

**DISSERTATION**

**FACTORS ASSOCIATED WITH MATERNAL MORTALITY AMONG WOMEN  
WHO RECEIVED ANTENATAL CARE AT KENYATTA NATIONAL HOSPITAL  
BETWEEN JANUARY 2006 AND DECEMBER 2015**

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**REG NUMBER: H58/96864/2013**

**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE  
OF MASTER OF MEDICINE IN OBSTETRICS AND GYNAECOLOGY**

**UNIVERSITY OF NAIROBI**

**2017**

## **DECLARATION**

This dissertation is my original work and has not been submitted for the award of a degree in any other university or published elsewhere.

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## **DEDICATION**

This project is specially dedicated to my beloved wife Dr. Estieer, my children Mercy Keji and Frentino Nyarsuk for their moral support throughout the project and to the rest of my family especially my father and mother for their love, encouragement, and support throughout my studies.

## **ACKNOWLEDGEMENTS**

I most sincerely thank the almighty God for giving me good health to carry out this project. I salute my supervisors Dr. Alfred Osoi, Prof. Koigi Kamau and Dr. Innocent Maranga for their individual contributions, advice, review and correction of dissertation manuscript which was most appreciated. Am convinced that without their support this study would not have been completed.

I greatly appreciate the encouragement of my classmate throughout the program as were always available with the useful suggestion.

I would like to thank the UNFPA for sponsoring me during my study. I am indebted to Kenyatta National Hospital for allowing me to conduct this project in their institution and for funding it.

Great appreciation to all other persons who assisted me in one way or another

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## **LIST OF ABBREVIATIONS AND ACRONYMS**

ANC	–	Antenatal Care
ICU	–	Intensive Care Unit
KDHS	–	Kenya Demographic & Health Survey
KNH	–	Kenyatta National Hospital
KMTC	–	Kenya Medical Training College
MMR	–	Maternal Mortality Ratio
TUFH	–	Towards unity for health
UON	–	University of Nairobi
UNFPA	–	United Nations Population Fund
UNICEF	–	United Nations Children’s Fund
WHO	–	World Health Organization

## **DEFINITION OF TERMS**

**Maternal Mortality:** Refers to death of a woman while pregnant or within 42 days after termination of pregnancy irrespective of the duration and site of the pregnancy from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes [1].

**Maternal Mortality Ratio:** Is the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births [1].

**Antenatal Care:** Antenatal care is the routine health control of presumed healthy pregnant women without symptoms (screening), in order to diagnose diseases or complicating obstetric conditions without symptoms, and to provide information about lifestyle, pregnancy and delivery [2].

## ABSTRACT

**Background:** Although MMR has reduced over the last two decades from 380 to 210 deaths per 100,000 live births globally, there are still many challenges in achieving acceptable levels. According to the new sustainable development goals (SDGs), SDG 3.1 targets to reduce by 2030, the global MMR to <70 per 100,000 live births.

**Objective:** To determine factors associated with maternal mortality among women who received antenatal care at Kenyatta National Hospital between January 2006 and December 2015.

**Method:** This was unmatched case-control study in which medical records were reviewed to identify cases and appropriate controls. Cases comprised women who experienced maternal mortality and controls comprised women who attended the antenatal clinic but did not die during the study period. The data was collected by using a structured questionnaire. Data collected was coded and entered into statistical analysis software (SPSS) version 23. Data was presented in the form of tables and figures. Logistic regression was used to evaluate the strength of the association of each determinant and associations was considered statistically significant at P values of <0.05. Estimates were presented as OR using 95% confidence interval.

**Result:** Between January 2006 and December 2016, a total of 200 files (50 cases and 150 controls) were identified. Cases had lower odds of having secondary education, OR 0.24 (95% CI 0.10-0.56),  $p < 0.001$  or tertiary education, OR 0.32 (95% CI 0.14-0.71,  $p < 0.001$ ). Cases had greater odds of preterm delivery, OR 2.81, 95% CI 1.43-5.03,  $p < 0.001$ . Hypertensive disease (eclampsia and preeclampsia) were the leading direct cause of maternal mortality (39.3%) and HIV/AIDS was the leading cause of indirect maternal mortality (36.4%). Conditions significantly associated with maternal mortality included: preexisting medical conditions (OR 6.048, 95% CI 3.012-12.15;  $p < 0.01$ ), cardiac disease OR 24.43 (95% 2.75-217.2)  $p < 0.01$ , HIV OR 6.20 (95% CI 2.49-15.44)  $p < 0.001$  and Anemia OR 4.371, 95% CI 1.041-18.34;  $p < 0.004$ ).

