145.5 maternal deaths per 100,000 live births for the 2020-2022 triennium, a slight increase from 2017-2019, when it was 141.6.
- There was an increase of maternal deaths due to NPRIs in 2021 as a result of the pandemic COVID-19.
- In all the three years, (2020, 2021 and 2022) NPRIs was the leading cause of maternal deaths followed by Hypertension in 2020 and 2022 followed by Obstetric Haemorrhage and Medical and Surgical conditions.
- Deaths occurred more at tertiary Hospitals followed by regional, then district hospitals respectively with less deaths occurring at CHCs, reflecting better referrals.
- More women died at the facility and few from outside the facility, then in transit in that order. That shows that our women are aware of the importance of seeking medical help although it might have been too late for them to be assisted when arrived at the facilities.
- There was a significant drop in deaths occurring outside the facility in 2022 as compared to 2021 (7.7% down to 1.4%) whereas there was an increase in CHC deaths from 6.5% to 11.4% which showed that the community is responding in seeking medical help although they are still presenting late.
- More deaths occurred amongst women aged 30 to 34yrs followed by those in 35 to 39yrs, 25 to 29yrs then 20 to 24yrs respectively. The leading cause of death in those years were Non-Pregnancy Related Infections, Obstetric Haemorrhage and Hypertension in that order.

- A large number of deaths occurred in women that had received Antenatal Care and had booked before 20 weeks, which reflects sub-standard management that they received at PHC facilities during ANC visits, especially Hypertension management.
- Most of the women who died had tested negative for the retroviral disease (HIV negative), but of concern, was the large percentage (44.4%) of women whose viral load was 1000 copies/ml and more, which might have been due to women who defaulted treatment.
- It is of concern that more women who died were undelivered. Amongst those who delivered, most were by caesarean section.
- Most women were referred from the Community Health Centre to District and upward to Regional and Tertiary Hospitals which is a good practice that needed to be sustained.
- Notably, Non-Pregnancy Related Infections (NPRI's) have dropped from 41 (35.0%) in 2021 to 15 (20.8%) in 2022 and Obstetric Haemorrhage from 24 (20.5) in 2021 to 12 (16.7) in 2022, with an increase in Hypertension from 14 (12.0) in 2021 to 15 (20.8) in 2022 respectively.
- In 2022, CHC had problems on arriving at the diagnosis in 27.8% of women which resulted in delayed referral, furthermore when correct diagnosis was made, there was substandard management of the patients at 14.9% in Regional and 11.1% in Tertiary, District and CHC respectively despite correct diagnosis having been made.
- Most women died during PNC which showed that monitoring at PNC was not properly done.

Discussion

This chapter reviews the numbers of death each year over a 25 years period and the findings are that there is notable fluctuating trend in numbers over the period. This may be due to improved reporting or success on the part of the healthcare system to achieve the desired goal of "**No Woman should die whilst pregnant, giving birth or after birth"**.

There was a significant drop in deaths occurring at CHC. This should be encouraged and reinforced by organising meetings with well performing institutions, discuss performance and give positive feedback in order to boost staff morale. Staff must not be addressed only when there are problems even in good performance they should also be appraised.

Recommendations

The following three key aspects of a health system are essential:
- Knowledgeable and skilled healthcare providers
- Appropriately resourced and accessible healthcare facilities (including equipment and human resources)
- Rapid inter-facility emergency transport system

These three basic building blocks of the Health System must be available to all pregnant women: especially the less informed and most disadvantaged people. When all these aspects are in place, rapid declines in the iMMR can be expected, as demonstrated by the reduction of deaths at CHCs and District Hospitals.

The North West Province is continuing with the implementation and monitoring of the NCCEMD's **5Hs** and **5Cs** recommendations to improve and save lives of the women at the reproductive age.

The 5 Hs are summarised as follows:
• **H**IV
• **H**aemorrhage
• **H**ypertension
• **H**ealth worker training and
• **H**ealth system strengthening

The last two (Health worker training and Health system strengthening) make up the three Basic Building Blocks of a health system as described above. They are essential to achieve the first three Hs (HIV, Haemorrhage, and Hypertension).

Implementation of the 5Hs is shown in the table below:

What	Priority activities to be implemented
Three Basic Building Blocks for the Health system	
Improve Health worker training	- Ensure In-service training, ESMOE, EOST and BANC Plus training, and sending nurses for advanced midwifery courses. - Continuing Professional Development of Medical Officers and Presentations to be conducted. - Evaluation of proper utilisation, recording and plotting of partogram to be continuously conducted. - Ensure onsite training with reinforcement strategy during training period. - Train HCP on HIV screening and treatment protocols. - Implement ESMOE and BANC Plus training at Nursing Colleges. - Enforce weekly fire drills at all delivery facilities. - O&G to manage pregnant women with medical conditions.
Strengthen Health system	- Implement Maternity dedicated inter-facility transport system within healthcare facilities and centralise maternity services with adequate human resources and equipment. - Identify, report and address the avoidable factors that contribute to maternal deaths. - Increase managerial accountability for reducing maternal deaths. - Strengthen clinical governance. - Ensure that hospitals practice non rotation of Maternity staff. - Conduct maternal mortality and morbidity meetings regularly, as planned and minutes to be documented. - Avail and communicate Referral criteria and routes to all delivery facilities. - Ensure functionality of established Maternity Waiting Homes in all the Districts. - Managers at all levels of care to ensure availability and accessibility of various modalities of contraceptives at all facilities. - Hospital and PHC senior managers to visit maternity units, attend M&M meetings and these activities to be part of their KPAs - Share recommendations from assessor's meetings with various Districts at DMTs. - Senior managers to conduct consultative meetings with HCP (midwifes and Drs) to display support. - Continuously conduct in- service training on protocols and guidelines. - Continuously develop IEC material in local languages. - Continue Community Based Outreach Teams in all Wards. - Create more posts for Advanced Midwives at Regional Hospitals, District Hospitals and CHC's. - Continuing partnership with private facilities. - Audits to form part of facility managers PMAs - Continue monthly data verification by Programme Managers and Local Area Managers.
Reduce deaths due to HIV and TB	- Promote the "know your status" and "plan your pregnancy "messages. - Conducted Awareness campaigns to promote Early ANC booking and adherence to treatment. - Provide high quality antenatal care to all women during pregnancy. - In-service HCP training on the latest Guidelines on an ongoing basis. - Conduct active screening of HIV co-infections, counsel and treat especially TB.

What	Priority activities to be implemented
	- Intensify management of HIV positive pregnant women Ensure that all eligible women receive ART to reduce mothers to child transmission of HIV infection. - Emphasise and discuss all areas of importance, substandard care and missed opportunities in mortality and morbidity meetings where patients have succumbed to non-pregnancy related infections. - Ensure adherence to protocols, guidelines and referral criteria.
Reduce deaths due to Haemorrhage	- Ensure availability of blood and blood products, e.g. Fresh Frozen Plasma (FFP) or Bioplasma in all delivery facilities. - Ensure availability of PPH boxes in all maternity units. - Continuation implementation of Post-Partum Haemorrhage monograph at all delivery facilities and updated ESMOE protocols including E Motive. - Impart skills on the basic nursing care to nurses especially pertaining to monitoring of vital signs in the first six hours after normal and caesarean section deliveries. - Emphasise Active management of the third stage of labour and recognise early signs of Haemorrhage at ESMOE trainings. - Ensure Adherence to protocols, guidelines and referral criteria.
Reduce deaths due to Hypertension	- Give all pregnant women Calcium supplementation during ANC. - Distribute and implement Early Warning Chart at all delivery facilities. - Ensure availability of Eclampsia boxes at all facilities performing deliveries and emphasis to be made on refilling them as soon as opened and used. - Emphasise proper management of Hypertension complications at ESMOE trainings. - Conduct awareness campaigns and community dialogues on quarterly basis at sub-District level to promote family planning and awareness to signs and symptoms of Imminent Eclampsia. - Ensure adherence to protocols, guidelines and referral criteria.

The **5Cs** give implementation strategies to move from the two Hs (Basic Building Blocks of the health system) to achieve the three Hs (reduction in maternal deaths due the HIV/ TB, Hypertension and Haemorrhage.
The **5Cs** are summarised as:

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

Implementation of the 5Cs is as shown in the table below:

How	Who
Care: Commitment to quality	- Managers (especially Maternity Operational Managers) and DCST including O&G Specialists should supervise and evaluate HCP (midwives and Drs) to ensure that emergency drills are performed regularly and that they have appropriate skills. - Consultative meetings to be conducted with Healthcare Professionals to discuss issues around quality care. - HCPs should make themselves available for training, to participate in drills and to behave in a professional manner. - Operational managers to conduct in-service training continuously on protocols and guidelines. - Hospital and PHC senior managers should visit maternity units, attend M&M meetings and these activities must be included in their KPAs. - Provincial Maternal Death Assessors should share Recommendations from assessor's meetings with Districts at DMTs. - Audits to form part of facility managers and DCST PMAs - Monthly data verification by programme managers and Local Area Managers to be done at all levels of care. - Integration of wellness and ANC clinics to be done.
Coverage	- Senior managers should refurbish old facilities to improve accessibility to maternity services. - District senior managers and Hospital CEOs should monitor functionality of Maternity Waiting Homes. - Senior managers should Create advanced midwifery posts in all the Hospitals and CHC's for proper management of pregnant women. - The district managers and the Hospital CEOs should monitor the impact of the out-sourced ambulances for transportation of patients from District Hospitals to Regional Hospitals. - All HCP to be trained on BANC Plus Strategy to be able to identify problems early before complications occur. - Mentor Mothers programme to be rolled out to all facilities handling pregnant women. - Senior managers to finalise and provide the correct staff establishment according to areas of high priority (including retention strategies). - District senior managers and the DCST should monitor functionality of established High Risk Clinics at District Hospitals & CHCS.
Caesarean section safety	- Community Doctors and interns should be evaluated on anaesthetic skills at Regional Hospitals by Clinical managers and O&G Specialists to improve safety of caesarean section at District Hospitals. - Implementation of C/section and PPH monographs should be intensified at all Districts Hospitals. - DCSTs to continue training, monitoring and evaluating fire drills at all delivery facilities. - All Regional Hospital to have functional Maternity Operating Theatres which adhere to the DOH Safe CS miniumum standards.
Contraception	- Managers at all levels of care to ensure availability and accessibility of various modalities of contraceptives. - Pregnancy awareness campaigns to be conducted at all Districts to promote contraception use to prevent unwanted pregnancies. - Ensure that all women have access to sexual and reproductive health services especially contraception. - HCP training on the new contraception policy, Intra Uterine Device and Implanon insertion to be continued to prevent unwanted pregnancies and illegal abortions.

How	Who
	- All HCP to motivate pregnant women, teenagers and all women of childbearing age to prevent unwanted pregnancies by the use of contraceptives.
Community involvement	- Conduct awareness campaigns, community dialogues on quarterly basis at sub-District level to address maternal issues. - PHC Re-engineering teams to continue with Community Based Outreach at all Wards across the Province. - CHW's to intensify conducting Mother PNC within six days at all Wards. - WBOTs to continue the use of pregnancy screening tool to identify women requiring contraception and refer them appropriately. - Mentor Mothers to support women during pregnancy, delivery and post-natal. - Continue extensive consultation with multiple stakeholders, including Traditional Health Practitioners, Traditional Leaders, Church Leaders and broader community on maternal health issues. - Continue educating communities and pregnant women on the importance and the use of MoM-Connect. - Involve Ward Counsellors', Hospital Boards, and Community radio stations in the conveying of health information. - Involve Community members in the cleanliness of the Hospitals surroundings.

