

M.MED

A RESEARCH REPORT BY:

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**A 10 year evaluation of postpartum maternal mortality at Chris Hani
Baragwanath Hospital (2004 -2013)**

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DECLARATION

I **M.M. Moletsane** declare that the work I am submitting for assessment contains no section copied in whole or in part from any other source unless explicitly identified in quotation marks and with detailed, complete and accurate referencing.

Signature

DEDICATION

To my family

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to those who have assisted me in the completion of my M.MED proposal and report.

In particular I would like to thank the following:

- My family and friends
- My research supervisor, Dr E. Bera
- Prof E Buchmann, for providing me with information I needed to collect data
- Prof Y Adam, HOD of department of obstetrics and gynaecology at Chris Hani Baragwanath Hospital for allowing me to sit in her office for countless hours collecting data
- Asanda Oyiya, secretary at department of obstetrics and gynaecology at Chris Hani Baragwanath Hospital for always making sure I'm aware of the office availability
- My statistician, Mr N Khosa

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ABSTRACT

This study examined postpartum maternal deaths at Chris Hani Baragwanath Hospital (CHBH) between January 2004 and December 2013. The aim was to gather reliable information about the trends and rates in postpartum maternal mortality which is important for resource mobilisation, planning and improvement in progress towards Millennium Development Goal 5 i.e. a 75% reduction in the maternal mortality ratio (MMR) from 1990 to 2015. The causes and predisposing factors to maternal deaths were scrutinised to identify factors involved in the stagnation of the MMR.

The medical records of all mothers who died at CHBH during 2004-2013, as contained in the individual patient files were used as data sources.

There were 409 maternal deaths out of 224 562 live births of which 261 were postpartum deaths. The MMR was 182 per 100 000 live births for the 10 years evaluated.

The main causes of death were indirect causes, predominantly non-pregnancy related infections, with respiratory tract infection, mostly pneumonia and tuberculosis being the predominant contributing factors.

It is recommended that all maternity units conduct, review and publish MMR in order to highlight and identify factors involved in the failure to reach the Millennium Developmental Goal i.e. a 75% reduction in MMR by 2015. Factors that are involved in the stagnation need to be more completely identified.

1. INTRODUCTION

A reduction of 75% in the maternal mortality ratio, from 1990 to 2015 was one of the Millennium Developmental Goals, (MDG), of the United Nations Secretariat. Maternal deaths have declined by nearly half since 1990, but falls short of the MDG target and in 2015 we have not reached the target. Nevertheless, many women die in childbirth when we have the means to save them.¹

According to Bradshaw and Dorrington² there is a uncertainty regarding the actual level of the Maternal Mortality Ratio (MMR) in South Africa, but what it is clear that maternal mortality has been increasing since the late 1990's and that South Africa was not on track to meet MDG number 5 i.e. a 75% reduction in the MMR.

A maternal death refers to a woman dying during pregnancy or within six weeks following a pregnancy.¹ Causes of maternal deaths are classified as direct and indirect. Direct causes refers to factors related to the pregnancy itself and indirect causes refer to pre-existing or underlying maternal disease.³ Co-incidental causes are excluded. Maternal mortality is generally stated as a ratio, the MMR, and is expressed as the number of maternal deaths per 100 000 live births.

Table 1 below illustrates the maternal mortality ratios for 2008; indicating that the majority of maternal deaths occurred in developing countries.

Table 1 Maternal mortality ratios for 2008

Per 100 000 live births	
Italy	4
Egypt	43
South Africa	237
Zimbabwe	624
Afghanistan	1595

(Source: Hogan et al, Lancet, 2010 cited in Buchmann).³

South Africa is one of the few developing countries that have a national formal enquiry into maternal deaths.

Table 2 below illustrates the maternal death summary (per province) for 2011 and 2012.

Table 2 South African Maternal death summary per province for 2011 and 2012

Table 1. Maternal death summary per province for 2011 and 2012 (2013 analysis)

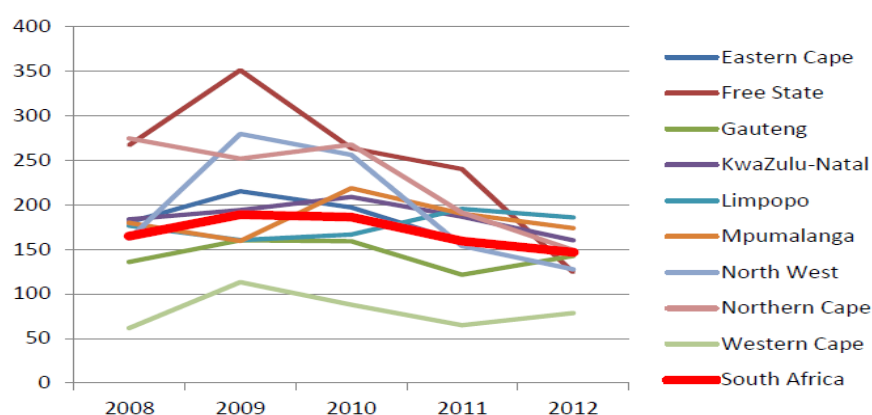
	2011				2012			
	LB	MD	iMMR	%	LB	MD	iMMR	%
Eastern Cape	132696	210	158.26	13.6	124963	183	146.44	12.8
Free State	51649	124	240.08	8.1	52190	65	124.54	4.6
Gauteng	211615	257	121.45	16.7	216115	308	142.52	21.6
KwaZulu-Natal	192779	360	186.74	23.4	193354	310	160.33	21.7
Limpopo	126846	248	195.51	16.1	127016	236	185.80	16.5
Mpumalanga	76791	146	190.13	9.5	78270	136	173.76	9.5
North West	61788	95	153.75	6.2	62619	80	127.76	5.6
Northern Cape	20931	40	191.10	2.6	22099	33	149.33	2.3
Western Cape	92578	60	64.81	3.9	95374	75	78.64	5.3
South Africa	967673	1540	159.14	100.0	972000	1426	146.71	100.0

LB – Live births, MD – maternal deaths, iMMR – institutional Maternal Mortality Ratio expressed per 100000 live births. MD include coincidental deaths

(Source: Adapted from Pattinson R., Fawcus S., Moodley J., 2013).⁴

Noticeably, fewer deaths were entered by most provinces in 2012 than in 2011, with the exception of Gauteng province which has entered 51 more deaths. The Tenth interim report on confidential enquiries into maternal deaths in South Africa, published in 2012, found a downward trend in maternal deaths since 2009/2010. Free State showed the most remarkable decline in maternal deaths from 2009. Gauteng and the Western Cape were the only provinces that have shown an upward trend since 2011.⁴ Illustrated by diagram 1 below.

Figure1: Graphic representation of the iMMR per province and for SA



(Source: Adapted from Pattinson R., Fawcus S., Moodley J.).⁴

According to Burrows et al⁵ maternal mortality has become increasingly rare in developed countries. As a result their study focussed on maternal morbidity rather than mortality, and found that the rates of morbidity for caesarean section deliveries were higher than for vaginal deliveries. However, Liu et al⁶ found that elective primary caesarean section deliveries with no obstetrical or clear medical indication are rising dramatically. The authors emphasise the urgent need to assess the risks of maternal complications and death associated with elective caesarean delivery for healthy women.

Despite the global rise in elective caesarean section as choice of delivery, it is unlikely that this trend is coupled with equal increases in medical indications for caesarean section as mode of delivery. Cognisance and understanding of the risks coupled with caesarean deliveries could prove important for the development of maternal mortality prevention strategies.⁶ The health and mortality of a country remains an important indicator of the economic success of the particular nation. Women continue to play a pivotal role in society as mothers, caregivers and even contributors to the economy.³ Reducing maternal mortality therefore remains a pertinent issue, in a developing country such as South Africa.

1.1 The research problem

Maternal mortality remains significantly high in developing countries as opposed to developed countries. South Africa, a developing country, remained unsuccessful in reaching the goal of decreasing maternal mortality by three quarters between 1990 and 2015 as set out by the MDG.

The research problem was to examine postpartum maternal deaths at CHBH from January 2004 to December 2013, to identify the causes and predisposing factors to postpartum maternal mortality, and to investigate whether postpartum maternal mortality at CHBH is similar or different across the two modes of deliveries.

1.2 The purpose of the study

The unit of analysis was the Department of Obstetrics and Gynaecology at CHBH in Johannesburg. The purpose of this research was to gather reliable information about the trends and rates in maternal mortality which is important for resource mobilisation, planning and improvement in progress towards MDG 5.

In unison Deneux-Tharaux et al ⁷ argues that

“...maternal mortality rates have shown little improvement during the past 20 years in developed countries, and factors involved in this stagnation need to be more completely identified. The method of delivery may constitute one potentially modifiable risk factor of maternal mortality.”

1.3 The objectives of the study

The main objective of the research was to audit trends in postpartum maternal deaths at CHBH over a 10 year period with respect to rates and pattern of causation.

The specific objectives were:

- To analyse causes of postpartum maternal deaths over that time period.
- To determine if there was an association of maternal death to the mode of delivery.
- To identify possible avoidable or preventable factors.

1.4 The research questions

The specific research questions for this study were:

- What were the main causes of postpartum maternal deaths at CHBH and is the trend similar to what is happening in the country?
- Were causes of deaths similar or different between the two modes of delivery?
- What were/are the factors that contributed to maternal deaths following normal vaginal deliveries (NVD's)?
- What were/are the factors that contributed to maternal deaths following Caesarean Section (CS)?
- Were there any avoidable factors?

2. LITERATURE REVIEW

Most of the maternal deaths are preventable, but progress in this area is inadequate, since the MDG target was to decrease the ratio by 75 percent and the global maternal mortality ratio only declined by 47 percent over the last two decades, from 400 maternal deaths per 100 000 live births to 210 between 1990 and 2010. Meeting the MDG target requires accelerated interventions and stronger political backing for women and children.¹

Conversely, in the United Kingdom (UK), maternal mortality is considered rare. In the UK it is 11.4 per 100 000 maternities; the direct maternal mortality rate from all causes is 1 per 20 000 maternities. The death rate for women who have vaginal deliveries is 16.9 per million compared to 82.3 per million for women who have caesarean section. However it was not possible to determine if the proportion of the increased risk was attributable to antecedent conditions or the procedure itself.⁸

The World Health Organisation published a report in 2005 that showed that 99 percent of maternal deaths took place in the developing countries and the maternal mortality ratio in these countries is 450 maternal deaths per 100 000 live births. The same report also found that four main causes of maternal mortality were: obstetric haemorrhage (mainly postpartum haemorrhage), infections, hypertensive disorders and obstructed labour. Further, it was also found that some women also die from poor nutritional status at conception and substandard care provided by the caregivers to them.⁹

Clark et al.¹⁰ found that 95 maternal deaths occurred out of 1.5 million deliveries between 2000 and 2006 (6.5 per 100 000 pregnancies) in the United States (USA). Furthermore it was found that the rate of maternal death causally related to mode of delivery was 0.2 per 100 000 for vaginal delivery and 2.2 per 100 000 for caesarean sections delivery, suggesting that the number of annual deaths resulting from caesarean delivery in the USA was about 20.