**Conclusion:** Among KNH ANC clinic attendees, the risk factors for maternal mortality included a lower level of education, preexisting medical conditions especially cardiac disease

and HIV/AIDS while hypertensive disorders and HIV/AIDSs were the leading causes of maternal mortality.

**Recommendations:** Based on the study findings, (i) being poor (lack education and unemployed) is in itself a barrier to seeking adequate care, a multi-sectoral approach to fight poverty among women in the society is recommended; (ii) there is evidence that screening for pre-existing medical conditions during the antenatal period plays a significant role in reducing the risk of death to the mother. Thus, efforts for specialized consultation and care is highly recommended; (iii) periodic maternal mortality studies should be done to monitor emerging trends in maternal mortality causes, as well as evaluate the effectiveness of interventions aimed at reducing maternal mortality.

## 1.0 INTRODUCTION

Globally, improving maternal health is one of the eight millennium development goals. In goal number five (MDGs) countries are committed to reducing mortality by 75% between 1990 -2015. According to UNFPA (2015), there has been an improvement in maternal health worldwide evidenced by a reduction in maternal mortality over the last two decades from 385 to 216 deaths per 100,000 live births [3].

All regions have made progress but the challenge still persists especially in developing regions. In Eastern Asia, Northern Africa and Southern Asia maternal mortality have declined by around two-thirds [4].

According to the new sustainable development goals (SDGs), SDG 3.1 targets to reduce by 2030, the global MMR to <70 per 100,000 live births [5].

Preventable maternal mortality occurs where there is a failure to give effect to the right of women to health quality and nondiscrimination. Response to maternal mortality must be accompanied by improvements along the continuum of care, including commitments to sexual and reproductive health, and family planning.

Maternal Health issues in Kenya are of National concern as maternal mortality remains unacceptably high. Efforts to reduce the maternal and perinatal mortality include the provision of free maternal services and advocacy (Beyond Zero Campaign, 2013).

According to recent internal audits at Kenyatta National Hospital (KNH), there were about 120 deaths in 2013 and 116 deaths in 2014 giving an estimated maternal mortality ratio to be 1,024 and 800 per live birth for 2013 and 2014 respectively. Although there is no systematic evaluation of the contribution of KNH to these mortalities, similar internal data estimated 5 and 7 deaths for 2013 and 2014 are from KNH while 115 and 109 deaths from other facilities.

As a referral facility, some of the maternal mortality that occurs at KNH may occur among patient referred from other facilities with severe complications and appropriate interventions to address such complications may avert the maternal mortality. On the other hand, maternal mortality may occur among patients who initiate or referred for and receive antenatal care at KNH. These KNH antenatal clinic attendees should have risk factors for maternal death identified early and appropriate interventions implemented to reduce the mortality since they



can benefit from increased contact and availability of highly skilled human resource and allied services.

Thus, there is a need to understand the determinants of mortality and whether its pre-existing conditions (which may be largely unpreventable) are the main causes of death among women who receive antenatal care at Kenyatta National Hospital.

It is expected that the study finding will contribute toward strategies to improve care for pregnant women attending form strategies to improve the care of pregnant women attending ANC at KNH as well as intrapartum and post-partum care at the hospital, especially among the preexisting medical conditions.

## **2.0 LITERATURE REVIEW**

### **2.1 Maternal Mortality**

Globally maternal mortality was estimated to be 2,890 which represents a reduction by 45-50 percent between 1990 and 2013. The study reveals that 99% of maternal death occurs in developing countries majority being in Sub-Saharan Africa and southern Asia. Sub-Saharan region alone has a high mortality accounting for 62 % (117,900), of global death [6].

At the country level, India and Nigeria account for 1/3 of all global maternal death, 17%, and 14% respectively. In Kenya, maternal mortality accounts for 6,300 maternal death [6].

Maternal mortality ratio estimated to be 210 per 100,000 live births decreased from 380 per 100,000 live births between 1990 and 2013, but developing countries still have a higher rate of about 14 times compared to developed countries [3].

