

**THE CAUSES OF TEENAGE MATERNAL MORTALITY AT CHRIS HANI
BARAGWANATH HOSPITAL IN SOWETO. A REVIEW OF CASES FROM 1997 TO
2011**

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ABSTRACT

Introduction

The most tragic outcome of a teenage pregnancy is a teenage maternal death. Research from African countries has shown that pregnant teenagers are at increased risk for maternal death when compared with older women, chiefly from complications of hypertension in pregnancy and pregnancy-related sepsis. The objectives of this study were to determine the proportion of maternal deaths accounted for by teenagers, and to describe associated obstetric factors, causes of death and avoidable factors.

Setting and methods

This was a descriptive retrospective study, using records of all maternal deaths at Chris Hani Baragwanath Hospital (CHBH) from 1997 to 2011. All maternal deaths at CHBH are notified to the national government, and complete patient records have been kept since 1997. All teenage (age less than 20 years) maternal deaths were found by hand-searching all maternal death files for the study period. Demographic and obstetric details were recorded, as well as the primary cause of death and avoidable factors in each case, using the methodology of the Confidential Enquiries into Maternal Deaths in South Africa.

Results

There were 33 teenage maternal deaths out of a total of 562 deaths (6.1%). Eighteen (54.5%) of the teenagers were 18 or 19 years old. Nine died without having booked for antenatal care. Twenty-six (78.8%) were 28 weeks or more pregnant or postpartum when they died. The most frequent causes of death were hypertensive disorders of pregnancy (n=10; 30.3%), including 9

cases of eclampsia, and non-pregnancy-related infections (n=10; 30.3%), including 6 cases of lower respiratory tract infection and 2 foreign nationals who died of malaria. Among the teenagers who died from non-pregnancy-related infections, 3 were HIV infected, 4 were HIV negative and 3 did not have HIV results. Infrequent causes of death included pregnancy-related sepsis (n=2; 6.1%), and postpartum haemorrhage (n=1; 3.0%). The most frequent avoidable factors were failure to book for antenatal clinic (n=5; 15.2%) and delay in seeking medical help (n=8; 24.2%).

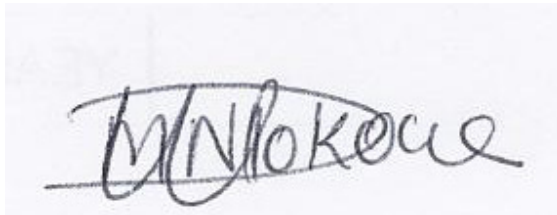
Conclusion

Maternal deaths in teenagers were infrequent and occurred in a lower proportion of all maternal deaths (6.1%) than expected, based on data suggesting a 13% teenage pregnancy proportion from a study done in 1999 to 2001. This finding differs from those in other African countries. The high frequency of eclampsia is similar to data from other countries, but pregnancy-related sepsis was not frequent. Development and maintenance of adolescent community resources and health services, including improving access to foreign teenagers, may improve health care utilisation by teenagers. Utilisation indicators would include use of contraception, uptake of termination of pregnancy services, and antenatal care attendance for ongoing pregnancies.

DECLARATION

I, Nteboheleng Moleboheng Pontsho Mokone, hereby declare that this research report is my own work. It has not been submitted before at any institution for any degree or examination. It is submitted to the University of Witwatersrand's Faculty of Health Sciences in partial fulfilment for the degree of Master of Medicine Obstetrics and Gynaecology.

Signed ...

A handwritten signature in black ink, appearing to read 'M Mokone', is written over a light blue rectangular background.

Date: 03-09-2013

ACKNOWLEDGEMENTS

I would like to express much gratitude and appreciation to Prof E J Buchmann for supervising this project; and to all the doctors who were involved in the review process of maternal deaths over the years.

DEDICATION

This work is dedicated to my family, the Mokone and Uzonwa family, for their constant support and encouragement. Thank you ever so much for your unending love and patience.

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LITERATURE REVIEW

Introduction

Teenage pregnancy presents a unique challenge to midwives and obstetricians, and is of special concern to communities around the world. Teenage mothers are often a high risk group due to their low socioeconomic status, low level of education and their financial dependence on others.¹ They are also more vulnerable to violence and sexual abuse.¹ A review by Paranjothy in 2008 looking at the epidemiology of teenage pregnancy in the United Kingdom (UK) reported that, compared to mothers aged above 30 years, teenage mothers were at increased risk of living in poverty and not completing their education.² Teenage pregnancy is associated with a relatively high incidence of maternal obstetric complications and adverse fetal outcomes. The World Health Organisation (WHO) defines adolescence as a stage of human development starting from age 10 to 19 years.³ In this research report, teenagers are considered as women aged less than 20 years.

The incidence of teenage pregnancy in developed countries is decreasing, but the United Kingdom (UK) still has the highest rate in Europe at five times that of France and eight times of the Netherlands.² In 1998, the UK had a rate of 16.6 per 1000 females aged 15-17 years compared to France at 3.4 and Netherlands at 2.2. Data from the United States indicates that the adolescent childbirth rate remains higher than that of other industrialised countries.⁴

There is no consensus in the literature reviewed as to whether the higher rate of obstetric complications associated with teenage pregnancy is as a result of the young gynaecological age as reported in studies by Chen et al⁵ and Kurth et al,⁶ or whether it is due to associated socio-

demographic factors like poverty, low education, and unmarried status as reported by Gotzak-Uzan,⁷ and Bukulmez.⁸ In the Eighth Report on Confidential Enquiries into Maternal Deaths in the United Kingdom, seven of the 14 teenage maternal deaths occurred in teenagers known to the social services.⁹

The adverse fetal outcomes most frequently reported are preterm delivery, low birth weight and relatively high neonatal mortality rate.^{5,6,10,11} A study conducted by Chen et al. in the United States of America (USA) reported that teenage pregnancy increased the risk of adverse birth outcomes like preterm birth, low birth weight and small for gestational age babies, independent of some of the important known confounders such as low socio-economic status, unmarried status, cigarette smoking during pregnancy, inadequate prenatal care and inadequate weight gain during pregnancy.⁵ Teenagers younger than 18 years exhibited poorer outcomes than those aged 18 to 19 years. Kurth et al. conducted a cross-sectional study in Gabon and reported adolescent age to be a risk factor for adverse pregnancy outcomes.⁶ They found that women younger than 16 years were more likely to deliver low birth weight infants compared to women older than 16 years, and that this was independent of other known risk factors for low birth weight, for example malaria or measures to prevent malaria, such as insecticide-treated bed-nets and intermittent preventive treatment of malaria in pregnancy.