An increase in caesarean deliveries has been reported in many developed countries; in France in particular this mode of delivery has increased from 10.8% in 1981 to 20.2% in 2003.⁷ The same authors conducted a retrospective review of their

Confidential Enquiry on Maternal Deaths (Enquête Confidentiallesur les Morts Maternelles) for the period 1996-2000 and found that caesarean deliveries were associated with a significantly higher risk (3.6%) of maternal death versus deaths occurring after vaginal deliveries.

A retrospective based cohort study conducted by Liu et al,⁶ of all women in Canada (excluding Quebec and Manitoba), who delivered from 1991 to 2005 found that the risk of severe maternal morbidity were higher with planned caesarean deliveries than those with planned vaginal deliveries.

There has been a rise in the rate of caesarean deliveries in several developed countries during the past decades, and although maternal deaths have become rare in high-resource countries, it remains a tragic event, and excess maternal mortality risk would have a strong effect on the balance between potential harms and benefits of caesarean delivery .¹¹

The caesarean section rate in South African public hospitals is about 18-20% and the assisted delivery rate less than 1%. Considering these statistics, Pattinson¹² infers that in most of maternity units in South Africa, unnecessary caesarean sections are being performed due to the lack or loss of skills to perform assisted deliveries.

Non-pregnancy related infections (mostly HIV), obstetric haemorrhage, and complications of hypertension in pregnancy are the three conditions that are responsible for almost two thirds of potentially avoidable maternal deaths in South Africa.¹¹

The most recent South African Saving Mothers Report indicated that deaths due to haemorrhage continue to rise, mainly due to intra-and postpartum caesarean section bleeding.¹¹ Table 2 below provides a comparison of MMRs for underlying causes of death from 2002 to 2012.

Table 2 Comparison of MMRs for underlying causes of death from 2002-2012

Disease category	2002-2004	2005-2007	2008-2010	2011&2012
Direct	77.99	69.73	81.39	73.2
Hypertension	27.72	23.85	24.58	21.6
Obstetric haemorrhage	19.51	18.82	24.91	23.9
Ectopic pregnancy	2.07	2.11	2.72	2.9
Miscarriage	5.03	5.21	6.73	6.5
Pregnancy-related sepsis	12.09	8.55	9.34	7.6
Anaesthetic complications	4.02	4.1	4.38	3.6
Embolism	2.82	2.19	3.37	3.5
Acute collapse - cause unknown	4.72	4.91	5.36	3.7
Indirect	63.12	75.37	86.86	68.8
Non-pregnancy-related infections	55.0	66.28	71.29	53.3
Medical and surgical disorders	8.12	9.09	15.57	15.6
Unknown	4.37	6.67	7.82	6.5
iMMR	145.48	151.77	176.22	148.7

(Source: Adapted from Pattinson R., Fawcus S., Moodley J., 2013).⁴

This table demonstrates the following key trends; a continuing decrease in maternal deaths due to non-pregnancy related infections, a reduction in deaths due to complications of hypertension, but there is no reduction in deaths due to obstetric haemorrhage. There has been an increase in maternal deaths due to bleeding during or after caesarean section. This has increased in 2012 compared with 2011 (increasing from 27.5% in 2011 to 35.3% in 2012 - a 28% increase). The 61 of the 64 deaths (95.3%) were regarded as possibly or probably avoidable in 2011 and 79 of the 81 deaths (97.5%) as possibly or probably avoidable in 2012 by the assessors.

According to Pattinson¹² conditions that are responsible for almost two-thirds of potentially avoidable maternal deaths in South Africa are non-pregnancy related infections, obstetric haemorrhage, and complications of hypertension in pregnancy. The author questions why we have been successful in decreasing deaths due to non-pregnancy related infections, but not the other conditions?

A retrospective study conducted in the USA, between 2000 and 2006; found that the leading causes of maternal deaths were complications of pre-eclampsia, pulmonary thrombo-embolism, amniotic fluid embolism, obstetric haemorrhage, and cardiac disease.⁵

A retrospective Canadian study by Liu et al⁶ found that the planned caesarean section sample had higher postpartum risk of cardiac arrest, hysterectomy, puerperal sepsis, anaesthetic complications, venous thrombo-embolism and bleeding requiring hysterectomy and prolonged hospital stay.

Similarly, the study conducted by Deneux-Tharaux et al⁷ showed that caesarean delivery was associated with a significantly higher risk of maternal death from complications of anaesthesia, puerperal infection and venous thrombo-embolism. However, the risk of death from postpartum haemorrhage did not differ significantly between vaginal and caesarean deliveries.

Pattinson¹² highlights the requirements for providing basic emergency obstetric care as stipulated by the World Health Organisation (WHO). These include the following “seven basic signal functions”; the ability to administer parenteral antibiotics, anticonvulsants and oxytocics, performing assisted delivery, manual removal of the placenta and manual vacuum aspiration of for uncomplicated incomplete miscarriages, and bag-and-mask ventilation of a neonate. These functions should be provided by every community health centre (CHC), since 60% of pregnant women deliver in public clinics, CHC’s or district hospitals.

In addition to the seven basic signal functions, the ability to perform a caesarean section and give a blood transfusion are necessary requirements for comprehensive emergency care by all district and higher levels of care.

Pattinson¹² emphasises and concludes that; “If South Africa is to make further advances in reducing the number of maternal and perinatal deaths, the health system will have to provide safe maternity units.” The author lists the following requirements for a “safe maternity unit”:

- Skilled staff, geared with the necessary facilities to provide the seven basic emergency obstetric care functions
- The availability of a proximate adequately staffed and facilitated district hospital to provide all comprehensive emergency obstetric care functions and,
- The availability of a prompt transport service between the basic and comprehensive care units

In unison the United Nations¹ in their 2013 MDG Report states that delivering a baby with the help of a skilled and supported caregiver (doctor, nurse or midwife) can decrease the risk of preventable death or disability. A birth attendant with the necessary training and medicines can administer help to prevent or manage life-threatening complications, such as heavy bleeding, or refer a patient to a higher level of care. According to this report, haemorrhage is still one of the important causes of maternal mortality and it is recommends that all obstetric units should have a protocol for the management of obstetric haemorrhage and that women at increased risk of haemorrhage should be delivered at a place with a blood bank on site.

Deneux-Tharaux et al⁷ concluded that when considering the mode of delivery, obstetricians and women should be cognisant of the increased risk of postpartum maternal death coupled with caesarean delivery as compared with vaginal delivery, even when caesarean sections are performed during the antepartum period (electively). They further state that knowledge of the specific causes of increased maternal mortality risk should inform preventative strategies at caesarean delivery.

The Royal College of Obstetricians and Gynaecologists⁸ recommend the following interventions to decrease the rate of caesarean section; Involving consultant obstetricians in the decision making for this mode of delivery, offering external cephalic version for breech presentation at 36 weeks (exceptions include women in labour, women with a uterine scar or abnormality, fetal compromise, ruptured membranes, vaginal bleeding or medical conditions), facilitating continuous support during labour for women with or without prior training, offering induction of labour beyond 41 weeks, performing fetal blood sampling before caesarean for abnormal cardiotocograph in labour when it is possible and there are no contraindications, using a 4-hour action line partogram for women in spontaneous labour with an uncomplicated singleton pregnancy at term.

Considering the increasing trend of choosing caesarean section as mode of delivery, coupled with the documented contribution of intra and postpartum caesarean section haemorrhage on maternal mortality statistics, an exploration of the causal link between mode of delivery and risk of maternal death would prove important during the formulation of maternal death prevention and reduction strategies.

Maternal health must be seen in a broader context than preventing maternal deaths. Most maternal deaths are avoidable tragedies, and so preventing or reducing them is of high priority. Maternal health is a priority, for mothers, their children, partners and extended families, and for a society as a whole.

3. THE RESEARCH METHODOLOGY

3.1 Research design

A retrospective descriptive study design was followed. The data that was reviewed and captured was that of all postpartum maternal deaths which occurred from 2004 to 2013 at CHBH.

3.2 Data sources

The medical records of all mothers who died at CHBH during 2004-2013 as contained in the individual patient files, was used as data sources. Maternal deaths records are filed in the Head of the Department (HOD) office.

3.3 Data collection techniques

All the relevant data was captured on a data capturing sheet. See Appendix for detailed data sheet used.

3.4 Sampling techniques

The study population included all mothers who died at CHBH within 42 days of delivery during 2004-2013.

CHBH is the largest hospital in South Africa, occupying around 173 acres (0.70km²), with approximately 3 200 beds and about 6 760 staff members. The hospital is in Soweto, Johannesburg, South Africa. It is financed and run by the Gauteng Provincial Health Authorities and one of 40 Gauteng provincial hospitals. It is a teaching hospital for the University of the Witwatersrand Medical School, along with

the Charlotte Maxeke Johannesburg Academic Hospital, Helen Joseph Hospital and the Rahima Moosa Mother and Child Hospital.

In 2013 there were 22847 births of which 8165 were by caesarean section at this hospital. There were 409 maternal deaths from 2004 to 2013 at CHBH, of which 289 were postpartum deaths following viable pregnancies. Among these, there were 18 peri-mortem caesarean sections, and another 10 caesarean sections done for fetal indications because of deteriorating maternal condition (effectively peri-mortem but not waiting for cardiac arrest). Therefore 261 cases were suitable for analysis.

The non-probability sampling method was used, with judgement sampling as the type of non-probability sampling since the sample inclusion criteria are:

- All women who died within 42 days post-delivery during 2004-2013, at CHBH.

The exclusion criteria were:

- All women who died at a gestational age of less than 26 weeks
- All women who died after 42 days of delivery
- Undelivered maternal deaths, including pregnancies that did not result in births (e.g. ectopic pregnancies, abortion)
- Peri-mortem caesarean sections.
- All women who died outside the sampling period of 2004-2013

3.5 Definition of key terms, concepts and variables

3.5.1 Maternal death - death of a woman while pregnant or within 42 days of termination of pregnancy irrespective of the duration and site of the pregnancy from any cause related to or aggregated by the pregnancy or its management

3.5.2 Normal vaginal delivery - birth of baby through the vagina

3.5.3 Caesarean section - a surgical procedure in which incisions are made through a pregnant woman's abdomen and uterus to deliver a baby.

3.6 Data analysis and interpretation

Study design: A retrospective descriptive study.

Simple structured qualitative analysis was used, using information gained from the data capturing sheet.

Two hundred and sixty one cases of postpartum maternal deaths that occurred at CHBH from 2004 to 2013 were analysed.