NB: These provincial Recommendations will be implemented alongside the NCCEMD national recommendations described in the 2020-2022 triennial report.

North West Provincial Assessors

Ms CN Modise	Provincial Maternal and Neonatal Health Coordinator
Dr HM Moatshe	O&G Specialist
Dr P Mokae	Specialist Anaesthetist
Ms VT Ditsele	Advanced Midwife
Dr NS Komane	O&G Specialist
Dr OI Adejayan	Family Physician
Ms KB Mooba	Advanced Midwife
Dr G Deaf	O&G Specialist
Ms ME Dintoe	Advanced Midwife
Ms KE Merementsi	Advanced Midwife
Ms M Siko	Advanced Midwife
Ms MJ Mamabolo	Advanced Midwife
Dr MG Mothupi	O&G Specialist
Ms BR Monei	Advanced Midwife

8.9 Western Cape

Key recommendations for the Western Cape
1. Pandemic preparedness to ensure women with obstetric emergencies have timeous care
2. Scale up E Motive approach for Early detection and treatment of PPH to all delivery facilities
3. Screening and early detection of TB to be improved
4. Integrated 6-week Postnatal clinics for mother and baby to be implemented
5. Medical/obstetric clinics to be promoted at regional and tertiary hospitals
6. Safe surgery and anaesthesia standards for CS to be audited and remediation done where indicated
7. Investigate inequities in outcomes between Metro West and East

Background to Western Cape maternity services

The Western Cape population is estimated at 7,231 000 (according to the 2022 mid-year population estimate by Statistics South Africa) which is 11.8% of the total SA population.

Within the Western Cape, there is a well-developed four-tiered system of maternity care with most deliveries taking place in district health facilities (district hospitals and midwife obstetric units). A package of care for the different levels (refined from existing national documents) as well as the skills needed to render the service and the equipment needed for each level of care was developed as a provincial policy document. In rural areas, the district hospitals do all deliveries and refer their specialist referrals to one of the three rural regional hospitals situated in Paarl, Worcester or George. All three of these hospitals have well developed outreach programmes with monthly visits to all the district hospitals that include morbidity and mortality meetings (PPIP), high risk obstetric clinics, specialist gynaecology clinics, and ESMOE training. Antenatal clinics refer complicated pregnancies to regional hospitals or to one of the two tertiary maternal and fetal medicine units, i.e. Groote Schuur or Tygerberg Hospitals.

In the metropolitan area of Cape Town, where two thirds of all the province's deliveries take place, 35% of all deliveries take place in midwife-only supported units (MOUs). The metro has four large district hospitals that provide maternity care (Karl Bremer, Helderberg, Khayelitsha and Mitchell's Plain Hospitals). A further 40% of deliveries take place at this level of care. The large metro district hospitals manage mainly referrals for poor progress in labour or suspected fetal distress from their respective MOUs, in addition to providing a district level package of care for gynaecology including emergency gynaecology.

The metro has three specialist hospitals (Mowbray, New Somerset, and Tygerberg Hospitals) which manage a further 20% of all deliveries at general specialist level and the remaining 5% of pregnancies with severe complications are referred to the tertiary/highly specialised units within the two central hospitals, Groote Schuur and Tygerberg. These hospitals are linked to two academic institutions, the University of Cape Town and Stellenbosch University respectively. Due to there being fewer district hospitals in the metro west area, New Somerset and Mowbray Maternity Hospitals also manage district level referrals from their MOUs and provide district level care to their surrounding areas.

There are six health districts in the Western Cape (Cape Town metro, West Coast, Cape Winelands, Overberg, Garden route and Central Karoo), but Cape Winelands has two regional hospitals, one on either side of the Limietberg mountains, and the geographical area of drainage therefore differs from the district boundaries. Paarl Hospital receives referrals from the West Coast and Winelands West; and Worcester Hospital from the Winelands East and Overberg areas. In addition, Saldanha Bay local municipality, although part of the West Coast sub-district, drains to New Somerset Hospital in the metro. Thus, for planning purposes there are five service drainage areas (George, Paarl, Worcester, Metro East, Metro West), each with a regional referral hospital and a clinical specialist as Head of General Specialist Services who is based at the regional hospital but provides clinical governance oversight, outreach and support for the whole drainage area.

Each of the five service delivery areas in the province works towards planning the maternity service and in the metro two technical teams (one in the GSH drainage/Metro West and one in the TBH drainage/Metro East) plan and implement the district health maternal and neonatal service (now also working on women's and child health) and address issues in service delivery. These technical teams are referred to as Service Coordinating Working Groups. Clinical governance for maternity and neonatal care is provided by a Provincial Clinical Guidance Committee (PCGC) comprised of the two Academic heads of department, the five provincial heads of general specialist services (three rural and two metropolitan, one of which chairs the meeting on a rotational basis), the NCCEMD facilitator, Maternal-Fetal, Reproductive Medicine and Oncology sub-specialists, a family physician and nursing representative, the MCWH deputy director and a senior manager that serves as link with the executive committee of the department of health.

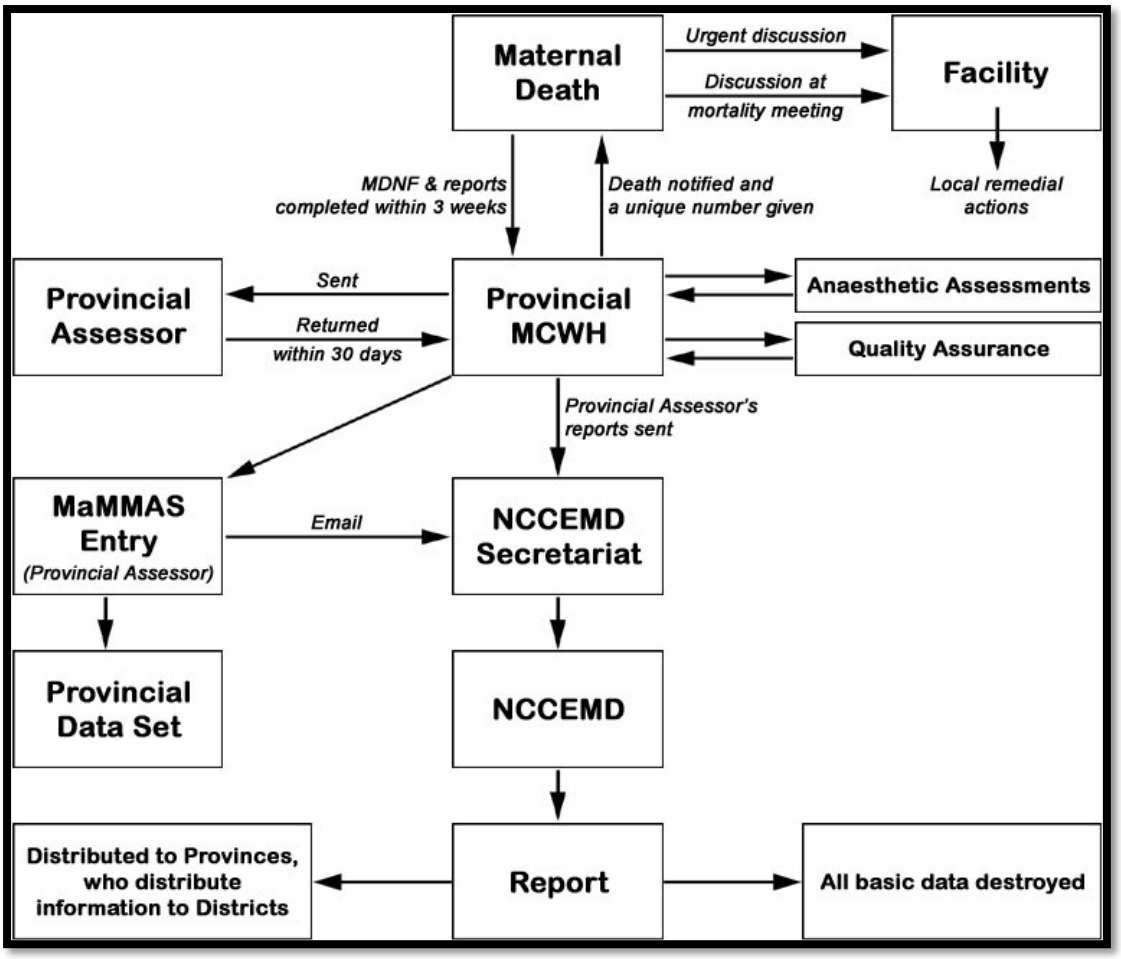
Five district specialist obstetricians have been appointed but there are no functioning DCST teams. ESMOE/EOST training is in process although restrictions associated with COVID-19 decreased the number of face-to-face training and simulation. From 2023 the province now has access to the K2 Perinatal training system, which is an online self-paced learning system available to doctors and nursing staff. This is deemed to replace some of the ESMOE content but should still be supplemented with regular simulation training in obstetric emergencies. The anaesthesia ESMOE module was revised with seven new e-learning lectures followed by a hands-on skills training day.

Process of the confidential enquiry into maternal deaths

The process is summarised in Figure one. The data presented in this report is derived from the MAMMAs database which includes anonymised data of every single Death during Pregnancy Childbirth and the Puerperium (DDPCP) with an assessment of cause, contributory factors, and avoidability or substandard care. These assessments were done by the WC maternal death assessment team composed of obstetricians, midwives, anaesthetists and family physicians; and coordinated by the MCWH coordinator. They assess in small groups which review deaths from other districts (not their own) and meet two monthly to monitor the process and discuss emerging problems. In addition, district data is provided by the MCWH coordinator from the provincial database Sinjani.

This report covers Western Cape deaths only. It is important to recognise that this report includes the COVID-19 pandemic which began in 2020.

Figure 1: Process of National Confidential Enquiry into Maternal Deaths



Maternal mortality in the Western Cape, 2020-2022

During this triennium, there were 299427 live births and a total number of 267 maternal deaths recorded with an iMMR of 89.2. There were 283 Deaths During Pregnancy, Childbirth and the Puerperium (DDPCP) reported to the NCCEMD. When the 16 Coincidental deaths were excluded, there were 267 maternal deaths.

Table 1. Maternal Mortality Western Cape 2020-2022

Western Cape	Live births	MaMMAS deaths (DDPCP)	MaMMAS MD	DHIS MD	MaMMAS MD (corrected)	MaMMAs iMMR	MaMMAs iMMR (corrected)	DHIS iMMR
2020	106058	105	99	77	99	93.35	93.35	72.6
2021	98746	105	101	79	101	102.28	102.28	80.0
2022	94623	73	67	63	67	70.81	70.81	66.6

There was a marked increase in the number of deaths in this triennium compared to previous years, with 99 deaths in 2020 and 101 in 2021 which coincided with the COVID-19 pandemic. The number of deaths in 2022 decreased to 67 almost the level of 2019 preceding the pandemic, when there were 56. The iMMR was 93.3/100 000 in 2020, compared to 102,3/100 000 in 2021, and 70.8/100 000 in 2022. The high iMMR in 2020 and 2021 was related to the increased number of deaths during the COVID-19 pandemic.