Maternal complications associated with teenage pregnancy include higher frequencies of pre-eclampsia, eclampsia and anaemia.^{12, 13} Usta et al.¹² did a retrospective chart review of singleton births at more than 24 weeks gestational age between 1994 and 2003 in Beirut where they compared outcomes of teenagers aged less than 20 years with those of women aged 25 to 30 years (controls). They reported a significantly higher rate of pre-eclampsia in teenagers of 2.9%

compared to 0.6% in the controls ($p=0.01$). They also reported a lower pre-delivery haematocrit level in the teenagers.

Maternal death is not a commonly reported complication of teenage pregnancy, although a few studies have mentioned an increased incidence of maternal deaths in teenagers and women above 35 years when compared to women aged 20 to 34 years.^{14,15} There are very few studies that address teenage maternal death, and no studies could be found that specifically considered teenage maternal death in South Africa. Table 1 shows the results of three studies on maternal mortality in teenagers in sub-Saharan Africa. All of the studies were facility-based, and were unable to record all deaths in the communities. The main themes emerging from these results are a high rate of teenage pregnancy mortality as a proportion of all maternal mortality, a lack of antenatal care, the role of hypertension in pregnancy, malaria and anaemia, and the contribution of severe infection, the latter probably the result of unsafe abortion and obstructed labour.

The tenth revision of the International Classification of Diseases, Injuries and Causes of Death (ICD 10), defines maternal death as a death of a woman while pregnant or within 42 days of termination of the pregnancy, irrespective of duration and site of pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.¹⁶ The priority given to maternal deaths worldwide is reflected in its inclusion in the Millennium Development Goals (MDGs). The fifth goal (MDG 5) is to globally reduce the maternal mortality ratio by 75% by 2015.¹⁷

Table 1. Studies that have investigated maternal mortality in teenage pregnancies

Author and year	Country	Study design	Numbers	Comments
Granja, et al. ¹⁸ 2001	Mozambique (Maputo)	Record review over 5 years (1989-1993)	52 teenage maternal deaths (total maternal deaths 239)	Hospital-based study 44% no antenatal care Causes: Malaria 27% Hypertension 21%, Puerperal infection 10%, Abortion 6%
Airede et al. ¹⁹ 2003	Nigeria (Sokoto)	Retrospective cross-sectional study over 10 years (1990- 1999)	46 teenage maternal deaths (total maternal deaths of 197)	Hospital based study 85% no antenatal care Causes : Eclampsia 46%, Obstructed labour 30% Anaemia 11% 54% deaths occurred postpartum
Ujah et al. ¹⁵ 2005	Northern Nigeria (Jos)	Record review over 11 years (1991-2001)	25 teenage maternal deaths (total maternal deaths of 211)	Hospital-based study 56% no antenatal care Causes: Induced abortion 37%, Eclampsia 26%, Sepsis 26%

In the first paper of The Lancet Maternal Survival Series (2006), it was noted that many countries are showing a decline in their maternal mortality ratio (MMR).²⁰ The maternal mortality ratio in industrialized countries had decreased to about 20 to 30 deaths per 100 000 live births. In Sweden the MMR was 300 deaths per 100 000 live births in 1935 but by 1960 it had decreased to 20 to 30 deaths per 100 000 live births. Thailand, a middle-income country, was able to reduce its MMR from 400 deaths per 100 000 live births in 1960 to 50 deaths per 100 000 live births in 1984. Other middle-income like Malaysia and Sri Lanka have also decreased their MMR by about fifty percent during the same period.²⁰

The World Health Organisation developed estimates of maternal mortality in 2008 and reported that of the estimated total of 358 000 maternal deaths worldwide in 2008, 99% of the deaths occurred in developing countries. Eighty-seven percent of all global maternal deaths occurred in sub-Saharan Africa and South Asia. Sub-Saharan Africa accounted for 204 000 (which was almost three fifths) of these deaths.²¹ In the same year, the adult lifetime risk of maternal death was reported to be highest in sub-Saharan Africa at 1 in 31, followed by Oceania at 1 in 110 and South Asia at 1 in 120. In contrast, the adult lifetime risk of maternal death in developed countries was only 1 in 4300.²¹ Most maternal deaths occur between the third trimester and the first week after the termination of pregnancy, especially in the first two days after delivery or abortion, with the greatest risk of the timing of death being around labour, delivery and immediate postpartum period.²⁰

In the Saving Mothers report for Confidential Enquiries into Maternal Deaths for the triennium from 2005 to 2007 of the Department of Health in South Africa, the five leading causes of maternal deaths were identified as non-pregnancy related infections (mainly acquired immune

deficiency syndrome (AIDS)) at 43.7%, complications of hypertension at 15.7%, obstetric haemorrhage (antepartum and postpartum haemorrhage) at 12.4%, pregnancy-related sepsis at 9% and pre-existing maternal disease at 6%.²² It was noted in the same report that 38.4% of maternal deaths reviewed were avoidable within the health care system, having excluded patient orientated factors.

Maternal death and age

In the Saving Mothers Report, deaths among women younger than 20 years made up 11.3% of all maternal deaths in that triennium.²² In the Fifth Report on the State of the World's Mothers, released in 2004 by the Save the Children organisation, it was reported that complications of pregnancy and childbirth were the leading cause of death in teenage girls aged between 15 and 19 years in poor countries.²³ It was also noted that in the same poor countries younger mothers aged 10 to 14 years had a maternal mortality rate five times higher than that of women aged 20 to 24 years. Ujah et al. from Jos University Teaching Hospital in North-Central Nigeria, reported that the greatest risk of death was among young teenagers, especially those younger than 15 years.²⁴ Mbonye, in a retrospective study of maternal deaths in 12 selected districts of Uganda, reported that 32.4% of maternal deaths occurred in women younger than 19 years as compared to 29.4% of deaths in women aged 20 to 24 years.¹⁴ Granja et al. in their study on adolescent maternal mortality in Mozambique, reported a maternal mortality ratio of 387 among adolescents (age younger than 20 years) compared to a ratio of 294 per 100 000 live births in women older than 20 years.¹⁸ A study by Conde-Agudele et al. in Latin America, where the MMR is much lower than in Africa, also reported that girls 15 years and younger were at higher risk for maternal death at a rate of 18.5 per 10 000 women compared to women aged between 16 and 19

years (at a rate 4 per 10 000 women), and older women aged 20 to 24 years at a rate of 4.1 per 10 000 women.²⁵