Tables and graphs were used to compare and interpret data collected

3.7 Ethical considerations

The identity of all mothers was protected, by not including any identifying information such as names, identity numbers and addresses on the data sheet.

3.7.1 Confidentiality

No identifying information, such names and hospital file numbers were included on the data capturing sheet.

3.7.2 Informed consent

Informed consent was not relevant to this study; however permission was obtained from the Chief Executive Officer of CHBH.

3.8 Limitations:

With a retrospective study design, some data are often lost and irretrievable. With reference to this study the following limitations existed:

- Mothers who delivered at home and subsequently died and were never notified or reported.
- Mothers who moved away post-delivery and died (within 42 days) in another region.

- Postpartum mothers who were admitted in medical wards without disclosing the fact that she delivered within the 42 days and subsequently died.

3.9 Funding:

All funding was provided by the researcher.

3.10 Statistics

- The data was analysed with the aid of a statistician(N.K)
- Descriptive statistics was employed by using means with standard deviations.
- Dichotomous data and percentages were used.

4. RESULTS

4.1 Maternal mortality

During the study period, 1 January 2004 to 31 December 2013, there were 409 maternal deaths out of 224 562 live births of which 261 were postpartum deaths. The MMR at CHBH was 182 per 100 000 live births during, range: 127 to 246 (Fig. 1).

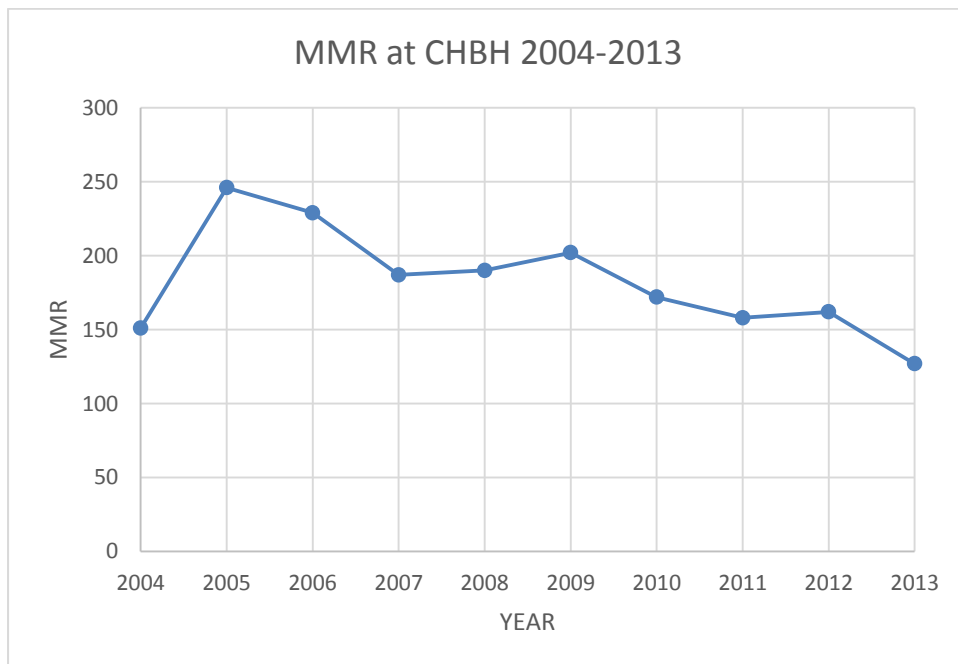


Figure 1: Maternal mortality ratio per year at CHBH, South Africa

Table 1: Total live births, number of maternal deaths and MMR at CHBH (2004-2013)

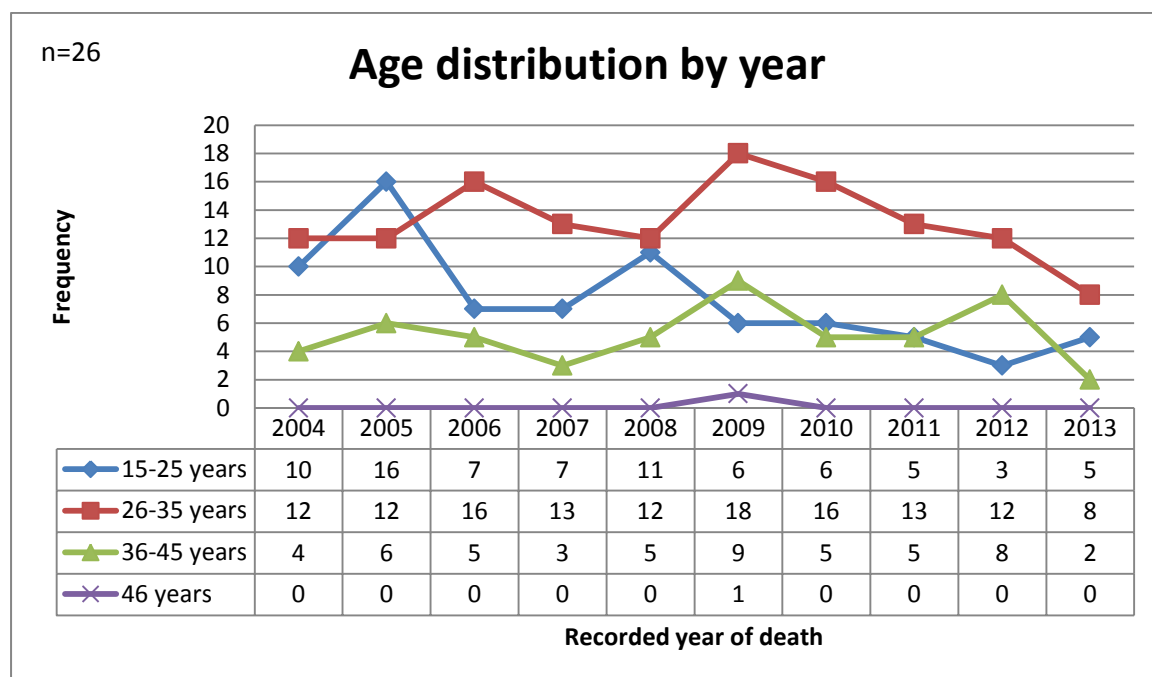
Year	Total live births	Number of Maternal Deaths	MMR (per 100 000 live births)
2004	19 202	29	151
2005	20 318	50	246
2006	22 746	52	229
2007	23 511	44	187
2008	23 566	45	190
2009	22 818	46	202
2010	23 271	40	172
2011	23 406	37	158
2012	22 877	37	162
2013	22 847	29	127
TOTAL	224 562	409	182

4.2 Sample demographics

4.2.1 Age

Figure 2 below presents the age groups of all the women who died during the 10 year evaluation of postpartum maternal mortality, from 2004 to 2013. The mean age of women who died was 29.5 years while 76 (29.2%) were younger than 26 years and 52 (20%) were older than 36 years of age. Age was not statistically significant to cause of death ($p = 0.547$).

Figure 2: Age distribution of postpartum maternal deaths at CHBH (2004-2013)



4.2.2 Parity

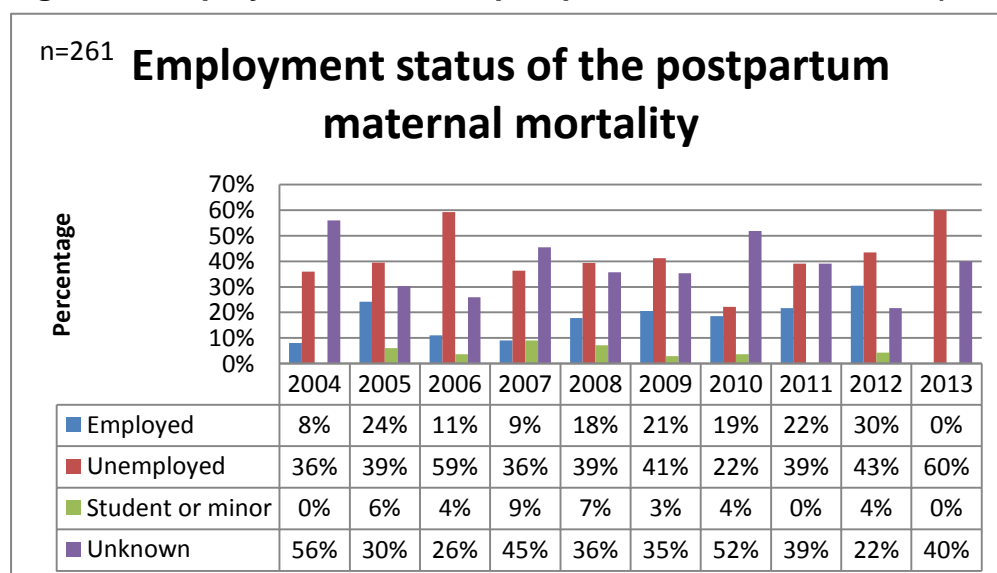
Parity (Table 2) was unknown in 9 cases (3.5%) of postpartum deaths ($n=261$), this may be attributable to poor history taking, poor clerking (administrative error), or impaired level of consciousness at time of presentation, or lack of time for history taking in the setting of emergency presentations. Of the remaining 252 women, 128 (51%) were either nulliparous or parity one, 119 (47%) multiparous, and 5 (2%) grand multiparous (parity>6). $p = 0.449$

Table 2: Parity of postpartum maternal deaths (2004-2013)

POSTPARTUM DECEASED PARITY				
Year	0-1	2-3	4-5	>6
2004	13	11	1	1
2005	20	9	5	0
2006	20	7	0	1
2007	9	8	1	2
2008	16	10	0	1
2009	9	18	6	0
2010	14	9	2	0
2011	10	9	2	0
2012	9	11	3	0
2013	8	7	0	0
Total	128	99	20	5

4.2.3 Employment status differences in mortality

Figure 3: Employment status of postpartum maternal deaths (2004-2013)



The distribution of deaths by employment status of postpartum maternal deaths is shown in Figure 3. Most of the postpartum maternal deceased were unemployed, although during 2004 and 2010 the majority of the employment status was unknown. This could be an indication of poor history taking and record keeping.