Sub-Saharan Africa had 510 per 100,000 live births with Sierra Leone having the highest maternal mortality ratio 1100; Cape Verde and Mauritius are the only two African countries with low MMR about 53 and 73% per 100,000 live births. In Kenya, estimates range from 360 deaths to 488 [6].

### **2.2 Causes of Maternal Mortality**

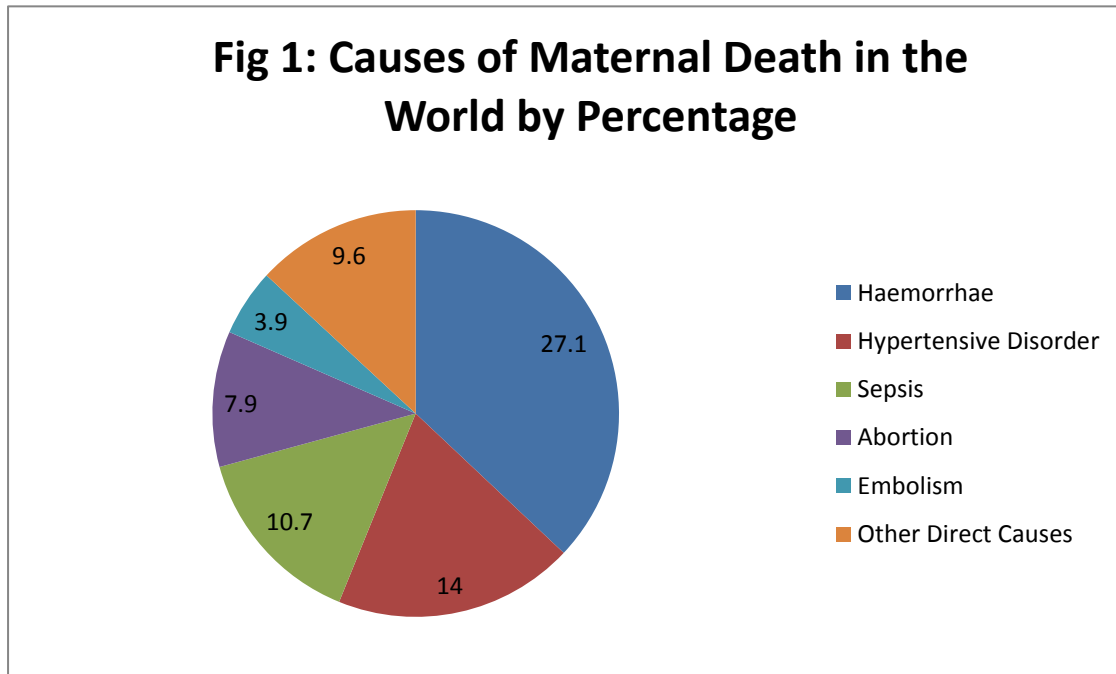
Globally, maternal deaths are classified as a direct and indirect cause. Direct cause account for 73% and indirect cause account for 27.5% of all deaths. Hemorrhage accounts for 27.1%, Hypertensive disease of pregnancy 14%, Sepsis 10.7%, and unsafe abortion 7.9%. Indirect causes are Malaria, Anemia, HIV/AIDS and Cardiovascular diseases, all of which may complicate or aggravate the pregnancy [7].

In sub-Saharan Africa, hemorrhage, infection, pre-eclampsia, obstructed labor and indirect cause (HIV) are the main causes of maternal death. In Kenya hypertension, hemorrhage and unsafe abortion are the commonest direct causes of death, whereas HIV is common indirect causes [8].

An unmatched case-control study [9] that was done in the United Kingdom involved a total of 135 women who died (cases) and 1661 women who survived severe complications. They

found out that pre-existing medical conditions are important factors associated with direct (Obstetric) death.

**Figure 1: Causes of Maternal Death in the World by Percentage**



**Source:**Lale, *et al.* (2014) [7]

A systemic review conducted by UNFPA in Morocco showed that female literacy rates are a strong factor for maternal mortality, the more illiterate the female population the lower the mortality rate [3].

A study found that HIV/AIDS, and hypertensive disease were the leading causes of maternal death, and hemorrhage was the leading cause of near-miss morbidity [10].