Use of antenatal care

Antenatal care is important for identifying pregnant women who are at high risk of developing complications.²⁶ It is generally accepted that the uncomplicated pregnant woman can receive antenatal care at a midwife-headed facility. Pregnant women who are at high risk for complications should be referred to an appropriate higher-level health facility, either at secondary or tertiary care level. In several studies it was noted that teenagers have less antenatal care visits than women aged 20 years and above.^{5,6,10}

Pregnant women who do not attend antenatal clinics ('unbooked mothers') seem to have a higher maternal mortality ratio compared to booked women.²⁴ The Centre for Maternal and Child Enquiries (CMACE) Saving Mothers' Lives report in the United Kingdom states that unbooked mothers made up 17% of all maternal deaths in the review period between 2006 to 2008.⁹ Ujah et al. reported that unbooked women had a 20 times higher maternal mortality rate than booked women.²⁴ Airede et al. from Sokoto in Nigeria noted in their study that 85% of maternal deaths occurred in unbooked women.¹⁹ Kullima et al. from northern Nigeria cited lack of antenatal care as a risk factor for maternal death.²⁷ Loto et al. in their comparative study carried out in University Teaching complex in Ile-Ife, Nigeria, showed a significant difference in the following pregnancy complications between booked and unbooked teenagers: anaemia in pregnancy, eclampsia, preterm delivery and low birth weight, with the unbooked teenagers having the

highest rate of complications.²⁸ The overall maternal mortality rate of teenagers (aged less than 20 years) was 1.9% compared to 1.4% of women aged 23 to 29 years. However, the maternal mortality rate in unbooked teenagers was 4.8% compared to 0% in booked teenagers. In comparing the unbooked teenagers to unbooked older controls (aged 23 to 29 years), the maternal death rate in teenagers was 4.8% compared to 2.5% of controls.

According to the South African Department of Health document entitled “Countdown to 2015: Maternal, Newborn and Child Survival”, the national percentage of pregnant women aged 15 to 49 years seen at least once by a skilled health care provider has increased.²⁹ From 1994 to 1995, 89% of pregnant women received antenatal care, which increased to 94% in 1996 and 92% in 2003. The Saving Mothers Report estimated the antenatal care attendance for the general pregnant population between 2005 and 2007 to be 95%.²² The Saving Mothers report’s findings suggest that 23.9% of maternal death cases did not receive antenatal care. This rate is much higher than the 5% unbooked rate for the general maternal population (Table 2).

Table 2. Antenatal care in maternal deaths in South Africa, 2005-2007

	Number	Percentage
Received antenatal care	2601	63.8
No antenatal care	818	20.1
Unknown	658	16.1

*Table information taken from Saving Mothers Report triennium 2005-2007

Causes of maternal death

Causes of maternal death are conventionally divided into direct and indirect causes.³⁰ A direct maternal death is as a result of complications of the pregnant state (pregnancy, labour and puerperium) or management thereof, and includes deaths caused by the following conditions: antepartum and postpartum haemorrhage, hypertension, ectopic pregnancy, abortion, pregnancy-related sepsis, anaesthetic death, acute collapse in pregnancy, and embolism.³⁰ An indirect maternal death is one resulting from a previously existing disease or a disease that developed during pregnancy and that was not due to a direct obstetric cause but was aggravated by the physiological effects of pregnancy. This includes pre-existing maternal diseases like cardiac, endocrine, respiratory, and haematological conditions, auto-immune diseases and non-pregnancy related infections such as AIDS, tuberculosis, pneumonia, malaria, urinary tract infections, meningitis and endocarditis.³⁰

The causes of maternal death vary with maternal age. According to the Saving Mothers report for 2005 to 2007, the causes of death in women younger than 20 years were complications of hypertension (17.4%), anaesthetic deaths (14%), pregnancy-related sepsis (12.6%), antepartum haemorrhage (12%), acute collapse (10.2%), pre-existing medical diseases (8.9%), postpartum haemorrhage (7%) and non-pregnancy related infections (4.3%).²² The contribution of Human Immunodeficiency Virus (HIV) and AIDS was 3%, included in the non-pregnancy related infections. Compared to older women, relatively few teenagers died from non-pregnancy related infections and postpartum haemorrhage in South Africa, while there was a higher proportion of deaths from antepartum haemorrhage and anaesthesia in the teenagers.²² In the study on adolescent maternal deaths in Sokoto, Nigeria, Airede et al. identified eclampsia (46%) and

prolonged obstructed labour (30%) as having caused 76% of deaths in their study.¹⁹ Anaemia was ranked third on the list of causes of death, being associated with 11% of deaths in these young women. In the Saving Mothers report, obstructed labour or prolonged labour were not recorded as primary causes of death so their impact on maternal deaths in South Africa is not clear.²²

The study done in north-central Nigeria by Ujah et al. found that unsafe abortion (36.9%), eclampsia (26.3%) and sepsis (26.3%) were the more frequent causes of death in adolescent women.¹⁵ Earlier studies by Ransome-Kuti stated that 50% of Nigeria's maternal deaths were in women aged 19 years or younger due to illegal abortions and that abortion complications were responsible for 72% of all deaths in this age group.³¹ Airede et al. found that abortion was not a common cause of death in adolescents. They attributed this to an apparently low frequency of induced abortions in the area of Nigeria where they conducted their study.