4.3 Causes of death classification

Figure 4: Overall classification of the cause of postpartum maternal deaths(2004-2013)

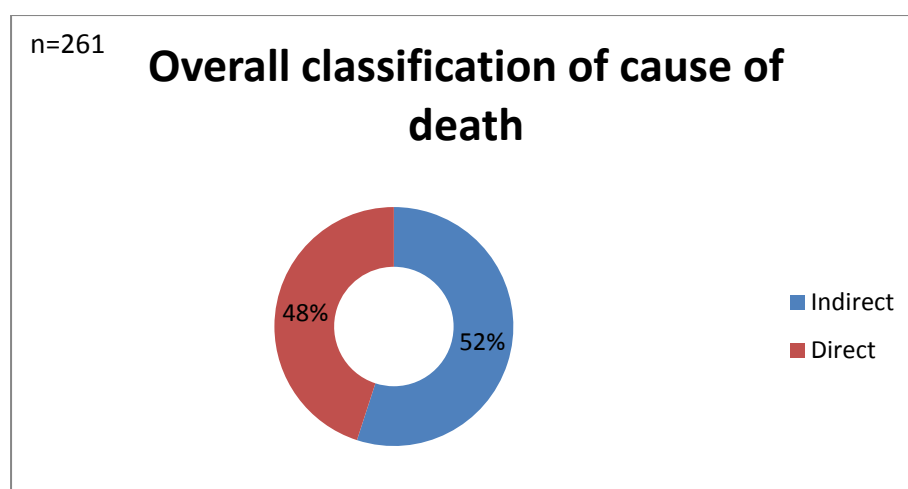


Table 3: Causes of postpartum maternal deaths at CHBH (2004-2013)

Direct causes	N	%
Pregnancy related infections	25	9.4
Obstetric haemorrhage	52	20.0
Complications of hypertension	44	16.9
Anaesthesia	5	1.9
Subtotal	126	48.2
Indirect causes	N	%
Medical disorders	18	6.9
Non-pregnancy related infection	90	34.5
Acute collapse	19	7.3
Other	8	3.1
Subtotal	135	51.8
TOTAL	261	100

Most women died of indirect causes (135/261 deaths, 52%; [Table 3](#)). The leading cause was non-pregnancy related infections (90/261 deaths, 34%), followed by acute collapse (19/261 deaths, 7%) and medical disorders (18/261 deaths, 7%). In the latter group 8/261 (3%) deaths were described as “other causes”.

Direct causes accounted for 126/261 deaths (48%; [Table 3](#)). Obstetric haemorrhage (52/261 deaths, 20%) and complications of hypertension (44/261 deaths, 17%) were the major contributors in this category, followed by pregnancy related infections (25/261 deaths, 10%).

Table 4 below gives a classification (indirect vs direct causes) of postpartum maternal deaths for each of the 10 years evaluated.

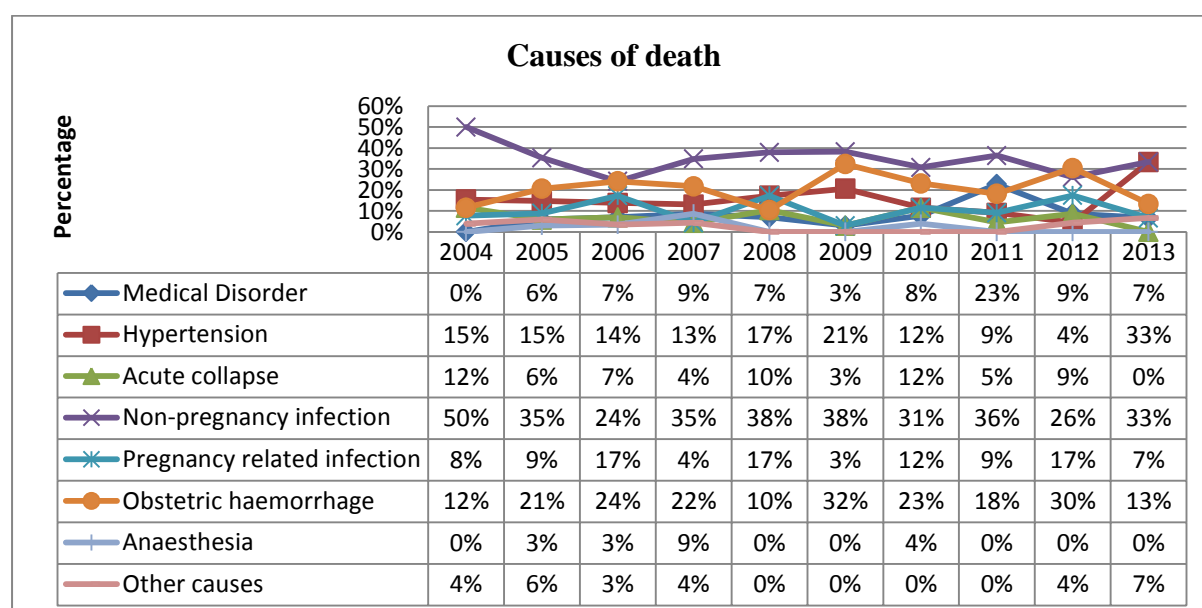
Table 4: Classification of the cause of death of postpartum maternal mortality at CHBH (2004-2013)

Year	Indirect	Direct
2004	17 65%	9 35%
2005	18 53%	16 47%
2006	12 43%	16 57%
2007	12 52%	11 48%
2008	16 57%	12 43%
2009	15 44%	19 56%
2010	14 52%	13 48%
2011	13 57%	10 43%
2012	11 48%	12 52%
2013	7 47%	8 53%
TOTAL	135 52%	126 48%

Deaths were categorised by age, nationality and HIV status of the women in order to establish prevailing patterns between the direct and indirect classifications of death and to establish prevailing patterns of the contributing circumstances to the event of death and the delays that could have made an impact on the causes of death.

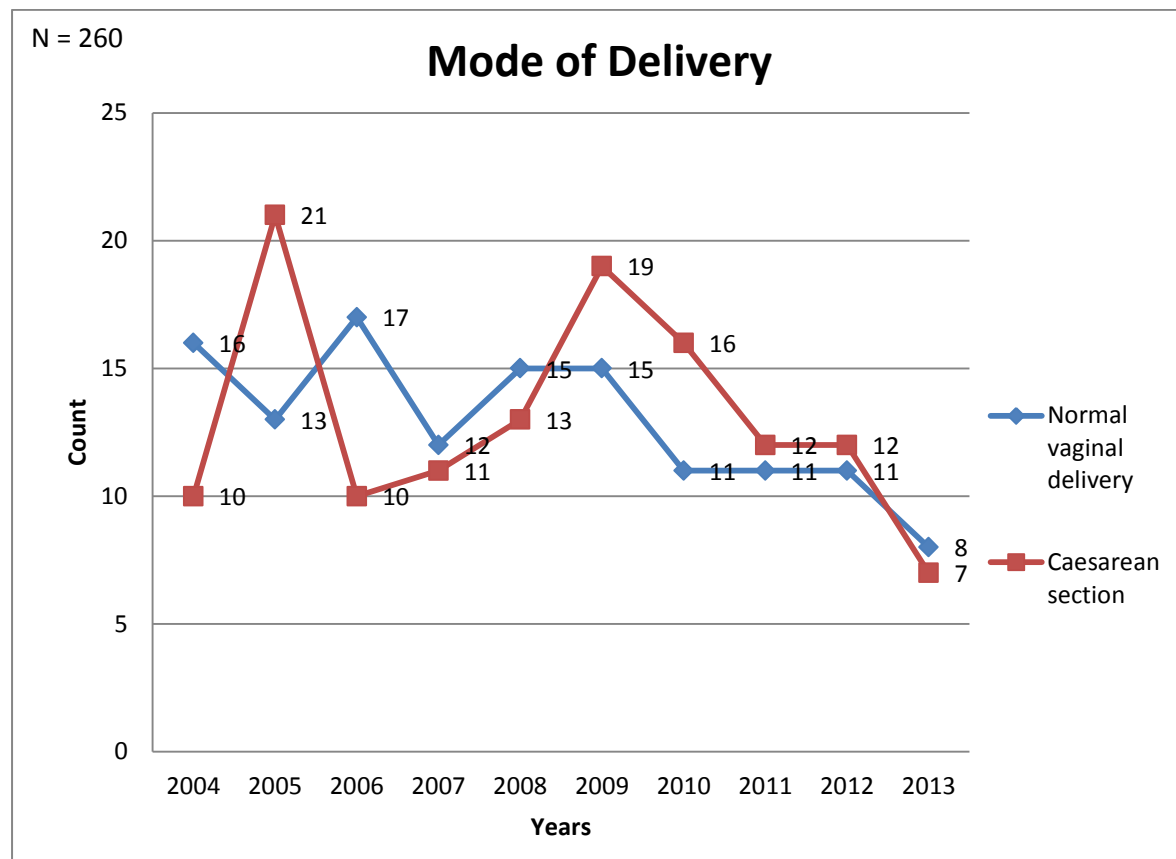
Below figure 5 illustrates the causes of postpartum maternal deaths at CHBH over period evaluated. Non-pregnancy related infections were the largest contributor to deaths that occurred between the periods of 2004 to 2011, 35% followed by obstetric haemorrhage at 20%. During 2012, the highest cause of death was due to obstetric haemorrhage, however; in 2013 non-pregnancy related infections surpassed that and was the main contributor of deaths.

Figure 5: The causes of death on postpartum maternal mortality at CHBH (2004-2013)



4.4 Mode of delivery

Figure 6: Mode of delivery of postpartum maternal deaths at CHBH (2004-2013).



*2008 – 1 patient had NVD for first twin and C/S for retained twin.

Table 5: Total numbers of NVD, C/S, postpartum NVD deaths, postpartum C/S deaths, MMR for NVD, MMR for C/S at CHBH (2004-2013)

	Total number of NVD	Total number of C/S	Number of postpartum NVDs deaths	Number of postpartum C/S deaths	MMR (per 100 000 live births) for NVD	MMR (per 100 000 live births) for C/S
2004	13 471	5731	16	10	119	175
2005	14 553	5765	13	21	89	364
2006	16 680	6066	17	11	102	181
2007	16 808	6703	12	11	71	164
2008	16 212	7354	15	14	93	190
2009	15 190	7628	15	19	99	249
2010	15 255	8016	11	16	72	200
2011	15 227	8179	11	12	72	147
2012	15 524	7353	11	12	71	163
2013	14 682	8165	8	7	54	86
Total	153 602	70960	129	133	84	187

Table 6: Causes of death across two modes of deliveries in postpartum maternal deaths at CHBH (2004-2013)

	NVD	C/S	N
Direct causes			
Pregnancy related infections	10 *(11)	15	25
Obstetric haemorrhage	27	25	52
Complications of hypertension	7	37	44
Anaesthesia		5	5
Subtotal	44	82	126
Indirect causes	NVD	C/S	N
Medical disorders	11	7	18
Non-pregnancy related infection	63	27	90
Acute collapse	8	11	19
Other	2	6	8
Subtotal	84	51	135
TOTAL	128	133	261

*2008–1 patient had NVD for first twin and C/S for retained twin.

4.5 The caesarean section rate

The total caesarean section rate is calculated as number of births delivered by caesarean section divided by total number of live births, multiplied by 100.