Figure 2. Western Cape Maternal Deaths 1998-2022

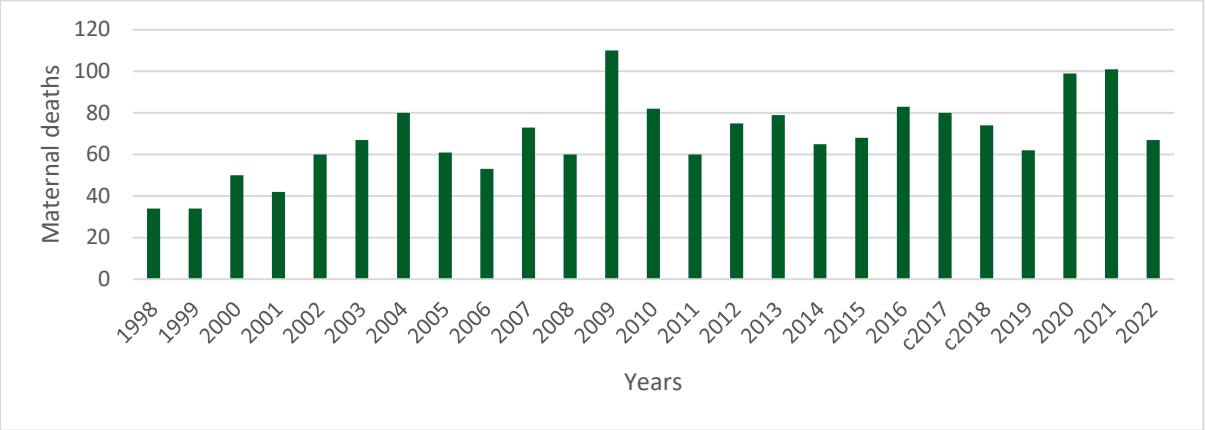
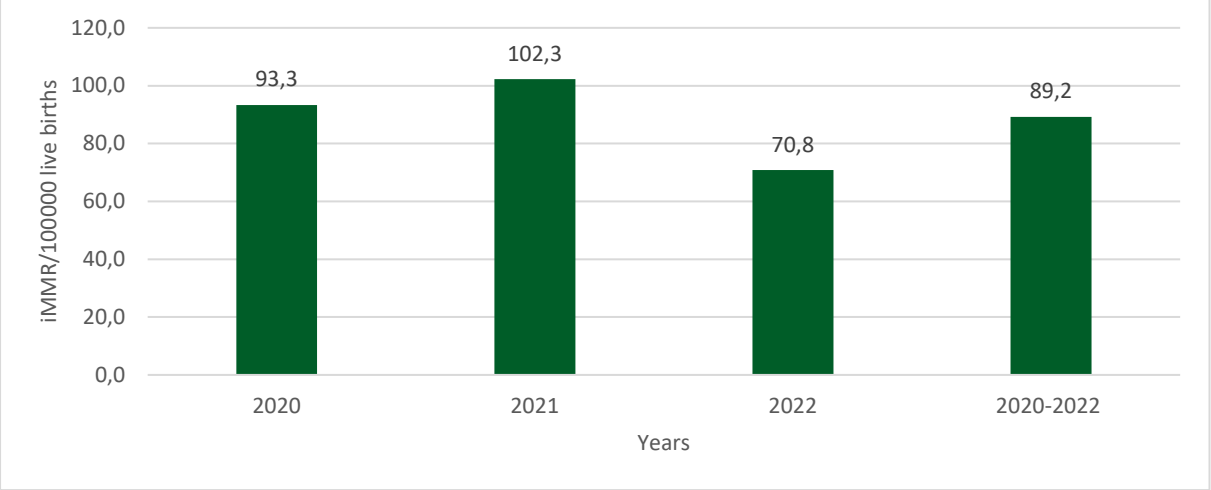
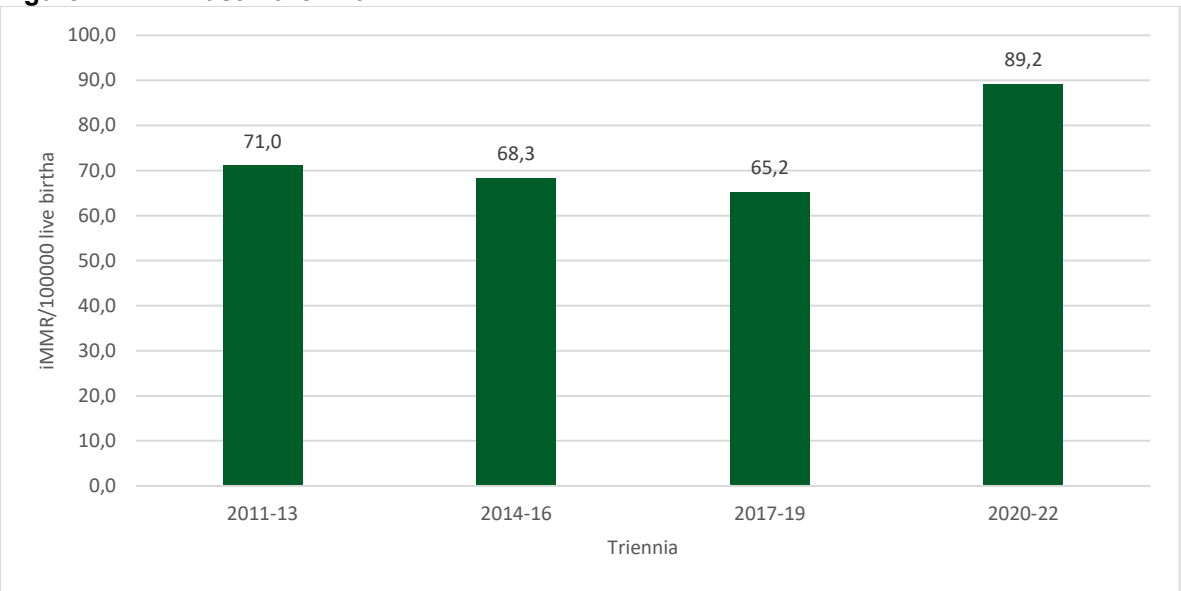


Figure 3. iMMR 2020-2022



The iMMR for the last 3 years has increased, and was the highest in 2021, this was mainly related to the COVID-19 mortalities. The iMMR for 2022 was 70.8, which was still higher than the previous 2 triennia, even though there were no reported COVID-19 deaths.

Figure 4. iMMR last 4 triennia



Demographic and clinical data

Place of death and Level of care

There were 283 DDPCP in the Western Cape Province across the six districts, with the highest number of deaths in the City of Cape Town. The numbers of deaths in this triennium have increased considerably since the last triennium. This triennium was characterised by the COVID-19 pandemic, which contributed to the surge in maternal deaths. Table 2 describes the number of deaths per district per triennium. The majority of deaths occurred at healthcare facility level. There were still some deaths that occurred at home and outside of hospital facilities. Deaths seldom occurred in transit. Out of the 283 deaths, 38 deaths occurred outside of a hospital facility, 12 deaths occurred in Community Healthcare centres, and 23 deaths occurred in Private hospitals. The majority of deaths occurred in Tertiary hospitals, compared to district and secondary hospitals (Table 3). The number of deaths outside and at CHCs remained relatively the same, but deaths at hospital facility level increased at all levels, including at private hospitals.

Table 2. Number of DDPCP per district by residence of the mother per triennium

District	2002-2004	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019	2020-2022
Metro	124	119	157	167	133	136	**200**
Cape Winelands	17	18	26	18	27	33	**36**
Overberg	7	7	10	2	8	11	**3**
West Coast	9	13	11	10	16	11	**8**
Central Karoo	5	4	7	0	5	5	**7**
Garden Route	28	22	31	17	27	24	**29**
Total W Cape	**190**	**183**	**242**	**214**	**216**	**220**	**283**

Table 3. District iMMR and number MDs 2020-2022

District where death occurred	Nr	Number of deliveries	iMMR
Cape Winelands District Municipality	36	47629	75.58
Central Karoo District Municipality	7	2878	243.22
City of Cape Town Metropolitan Municipality	***200***	190889	104.77
Garden Route District Municipality	29	29883	97.05
Overberg District Municipality	3	13547	22.15
West Coast District Municipality	8	15602	51.28
Total	**283**	**300428**	**94.20**

The largest number of deaths occurred in the Cape Town Metro, a tot al 200, with an iMMR of 104.7. There was a discrepancy in the distribution in the Metro West area with 57 (29%) and Metro East 112 (56%) the remaining Metro deaths occurred in private practise. This makes the iMMR of the Metros' Metro West 57 and Metro East 116.9. The reason for the discrepancy is unclear from the data require further investigations. The highest iMMR was in the Central Karoo district, although the absolute numbers are small.

Table 4. Comparison of levels of care where DDPCP's occurred 2011-2022

Level	2011-2013		2014-2016		2017-2019		2020-2022	
	N	%	N	%	N	%	N	%
Home/outside facility	19	8.9	26	12	35	15.9	38	13.4
CHC or MOU	9	4.2	9	4.2	14	6.4	12	4.2
Level 1 (district)	36	16.8	43	19.9	32	14.5	48	16.9
Level 2 (regional)	34	15.9	36	16.7	37	16.8	52	18.3
Level 3 (Central)	112	52.3	94	43.6	97	44.1	110	38.8
Private	4	1.9	8	3.7	5	2.3	23	8.1

Maternal age

Details of the number of maternal deaths per age category are shown in table 6. There was a reduction in the number of deaths in women below the age of 24, however, the number of deaths in women between 25 and 44 increased. These findings are also mostly likely explained by the COVID-19 pandemic as risk factors for severe COVID-19 were age-related.

Table 5. Number of maternal deaths per age group

Age	2014-2016 Number	2014-2016 %	2017-2019 Number	2017-2019 %	2020-2022 Number	2020-2022 %
<20	14	6.5	16	7.3	11	3.8
20-24	42	19.4	27	12.3	29	10.2
25-29	61	28.2	68	30.9	67	23.6
30-34	59	27.3	55	25.0	81	28.6
35-39	35	16.2	39	17.7	70	24.7
40-44	4	1.9	14	6.4	19	6.7
45+	0	0	1	0.5		
Unknown	1	0.5	0		6	2.1

Antenatal care attendance

Table 6. Antenatal care attendance by triennium

	2011-2013		2014-2016		2017-2019		2020-2022	
	N	%	N	%	N	%	N	%
Attended	145	67.8	157	72.7	149	67.7	199	70.3
Not Attended	42	19.6	35	16.2	45	20.5	45	15.9
Unknown	27	13	24	11.1	26	11.8	39	13.7

The number of women who attended antenatal clinic was 199, with the percentage (70%) remaining similar to the previous trienniums.

Parity

Proportionally there were less maternal deaths in nulliparous patients, this could possibly be related to COVID-19 mortality increasing with age.