The World Health Organisation defines unsafe abortion as a procedure for terminating an unwanted pregnancy either by persons lacking necessary skills or in an environment lacking minimum medical standards, or both.³² Unsafe abortions occur in both developed and developing countries but the majority (more than 97%) occur in developing countries.³³ Abortion mortality accounts for 13% of all maternal mortality worldwide.³⁴ Grimes et al. in 2006 reported that, in Africa, teenagers (15 to 19 years) accounted for 25% all unsafe abortions.³⁵ In the Saving Mothers report for 2005 to 2007, abortion accounted for 3.4% of all maternal deaths. When comparing this figure to that of the report for 1999 to 2001 where the percentage of maternal deaths resulting from abortion was 4.9%, there was a decline in maternal death caused by unsafe abortion. This was largely attributed to the passing of the Choice of Termination of Pregnancy

Act in 1996, making safe termination of pregnancy legally accessible in safe health facilities with trained medical personnel.³⁶ Legalising abortion and the availability of well-trained health workers, together with access to modern contraception, have proved to be effective strategies in reducing the mortality and morbidity of unsafe abortions in South Africa.³⁵

Kullima et al, from northern Nigeria, found the leading causes of death in their sample of teenage maternal deaths to be eclampsia (46.4%), pregnancy-related sepsis (17%) and postpartum haemorrhage (14.3%).²⁷ In Mozambique, Granja et al. found that the leading causes of teenage maternal death were malaria (27%), pregnancy induced hypertension and eclampsia (21%), puerperal infection (15%) and abortion (10%).¹⁸ The authors considered 79% of the teenage maternal deaths to be avoidable. Conde-Agudelo et al. commented that in their study anaemia, postpartum haemorrhage and puerperal endometritis might have contributed to the increased risk of maternal death among young teenagers aged 16 years and less.²⁵

HIV and AIDS has not been noted as a frequent cause of teenage maternal mortality. This should not be surprising, given the latency period of the infection. In Sub-Saharan Africa, where there is a high HIV prevalence, HIV and AIDS has become a dominant cause of maternal mortality. In 2008 it was estimated that 42 000 deaths occurred among pregnant women worldwide from HIV and AIDS.²¹ Nine per cent of all maternal deaths in Sub-Saharan Africa in 2008 were the result of HIV and AIDS. The MMR for this region was calculated to be 640 deaths per 100 000 live births, but after excluding deaths caused by HIV and AIDS, the MMR was estimated at 580 deaths per 100 000 live births.²¹ However, Le Coeur et al. observed in a report from Pointe Noire, Congo, that HIV infection caused a four-fold increase in the maternal mortality ratio.³⁷ Bicego et al., from Malawi and Zimbabwe, added that HIV and AIDS increased maternal

mortality through an increase in direct causes like puerperal sepsis or indirect causes like anaemia and tuberculosis.³⁸ Khan et al. did a prospective study in Durban, South Africa, looking at the impact of HIV infection on maternal mortality.³⁹ They noted that women with HIV and tuberculosis co-infection had a mortality rate of 121.7 per 1000 live births compared to 38.5 per 1000 live births in women who had tuberculosis without HIV-1 co-infection.

In the Saving Mothers report for 2005 to 2007, HIV and AIDS-related complications accounted for 43.7% of the maternal deaths, but it was not indicated what proportion of those deaths occurred in teenagers.²²

Avoidable factors for maternal deaths in teenagers

When reviewing maternal deaths and women with poor maternal outcomes, it is important to look at avoidable factors that might have contributed to the poor outcomes. Avoidable factors are divided into patient orientated problems, administrative problems and health worker orientated problems.²¹

Patient orientated problems would include the following: no attendance and infrequent attendance of antenatal care facilities, delay in seeking medical help, and refusal of medication or surgery or advice, and unsafe abortions. In South Africa the majority of patient orientated problems are non-attendance and delayed attendance at antenatal care facilities. The Saving Mothers report for 2005 to 2007 estimated that 44% of maternal deaths were avoidable for patient orientated reasons, and that 26% of deaths from abortion were the result of unsafe abortions.²² The latter figure may be an underestimate since hospital records frequently make no

mention of whether an incomplete miscarriage was illegally induced or not. The United Kingdom CMACE report for 2006 to 2008 indicates that 26% of women who died during that period had either no or poor antenatal care.⁹

Administrative problems include poor transport facilities, lack of health care facilities and lack of appropriately trained staff. Health care provider problems refer to the failure of health care workers to follow protocols, poor problem recognition, and poor initial clinical assessment. Administrative and health care provider problems represent avoidable factors within the health system, which can be remedied by health system interventions. In the Saving Mothers report for 2005 to 2007, 38.4% of all maternal deaths were assessed as avoidable within the health care system, having excluded the patient orientated problems.

The Saving Mothers report for 2005 to 2007 did not separate discussion of avoidable factors by age group, and therefore there is no data in that report on avoidable factors for teenage maternal mortality.

Strategies to prevent teenage maternal death

Teenagers need to be educated on ways to protect themselves against unplanned pregnancies. They must be encouraged to delay their sexual debut, and be given information on protecting themselves against pregnancy and sexually transmitted infections. Owen et al. in the UK did a survey and systematic review of different school-linked sexual services models.⁴⁰ They identified 3 models: one staffed by nurses, another consisting of a multi-professional team but excluding medical practitioners, and a third consisting of a multi-professional team including a

medical practitioner. All the models showed a reduction in births to teenage mothers, but the authors could not comment on their effects on teenage conception rates and sexually transmitted infections. A study conducted in the Western Cape by Mason-Jones et al. in 2010 assessed the effect of peer education programs on delaying the age of sexual debut and increasing condom usage among grade 10 students (15 to 16 year olds) in public schools.⁴¹ The authors concluded that peer education programs were ineffective as there were other social circumstances and firmly held belief systems that influenced the decision of these teenagers when it came to sex and condom usage. Kesterton et al. in the USA found that even though school-based and youth centre-based programs for sexual and reproductive health services for teenagers were effective in increasing awareness and knowledge, they did not increase the use of these services.⁴² However, community acceptance of these services seemed to increase their use.

Kahn et al. reported that there was 19% decrease in teenage pregnancy rates in the USA, between 1970 and 1990, and attributed this to an increase in contraception usage in the same period.⁴³ A report from the USA compiled by the Guttmacher Institute on American teenage sexual and reproductive health compared pregnancy rates of American teenagers to those of European teenagers.⁴⁴ European teenagers were found to have a lower pregnancy rate because they were more likely to be using contraceptives. In the same report, a 42% decline in American teenage pregnancies was noted in 2008 compared to 1990 and this was said to be due to improved use of contraception and the delaying of sexual debut. The Centers for Disease Control and Prevention analysed data from 2004 to 2008 from the 'PRAMS' surveillance systems and reported that 50.1% of the teenagers that had unplanned pregnancies resulting in live births were not using any form of contraception.⁴⁵ A South African study by Moultrie et al. in rural KwaZulu-Natal

reported a decline in teenage fertility rates from 2001 to a rate of 73 per 1000 in 2005, and found during that same period there was an increase in contraception usage.⁴⁶

From reviewed literature it is clear that an increased use of contraceptives in teenagers leads to a decrease in teenage fertility rates, i.e. the live births in teenage mothers, but its effect on teenage pregnancies is not so widely reported. A Finnish study on use of oral contraceptives among teenagers between 1981 and 2003 noted that there was an increase in abortions among teenagers when public health reforms that led to a decline in oral contraceptive usage were introduced in that country.⁴⁷ A local community-based study of a sample of all pregnancies in Soweto from 1999 to 2001 found significantly higher rates of pregnancy terminations in teenagers compared with women aged 20 to 34 years.⁴⁸ This suggests local knowledge and utilisation of termination of pregnancy services in the teenage group.