Studies reveal that severe obstetric morbidity (near miss) is a more sensitive measure for pregnancy outcomes than mortality alone and represents a more useful indication of obstetric care than mortality, and is more used in developed countries as a tool for monitoring and improvement of maternal health services but is limited due to lack of uniform criteria for identification of cases [11] [12].

### **2.3 Preexisting Medical Conditions**

The immediate causes of maternal deaths are a range of medical problems or complications which can be divided into:

- I. Direct causes: (i) early causes: abortion, ectopic pregnancy, and (ii) late causes: hemorrhage, sepsis, hypertensive disorders (eclampsia) and obstructed labor
- II. Indirect causes: malaria, hepatitis, and anemia.

These complications account for direct obstetric deaths in developing countries. Indirect obstetric deaths account for 25 percent of all deaths in developing countries, that is, deaths due to pre-existing medical conditions such as malaria, hepatitis, and anemia which are made worse by pregnancy [13]. Pregnant women may be particularly susceptible to viral hepatitis and more likely to die from the condition [14].

According to a study by the CDC of pregnancy-related mortality in the U.S. between 1991 and 1997, the leading causes of maternal death are hemorrhage, hypertensive disorder, pulmonary embolism, amniotic fluid embolism, infection, and pre-existing chronic conditions (such as cardiovascular disease) [15]. The study indicated a four-fold increased risk of pregnancy-related death for black women and increased risks for older women and women with no prenatal care. Whether due to better management, increased awareness or quality improvement, the numbers of deaths related to hemorrhage are declining, while deaths attributable to other medical conditions (including cardiovascular, pulmonary and neurologic problems) have significantly increased [16].

A case-control study in Moi teaching hospital in Kenya found that factors associated with maternal mortality include having no education, skilled attendance at birth, having no ANC visit, being admitted with eclampsia with risk factors of 22% cases 5% control, hemorrhage 13% cases 5% control and being admitted with preexisting medical condition (that is, 27% cases 10% control) [17].

A retrospective descriptive study review of maternal mortality at Kenyatta National Hospital found that maternal death occurred among women in the optimum reproductive age and most of them had not attended any ANC clinic [18].

A study found that contraceptive use is often important to change women situation in life by reducing high-risk births in particular, especially high-parity births, family planning reduced the MMR and thus averted additional maternal deaths indirectly. This indirect effect can reduce a country's MMR from low to high levels of contraceptive use. Increases in the use of

modern contraceptives have made an important contribution to reducing maternal mortality in the developing world [19].

Researchers conducted a study in Nigeria and found that most of the maternal mortality due to abortion can be prevented by access to effective contraceptive methods which reduce unwanted pregnancies and high-risk pregnancy but it cannot eliminate them [20].

Another study found that women who had an abortion are at greater risk to repeat this condition than those who have not had the episode because they lack the necessary information to prevent unwanted pregnancies and further induced abortions [21]. Possible explanations linked to the quality of post-abortion family planning and coverage of long-acting methods should be explored. For this reason use of family planning reduces maternal mortality and morbidity.

#### **2.4 Role of Antenatal Care**

Antenatal care is a backbone and important determinant of maternal mortality which has been shown to reduce maternal mortality and has a positive effect on maternal outcome [6]. A study done in Nepal among 1,056 showed that maternal mortality is low in booked compared to those not booked antenatal clients [22].

ANC increased in most of the world in the last 10 years, but only 46% of women in developing countries benefit from skilled care provider during pregnancy and childbirth. [7] In Kenya only 62% give birth in the presence of skilled health personnel who are able to address complication [23].

WHO recommended four ANC visits a trained and skilled person during pregnancy but in developing countries, only 1/3 have 4 visits or more in contrast to developed countries in which at least 4 antenatal visits are attended by a skilled health provider during intrapartum, antepartum, and postpartum [6]. A study by KDHS stipulated that 58% of women in Kenya reported having four or more ANC visits for their most recent birth [8].

UNICEF showed that in developed countries 2/3 of pregnant women present to ANC in the first trimester while in developing countries (Sub-Saharan) most women wait until the second trimester, and even present in the third trimester [24]. Women living in urban areas are generally twice as likely as those living in rural areas to report more ANC visit.