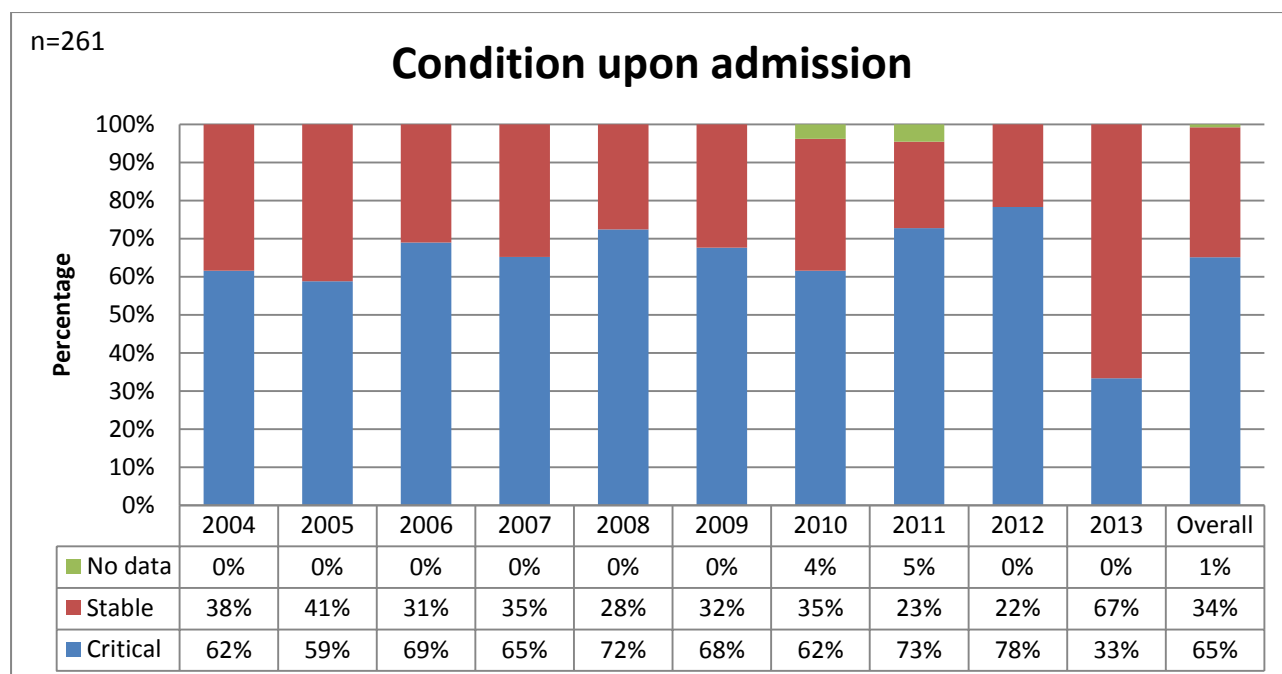
Table 7 shows the caesarean section rate at Chris Hani Baragwanath Hospital from 2004 to 2013.

Table 7: Caesarean section rate at CHBH (2004-2013)

Year	Total live births	Total number of caesarean sections	Total caesarean section rate
2004	19 202	5731	30%
2005	20 318	5765	28%
2006	22 746	6066	27%
2007	23 511	6703	29%
2008	23 566	7354	31%
2009	22 818	7628	33%
2010	23 271	8016	34%
2011	23 406	8179	35%
2012	22 877	7353	32%
2013	22 847	8165	36%
TOTAL	224 562	70960	32%

4.6 Conditions upon admission

Figure 7: Condition upon admission of postpartum maternal deaths at CHBH (2004-2013).



Stable means: Systolic blood pressure (SBP) > 100mmHg, pulse < 120 beats per minute and Glasgow Coma Scale (GCS) of 15/15

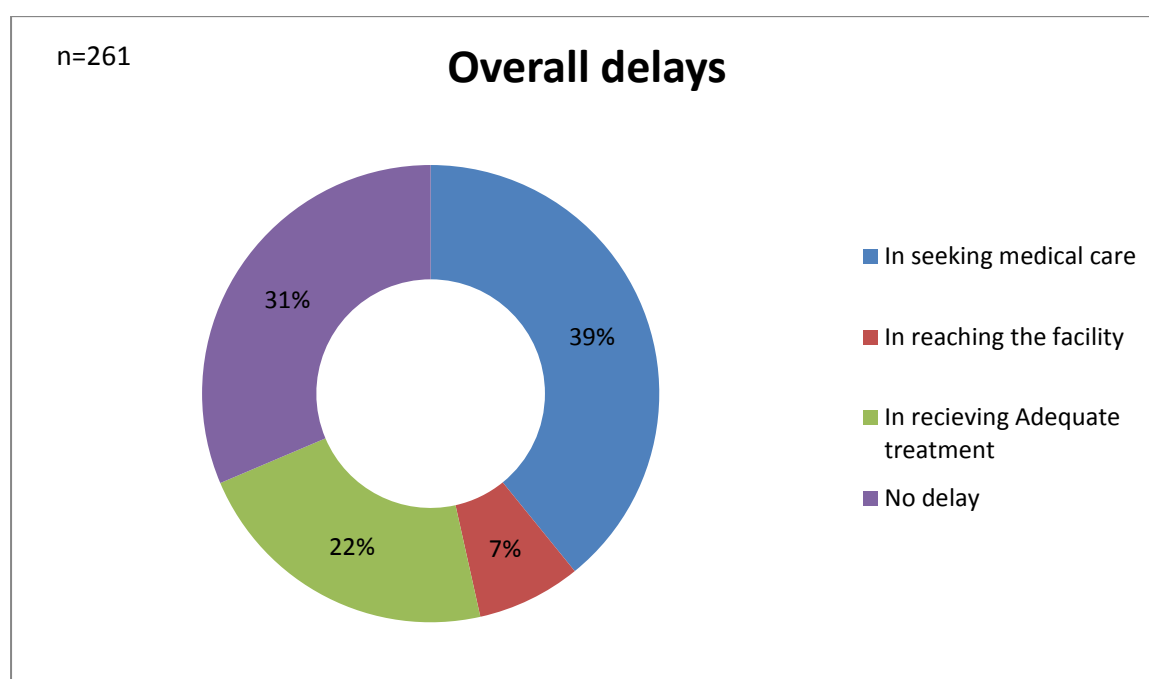
Critical means: SBP < 100mmHg, pulse > 120 beats per minute and GCS < 15/15

4.7Delays

Table 8: Delay in care for postpartummaternal deaths at CHBH (2004-2013).

Year	In seeking medical care	In reaching the facility	In receiving adequate treatment	No delay	Total
2004	16	0	10	0	26
2005	18	6	4	6	34
2006	15	2	3	8	28
2007	10	0	3	10	23
2008	9	0	6	13	28
2009	12	2	5	15	34
2010	6	3	6	12	27
2011	7	1	12	3	23
2012	4	3	6	10	23
2013	4	3	2	6	15

Figure 8: Overall delays in care for postpartum maternal deaths at CHBH (2004-2013).



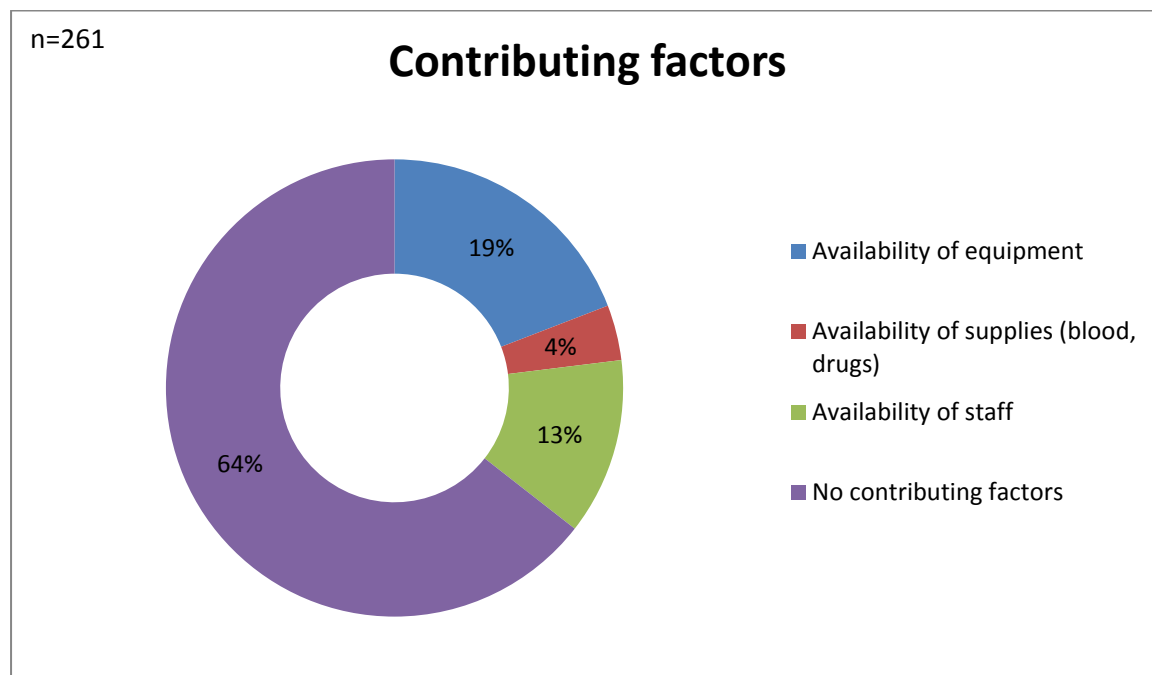
None of the 3 mentioned factors contributed significantly to the cause of death ($p = 0.151$).

4.8 Contributing factors

Table 9: The contributing factors to the event of death of the postpartum maternal mortality at CHBH (2004-2013).