Once pregnant and opting for pregnancy continuation, teenagers must be encouraged to attend antenatal clinics early in their pregnancy. Antenatal clinic attendance was associated with an increase in the number of deliveries where there was a trained person, be it a traditional midwife or a medical professional, to assist with the delivery. Antenatal clinics that are specific to teenagers have been reported to have the potential of increasing teenage antenatal attendance.⁴⁹ The UK study by Das et al. showed that dedicated teenage antenatal clinics had a higher attendance at 42% compared to the general antenatal clinics (15% at community-based antenatal clinics, 5% at hospital-based clinics).⁵⁰ Ukil et al., in another UK-based study, reported that in younger teenagers (aged 16 years and less) who attended a dedicated teenage antenatal clinic there was a good pregnancy outcome compared to that of older women.⁵¹

In South Africa, family planning services, termination of pregnancy, and antenatal care services are free at public health facilities, but current utilisation by teenagers may still be low. There have been some studies that looked at possible reasons. The teenagers reported that in some cases there was a lack of accurate information, a negative attitude of the nurses towards them, a tendency for traditional and cultural practices to make it difficult for them to accept these health services, and problems with accessibility.^{52, 53}

PROBLEM STATEMENT AND OBJECTIVES

It is clear from the literature that teenage pregnancy has an increased risk of adverse pregnancy outcomes, complicated by a tendency to less antenatal care in this age group. There are no studies of maternal mortality in South Africa that specifically investigated teenage pregnancy mortality. However, the Saving Mothers report for 2005 to 2007 mentioned a relatively high proportion of maternal deaths in teenagers. In the absence of local data, it is proposed that this situation be studied at Chris Hani Baragwanath Hospital, the largest maternity centre in South Africa, to review the causes of maternal deaths in teenagers and to determine whether the deaths could have been avoided. Since the hospital provides care to a large population in Gauteng, it is likely that a sufficient number of teenage maternal deaths can be found to derive statistically helpful data. Analysis of these deaths will allow planning for interventions aimed at teenage pregnancies. For example, if it is found that deaths could have been avoided by earlier or more frequent antenatal clinic attendance, then a programme focused on pregnancy confirmation and early clinic attendance can be aimed at teenagers or school-going children.

The study aimed to achieve the following specific objectives:

1. To determine the proportion of maternal deaths that occurred in teenagers from 1997 to 2011 at Chris Hani Baragwanath Hospital.
2. To describe demographic and obstetric characteristics of teenage maternal deaths from 1997 to 2011 at Chris Hani Baragwanath Hospital.
3. To describe the primary obstetric causes and avoidable factors for maternal deaths in teenagers from 1997 to 2011 at Chris Hani Baragwanath Hospital.
4. To determine any trends in maternal deaths in teenagers from 1997 to 2011.

METHODS

Study design and setting

This was a retrospective descriptive study. The study was undertaken at Chris Hani Baragwanath Hospital (CHBH), an academic secondary and tertiary referral institution in Soweto, south-west of Johannesburg. Chris Hani Baragwanath is the only government hospital for Greater Soweto and surrounding settlements, mainly Orange Farm, Lenasia, Eldorado Park and numerous informal settlements. The population of this area is approximately two million. There are seven midwife obstetric units (MOUs) functioning in this region, and these units refer all their problem maternity cases to CHBH. There is no officially designated district level hospital in Soweto. Several hospitals (Natalspuit, South Rand, Kopanong, Sebokeng, and Klerksdorp in Northwest Province) also transfer problem cases to Chris Hani Baragwanath Hospital. The maternity department has retained all clinical records of maternal deaths known to the department from 1997 to date, encompassing 15 years of the study period. The records of deaths retained in the department are those that were reported to the provincial authorities as part of national compulsory maternal death notification that has been in place since 1997. The number of births recorded for Chris Hani Baragwanath Hospital for the 15 years is 304 791, and for the referring MOUs approximately 120 000.

Study population and sample size

This study included all adolescent women or girls who were less than 20 years old at the time their pregnancies terminated, and died at CHBH in the 15 years from 1 January 1997 to 31 December 2011. All notified maternal deaths at CHBH were included, wherever they may have occurred – in maternity, in gynaecology, in the intensive care unit, in the medical wards or in any

patient care setting in the hospital, as well as deaths on arrival at hospital. Only women who died during pregnancy or within 42 days after the end of pregnancy were studied, in keeping with the definition of maternal death as stated in the introduction. There was no *a priori* sample size calculation for this study.

Data collection

All the case files of maternal deaths in women less than 20 years old were reviewed and the relevant data transferred to a data sheet designed for the study. The variables gathered and analysed are illustrated on the data sheet attached as Appendix A. All data collection was done by the researcher.

The key variables analysed were:

- Age in years at time of death
- Year in which they died
- Parity at time of pregnancy, and gravidity at time of death
- Gestational age in weeks at birth or termination of the pregnancy
- Antenatal care received and total number of visits
- HIV status and if positive, the CD4 count and treatment being administered
- Medical conditions: pre-existing or diagnosed in pregnancy
- Timing of death: antenatal, intrapartum or postpartum
- Pregnancy state at time of death: pregnant, early pregnancy loss or postpartum
- Place of delivery: hospital, MOU or other
- Mode of delivery: vaginal, caesarean section

- Primary cause of death according to the classification used in the Saving Mothers report for 2005 to 2007
- Final cause of death according to the classification used in the Saving Mothers report for 2005 to 2007
- Avoidable factors: patient, administrative, health care worker-related, according to the methodology used in the Saving Mothers report for 2005 to 2007¹⁸

In most cases, the cause of death was reported from the clinical opinion of the doctors, after review by the researcher, and not necessarily from a post-mortem examination. Avoidable factors were assigned by the researcher, based on subjective clinical judgment.¹⁸

Data management and analysis

Data was abstracted from the data sheets onto Microsoft Excel and then imported in Stata 11 (Statacorp, College Station, Texas). Statistical analysis was descriptive, and involved calculations of means \pm standard deviations, medians and ranges, and frequencies with percentages. Comparisons of frequency data were performed using Fisher's exact test, with statistical significance defined as a P value less than 0.05.