ANC help women to understand warning signs during pregnancy and childbirth and it can be a source for micro-nutrients supplementation, treatment of hypertension to prevent pre-eclampsia /eclampsia, immunization against tetanus, HIV testing and medication to prevent mother to child transmissions of HIV in cases of HIV positive pregnant women. These are significant to improve fetal outcome and maternal health [25].

A study done in Syria found that there is a need to improve ANC which would help early identifications of high-risk pregnancy and important to both: developing protocols to prevent/manage pre-eclampsia and eclampsia and training health care professionals to manage infrequent but fatal conditions like sepsis [26].

Women attending ANC have more than 7 times increased the chance of delivery in a health facility and women with a relatively high level of ANC use trained assistant at delivery almost 4 times higher than women with low level of care [27] [28].

A systemic review found that many factors affecting maternal utilization of ANC in developing countries, maternal education, husband education, marital status, availability cost, household income, women employment, media exposure, and cultural belief are the main factors affecting ANC attendance [29].

A study found that educational and cultural factors (illiteracy or ignorance) together with persistent lack of resource in the global critical situation all affect ANC visiting and then maternal mortality [30].

A study done in Uganda showed that presence of skilled birth attendant at birth is a vital intervention for saving a life. Yet many women particularly where maternal mortality ratio is highest, do not have a skilled birth attendant at delivery. The study further stipulates that approximately 95% of women attend ANC, only 58% of them delivered in a health facility [31].

## **2.5 Role of Tertiary Facility**

A recent multi-country randomized control-trial led by the WHO and a systematic review showed that essential interventions can be provided over four visits at specified intervals, at least for healthy women with no underlying medical problems. The result of this review has prompted WHO to define a new model of ANC based on four goal-oriented visits [3].

This model has been further defined by what is done in each visit and is often called focused antenatal care. The optimum number of ANC visits for limited resource settings depends not only on effectiveness but also on costs and other barriers to ANC access and supply. For instance, a recent study from southern Tanzania found that health workers spent an average of 46 minutes providing focused ANC to a first time client, and 36 minutes for a revisiting client. This was thirty minutes more on average than the current practice and poses challenges for service delivery [15].

For many of the essential interventions in ANC, it is crucial to have early identification of underlying conditions, for example, prevention of congenital syphilis, control of anemia, and prevention of malaria complications. Hence the first ANC visit should be as early as possible in pregnancy, preferably in the first trimester. The last visit should be at around 37 weeks or near the expected date of birth to ensure that appropriate advice and care have been provided to prevent and manage problems [6].

A retrospective review of obstetric case study found that developing countries carry a high burden of maternal mortality and morbidity which may be related to improper management of Obstetric emergency at referral facilities, poor referral system, poor access and utilization of health services and limited availability of blood and blood product [32].

Another retrospective study was done in Kenya's Moi Teaching and Referral Hospital involved 150 maternal deaths as cases and 300 controls showed the importance of maternal education in improving women knowledge and empowering them to take an active role in their own health as well as gaining access to skilled care at birth and during pregnancy [17].

Family and community involvement is crucial for healthy home behaviors during pregnancy and has been shown to be a major determinant of use of ANC services. Establishing links between the community and the facility can increase utilization of services, including ANC, and impact maternal and neonatal mortality as well as stillbirths.

### **3.0 CONCEPTUAL FRAMEWORK**

#### **3.1 Narrative**

Kenyatta National Hospital is endowed with quality obstetric services from the antenatal to the postpartum period. High-risk pregnant women seeking antenatal care benefit from a multidisciplinary approach to antenatal care, planned delivery and enhanced quality of intrapartum and postpartum care. During any of these periods, complications are addressed in a timely manner to avoid maternal death.