Table 7. Maternal deaths by parity

Parity	2014-2016 N	2014-2016 %	2017-2019 N	2017-2019 %	2020-2022 N	2020-2022 %
0	55	25.5	62	28.2	64	22.6
1	64	29.6	47	21.4	76	26.8
2	51	23.6	47	21.4	60	21.2
3	20	9.3	22	10.0	40	14.1
4	5	2.3	13	5.9	16	5.6
5	3	1.4	4	1.8	5	1.7
6+	0	0	2	0.9	2	0.7
Unknown	18	8.3	23	10.5	20	7.0

HIV

The percentage of women who were HIV positive has decreased compared to different trienniums. The reason for this is unknown but could be due to the universal roll out of antiretroviral therapy, to all people living with HIV.

Table 8. HIV Status comparison 2011-2022

	2011-2013		2014-2016		2017-2019		2020-2022	
HIV Status	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Positive	86	40.2	66	30.6	64	29.1	80	28.2
Negative	96	44.9	118	54.6	126	57.3	165	58.3
Unknown	32	15	32	14.8	30	13.6	38	13.4

Causes of Maternal Deaths

Between 2020 and 2022 there were 299 427 live births, with the highest number of births in 2020. There were 99 maternal deaths in 2020, 101 in 2021 and 67 in 2022. The COVID-19 pandemic peaked between 2020 and 2021, which would explain the increase in the maternal mortality in 2020 and 2021. The leading cause of death remained non-pregnancy related infections, followed by medical and surgical disorders, then hypertension and obstetric haemorrhage. The maternal mortality rate for the triennium was 89.7/100 000. The year 2021 had the highest MMR. There were an additional 70 deaths due to COVID-19 in 2020 and 2021, which were not there in previous trienniums.

Table 9. Triennial Comparison of Causes of Death 2011 – 2022

	2011-2013		2014-2016		2017-2019		2020-2022	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Direct	**90**	**45**	**96**	**49.2**	**106**	**52.2**	**112**	**31.9**
Hypertension	36	18	26	13.3	25	12.3	32	11.3
Haemorrhage	14	7	21	10.8	21	10.3	28	9.9
Ectopic pregnancy	1	0.05	6	3.1	6	3	5	1.7
Miscarriage	5	2.5	4	2.1	3	1.5	3	1.1
Preg. Related Sepsis	16	8	13	6.7	17	8.4	12	4.2
Anaesthetic related	1	0.05	4	2.1	5	2.5	3	1.1

	2011-2013		2014-2016		2017-2019		2020-2022	
	N	%	N	%	N	%	N	%
Embolism	10	5	13	6.7	16	7.9	15	5.6
Acute collapse	7	3.5	4	2.1	5	2.5	10	3.5
Adverse drug reactions	0		1		3	1.5	0	0
Miscellaneous	0		4	2.1	5	2.5	4	1.4
Indirect	**106**	**53**	**91**	**46.7**	**84**	**41.4**	**145**	**54.3**
Non-pregnancy-related Infection	67	33.5	46	23.6	49	24.1	110	41.2
Medical and Surgical Disorder	39	19.5	45	23.1	35	17.2	35*	12.3
Unknown/Other	**4**	**2**	**8**	**4.1**	**13**	**16.4**	**10**	**3.5**
Total Maternal Deaths	**200**	**100**	**195**	**100**	**203**	**100**	**267**	**100**
Coincidental	14		21		17		16	
DDCP	214		216		220		283	

Primary Cause of death

When looking at primary obstetric cause of death these were the leading single causes.

Table 10. Primary Cause of Death

Primary Obstetric Cause	Number (% of total n = 283)
COVID-19	70 (24.7)
Eclampsia	17 (6.0)
Cardiac (cardiomyopathy, Rheumatic heart disease, Other)	15 (5.3)
Embolism	15 (5.3)
Tuberculosis	13 (4.5)
Pregnancy related Sepsis	12 (4.2)
Acute Collapse	10 (3.5)
Bleeding after CS	9 (3.2)

When looking at the primary cause of death, other than COVID-19 which is discussed below, there were a high number of deaths related to Eclampsia. Tuberculosis, and Cardiac disease remain a concern. The high number of embolism deaths could also be related to COVID-19, or a higher detection rate due to increased access to diagnostic testing, and postmortem investigations.

Delivery route

There were 109 maternal deaths in women who had a caesarean section, compared to 76 women who had a vaginal delivery and 86 women who were undelivered. The caesarean delivery rate for the triennium was 29.8%. The largest proportions of deaths of women who were delivered by CD were in the NPRI, M&S and obstetric Heamorrhage categories.

Table 11. Delivery outcomes per triennium

Route of delivery	2011-2013		2014-2016		2017-2019		2020-2022	
	N	%	N	%	N	%	N	%
Vaginal	57	28.3	51	23.6	60	27.3	76	26.9
Assisted	2	1	7	3.2	2	0.9	11	3.9
Caesarean deliveries	73	36.3	74	34.3	64	29.1	109	38.2
Ectopic					7	3.2	6	2.1
Undelivered	69	34.4	84	38.9	87	39.5	90	31.8

Caesarean delivery case fatality rates

The number of deaths who had a CD and the case fatality rate for CS increased significantly in 2020-2022. There were 38 women who died of NPRI who had a CS which can account for some of the increase, as in many women with severe COVID-19 delivery by CS was indicated to improve ventilation of the mother. Heamorrhage, hypertension and embolism were the other categories where there had high numbers of CD, see table 13. There was an increase in the caesarean section rate in the province, with the current rate of 29.8%, this is not taking the private sector into consideration see table 14. The bleeding at CD case fatality rate has increased in the province to 11/100 000 CD compared to 6.9 in the previous triennium, see table 15.

Table 12. Delivery route per cause of death

Primary obstetric problems	CD	%	Vaginal	%	Undelivered	%	TOTAL
Coincidental cause	0	0	1	7.14	13	92.86	14
Medical and surgical disorders	14	43.75	5	15.63	13	40.63	32
Non-pregnancy-related infections	39	37.50	28	26.92	37	35.58	104
Pregnancy-related sepsis	5	41.67	6	50.00	1	8.33	12
Obstetric haemorrhage	13	50.00	12	46.15	1	3.85	26
Hypertension	14	45.16	7	22.58	10	32.26	31
Anaesthetic complications	2	66.67	0	0.00	1	33.33	3
Embolism	8	53.33	4	26.67	3	20.00	15
Acute collapse - cause unknown	5	50.00	3	30.00	2	20.00	10

Table 13. Caesarean Section Case Fatality rates

	2014 - 2016	2017 – 2019	2020-2022
Total deliveries	296756	285896	306012
Caesarean deliveries	83353	80370	91123
CD rates	28.1%	28.1	29.8
CD deaths	74	64	109
CD Case Fatality Rate	88.8	79.6	119.6

	2014 - 2016	2017 – 2019	2020-2022
	per 100,000 CD	per 100,000 CD	Per 100,000 CD

Table 14. BLDACD and BLDACD rates per province 2020-2022

Province	CD 2020-2022 N	CD Rate 2020-2022 %	BLDACD death 2020-2022 N	BLDACD CFR 2020-22 per 100,000 CD	BLDACD CFR 2017-19 per 100,000 CD	BLDACD CFR 2014-16 per 100,000 CD
Western Cape	91123	29.8	10	11	6.9	15.6
South Africa	889497	28.8	198	22.3	23.6	31.7

NPRI and the Impact of COVID-19

NPRI remained the leading cause of death, 110 (36.74%) of all deaths. It was the leading cause in 2020 where 45 (42.43%) deaths were caused by NPRI and in 2021 there were 52 (52.55%), However in 2022, it was only the second most common cause with 13 (13.74%) deaths. There were 46 (41%) known to be HIV positive.

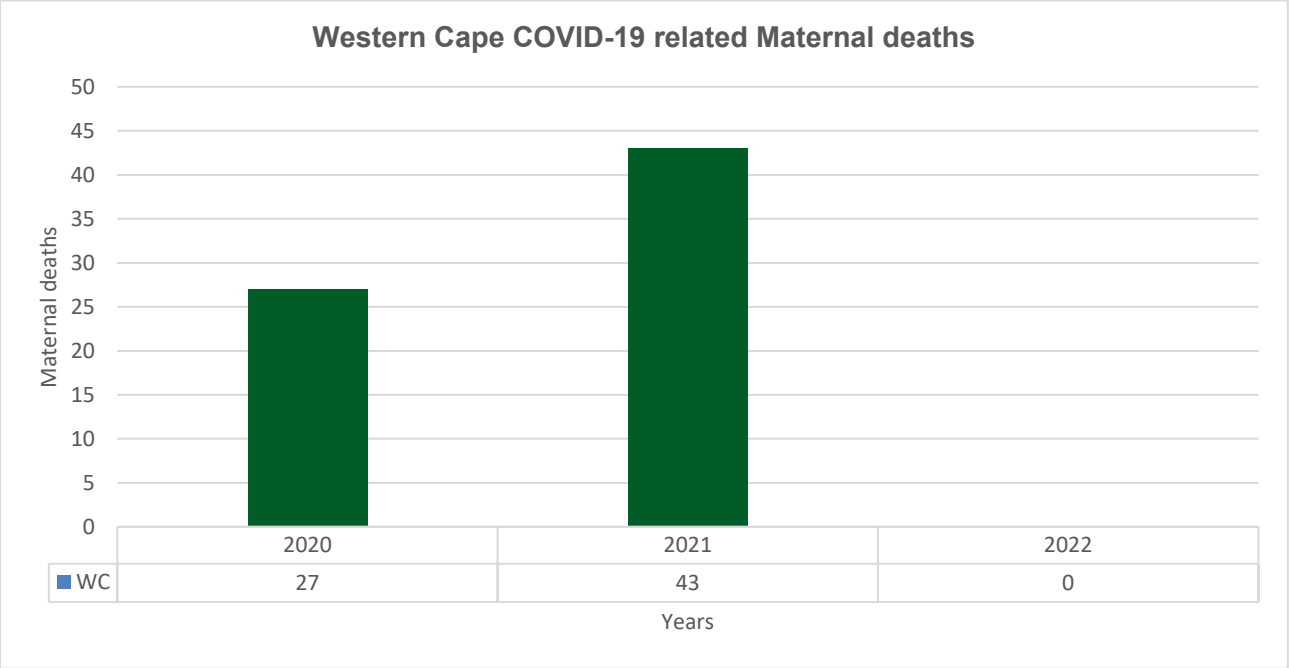
COVID-19 was the biggest underlying infection in this category with 70 (26.2%) maternal mortalities directly caused by COVID-19 infection. In 2020 there were 27 (29%) deaths from COVID-19, 2021 43 (42%). It is likely that these numbers are not fully representative of all the deaths as universal screening with PCR testing of all pregnant women was not feasible in the province. In the category of NPRI there were an additional seven deaths from “Other Pneumonia” and 74 categorised as “Other” which includes the 70 specified as COVID-19. It is possible that COVID-19 could have contributed to both the unknown cause category (10 deaths) and the large number, 15, of embolism deaths, as these are both associated with COVID-19.