Ethical approval

Ethics approval to conduct the study was obtained from the Human Research Ethics Committee of the University of Witwatersrand, and the approval letter with clearance number M110708 is attached as Appendix B.

To respect confidentiality, the data sheet did not contain any of the patients' names or hospital numbers. Hospital permission to conduct the study was granted by the Chris Hani Baragwanath Hospital Medical Advisory Committee, on behalf of the Chief Executive Officer. The hospital permission letter is attached as Appendix C.

RESULTS

There was a total of 562 recorded maternal deaths over the 15 year period, from January 1997 to December 2011, and 33 (6.1%) of these deaths occurred in teenage pregnancies (Table 3). The mortality proportions for the three 5-year periods were 11/156 (7.1%) for 1997 to 2001, 12/199 (6.0%) for 2002 to 2006, and 10/207 (4.8%) from 2007 to 2011 ($P=0.69$). The mean age of the teenage maternal deaths was 17.4 ± 1.4 years with a range of 15 to 19 years (Table 4). The parity distribution showed that 84.9% were nulliparous while 15.1% had one previous delivery (Table 5). There were 4 teenagers with 1 previous pregnancy, and 1 with 2 previous pregnancies. At the time of death, 27 cases (81.8%) were gravida 1 and 15% were gravida 2 and there was one who was gravida 3 (Table 6). The mean gestational age at the time of abortion, delivery or death was 32.9 ± 6.9 weeks with a range of 16 to 41 gestational weeks (Table 7).

Twenty-two out of 33 (66.7%) of the teenage mothers who died received antenatal care. Nine (27.3%) were unbooked (Table 8). The mean gestational age at booking was 24.5 ± 7.0 weeks with a range of 12 to 38 weeks (Table 9). The number of antenatal clinic visits varied from 1 to 10 visits with a mean of 4.0 ± 2.4 visits (Table 10).

Table 3. Distribution of maternal deaths over the study period

Year	Total number of deaths	Number of teenage deaths
1997	37	3
1998	35	5
1999	27	1
2000	27	2
2001	30	0
2002	35	3
2003	17	1
2004	45	1
2005	50	6
2006	52	1
2007	43	2
2008	42	2
2009	46	2
2010	38	1
2011	38	3
Total	562	33

Table 4. Summary of maternal age at time of death in teenage pregnancies (n=33)

Age in years	Frequency	Percentage
15	2	6.1
16	7	27.3
17	6	18.2
18	9	27.3
19	9	27.3

Table 5. Parity distribution of teenage maternal deaths before delivery (n=33)

Para	Frequency	Percentage
0	28	84.9
1	4	12.1
2	1	3.0

Table 6. Gravidity distribution at time of death in teenage pregnancies (n=33)

Gravidity	Frequency	Percentage
1	27	81.8
2	5	15.2
3	1	3.0

Table 7. Gestational age at time of miscarriage, delivery or death (n=33)

Gestation age in weeks	Frequency	Percentage
16	1	3.0
20	2	6.1
22	2	6.1
24	1	3.0
26	1	3.0
28	1	3.0
30	2	6.1
32	2	6.1
34	1	3.0
35	2	6.1
36	6	18.2
38	6	18.2
39	4	12.1
40	1	3.0
41	1	3.0

Table 8. Characteristics of antenatal care for teenage maternal deaths (n=33)

Antenatal care received	Frequency	Percentage
Booked	22	66.7
Unbooked	9	27.3
Unknown	2	6.1

Table 9. Summary of gestational age at booking for teenage maternal deaths (n=22)

Gestational age at booking in weeks	Frequency	Percentage
12 to 19	7	31.8
20 to 27	7	31.8
28 to 34	5	22.7
35 and above	3	13.6

Table 10. Summary of number of antenatal clinic visits for teenage maternal deaths (n=22)

Number of visits	Frequency	Percentage
1 to 2	7	31.8
3 to 4	10	45.5
5 and above	5	22.7

The HIV serostatus was unknown in 15 of the pregnancies, negative in 11 and positive in 7 (45.5%, 33.3% and 21.2% respectively). Only 2 out of 33 cases had documented CD4 counts. None of the teenagers were on highly active antiretroviral treatment (HAART). Two were documented as being on the Prevention of Mother to Child Transmission (PMTCT) regimen that was used at the time they were pregnant. Sixteen teenagers (48.5%) had medical conditions or non-pregnancy related infections at time of admission to the hospital (Table 11). The most frequent conditions were anaemia (n=5) and pneumonia (n=4). The most likely cause of anaemia, although not confirmed, was iron deficiency.

Table 11. Summary of medical conditions in teenage maternal deaths (n=33)

Medical condition	Frequency	Percentage
Pneumonia	4	12.1
Anaemia	5	15.2
Malaria	2	6.1
Cardiac disease	1	3.0
Tuberculosis	1	3.0
Meningitis	1	3.0
Epilepsy	1	3.0
Impaired mental development	1	3.0
None	17	51.5

Twenty-two teenagers (66.7%) died in the postpartum period, 6 died in the antenatal period, 4 died in labour, and 1 died in early pregnancy below 20 weeks of gestation. Twenty (60.6%) had delivered at the time of death, 10 (30.3%) were undelivered and 3 (9%) had miscarriages. Most (84.8%) were delivered at CHBH, with 2 delivering at a local clinic and 3 outside of health facilities. Six of the 33 teenagers (18.2%) had vaginal deliveries, 14 (42.4%) were delivered by caesarean section, 3 (9.1%) had miscarriages and 10 (30.3%) were undelivered at the time of death (Table 12). Elective caesarean sections were performed in 2 of the 14 teenagers (14.2%). Table 12 lists the pregnancy characteristics of the teenage maternal deaths. Hypertension and its complications were the leading cause of death, accounting for 10 (30.3%) of the deaths. This was followed by respiratory infections, including pneumonia and tuberculosis, with 6 deaths (18.2%). The discrepancy in the pneumonia and tuberculosis numbers in Tables 11 and 13 is explained by 1 patient who died of aspiration pneumonia. This was the primary cause of death and not a pre-

existing coincidental medical finding. A total of 10 deaths resulted from non-pregnancy related infections, in which 3 teenagers were HIV infected, 4 were HIV negative, and 3 did not have HIV results. Three deaths (9.1%) were iatrogenic (anaesthesia or blood transfusion reaction). Pregnancy-related sepsis, cardiac disease, malaria and anaesthetic complications each resulted in 2 (6.1%) of deaths (Table 13).