Year	Availability of equipment	Availability of supplies (blood, drugs)	Availability of staff	No contributing factors	Total
2004	4	1	7	14	26
2005	7	1	2	24	34
2006	8	3	0	17	28
2007	1	1	2	19	23
2008	5	2	0	21	28
2009	7	1	0	26	34
2010	4	3	1	19	27
2011	5	1	6	11	23
2012	6	1	1	15	23
2013	8	1	1	5	15

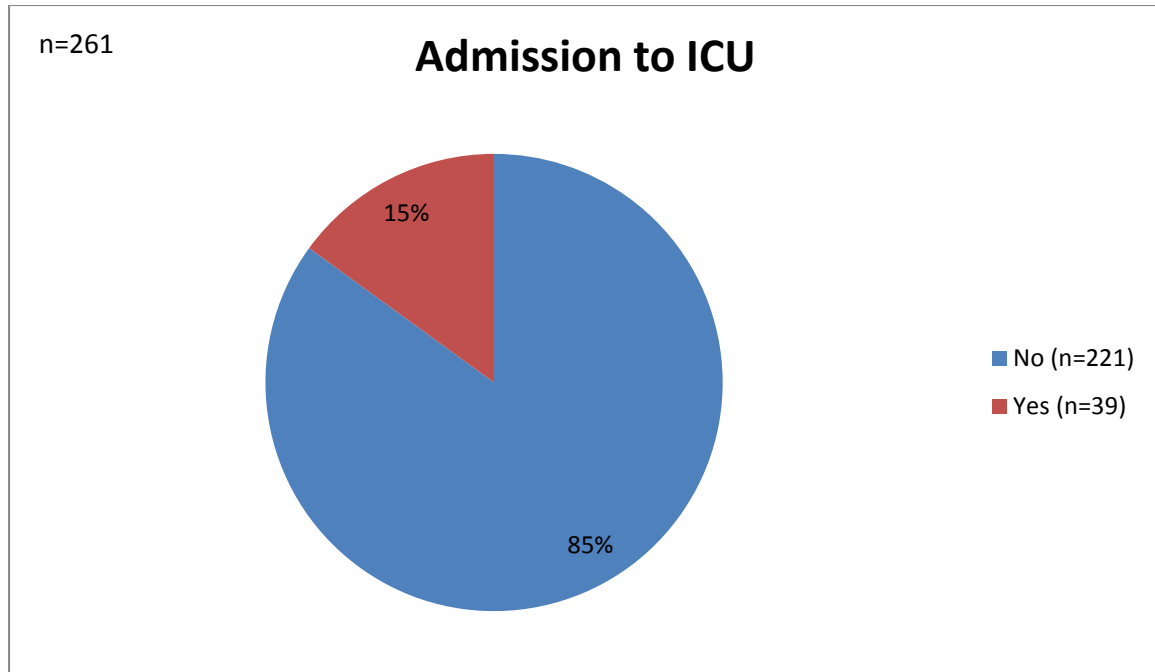
Figure 9: The overall contributing factors to the event of death of the postpartum maternal mortality at CHBH (2004-2013).



Contributing factors $p = 0.483$

4.9 Admission to ICU

Figure 10: Overall Admission to ICU of postpartum maternal deaths at CHBH (2004-2013).



4.10 Contributory conditions

4.10.1 Comorbidities

Table 10: Comorbidities of the postpartummaternalmortality at CHBH (2004-2013).

Year	None	Hypertension	HIV	Other	Previous C/S	Unknown
2004	5	5	14	0	1	2
2005	8	0	19	2	1	3
2006	6	2	15	2	0	0
2007	6	0	14	3	1	1
2008	7	0	13	3	3	3
2009	8	2	18	2	4	2
2010	5	3	15	3	1	1
2011	2	2	15	0	1	1
2012	7	0	16	0	1	1
2013	6	2	7	2	0	1
Total	60	17	146	19	13	17

HIV status p -value = 0.000

4.10.2 Differences in postpartum maternal mortality by HIV status

Figure 11: HIV status of the postpartummaternal deaths at CHBH (2004-2013)

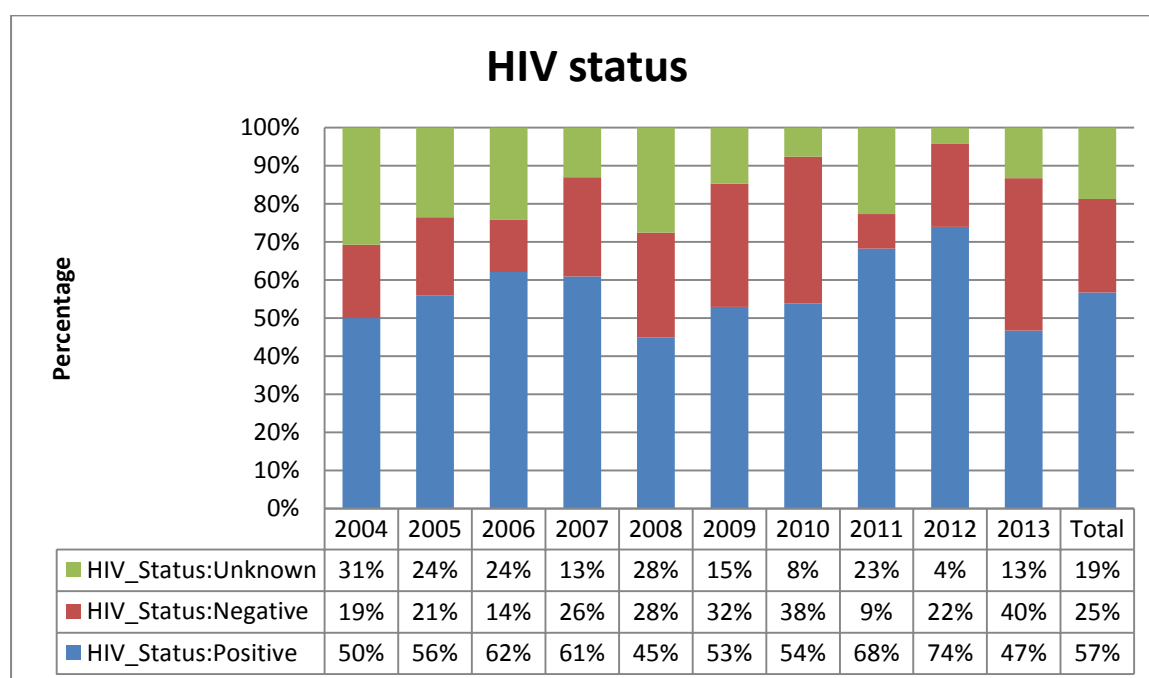


Table 11: HIV positive postpartum maternal deaths treatment status at CHBH(2004-2013).

Year	Received antiretroviral therapy	Received no antiretroviral therapy	No data
2004	8%	54%	38%
2005	11%	21%	68%
2006	0%	28%	72%
2007	29%	57%	14%
2008	15%	69%	15%
2009	22%	11%	67%
2010	21%	36%	43%
2011	60%	20%	20%
2012	19%	31%	50%
2013	29%	29%	43%
Overall	20%	34%	46%

4.10.3 Antenatal care attendance (ANC)

Figure 12: Postpartum maternal deaths ANC attendance at CHBH (2004-2013).

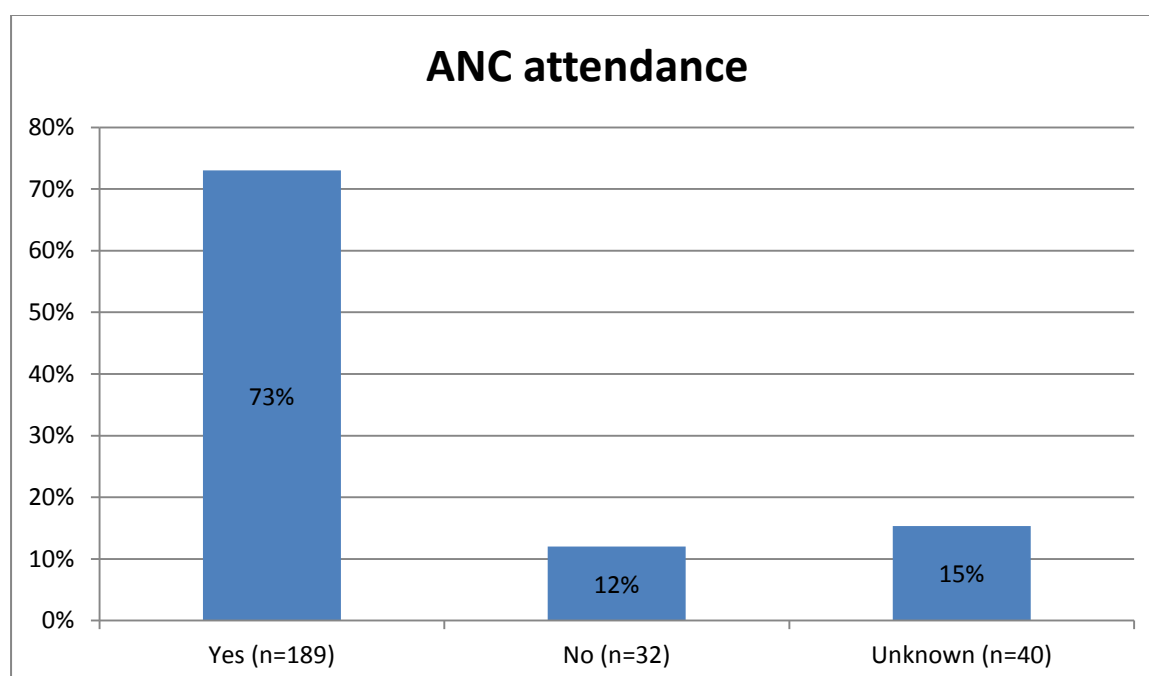
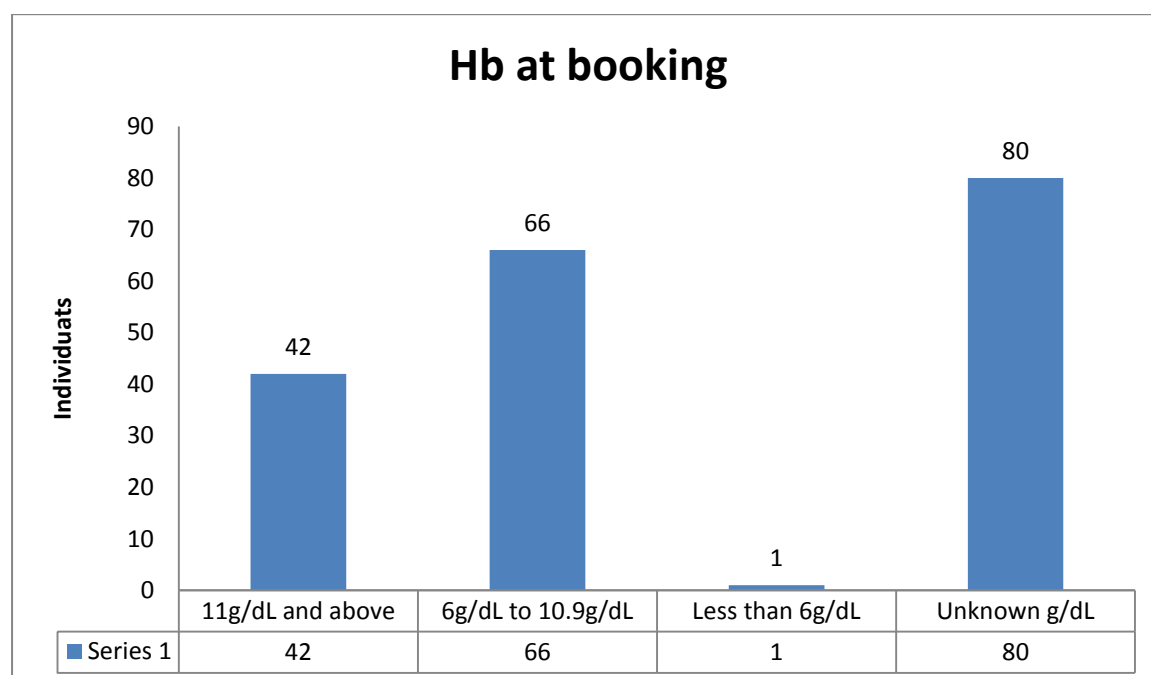
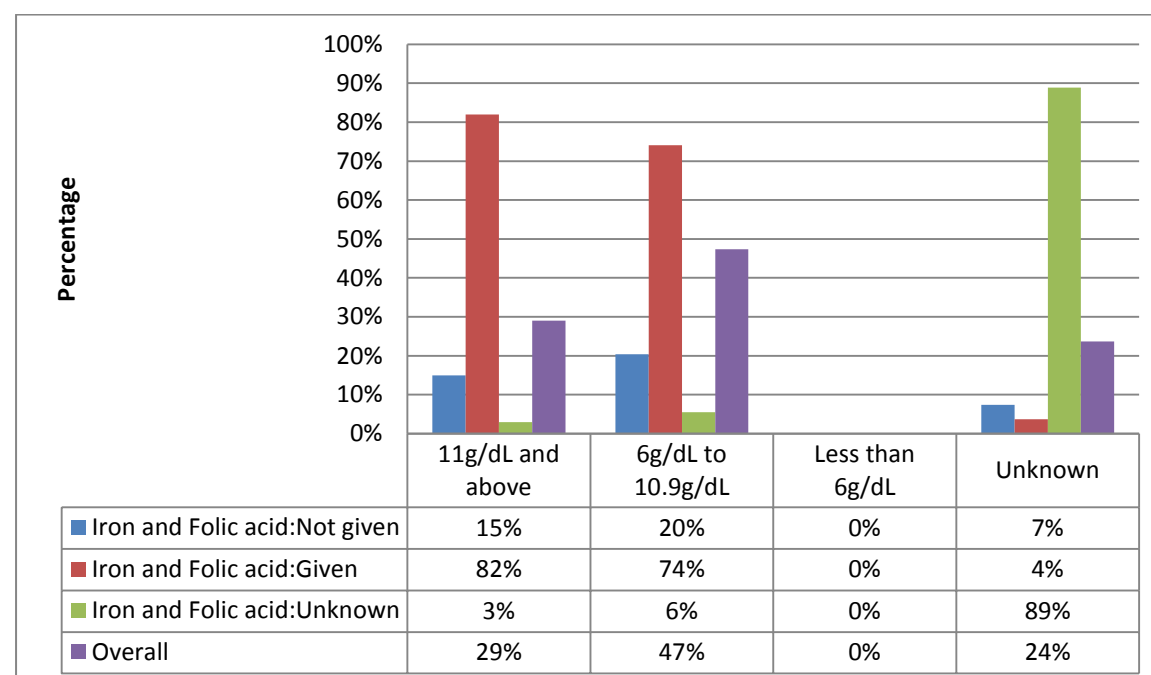