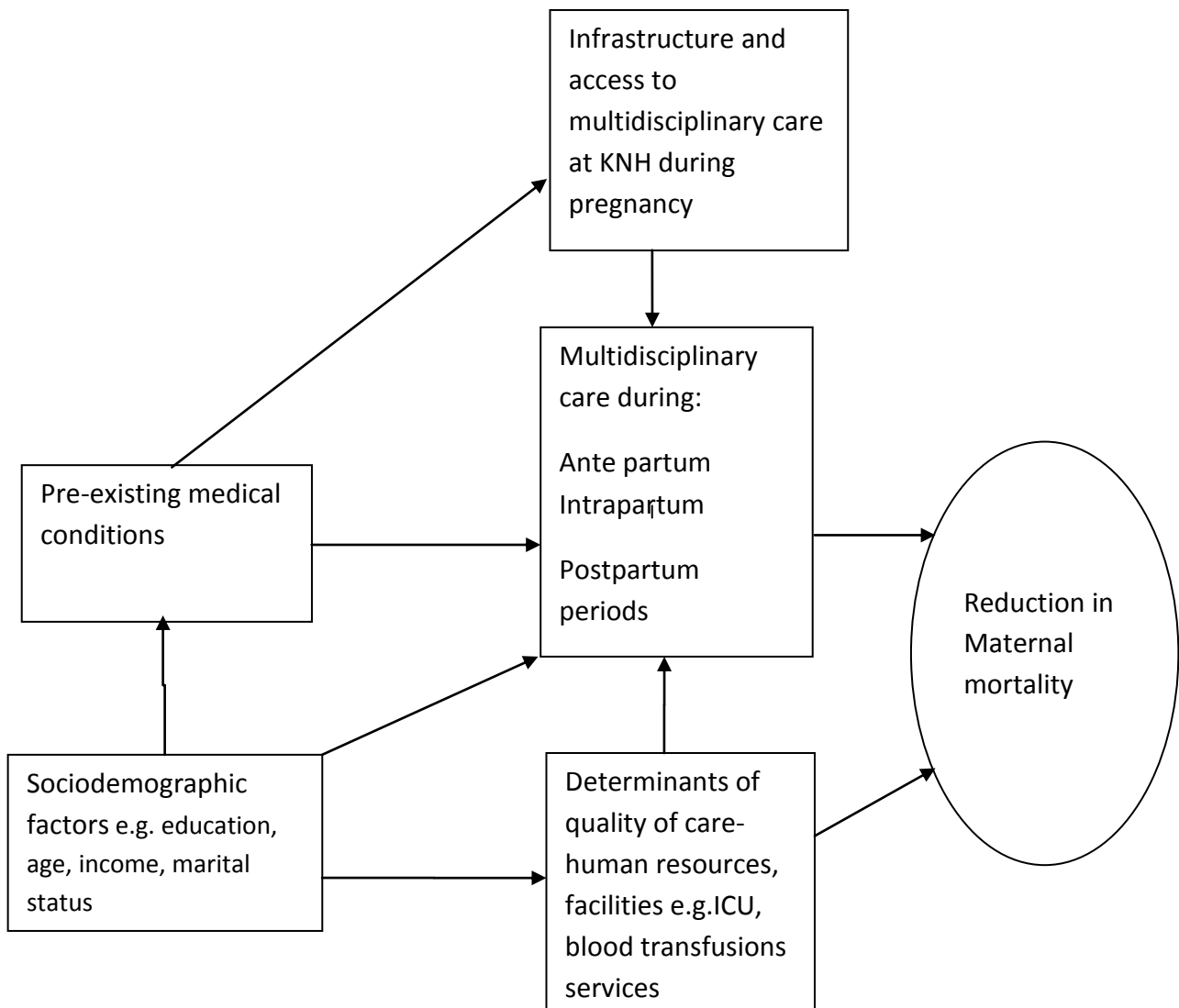
Maternal death can arise from either health systems challenges or patient factors. Such system factors may include inadequate blood transfusion services due to rare blood types, delayed provision of timely specialized services such as intensive care unit (ICU) and delay in appropriate medical care due to limitations of specialized human resources or high competition for relevant bed space.

Individual intrapartum events that may occur despite the availability of resources include sudden death like acute pulmonary embolism or amniotic fluid embolism. Postpartum individual factors may include a late return for care after puerperal sepsis and related morbidity. The individual contribution to delay may be due to socio-demographic and economic factors like poor social support, low income and low levels of education.

Although women with preexisting medical conditions especially of severe forms are more likely to have adverse outcomes despite antenatal care attendance, ANC attendance at KNH should be protective due to better access to multidisciplinary care.