Table 12. Pregnancy characteristics of teenage maternal deaths (n=33).

Characteristic	Frequency	Percentage
Time of death:		
Pregnancy <20 weeks	1	3.0
Pregnancy ≥20 weeks	6	18.2
Intrapartum	4	12.1
Postpartum	22	66.7
Place of death:		
Hospital	28	84.9
Midwife obstetric unit	2	6.1
Not in health facility	3	9.1
Mode of delivery:		
Miscarriage	3	9.1
Vaginal	6	18.2
Caesarean section	14	42.4
Undelivered	10	30.3

In 18 deaths (56.3%), no patient related avoidable factors were found. The commonest patient related avoidable factors were delay in accessing medical help and declining medication or advice. The administrative problems identified were lack of health care facilities in 15.6%, lack of appropriately trained staff in 15.6%, and delay in initiating critical care in 12.5% of deaths.

Among the health worker related problems noted were substandard management in 21.9% and clinical monitoring problems in 15.6% of deaths (Table 14).

Table 13. Causes of teenage maternal death (n=33)

Primary cause of death	Frequency	Percentage
Hypertension complications:		
Eclampsia	9	27.3
Liver haemorrhage	1	3.0
Pneumonia / tuberculosis	6	18.2
Acute collapse / embolism	3	9.1
Cardiac disease	2	6.1
Malaria	2	6.1
Complications of anaesthesia	2	6.1
Pregnancy-related sepsis	2	6.1
Postpartum haemorrhage	1	3.0
Meningitis	1	3.0
Leptospirosis	1	3.0
Status epilepticus	1	3.0
Autoimmune thrombocytopaenia	1	3.0
Blood transfusion reaction	1	3.0

Table 14. Avoidable factors that contributed to teenage maternal deaths (n=32*)

Avoidable factors	Frequency	Percentage
Patient orientated problems:		
No avoidable factor	18	56.3
No antenatal care	2	6.3
Delay in accessing medical help	5	15.6
Declined medication / advice	3	9.4
Unsafe abortion	1	3.1
No antenatal care and delay in accessing medical help	3	9.4
Administrative problems:		
No avoidable factor	17	53.1
Lack of accessibility	1	3.1
Delay in accessing care due to overburdened service	4	12.5
Lack of health care facilities	5	15.6
Lack of appropriately trained staff	5	15.6
Health worker related problems:		
No avoidable factor	15	46.9
Initial assessment	1	3.1
Problem recognition / diagnosis	2	6.3
Delay referring patient	2	6.3
Substandard management	7	21.9
Monitoring problems	5	15.6

* The total number of cases reviewed for avoidable factors was 32 instead of 33 because there was one file which had missing information.

A number of deaths deserve mention for illustrative purposes. The 2 teenagers who died from malaria were unbooked, and both transferred in critically ill condition from other institutions. One was Zimbabwean and the other had recently migrated from Mozambique. The avoidable factors here were primarily patient related, although issues of access may have played a part because of their foreign status.

Another patient died after having an unsafe abortion done. She arrived already in septic shock and, despite being managed in the intensive care unit, her condition did not improve. At the time that she was pregnant, legal termination of pregnancy facilities were not yet available.

A 16 year old HIV infected patient, with unknown CD4 count, presented a few days after caesarean section with wound sepsis. This was assessed as mild by the admitting doctor and she was admitted for antibiotic treatment. She deteriorated rapidly in the ward and died from overwhelming sepsis. This case caused considerable media interest, and adverse publicity for the hospital.

DISCUSSION

Teenage maternal death is not a frequent event at CHBH, but it is of course tragic and seems unnecessary, given the assumption that most teenage pregnancies are unplanned. The proportion of teenage pregnant deaths (6.1%) is considerably lower than the proportion of teenage pregnancies (out of all pregnancies) reported in Soweto in 1999 and 2001 (13.0% and 13.3%).⁴⁸ This suggests that pregnant teenagers in this area are at lower risk of maternal death than older women, a finding that differs from South African data in the Saving Mothers report of 2005 to 2007 (no increased risk),²² and findings from other African countries (increased risk).^{14,15} No specific trends in teenage maternal mortality could be detected over this time, possibly because of low numbers of deaths.

Pregnancy related hypertension and particularly eclampsia was the leading cause of teenage maternal death in this study, and this is in agreement with the findings of the Saving Mothers Report of 2005 to 2007 and other studies in Mozambique,²³ and Nigeria.^{25,26} Obstetric clinicians need to be aware of the potential for death in eclamptic young women and teenagers. Non-pregnancy related infection has consistently been the largest category of causes for maternal deaths in South African in recent years.²² The 10 teenage deaths from such infections were related to HIV in only 3 instances, although the HIV result was unknown in another 3. Unfortunately, the CD4 counts were unknown in all of the HIV related deaths from non-pregnancy related infections. This series of teenage maternal deaths reported relatively few cases of pregnancy-related sepsis, unlike findings from elsewhere in Africa.^{15,18,19} This is reassuring in the local setting, because such deaths often represent neglect or unsafe health practices, for example unsafe abortion and unattended childbirth, which can be expected to be relatively

frequent in teenage pregnancies. It could be assumed that the legalization of abortion may have played a role in reducing maternal death from septic abortion. It was also reassuring that only 1 teenager died from obstetric haemorrhage.