Figure 13: Haemoglobin (Hb) at booking for postpartum maternal deaths that attended ANC at CHBH (2004-2013).



Hb at booking had no significant association to the cause of death ($p>0.05$).

Figure 14: Hb at booking and Iron and folic acid supplements for postpartum maternal deaths that attended ANC at CHBH (2004-2013).



5. DISCUSSION

In this study at Chris Hani Baragwanath Hospital the maternal mortality ratio was 182 per 100 000 births in the years 2004 to 2013. This is higher than the South African MMR that was published in The South African Ninth Interim Saving Mothers report which showed MMR from 2002 to 2012 was 148 per 100 000 births. The study also showed the highest MMR was in 2005, at 246 per 100 000 births. The lowest was in 2013, 127 per 100 000 births, reflecting progress towards reaching MDG 5.

A similar study done in Cairo, Egypt found that MMR was 79 per 100 000 live births in the two years studied, which was the same as the Egypt's reported MMR of 84/100 000.⁹ According to Trends in maternal mortality: 1990 to 2013, in developing countries (230) the MMR was 14 times higher than in developed countries.¹⁶ MMR is thought to be high if it is more than 300-499 maternal deaths per 100 000 live births and extremely high if it is more than 1000 maternal deaths per 100 000 live births.¹⁴

In the current study the main causes of postpartum death in the ten years examined were indirect causes, accounting for 52% of postpartum maternal deaths. Direct causes accounted for 48% of postpartum maternal deaths. Direct causes refers to factors related to the pregnancy itself and indirect causes refer to pre-existing or underlying maternal disease. Coincidental causes were excluded.

Causes of postpartum maternal deaths

The current study identified three conditions as the leading cause of postpartum maternal deaths (non-pregnancy related infections 35%, obstetrics haemorrhage 20% and complications of hypertension in pregnancy 17%).

In Saving Mothers 2011-2013, non-pregnancy related infections, obstetrics haemorrhage and complications of hypertension in pregnancy were also the conditions that contributed to two-thirds of preventable maternal deaths. The fifth Saving Mothers report (2008 – 2010) also reported similar conditions as the leading cause of maternal deaths.¹⁵

Saleh et al.⁹ revealed that the four main causes of maternal mortality were obstetric haemorrhage (mainly postpartum haemorrhage), infection, hypertensive disorders

and obstructed labour. It also showed that women can also die from poor nutritional status at conception and the substandard care provided by caregivers to them.

Association of maternal death to mode of delivery

In this study at CHBH out of 261 postpartum deaths 128 cases had normal vaginal deliveries (NVD) and 132 had caesarean section. One case had NVD for first twin and caesarean section for retained second twin. In all the 10 years evaluated the CS MMR was higher than the NVD MMR. Caesarean section MMR was 187/100 000 live births in the period evaluated and normal vaginal deliveries MMR was 84/100 000 live births. The MMR was more than double after CS compared with NVD.

Caesarean section MMR was the highest in 2005, at 364/100 000 live births and has been fluctuating through the years evaluated. In 2012 obstetrics haemorrhage was the leading cause of death, the CS MMR was 163/100 000 and NVD MMR was 71/100 000. However it will be difficult to prove that this can be attributable to mode of delivery as other factors can be involved. In 2013 the MMR for both NVD and CS were at its lowest 54/100 000 live births for NVD and 86/100 000 live births for CS, reflecting progress towards reaching MDG 5.

The current study showed that direct causes of death were more in women who had caesarean section as mode of delivery than those who delivered by normal vaginal delivery. Sixty five percent (82/126) of all direct causes of death in the postpartum maternal deaths were from women who had caesarean sections and 35% (44/126) had normal vaginal deliveries. The opposite was observed in the indirect causes of death, were most of the postpartum maternal deaths were from women who had vaginal deliveries. Sixty two percent (84/135) of all indirect causes of death were from women who had vaginal deliveries and 38% (51/135) had caesarean sections.

Main causes of death from NVD

The leading cause of death in postpartum maternal deaths that delivered by NVD were non-pregnancy related infections (63/128, 49%), followed by obstetric haemorrhage (27/128, 21%) then pregnancy related infections and medical disorders at 9% (11/128).

Main causes of death from CS

In this study the main cause of death from women that delivered by CS was complications of hypertension at 28% (37/133) followed by non-pregnancy related infection (27/133, 20%) then obstetric haemorrhage (25/133, 19%).

A Canadian study by Liu et al⁶ found patients that had caesarean section had higher postpartum risk of cardiac arrest, hysterectomy, puerperal sepsis, anaesthetic complications, venous thrombo-embolism and haemorrhage requiring hysterectomy and prolonged hospital stay.

Saving Mothers 2011 – 2013 reported that out of 2831 066 deliveries 655 686 were caesarean sections, with a national CS rate of 23.1%. 1243 maternal deaths where a caesarean section was the mode of delivery and 1471 deaths were after normal vaginal delivery. The CS rate for women that died was higher than the national average, at 33%. Bleeding during or after CS was the most serious issue identified by the report. Of all the women who died during or after a CS, one third was due to hypovolaemic shock.

Saving Mothers report also highlighted that there are limitations of estimating fatality rates from caesarean section, as it is not easy to separate the risk associated with the disorder for which the surgery is done, from the risk associated with the surgery itself. The risk of death from vaginal delivery was 1 and the overall relative risk of death from a caesarean section was 2.8.¹⁵

This study exposed caesarean section rate at CHBH increasing from 30% in 2004 to 36% in 2013. The overall caesarean section rate in the 10 years evaluated was 32%. Burrows et al⁵ found that the rates of morbidity for caesarean section deliveries were higher than that for vaginal deliveries in their study. Liu et al⁶ found that elective primary caesarean section deliveries with no obstetrical or clear medical indication

are increasing dramatically. Therefore it is important to assess the risks of maternal complication and deaths associated with CS. The CS rate at CHBH was 32% which was high; this is an area that should be examined further as the MMR was more than double after CS compared to NVD. Maternal death from obstetric haemorrhage is on the increase as reported in the latest Saving Mothers but in this study the risk of death from postpartum haemorrhage did not differ significantly between vaginal and caesarean section deliveries (NVD 21% and CS 19%).

Avoidable or preventable factors

None of the 3 delays evaluated in the current study contributed significantly to the cause of death ($p=0.151$).

According to Pacagnella et al¹⁶ providing timely treatment for obstetric emergencies is the key to decrease maternal mortality. Three delay methods to evaluate the circumstances surrounding access to appropriate emergency obstetric care was developed by Thaddeus and Maine two decades ago. Those authors described delay as having 3 phases.

1. Delay in deciding to seek care by individual and/ or family.
2. Delay in reaching an adequate health care facility.
3. Delay in receiving adequate care at the health facility

Therefore, the three delay phases are helpful to realise a solution and prognosis of maternal death from the onset of complications.

Pacagnella et al¹⁶ also showed an obvious relation between delay in receiving obstetric care and maternal deaths. In addition, finding that with more numbers of delayed adequate treatments the results become worse, concluding that despite reasonable clinical mishaps with pregnancies, the difference in saving a life is a matter of early detection and proper treatment.

Possible contributing circumstances

Three contributing factors that could have had an influence on postpartum maternal mortality were identified and a clear assessment was done on the availability of equipment, availability of supplies and availability of staff. None of the three mentioned factors contributed significantly to the cause of the death ($p = 0.483$)

Admission to ICU

Only 15% of the postpartum maternal deaths were admitted to ICU. In this study majority of postpartum maternal deaths were classified as critical upon admission. Since CHBH does not have its own maternity intensive care unit (ICU), this could be seen as an area that can improve outcomes of maternal health if an ICU that was near and readily accessible was available.