### 3.2 Schematic



**Figure 2: Schematic Conceptual Framework**

#### **4.0 RATIONALE**

Maternal mortality in sub-Saharan Africa remains high despite improved antenatal and intrapartum care. The quality of maternal care can be measured by its impact on maternal mortality. As a referral institution, maternal mortality may arise from patients who receive and those who do not receive ANC at Kenyatta National Hospital (KNH). Women with pre-existing conditions are more likely to be referred early in pregnancy and therefore more likely to have better outcomes. Patients who are referred after developing complications during the intrapartum and postpartum period may not benefit from risk stratification and optimum care, compared to those who receive ANC at KNH.

It is therefore expected that ANC should go a long way in reducing MMR and influencing the use of skilled delivery care among women. Recent findings show that KNH ANC attendance is relatively high, meaning that women are willing to present themselves for care. In addition, Kenya has adopted the WHO recommended focused ANC (FANC) model known to improve quality. Despite this, the MMR of 362 per 100,000 live births estimated by KDHS in 2014 is still high and the recent estimates of WHO, UNICEF, UNFPA, the World Bank Group and UN Population Division also highlight insufficient progress.

In order to develop effective interventions and to guide priority for use of limited resources in this setting, it is important to understand the factors that are associated with maternal mortality among those patients who received care at KNH. Findings of this study should inform policy, resource allocation and quality of care received by KNH ANC attendees.

## **5.0 RESEARCH QUESTIONS AND HYPOTHESIS**

### **5.1 Research Question**

What are the factors associated with maternal mortality among women who received antenatal care at Kenyatta National Hospital between January 2006 and December 2015?

### **5.2 Hypothesis**

**Null:** There are no specific factors associated with maternal mortality among women who received antenatal care at Kenyatta National Hospital.

**Alternative:** There are specific factors associated with maternal mortality among women who received antenatal care at Kenyatta National Hospital.

## **6.0 OBJECTIVES**

### **6.1 Broad Objective**

To determine the factors associated with maternal mortality among women who received antenatal care at Kenyatta National Hospital between January 2006 and December 2015.

### **6.2 Specific Objectives**

1. To determine socio-demographic and obstetric factors associated with maternal mortality among women who received antenatal care at Kenyatta National Hospital between January 2006 and December 2015.
2. To determine the role of obstetric and non-obstetric conditions among women who received antenatal care at KNH between January 2006 and December 2015.
3. To evaluate the association between the preexisting medical conditions and maternal mortality among women who received antenatal care at KNH between January 2006 and December 2015.

## **7.0 METHODOLOGY**

### **7.1 Study Design**

Unmatched case-control study

This was an unmatched case-control study in which medical records were reviewed to identify cases and appropriate controls. Cases comprised women who experienced maternal mortality as identified from manual hospital records between January 2006 and December 2015.

Cases must have attended the antenatal clinic at least once at KNH prior to their delivery or death. All deaths from the antenatal period to 6 weeks postpartum were counted as cases. Cases were selected retrospectively and sequentially from the most recent delivery and or death until the required sample was achieved.

Trained staff collected the required information using the standard audit form. The hospital through the medical records systems keeps cases of maternal mortality over the years. From this list, we identified women who died and also received care at KNH.

Unmatched controls comprised women who attended the antenatal clinic but did not die during the study period. Controls may have delivered or presented with the same condition as the cases over the time period of January 2006 to December 2015. For each case, three controls were selected.

Unmatched Control was also selected retrospectively and sequentially from the most recent delivery until the required sample size was achieved.

From both cases and controls, we abstracted information from the file concerning the socio-demographic factors, for example, age, income, education, obstetric factors, onset and frequency of antenatal visits, underlying medical conditions and cause of death.

### **7.2 Study Setting**

The study was conducted at the department of reproductive health, KNH. KNH is one of the biggest teaching and referral hospital in the East African region and the largest in Kenya, located in the capital city Nairobi. The hospital is about 3-4 kilometers from the city center

and has Capacity of 2,519 beds. It serves as a primary hospital serving residents of Nairobi and referral patients from different places across Kenya.

KNH is the main hospital for College of the Health Sciences University of Nairobi for both undergraduates and post-graduates, and it is also used by Kenya Medical Training College (KMTC) as a training center for various courses in the medical field.

The maternal unit consists of ANC clinic, labor ward, theatre, and other four wards. The ANC received about 2,164 clients per month and it's managed by consultants, senior house officers, and registered nurses. Additionally, it is managed by resident senior house officer, medical officer intern, clinical officer intern, and well-skilled midwives.