Antenatal care attendance has the potential to detect hypertension early, and allow referral and appropriate management. This applies also to anaemia and HIV, which were co-existent in a number of the teenagers that died. This study found that there was a relatively high percentage of unbooked pregnancies (27.3%) in the teenagers that died, and that the majority of the booked teenage mothers in our study booked only after 20 weeks gestational age. This might be due to them not being aware that they were pregnant or not wanting to acknowledge the pregnancy. Also, if they were attending school, they might not have wanted to miss school by attending clinics that were only open during working hours. Access problems, especially for foreign teenagers, were highlighted by the 2 cases of death from malaria. It might be worthwhile to investigate the possibility of implementing dedicated adolescent health services including teenage antenatal clinics in the public health sector as they have been reported to improve antenatal clinic attendance and pregnancy outcomes in teenagers.^{49,50,51} Most of the booked patients had uneventful antenatal care and seemed to complicate late in the third trimester. This would suggest that pregnant teenagers might need more frequent and vigilant monitoring late in third trimester, especially to detect hypertension and proteinuria as precursors to eclampsia, the most frequent single cause of death in local pregnant teenagers.

The health worker related avoidable factors did not appear to differ from those reported for all maternal deaths in the Saving Mothers report of 2005 to 2007.²² Medical errors still do occur and

need to be addressed by training and availability of protocols in all institutions. CHBH has had comprehensive obstetric protocols in place during the entire 15 years of the study. A recent innovation, also tested and implemented at CHBH, is training of medical interns using the ESMOE (Essential Steps for Management of Obstetric Emergencies) teaching course.⁵² Also, the Health Professions Council of South Africa has made it compulsory for every medical intern to have done a specific number of obstetric anaesthetic cases under supervision before being allowed full registration as a medical practitioner. This may improve patient safety and also decrease the number of deaths from complications of anaesthesia. All of these measures may lead to less maternal deaths attributable to health worker avoidable factors, for all age groups including teenagers.

At the centre of strategies to prevent teenage maternal death is the continuous education of teenagers and the public on the importance of antenatal care and seeking medical help early when pregnant. There also need to be comprehensive reproductive health programmes for teenagers, that include sexual education, and easy access to family planning facilities, including emergency contraception. There should also be readily available information and easy access to facilities that offer safe termination of pregnancy and screening and management of sexually transmitted infections. One of the more commonly reported obstacles to using the free family planning and termination of pregnancy services is the negative and unsupportive attitude of the medical staff.^{53,54} Community involvement in the implementation and encouragement of the use of these programmes and facilities in their areas is necessary as it is reported to increase the effectiveness of such programmes.⁴²

Some limitations need to be acknowledged. As this was a hospital based study, deaths that occurred in the community or at community clinics would have been missed. However, experience from the Soweto community is that very few maternal deaths occur outside health facilities. Also, some maternal deaths from non-pregnancy related causes might have occurred in medical or surgical wards in CHBH. These factors may result in a reduced numerator in the fraction that gave a 6.1% relative frequency of teenage maternal deaths, and an underestimate of the contribution of teenage maternal deaths. In contrast, referrals from other hospitals or regions (there were at least 3) may have inflated the numerator and resulted in overrepresentation. However, if reporting of maternal deaths in other age groups is similarly affected, the fraction reported may be close to the true proportion. Because of the numerator problems, no attempt was made in this study to report population-based age-specific maternal mortality ratios. The primary and final causes of death were based on the clinical opinion of attending doctors and not on postmortem findings. The clinical records were not always complete, so some of the important clinical entities, for example, the information on HIV status, could not be reported on in full. It is important when assessing the quality of service being rendered to pregnant women to look not only at maternal mortality but to also assess the maternal near-miss. Maternal near-miss is defined as women who nearly died but survived a complication during pregnancy, childbirth or within 42 days of termination of pregnancy.⁵⁵ This study looked specifically at the causes of teenage maternal death but to get a more complete picture of the quality of medical care being offered in our maternity department, a study including the cases of near misses would have to be done. Finally, despite a long study time period of 15 years, the numbers of maternal deaths were too few for statistical comparisons and hypothesis testing.

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Appendix A

Data sheet

Patient's information:

1. Age
2. Parity and gravidity
3. Address
4. Gestational age at time of death
5. Antenatal care received- Yes ☐ No ☐
 - gestational age at booking number of visits
6. HIV status- Positive ☐ CD4 count HAART ☐ PMTCT ☐ None ☐
 Negative ☐
 Unknown ☐
7. Medical disease..... No ☐ Yes ☐
 Before pregnancy ☐ during pregnancy ☐
8. Primary cause of death.....
9. Final cause of death.....
10. Timing of death: Antenatally ☐ Intrapartum ☐ Postpartum ☐
11. Pregnancy-state at time of death: Pregnant ☐
 Aborted ☐
 Delivered ☐
12. Delivery: Place- Bara ☐ Local clinic ☐ Other ☐
 Method- Vaginally ☐ Caesarean section ☐
13. Death avoidable because of no/infrequent/late attendance at antenatal clinic ☐

Appendix B

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Dr NMP Mokone

CLEARANCE CERTIFICATE

M110708

PROJECT

Review

The Causes of Teenage Maternal Mortality at
Chris Hani Baragwanath Hospital in Soweto: A
of Cases from 1997 to 2011

INVESTIGATORS

Dr NMP Mokone.

DEPARTMENT

Department of Obstetrics & Gynaecology

DATE CONSIDERED

29/07/2011

DECISION OF THE COMMITTEE*


Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE

29/07/2011

CHAIRPERSON


(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Prof E Buchmann

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**
PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Appendix C

MEDICAL ADVISORY COMMITTEE
CHRIS HANI BARAGWANATH HOSPITAL
PERMISSION TO CONDUCT RESEARCH

Date: 12 July 2011

TITLE OF PROJECT: The causes of teenage maternal mortality at Chris Hani Baragwanath Hospital in Soweto. A review of cases from 1997 to 2011

UNIVERSITY: Witwatersrand

Principal Investigator Dr NMP Mokone

Department: Obstetrics

Supervisor (If relevant): Prof E Buchmann

Permission Head Department (where research conducted) Yes

Date of start of proposed study: August 2011

Date of completion of data collection September 2011

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Hospital. The CEO /management of Chris Hani Baragwanath Hospital is accordingly informed and the study is subject to:-

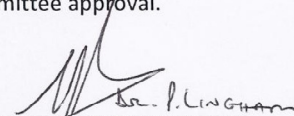
- Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.
- the Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- the MAC will be informed of any serious adverse events as soon as they occur
- permission is granted for the duration of the Ethics Committee approval.



Recommended

(On behalf of the MAC)

Date: 12 July 2011

Approved/Not Approved

Hospital Management

Date: 14 July 2011