Age

Association between cause of death and age showed that age was not statistically significant to the cause of death of the postpartum maternal deaths over the period evaluated ($p=0.547$). In this study the highest percentage in mortality was amongst those in the age group of 26-35 years (50%), mortality in this age group peaked during 2009, with 18 deaths. This group was followed by the age groups 15–25 and 36-45 years (29% and 20%, respectively). The mortality incidence varied across the 26-35 year group range: 8 (2013) and 18 (2009), demonstrating a 25% decline from the mean of 13 for the last year of the study period (2013). The overall mean of all the age groups is 29.58 which is equivalent to 30 years, the minimum age was a 15 year old woman who falls in the period 2006 and the maximum age was a 46 year old woman who died in 2009.

According to Asamoah *et al*¹⁸ pregnancies are less safe with advance maternal age. In their study risk of maternal death due to miscellaneous causes increased with age. These miscellaneous causes comprised mainly of deaths from unspecified causes, uterus rupture, complications of obstetrics surgery, anaesthesia, embolism, other complications of pregnancy, childbirth and the puerperium. They also mentioned a similar study conducted in Bangladesh found that pregnancies are more dangerous in women over 35 years of age than that of their younger counterparts.

Saving Mothers 2011 – 2013 reported that teenagers were more susceptible of dying due to anaesthesia more often than most and women over 34 years old are at risk of dying due to most conditions. It also reported that women between ages of 25 – 40 years were the highest in non- pregnancy related infections, showing the increasing maturity of the HIV epidemic. Their report showed clearly that mortality increases with the increasing age.¹⁵

Employment status

In the current study most of the postpartum maternal deaths were unemployed females in the 8 years of the evaluation. In 2004 and 2010 majority of the employment status was unknown this shows that there is need for improvement in medical record keeping.

Maternal mortality is an indicator of female status in society, a robust indicator of human development. It's closely associated with socioeconomic deprivation of a nation. Prevention of maternal mortality is important and extremely sensitive to obstetric care standard and for better outcomes these needs to be continually modified. The difference in maternal mortality ratios between low and high-income countries comes from the difference in management of pregnancy complications that can potentially lead to death.¹⁶

Parity

In this study 51% of the postpartum maternal deaths were nulliparous or had parity of one, 46% multiparous and 2% grand multiparous. Multiparity was not associated with increased risk of death as other similar studies has shown.

HIV status

The results of this study indicate that a total of 261 of the postpartum maternal deaths took place in the CHBH over the study period 56% were HIV positive, 25% were HIV negative and 19% were unknown to be either HIV positive or HIV negative. The HIV status of the women contributed significantly to the postpartum deaths ($p < 0.0001$).

In Saving Mothers 2011 - 2013 reported that HIV testing of maternal deaths has improved significantly with 87% of maternal deaths being tested for HIV infection. Most of the maternal deaths that tested for HIV were HIV positive, 65.3% of the 87% that tested. Non-pregnancy related infections were the most common cause of death among the HIV infected women.¹⁵

ANC attendance

This evaluation showed that on overall, 12% of all postpartum maternal patients did not attend antenatal care as compared to 73% who attended over the period of 10 years, however; a concerning issue is that a large percentage resulting to 15% are patients who the evaluation cannot account for whether they did attend the antenatal care or not (poor record keeping). It was observed that secondary and private antenatal cares services were not used as ANC locations in the 10 year period of evaluation as compared to primary and tertiary antenatal care.

Antenatal care's importance lies in its ability to detect preclinical or early morbid conditions in pregnant women and opportunity to treat or control them. Antenatal screening can only have an influence in reducing maternal mortality if the main causes of maternal deaths have detectable pre-morbid states for which there are efficacious and acceptable remedial interventions. Out of all major contributors to maternal mortality in developing countries, only malaria, HIV and pre-eclampsia/eclampsia meet those criteria. Antenatal care services will not identify those women who will develop infections, have postpartum haemorrhage or have obstructed labour. In countries that have low prevalence for HIV and malaria the potential contribution of antenatal screening to reduction of maternal mortality is limited. Access to antenatal care services will contribute in a little way but will not yield significant reduction in maternal deaths.¹⁹

Since South Africa has high prevalence of HIV, antenatal care services can identify women that are infected and this can help reduce the non-pregnancy related infection deaths. These were also the leading cause of postpartum maternal deaths in this study.

Hb at booking

The current study only looked at the Hb levels of those postpartum maternal deaths that were attending antenatal care. A level of haemoglobin known in the postpartum maternal deaths at CHBH over the years evaluated was 57% (102/179). The SA Maternity Care Guidelines defines anaemia as haemoglobin less than 11g/dL.¹⁵ Therefore, percentage of women who were anaemic at booking was 62% (63/102). This study showed that Hb at booking did not contribute significantly to the cause of

death. Haemoglobin values of 77 women who attended antenatal care were not recorded or unknown, which indicates that there is room for improvement in medical record keeping.

Most women were on iron and folic acid supplements while attending antenatal care. Haemoglobin level might have increased by the time they delivered. Hb level prior to labour or delivery would have helped reflect the importance of anaemia as a contributory cause to postpartum maternal mortality.

In Saving Mothers 2011 – 2013 it was noted that the importance of anaemia as contributory cause of maternal death has been under estimated. It was reported that anaemia was present in 42.7% of maternal deaths and was highest in early pregnancy losses followed by non-pregnancy related infections. It was also present in 39.4% of pregnancy related infections and 30.3% of those who died from obstetrics haemorrhage.¹⁵

6. STRENGTH OF THE STUDY

The study evaluated large number of maternal deaths over a 10 year period and most of the maternity records were retrievable.

7. LIMITATIONS OF THE STUDY

As a retrospective study design, some data was lost or irretrievable. Quality of medical records was in a poor state (old and worn of). Also hand written documents that were difficult to read or incompletely filled.

8. CONCLUSION

In conclusion, the study showed that the main causes of postpartum maternal deaths at CHBH were non-pregnancy related infections, obstetrics haemorrhage and complications of hypertension. This was similar to the findings of the latest Saving Mothers. The maternal mortality ratio (MMR) was 182 per 100 000 births in the years 2004 to 2013. In all the 10 years evaluated the caesarean section MMR was more than twice higher than the normal vaginal delivery MMR. Risk of death from obstetrics haemorrhage did not differ significantly between the two modes of deliveries. The only significant contributory factor was the HIV status of the postpartum women who died.

As this study focused on postpartum maternal deaths, we were unable to assess the role played by first trimester complications (ectopic pregnancies, abortions) and women that died while still pregnant in the MMR at CHBH.

We recommend that all maternity units review and publish MMR in order to highlight and identify factors involved in the failure to reach the MDG. Factors involved in the stagnation need to be more completely identified. In order to reduce maternal deaths it is important to have protocols to manage obstetrics emergencies, audit maternal records, train junior staff members and patient education.

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10. APPENDICES

10.1 APPENDIX A: DATA CAPTURING SHEET

A 10 year evaluation of postpartum maternal mortality at Chris Hani Baragwanath Hospital (2004-2013)

1	Mode of delivery	Normal vaginal delivery
		Caesarean section
2	If NVD, was delivery assisted (forceps, vacuum)	Yes
		No
		N/A
3	VBAC	Yes
		No
		N/A
4	If C/S, timing of procedure	Pre-partum(before labour and/or ROM) elective
		Intrapartum (emergency)
		Reason for C/S
5	Age	
6	Race	Black
		White
		Coloured
		Asian
		Unknown
7	Nationality	South African
		Non- South African
		Unknown
8	Employment status	Employed
		Unemployed
		Self employed
		Student or minor
		Unknown
9	Gravidity	
10	Parity	

11	Miscarriages	
12	HIV Status	Positive
		Negative
		Unknown
		If pos, CD4 count
		On treatment or not
13	Co-morbidities	None
		Hypertension
		Diabetes
		Asthma
		Epilepsy
		HIV
		Cardiac
		Other
14	ANC attendance (Booked)	Yes
		No
		Unknown
14.1	If yes, number of ANC visits	
		Not indicated
15	ANC location	Primary
		Secondary
		Tertiary
		Private
		Unknown
		N/A
16	Maternal risk status(At booking)	High
		Low
17	Pregnancy risk factors	
17.1	Hb at booking	
17.2	Iron and folic acid supplements	Given
		Not given
17.3	RPR	Negative
		Positive
		If pos, treatment given or not

17.4	Tetanus toxoid received	Yes
		No
18	Gestation at time of delivery	
19	Location of delivery	BBA
		MOU
		District hospital
		Secondary hospital
		Tertiary hospital
20	Birth attendant	Lay person
		Unknown
		Nurse
		Midwife
		Medical Officer
		O&G Registrar
		O&G Specialist
		Other
21	Outcome of baby	Stillborn
		Alive
		Unknown
22	Estimated blood loss at delivery	
23	Duration of labour	First stage
		Second stage
		Third stage
24	Condition upon admission at CHBH	Stable
		Critical
25	Admission to ICU	Yes
		No
26	Interventions performed following admission	Transfusion
		CPR
		Investigations
		Medical treatment
		Laparotomy
		Hysterectomy

27	Delays	In seeking medical care
		In reaching the facility
		In receiving adequate treatment
28	Contributing circumstances to the event	Availability of equipment
		Availability of supplies (blood, drugs)
		Availability of staff
29	Classification of cause of death	Direct
		Indirect
30	Cause of death	
31	Where patient died	ICU
		Ward
		DOA
32	Post-mortem	Yes
		No

NVD – Normal vaginal delivery

VBAC – Vaginal birth after caesarean section

C/S – Caesarean Section

ANC – Antenatal clinic

BBA – Born before arrival

MOU – Midwife obstetric Units

CPR – Cardiopulmonary resuscitation

10.2 APPENDIX B: ETHICS CLEARANCE CERTIFICATE



R14/49 Dr Matsepo Moletsane

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M150504

NAME: Dr Matsepo Moletsane
(Principal Investigator)

DEPARTMENT: Obstetrics and Gynaecology
Chris Hani Baragwanth Academic Hospital

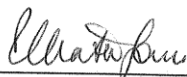
PROJECT TITLE: A 10 Year Evaluation of Postpartum Maternal Mortality
at Chris Hani Baragwanth Academic Hospital
(2004 - 2013)

DATE CONSIDERED: 29/05/2015

DECISION: Approved unconditionally

CONDITIONS: Title change (12/05/2016)

SUPERVISOR: Dr Ebrahim Bera

APPROVED BY: 
Professor P. Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 12/05/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 10004, 10th floor, Senate House/2nd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/We fully understand the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit to the Committee. **I agree to submit a yearly progress report.** The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in May and will therefore be due in the month of May each year.

Principal Investigator Signature _____

Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

10.2 APPENDIX C: TURNITIN RECEIPT

5/26/2016

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▼ Assignment Details

Open Date	Jan 13, 2016 11:03 AM
Graded?	No
Resubmissions Allowed?	Yes
Remaining Submissions	Unlimited
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