Table 15. Causes of Death, NPRI

Non-pregnancy-related infections	110	%
- PCP pneumonia	2	1.8
- Other pneumonia	7	6
- TB	13	11.8
- UTI	2	1.8
- Appendicitis	2	1.8
- Cryptococcal meningitis	2	1.8
- Other meningitis	5	4.5
- Gastroenteritis	2	1.8
- Wasting syndrome	1	0.9
- Other*	74	76
**COVID-19*	*70*	*63.6*

**COVID-19 related deaths were classified as NPRI/Other/COVID-19*

Figure 5. COVID-19 Mortalities per year



The deaths due to NPRI occurred at all levels of care include 12 (10%) in the private sector, 19 (17%) in district hospital, 25 (22%) at regional hospitals and 22 (40%) at tertiary level hospitals, there were also six outside facilities and four at community heath clinics.

The deaths occurred mainly in the Cape Town metro 77 (70%), with 15 (13%) in the Eden district and 14 (12.7%) in the Cape Winelands and four West Coast. There were none in the Central Karoo and Overberg which could be explained by the decrease incidence of COVID-19 in rural areas during the pandemic, or that these women were referred to higher levels of care.

Respiratory failure was the final cause of death in 38.2% of all deaths, as it is the most common mechanism of death related to COVID-19. With the roll-out of vaccinations and the decreased virulence of the later strains, there were no further deaths from COVID-19 in 2022.

Maternal deaths indirectly related to COVID-19

Several health system changes were implemented, to avail resources to the expected burden on the health system. Antenatal and intrapartum care were considered essential services and did not de-escalate during the pandemic However, health workers and patients' fear, access, transport and income loss at this time could have affected the quality and accessibility of antenatal care.

Avoidable factors missed opportunities and substandard care.

Maternal death assessor teams review all cases of maternal mortality to identify avoidable factors and substandard care. This is to highlight areas of improvement. In 179 (63%) of the deaths, no substandard care was identified, and in 34 (12%), it was deemed that suboptimal care had a probable impact on the outcome. These numbers were similar in the previous triennium.

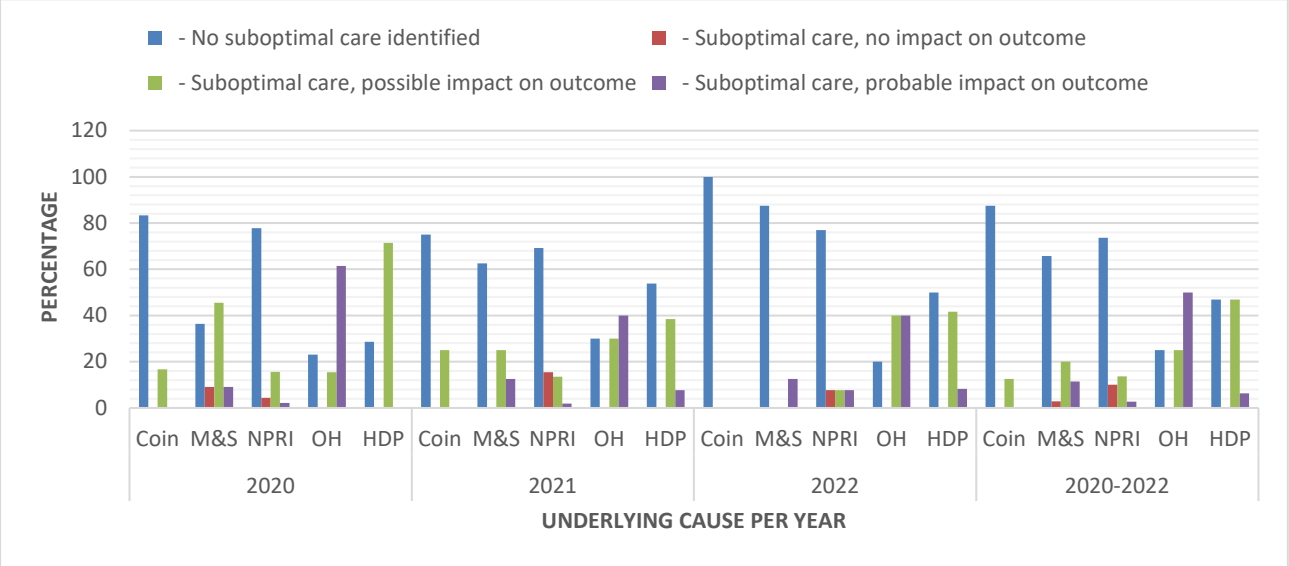
Table 16. Impact of Suboptimal Care 2017-2019 vs 2020-22

Impact of suboptimal care	2020-22 (n)	%	2017-19 (2)	%
No suboptimal care identified	179	63.3	132	60
Suboptimal care, no impact on outcome	15	5.3	17	7.7
Suboptimal care, possible impact on outcome	55	19.4	40	18.2

Impact of suboptimal care	2020-22 (n)	%	2017-19 (2)	%
Suboptimal care, probable impact on outcome	34	12.0	31	14.1
Total	**283**		**220**	

When the standard of care is reviewed by cause of death the distribution of suboptimal care per five leading causes is illustrated in Figure 6. For NPRI, in 81 (73%) of cases there was no suboptimal care identified, and only in 3 (2.7%) suboptimal care could have probably impacted the outcome. In M & S, there was suboptimal care in 12 (34%) cases; in four, it could have impacted the outcome. Alarmingly in the cases where OH was the cause of death, there were only 7 (25%) of cases with no suboptimal care and in 14 (50%), suboptimal care could have probably impacted the outcome.

Figure 6. Impact of Suboptimal Care per Underlying Cause



Avoidable Factors

There were no major differences in overall avoidability from the previous triennia. Patient orientated factors were slightly less, and administrative factors were significantly more than previous years. Likely reflecting the collateral effect of the COVID-19 pandemic. Avoidable factor by level of care remained similar with a trend to decrease as level of care increases, showing resilience and dedication of healthcare providers.

Table 17. Avoidable factors, missed opportunities and substandard care

Category	Percentage of avoidable factors in assessable cases			
	2011-2013	2014-2016	2017-2019	2020-2022
Patient orientated	31.8	29.6	39.1	26.9
Administrative factors	15.4	7.4	10.9	19.4
Health worker related emergency management problems				
- Primary level	29	37.5	27.5	28.5
- Secondary level	14.5	29.3	30.4	18.4
- Tertiary level	15.4	27.8	15.7	18.1
Resuscitation	36.9	32.4	30	32.9

With regards to patient orientated factors there were less avoidable factors identified as the previous triennium,

and less cases where there were no antenatal care. This shows that women continued to seek care for their pregnancies despite the pandemic. Delay seeking help 47 (16.6%) was the most common factor followed by declining medical advice 21 (7%).

Table 18. Avoidable factors, missed opportunities and substandard care with respect to patient-orientated problems

	Percentage of assessable deaths with avoidable factors			
	2011-2013 (n=214)	2014-2016 (n=216)	2017-2019 (n=220)	2020-2022 (n=283)
No avoidable factors	53.7	57.9	47.7	55.1
No antenatal care	14.5	7.9	13.2	8.8
Infrequent antenatal care	2.8	4.2	9.5	2.1
Declined medication/surgery/advice	Not assessed	Not assessed	Not assessed	7.4
Delay in seeking medical help	15	9.7	17.3	16.6
Unsafe abortion	0	0.5	0	0
Other	0.9	5.1	4.1	0.7

Table 19. Avoidable factors, missed opportunities and substandard care with respect to administrative problems for all cases

Major Problems	2014-2016 n=216 (%)	2017-2019 n=220(%)	2020-2022 n=283(%)
No avoidable factor	181 (83)	182(82.7)	194(86.5)
Transport problem home to institution	0	2(0.9)	4(1.4)
Transport problem between institutions*	7(3)	4(1.8)	11(3.8)
Barriers to entry	1(0.4)	0	0
Lack of accessibility	0	1(0.4)	2(0.7)
Delay in attending to patient (Overburdened service)	Not assessed	Not assessed	11(3.8)
Lack of healthcare facilities	1(0.4)	4(1.8)	3(1)
Lack of ICU facilities	1(0.4)	3(1.3)	17(6)
Lack of blood products**	0	4(1.8)	2(0.7)
Lack of personnel	0		7(2.4)
Lack of appropriately trained staff	4	2	11
Communication problems	4	2	6
Other	2	5	2

The largest contributing factors to administrative problems were lack of ICU facilities 17 (6%), delay in attending patient (overburdened services) 11, lack of appropriately trained staff 11 and delays with inter-institution transport. It is likely that many of these coincided with the overburdened services during the COVID-19 pandemic.

Table 20. Medical Management Avoidable factors

Medical management problems	CHC/MOU N (%)	District N (%)	Regional N (%)	Tertiary N(%)	Private N (%)
Managed at Level	89 (100)	137(100)	87(100)	127(100)	30(100)
Lack of information	18(20.2)	15(10.9)	14(16.1)	12(9.4)	6 (20)
No avoidable factor	53(59.6)	85(62)	58 (66.7)	93 (73.2)	15 (50)
Initial assessment	1(1.1)	4(2.9)	2(2.3)	1(0.8)	0
Problem with recognition / diagnosis	8(9)	24(17.5)	7(8)	13(10.2)	7(23.3)
Delay in referring the patient	4(4.5)	9(6.6)	1(1.1)	0	2(6.7)
Managed at inappropriate level	3(3.4)	10(7.3)	2(2.3)	0	0
Incorrect management (Incorrect diagnosis)	2(2.2)	4(2.9)	3(3.4)	3(2.4)	4(13.3)
Sub-standard management (Correct diagnosis)	8(9)	10(7.3)	8(9.2)	12(9.4)	1(3.3)
Not monitored / Infrequently monitored	4(4.5)	1(0.7)	1(1.1)	2(1.6)	1(3.3)
Prolonged abnormal monitoring with no action taken	1(1.1)	1(0.7)	3(3.4)	4(3.1)	1(3.3)

The biggest contributing avoidable factor identified from the medical care was with problem recognition and diagnosis, table 21, this occurred at all levels of care, CHC 9%, 24 (17.5%) DH, 7 (8%) RH, 13 (10.2%) TH and 7 (23.3%) PH. This was followed by Substandard management and correct diagnosis.

Anaesthesia related mortalities 2020-2022

Compiled by Jonathan Burke and Esther Cloete (Records from MaMMAS and DRAMA databases)
There were a total of 91123 caesarean deliveries (CD), performed in the Western Cape public sector during this triennium. Of these 70% were performed in the City of Cape town metro geographical area. In 109 (39%) of the total 283 maternal deaths recorded for the triennium, an anaesthetic was administered.

DRAMA database avoidable factors *(In order of frequency)*

- Administrative:
  - District junior staff anaesthetising high-risk patients. In some situations this is inevitable but the importance of early consultation with the referring hospital for advice and management should be highlighted, as well as the fact that ESMOE training should be done regularly.
  - Lack of required drugs (bupivacaine with dextrose).
  - No access to theatre due to limited theatre capacity.
  - Delay in ambulance transfer to a higher level of care.
- Clinical decision-making: (In order of frequency)
  - Delay in recognition of symptoms or complications.
  - CD spinal hypotension inadequate vasopressor use. Adrenalin dose inappropriate for hypotension management.
  - Inadequate resuscitation fluids/blood products. No blood ordered pre-op with high haemorrhage risk.
  - Ambulance transfer of critically ill patient who dies enroute.
  - Pulmonary embolism deaths post-surgery. Are anaesthetists following the guidelines?
- Record keeping:
  - substandard records: fluid co-load, uterine displacement, testing of block height not recorded, drug administration, no notes on resuscitation.

In one record the spinal anaesthetic was assessed to have contributed to the death with obstetric haemorrhage assessed the primary cause. In three records the anaesthetic was assessed to be the primary cause of death

- two spinal anaesthetic deaths
- one general anaesthetic death

Spinal anaesthesia learning points and recommendations.

Hypotension following spinal anaesthesia is very common (80%). This is mostly due to the spinal anaesthetic induced sympathectomy resulting in vasodilatation. Anticipation and prevention of hypotension is key to good maternal outcomes.

- **Basic management**: Left lateral uterine displacement, 500ml - 1000ml fluid co-loading and aggressive vasopressor use to ensure haemodynamic goals of 80mmHg mean non-invasive blood pressure, heart rate of 80 beats per minute and maintaining O2 saturation above 96%. If aggressive vasopressor use is unsuccessful in restoring haemodynamic stability administer adrenalin boluses (10-20 microgram not 1mg)
- **Monitor** while standing next to the patient, finger on the pulse, communicate with the patient to assess cerebral perfusion and test the level of the block for the first 10-15 min after the spinal injection. Early recognition of block height and cardiorespiratory changes are vital to guide management.
- **Testing the block height** should include a bilateral hand grip test as a high spinal block above T4 level will be missed if only the thoracic nerves are tested. It is essential not to be distracted while monitoring the patient from the time the spinal is in until the corners of the uterus are sutured, and bleeding is under control.
- **Severe hypotension** will cause cerebral hypoperfusion, apnoea and hypoxia resulting in cardiac arrest. Rapid treatment of hypotension should prevent apnoea, hypoxia and arrest. In the case where the haemodynamic status has been restored and the patient is still not breathing manage as a high spinal by active opening of the airway, intubation and ventilation. Do not administer an induction agent like propofol to a hypotensive unconscious patient. Succinylcholine may be needed to assist with intubation.
- **High spinal** is a continuum of symptoms in the cardiovascular, respiratory and neurological systems. Patients with a potentially high spinal should be monitored meticulously and rapid conversion to intubation as needed. https://www.sajaa.co.za/index.php/sajaa/article/view/1791
- **Heavy Bupivacaine is out of stock, what do I do now?** When using isobaric bupivacaine the position is as important as with hyperbaric bupivacaine. It might cause greater hemodynamic instability in the patient as well as a lower level of spinal blockade. Hyperbaric bupivacaine has a slightly faster onset of action while Isobaric has a longer duration of action.
- **My patient is shorter than 1.5m, what volume do I add to my spinal anaesthetic?** Ideally, patients on the spectrums of weight and height should be referred to a higher level of care. If not possible use a dose of 0.06mg/cm hyperbaric bupivacaine for the very short <150 cm patient. This will be a dose of 1.8ml of Hyperbaric Bupivacaine 0.5% and instead of the standard recommendation of 2ml of Hyperbaric Bupivacaine.
- **Differential diagnosis for sudden collapse/arrest during spinal anaesthesia** Consider other causes for arrest: high spinal, hypoxia, venous thromboembolism, haemorrhage, anaphylaxis, eclampsia, cardiac conditions: mitral stenosis, cardiomyopathy, aortic dissection, and amniotic fluid embolism.
- **Peri-mortem caesarean section**.

General anaesthetic learning points and recommendations.

Airway complications are often unexpected, and it is not always possible to predict the high-risk airway.

- **Airway evaluation** for all patients coming to theatre should be standard of care.
- **Theatre preparation** for the unexpected difficult airway should include all emergency drugs, airway equipment with immediate access to a video laryngoscope for all obstetric general anaesthetics.
- **A plan for failed intubation** should be made and communicated to the team before induction, to awaken or to proceed with surgery.
- **Apnoeic oxygenation** via anaesthetic face mask, nasal prongs or nasopharyngeal airway is recommended for all general anaesthetics. It is however not effective if the airway is obstructed by the tongue and soft tissue. The method below can overcome the problem of airway obstruction and improve oxygenation during difficult intubation.
- **Cricoid pressure** can be reduced/released sightly if that contributes to difficult laryngoscopy.
- **Difficult airway scenario** algorithm training

Full guidelines available: https://das.uk.com/guidelines/obstetric_airway_guidelines_2015

Summary of findings from 2020-2022 Western Cape report

During 2020-2022 there were an increase in the number of maternal deaths in the Western Cape as well as the country. Most of the excess deaths (24%) were directly from COVID-19. There was an increase from deaths due to obstetric Haemorrhage and hypertensive disorders specifically Eclampsia, and Embolism, this could be due to the increase Burdon on the health system, as well as the lack of regular ESMOE training during and after the COVID-19 pandemic. The case fatality rate for CD increased markedly, with an increases case fatality rate due to bleeding at CS. The leading causes of death in the Western Cape differ somewhat to that of the National report, with Medical and Surgical disorders and Embolism higher on the list, which is more in keeping with high-income countries. This could be due to improved care in some areas and perhaps the impact of the obesity pandemic; however, as BMI is not captured, this is not clear in the data. This should be assessed in future. Lack of ICU facilities and transport between facilities were administrative factors that contributed to deaths. Problem recognition and lack of appropriately trained staff were the highest occurring staff-related contributors.

Recommendations

Approach to Key Recommendations for the Western Cape 2020-2022
STANDARDISE: Denominators per live births in public sector but not private sector. Need to engage more with the private sector.
CONTINUE*:* Continue focus on safe Caesarean Delivery. TB remains a concern, early detection and screening should continue to be prioritised. Screening and prioritising thromboprophylaxis for women at high risk.
IMPLEMENT: E Motive as a new intervention, should be implemented as part of ESMOE. NASG- Not yet implemented needs to be procured. Postnatal policy which encourages integrated six-week postnatal visits for mother and baby, has not yet been implemented, meaning women have inadequate postnatal surveillance. Add recording of BMI to assessor's sheet.
ADVOCATE: Capacity at regional hospital should increase, theatre facilities as well as healthcare workers. The high iMMR in Metro East needs further attention and thorough investigation.
NEW FOCUS: Community Health Workers to empower women to seek help during the antenatal and post-natal periods. Improve clinical governance of the management of early pregnancy complications, by involving community health workers.

Table 20. 5 leading causes with problems and crosscutting issues for recommendations

Cause of death	Number (%)	Comments and Recommendations
1. NPRI	110(41.2%)	This remains the leading cause. Infectious diseases especially respiratory tract infections in pregnancy should be part of undergraduate and ESMOE training. Screening, treatment of TB and HIV should remain a priority.
2. M&S	35 (12.3%)	Collaboration with specialist clinics, and provision of contraception to women with high-risk conditions such as cardiac disease is essential.
3. Hypertension	32(11.3%)	Hypertensive burden remains high in the province, ESMOE training and vigilant management of women with pre-eclampsia and eclampsia is crucial.
4. Haemorrhage	28(9.9%)	Implementation of E-motive approach for PPH is recommended. Procurement and use of NASG should be implemented. Continued focus on Safe CS is needed

Cause of death	Number (%)	Comments and Recommendations
5. Embolism	15(5.6%)	Risk assessment for embolic disease and appropriate prophylaxis should become part of obstetric training and management.

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9. APPENDICES

Appendix 9.1. Validity of data and corrections made for suspected under-reporting

For each province, where the DHIS data was greater than the MaMMAS maternal deaths (DHIS>MaMMAS), MaMMAS data was corrected. MaMMAS MD was corrected to DHIS MD value. The percentage increase in MaMMAS data was used to correct the DDPCP

Table A.1. 2020-2022. Corrected maternal deaths, and iMMR *(© corrected)*

2020	Live births	MaMMAS deaths (DDPCP)	MaMMAS MD	DHIS MD	MaMMAS MD (corrected)	MaMMAs iMMR	MaMMAs iMMR (corrected)
© ec Eastern Cape Province	109077	146 (c168)	139	160	160	127.43	146.69
fs Free State Province	48452	93	89	70	89	183.69	183.69
© gp Gauteng Province	240270	260 (c276)	255	271	271	106.13	112.79
kz KwaZulu-Natal Province	214694	252	250	220	250	116.44	116.44
lp Limpopo Province	140542	167	166	157	166	118.11	118.11
mp Mpumalanga Province	92094	99	95	77	95	103.16	103.16
nc Northern Cape Province	22042	23	23	17	23	104.35	104.35
nw North West Province	62026	83	81	72	81	130.59	130.59
wc Western Cape Province	106058	105	99	77	99	93.35	93.35
South Africa	**1035255**	**1228 (c1266)**	**1197**	**1121**	**1234**	**115.62**	**119.20**

2021	Live births	MaMMAS deaths (DDCP)	MaMMAS MD	DHIS MD	MaMMAS MD (corrected)	MaMMAs iMMR	MaMMAs iMMR (corrected)
ec Eastern Cape Province	110909	154	153	151	153	137.95	137.95
fs Free State Province	49073	115	114	100	114	232.31	232.31
© gp Gauteng Province	227182	331 (c349)	323	341	341	142.18	150.10
kz KwaZulu-Natal Province	214224	280	276	274	276	128.84	128.84
lp Limpopo Province	135892	200	196	191	196	144.23	144.23
mp Mpumalanga Province	95700	168	167	142	167	174.50	174.50
nc Northern Cape Province	22528	43	43	38	43	190.87	190.87
nw North West Province	61528	117	116	97	116	188.53	188.53
wc Western Cape Province	98746	105	101	79	101	102.28	102.28
South Africa	**1015782**	**1513 (c1531)**	**1489**	**1413**	**1507**	**146.59**	**148.36**

2022	Live births	MaMMAS deaths (DDCP)	MaMMAS MD	DHIS MD	MaMMAS MD (corrected)	MaMMAs iMMR	MaMMAs iMMR (corrected)
ec Eastern Cape Province	103147	134	133	132	133	128.94	128.94
fs Free State Province	47336	59	55	50	55	116.19	116.19
© gp Gauteng Province	218619	216 (c272)	211	266	266	96.51	121.67
© kz KwaZulu-Natal Province	215381	181 (c197)	176	189	189	81.72	87.75
© lp Limpopo Province	124648	119 (c144)	118	143	143	94.67	114.72
mp Mpumalanga Province	82270	113	113	105	113	137.35	137.35
nc Northern Cape Province	22153	26	26	22	26	117.37	117.37
nw North West Province	59951	72	70	65	70	116.76	116.76
wc Western Cape	94623	73	67	63	67	70.81	70.81

Province							
South Africa	**968128**	**993 (c1090)**	**969**	**1035**	**1062**	**100.09**	**109.70**

Appendix 9.2. 2020-2022. iMMR per district

Province	District	Maternal death	Births in facility	iMMR
ec Eastern Cape Province	Alfred Nzo Districts	25	39696	62.98
ec Eastern Cape Province	Amathole+ Buffalo city	104	68147	152.61
ec Eastern Cape Province	Chris Hani	41	34172	119.98
ec Eastern Cape Province	Joe Gqabi District Municipality	2	14446	13.84
ec Eastern Cape Province	Nelson Mandela Bay Metropolitan	95	57787	164.40
ec Eastern Cape Province	Oliver Tambo	156	90883	171.65
ec Eastern Cape Province	Sarah Baartman	11	18589	59.17
ec Eastern Cape		**434**	**323720**	**134.07**
fs Free State Province	Fezile Dabi	40	22978	174.08
fs Free State Province	Lejweleputswa	64	31763	201.49
fs Free State Province	Mangaung Metropolitan Municipality	93	50040	185.85
fs Free State Province	Thabo Mofutsanyana	67	38699	173.13
fs Free State Province	Xhariep District Municipality	3	2481	120.92
fs Free State		**267**	**145961**	**182.93**
gp Gauteng Province	City of Johannesburg Metropolitan Municipality	281	229959	122.20
gp Gauteng Province	City of Tswhane Metropolitan	208	166893	124.63
gp Gauteng Province	Ekurhuleni Metropolitan Municipality	225	199582	112.74
gp Gauteng Province	Sedibeng District Municipality	42	44107	95.22
gp Gauteng Province	West Rand District Municipality	51	49004	104.07
gp Gauteng		**807**	**689545**	**117.03**
kz KwaZulu-Natal Province	kz Amajuba District Municipality	35	30625	114.29
kz KwaZulu-Natal Province	kz eThekwini Metropolitan Municipality	268	208212	128.71
kz KwaZulu-Natal Province	kz Harry Gwala District Municipality	19	24645	77.09
kz KwaZulu-Natal Province	kz iLembe District Municipality	26	36060	72.10
kz KwaZulu-Natal Province	kz King Cetshwayo District Municipality	90	65498	137.41
kz KwaZulu-Natal Province	kz Ugu District Municipality	47	43738	107.46
kz KwaZulu-Natal Province	kz uMgungundlovu District Municipality	116	60161	192.82
kz KwaZulu-Natal Province	kz Umkhanyakude District Municipality	14	49990	28.01
kz KwaZulu-Natal Province	kz Umzinyathi District Municipality	17	35468	47.93
kz KwaZulu-Natal Province	kz Uthukela District Municipality	37	41293	89.60

Province	District	Maternal death	Births in facility	iMMR
kz KwaZulu-Natal Province	kz Zululand District Municipality	44	52142	84.38
kz KwaZulu-Natal		**713**	**647832**	**110.06**
lp Limpopo Province	lp Capricorn District Municipality	237	87315	271.43
lp Limpopo Province	lp Mopani District Municipality	71	88089	80.60
lp Limpopo Province	lp Sekhukhune District Municipality	68	83243	81.69
lp Limpopo Province	lp Vhembe District Municipality	68	96139	70.73
lp Limpopo Province	lp Waterberg District Municipality	42	46296	90.72
lp Limpopo		**486**	**401082**	**121.17**
mp Mpumalanga Province	mp Ehlanzeni District Municipality	180	137657	130.76
mp Mpumalanga Province	mp Gert Sibande District Municipality	91	64866	140.29
mp Mpumalanga Province	mp Nkangala District Municipality	109	67541	161.38
mp Mpumalanga		**380**	**270064**	**140.71**
nc Northern Cape Province	nc Frances Baard District Municipality	40	25371	157.66
nc Northern Cape Province	nc John Taolo Gaetsewe District Municipality	23	14688	156.59
nc Northern Cape Province	nc Namakwa District Municipality	1	4622	21.64
nc Northern Cape Province	nc Pixley ka Seme District Municipality	7	8707	80.40
nc Northern Cape Province	nc Zwelentlanga Fatman Mgcawu District Municipality	21	13335	157.48
nc Northern Cape Province		**92**	**66723**	**137.88**
nw North West Province	nw Bojanala Platinum District Municipality	98	65861	148.80
nw North West Province	nw Dr Kenneth Kaunda District Municipality	71	38218	185.78
nw North West Province	nw Dr Ruth Segomotsi Mompati District Municipality	34	31165	109.10
nw North West Province	nw Ngaka Modiri Molema District Municipality	69	48261	142.97
nw North West Province		**272**	**183505**	**148.22**
wc Western Cape Province	wc Cape Winelands District Municipality	36	47629	75.58
wc Western Cape Province	wc Central Karoo District Municipality	7	2878	243.22
wc Western Cape Province	wc City of Cape Town Metropolitan Municipality	200	190889	104.77
wc Western Cape Province	wc Garden Route District Municipality	29	29883	97.05
wc Western Cape Province	wc Overberg District Municipality	3	13547	22.15
wc Western Cape Province	wc West Coast District Municipality	8	15602	51.28
wc Western Cape		**283**	**300428**	**94.20**
SA Total		**3734**	**3028860**	**123.28**

Province	District	Maternal death	Births in facility	iMMR

NOTE: Live births used to calculate the district iMMR is a recently updated version. Thus the total live births and therefore the iMMR per province and for SA total increased.

Appendix 9.3. 2020-2022. Causal Subcategories of death for each primary obstetric cause per province

Primary obstetric problems	Eastern Cape	Free State	Gauteng	Kwa-Zulu Natal	Limpopo	Mpumalanga	North West	Northern Cape	Western Cape	Total
Coincidental cause	**9**	**9**	**18**	**11**	**6**	**5**	**5**	**0**	**16**	**79**
- MVA	3	2	2	4	3	4	1		2	21
- Other accidents		1	1	1	1	1	1		4	10
- Assault	1	2	15	2			1			21
- Other	5	4		4	2		2		10	27
Medical and surgical disorders	**57**	**41**	**118**	**111**	**63**	**43**	**35**	**10**	**35**	**513**
- Cardiomyopathy	6	7	19	27	18	8	6	2	8	101
- Rheumatic heart disease	5	1	5	11				1	5	28
- Other cardiac disease	6	1	5	8		5	1		2	28
- Endocrine		1	9	6	6	2	3	1	3	31
- GIT	1	1	5	8	6	2	3		7	33
- CNS	5	2	9	13	4	2	3			38
- Respiratory	7	13	12	3	7	3	9	3	3	60
- Haematological	2	2	2	3	5	1	1	1	1	18
- Genito-urinary	1	2	1	1	1				1	7
- Suicide	7	1	4	4		7			3	26
- Substance abuse				1						1
- Other psychiatric disease			1	1						2
- Neoplasm	4		15	17		7				43
- Auto-immune		1	2	2	2	1				8
- Other	13	9	29	6	14	5	9	2	2	89
Non-pregnancy-related infections	**155**	**50**	**187**	**257**	**107**	**97**	**74**	**26**	**110**	**1063**
- PCP pneumonia	4	16	25	22	14	13	12	1	2	109
- Other pneumonia	11	6	21	25	5	16	13	6	7	110
- TB	43	4	20	45	17	12	20	3	13	177
- UTI	1					1			2	4
- Appendicitis			3	1		1			2	7
- Malaria				1	1					2
- Cryptococcal meningitis	1		1	10	9	1			2	24
- Other meningitis	11	2	4	9	6	5	2		5	44
- Kaposi's sarcoma			2	1	1	1				5
- Toxoplasmosis						1	1			2
- Hepatitis			1	1	1	1				4
- Gastroenteritis	3			2	4	1			2	12
- Wasting syndrome	2		4	4	1	1			1	13
- Other	79	22	106	136	48	43	26	16	74	550
Ectopic pregnancy	**8**	**9**	**26**	**20**	**18**	**7**	**6**	**4**	**5**	**103**
- Less than 20 weeks	6	9	22	17	18	7	4	4	4	91
- More than 20 weeks (extrauterine pregnancy)	2		4	3			2		1	12

Primary obstetric problems	Eastern Cape	Free State	Gauteng	Kwa-Zulu Natal	Limpopo	Mpumalanga	North West	Northern Cape	Western Cape	Total
Miscarriage	**19**	**4**	**49**	**31**	**21**	**19**	**17**	**3**	**3**	**166**
- Septic miscarriage	15	4	29	19	16	12	10		2	107
- Haemorrhage (non-traumatic)	3		8	7	2	5	4	2	1	32
- Uterine trauma			4	1	1					6
- GTD	1		7	2		2				12
- Following legal TOP			1	2	2		3	1		9
Pregnancy-related sepsis	**21**	**15**	**40**	**31**	**32**	**23**	**9**	**4**	**12**	**187**
- Chorioamnionitis (ruptured membranes)		1	3	3		1	1			9
- Chorioamnionitis (intact membranes)	1		1	1	1		1			5
- Puerperal sepsis after NVD	9	7	13	8	17	7	3	2	7	73
- Puerperal sepsis after CD	8	6	21	14	11	10	3	1	4	78
- Bowel trauma at CD	3	1	2	5	3	5	1	1	1	22
Obstetric haemorrhage	**55**	**45**	**137**	**95**	**91**	**82**	**52**	**14**	**28**	**599**
- Abruption with hypertension	5	4	12	12	1	10	7	2	2	55
- Abruption without hypertension	1	2	5	10	8	5	3	2	1	37
- Placenta praevia	4	2	6	2	1	3	2			20
- Other APH not specified	2	2	2	1	4	2	2			15
- Ruptured uterus with previous CD	6	2	9	10	5	4	6		1	43
- Ruptured uterus without previous CD	5	3	11	5	9	6	3	1	4	47
- Uterine atony after vaginal delivery	5	2	15	13	11	9	5	2		62
- Vaginal trauma after vaginal delivery	1	3	4	1	1	2		1		13
- Cervical trauma after vaginal delivery	2	5	4	2	6	1		1	1	22
- Retained placenta after NVD (morb adherent)	1	5	2	3	1	1	2	2	2	19
- Retained placenta after NVD (not adherent)	3	1	5	3		3	6	1	4	26
- Inverted uterus after vaginal delivery	2	1								3
- Other PPH not specified after vaginal delivery	4	2	5	5	8	9	3		3	39
- Bleeding during CD (morbidly adherent placenta)		1	10	5	2	4	2			24
- Bleeding during CD (not adherent placenta)	1	2	11	11	8	2	1		1	37
- Bleeding after Caesarean delivery	13	8	36	12	26	21	10	2	9	137

Primary obstetric problems	Eastern Cape	Free State	Gauteng	Kwa-Zulu Natal	Limpopo	Mpumalanga	North West	Northern Cape	Western Cape	Total
Hypertension	**67**	**52**	**120**	**63**	**87**	**54**	**46**	**18**	**32**	**539**
- Chronic hypertension	1	3	6	4	4		1	1	1	21
- Gestational hypertension	2	1	5	1	13	1		1	2	26
- Pre-eclampsia with severe features	17	10	25	19	4	17	6	5	5	108
- Pre-eclampsia without severe features	6	9	6	1	2		2	1	1	28
- Eclampsia	36	17	61	34	38	27	28	6	17	264
- HELLP	5	12	14	3	26	8	9	2	3	82
- Liver rupture			3	1		1		2	3	10
Anaesthetic complications	**11**	**5**	**7**	**12**	**19**	**14**	**5**	**1**	**3**	**77**
- General anaesthetic	1		2	2	6	4	1		1	17
- Spinal anaesthetic	10	5	5	10	13	10	4	1	2	60
Adverse drug reactions	**2**	**2**	**7**	**5**	**8**	**2**	**0**	**0**	**0**	**26**
- ARV medication			2		4					6
- TB medication				1		1				2
- Other medication	2	2	3		1					8
- Herbal medication			2	4	3	1				10
Embolism	**20**	**8**	**16**	**19**	**17**	**13**	**4**	**4**	**15**	**116**
- Pulmonary embolism	18	7	14	19	15	10	4	4	11	102
- Amniotic fluid embolism	2	1	2		2	3			4	14
Acute collapse - cause unknown	**6**	**0**	**27**	**13**	**3**	**5**	**7**	**1**	**10**	**72**
Miscellaneous	1	2	0	3	2	2	0	1	4	15
- Hyperemesis gravidarum	1	2		3	2	1				9
- Acute fatty liver						1		1	4	6
Unknown	**3**	**25**	**55**	**42**	**12**	**14**	**12**	**6**	**10**	**179**
- Death at home or outside health services	2	22	29	13	11	8	8	3	4	100
- No primary cause found		1	6	9		2	3		5	26
- Lack of information	1	2	20	20	1	4	1	3	1	53
Total:	**434**	**267**	**807**	**713**	**486**	**380**	**272**	**92**	**283**	**3734**

Appendix 9.4. 2020-2022. Final and Contributory causes of death for Primary Obstetric causes

2020-2022	ALL	M&S	Cardiac disease	NPRI	Ec	Miscarriage	PRS	OH	HDP	AR	ADR	Emb	AC	Miscellaneous	Unknown	Home	Coin
Circulatory system	**1479**	**72**	**17**	**213**	**92**	**159**	**176**	**595**	**73**	**14**	**3**	**7**	**7**	**2**	**13**	**3**	**33**
- Hypovolaemic shock	838	26	7	26	73	55	11	535	50	11	1	3	7	2	3	2	26
- Septic shock	641	46	10	187	19	104	165	60	23	3	2	4			10	1	7
Respiratory failure	**1364**	**128**	**50**	**805**	**14**	**34**	**32**	**40**	**119**	**41**	**6**	**45**	**15**	**1**	**14**	**4**	**16**
- Respiratory failure	1364	128	50	805	14	34	32	40	119	41	6	45	15	1	14	4	16
Cardiac failure	**538**	**40**	**117**	**84**	**9**	**15**	**15**	**41**	**169**	**15**	**1**	**16**	**6**	**1**	**4**	**1**	**4**
- Pulmonary oedema	538	40	117	84	9	15	15	41	169	15	1	16	6	1	4	1	4
Embolism	**193**	**11**	**26**	**27**	**3**	**7**	**4**	**7**	**19**	**2**	**0**	**75**	**9**	**0**	**0**	**1**	**2**
- Acute collapse due to embolism	193	11	26	27	3	7	4	7	19	2		75	9		0	1	2
Renal failure	**543**	**73**	**17**	**150**	**5**	**37**	**51**	**54**	**108**	**4**	**10**	**6**	**1**	**8**	**12**	**0**	**7**
- Renal failure	543	73	17	150	5	37	51	54	108	4	10	6	1	8	12		7
Liver failure	**251**	**48**	**2**	**59**	**0**	**12**	**21**	**20**	**51**	**0**	**11**	**5**	**0**	**5**	**12**	**0**	**5**
- Liver failure	251	48	2	59		12	21	20	51		11	5		5	12		5
Cerebral complications	**604**	**74**	**11**	**109**	**3**	**8**	**8**	**23**	**309**	**21**	**4**	**1**	**4**	**3**	**6**	**3**	**17**
- Intracranial haemorrhage	204	17	3		1	2		5	164	1	2			1	2	1	5
- Cerebral oedema resulting in coning	59	10	1	9		1	1	3	32	1					0		1
- Meningitis	69	6	1	60			2		2						0		
- Cerebral emboli	12	2	4	1		1	2								0		
- Brain death following hypoxic event	139	16	1	14		3	1	13	66	15	2	1	2		1		4
- Unspecified	121	23	1	25	2	1	2	2	45	4			2	2	3	2	7

2020-2022	ALL	M&S	Cardiac disease	NPRI	Ec	Miscarriage	PRS	OH	HDP	AR	ADR	Emb	AC	Miscellaneous	Unknown	Home	Coin
Metabolic	**527**	**94**	**17**	**156**	**9**	**41**	**37**	**65**	**61**	**5**	**7**	**1**	**1**	**15**	**9**	**0**	**9**
- Maternal ketoacidosis	134	22	5	37	1	11	10	14	20	4	2	1	1	2	1		3
- Electrolyte imbalance	187	36	5	66	2	12	9	22	17	1	3			10	2		2
- Thyroid crisis	11	2	1	1	1	1			4		1				3		3
- Lactic acidosis	150	25	5	36	4	16	13	24	18		1			2	0		
- Other	45	9	1	16	1	1	5	5	2					1	3		1
Haematological	**804**	**67**	**13**	**123**	**37**	**82**	**28**	**329**	**85**	**1**	**7**	**6**	**2**	**2**	**15**	**0**	**7**
- DIC	478	37	6	47	17	45	21	222	56		5	4	1	1	11		5
- Severe anaemia	326	30	7	76	20	37	7	107	29	1	2	2	1	1	4		2
Immune system	**372**	**26**	**3**	**252**	**8**	**8**	**26**	**20**	**14**	**1**	**2**	**7**	**1**	**1**	**0**	**2**	**1**
- Immune system failure	372	26	3	252	8	8	26	20	14	1	2	7	1	1	0	2	1
Maternal deaths	**6675**	**633**	**273**	**1978**	**180**	**403**	**398**	**1194**	**1008**	**104**	**51**	**169**	**46**	**38**	**85**	**14**	**101**
Unknown	**262**	**13**	**2**	**15**	**5**	**1**	**2**	**7**	**14**	**3**	**2**	**4**	**33**	**0**	**43**	**111**	**7**
- Home death	123	7	1	8	1	1		5	8			2	4		8	72	6
- Unknown	139	6	1	7	4		2	2	6	3	2	2	29		35	39	1
Other	**317**	**59**	**19**	**77**	**6**	**12**	**18**	**17**	**33**	**15**	**5**	**7**	**14**	**1**	**12**	**3**	**19**
- Other	317	59	19	77	6	12	18	17	33	15	5	7	14	1	12	3	19
Total	**3734**	**356**	**157**	**1063**	**103**	**166**	**187**	**599**	**539**	**77**	**26**	**116**	**72**	**15**	**79**	**100**	**79**
% of total deaths:		**9.6**	**4.1**	**28.5**	**2.8**	**4.4**	**5**	**16**	**14.4**	**2.1**	**0.7**	**3.1**	**1.9**	**0.4**	**2.1**	**2.7**	**2.1**

Appendix 9.5. Recommendations from Saving Mothers triennial report 2017-2019

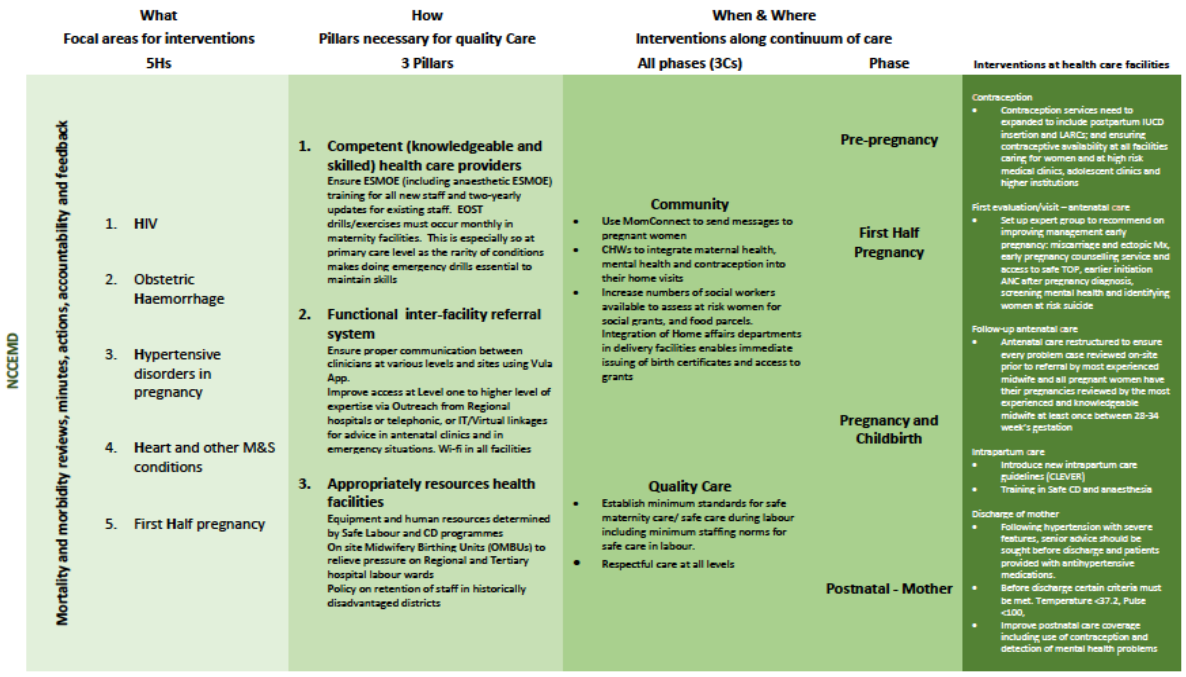
The recommendations assume that **every** site conduct **morbidity and mortality review** meetings, where **minutes** are kept, **actions** assigned to individuals and there is **feedback** at subsequent meetings to hold individuals to **account**.

Summary of crucial recommendations

- Contraception services need to expand to include postpartum IUCD insertion and LARCs; and ensuring contraceptive availability at all facilities caring for women and at high-risk medical clinics.
- Set up an expert group to recommend on improving management of early pregnancy and its complications: miscarriage and ectopic management, early pregnancy counselling service and access to safe TOP, earlier initiation of antenatal care after pregnancy diagnosis, screening for mental health issues and identifying women at risk of suicide.
- Antenatal care restructured to ensure every problem case reviewed on-site prior to referral by most experienced midwife and all pregnant women have their pregnancies reviewed by the most experienced and knowledgeable midwife at least once between 28-34 week's gestation.
- Establish On-site Midwife run Birthing Units (OMBUs) at all large district, regional and tertiary hospitals (conducting large numbers of births for women with no risk factors).
- Establish a Safe Labour criteria and evaluation programme like the Safe Caesarean Delivery (surgery and anaesthesia) programme and maintain focus on the Safe CD programme.
- Implement the updated PMTCT protocol for better HIV management and TB detection.
- Ensure ESMOE (including anaesthetic ESMOE) training for all new staff and two-yearly updates for existing staff. EOST drills/exercises must occur monthly in maternity facilities. This is especially so at primary care and district hospital level as the rarity of conditions makes doing emergency drills essential to maintain skills. Each hospital and CHC should have at least one on-site trainer able to run the relevant ESMOE modules and drills.
- Ensure functional communication channels exist for consultation with and referral to higher levels of care e.g. by using the "Vula App".
- Prior to discharge from a ward and facility, specific criteria must be met and documented.

The following poster summarises the crucial recommendations according to the five Hs (priority conditions), essential health system pillars and key interventions along the continuum of care.

Poster of key Recommendations from Saving Mothers triennial report 2017-2019



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