The labor ward operates throughout 24 hours basis and conducts about 1,255 births per month.

Patients with complications including of medical or surgical nature receive multidisciplinary care either in the unit or other units. Any obstetric cases transferred to other units, for example, Renal and ICU shall be managed by both teams (specific and obstetric team).

Maternal mortality review or meeting is done by the registrars every month under supervision of consultants.

### **7.3 Study Population**

All women who received antenatal care at Kenyatta National Hospital between January 2006 and December 2015

### **7.4 Inclusion Criteria**

*Cases* – All women who received ANC at KNH and died while pregnant or within 42 days following termination of pregnancy at KNH

*Control*– All women who received ANC at KNH but did not die during the study period when the cases died.

## 7.5 Exclusion Criteria

All women who did not receive ANC at KNH irrespective of survival or death status

## 7.6 Sample Size and Sample Procedure

$$n = \frac{\left[ z_{\alpha/2} \sqrt{(r+1)pq} + z_{1-\beta} \sqrt{rp_1q_1 + p_2q_2} \right]^2}{r(p_1 - p_2)^2}$$

*Source:* [33]

$Z_{\alpha} = 1.96$  representing standard normal deviate for 95% confidence

$Z_{\beta} = 0.84$  representing 80% power to detect a specified difference between case and control group

$p_1$  = prevalence of risk factors in the cases (22% of maternal deaths in MTRH had eclampsia).

$p_2$  = prevalence of risk factor in controls (5% of controls are also estimate to have eclampsia)

$r$  = ratio of cases to controls (set to 1:3)

Odds ratio=2

$p = p_1 + p_2 / 2 = (22 + 5) / 2 = 13.5\%$

Substituting the figures in the formula:

$$n = \frac{[1.96 \sqrt{(r+1)pq} + 0.84 \sqrt{r p_1 q_1 + p_2 q_2}]^2}{r(p_1 - p_2)^2}$$

$$n = \frac{[1.96 \sqrt{4(0.135 \times 0.865)} + 0.84 \sqrt{3 \times 0.22 \times 0.78 + 0.05 \times 0.95}]^2}{3(0.22 - 0.05)^2}$$

$$N = \frac{[1.96 \times 0.4671 + 0.84 \times 0.0245]^2}{0.033} = 42$$

Therefore, 42 cases and 126 controls was recruited yielding a total sample size of 168

We will add 10 % for any incomplete data and enroll a total of 184 clients.

## **7.7 Source and Method of Recruitment**

Permission was obtained from the head of Department of Statistic and Record (KNH).

A structured form for collecting data was used. A pretested designed structural Questionnaire was used. Questionnaires which were incomplete or incorrectly filled were rejected.

The maternal death that meets the inclusion criteria was identified retrospectively from hospital registered records by both the investigator and the research assistants.

## **7.8 Data Variables**

### **7.8.1 Dependent Variable**

Maternal Mortality – This was coded as yes (for cases) or no (for controls). We then used this to model the probability of being a case having a preexisting medical condition.

### **7.8.2 Independent Variable**

Preexisting medical condition, for example, diabetes, hypertension, malignancy, cardiac disease and liver disease

Other risk factors: age, education, occupation, number of visits, parity, and gestational age.

## **7.9 Data Management**

The data was collected by using a structured questionnaire (Appendix I).

Data was kept in a secure lockable cabinet only accessible by the principal investigator and statistician.

Data collected was assessed and entered on a daily basis (to ensure completeness) into a password MS access database.

### **7.9.1 Data Entry**

We used a double entry with verification to check and to correct any errors.



The researcher and research assistants who were medical officer intern and clinical officer intern were trained on filling the questionnaire in a standard way.

We identified cases of maternal death which were recruited as cases and those without maternal death were the control.

### **7.10 Data Analysis**

Data collected was coded and entered into statistical analysis software (SPSS) version 23.

Data was presented in the form of tables and figures. The causes of maternal mortality were presented in frequency and percentages.

For descriptive statistics, we used means and standard deviation for continuous data and proportions for categorical data.

We used logistic regression to evaluate the strength of the association of each determinant and associations was considered statistically significant at P values of  $<0.05$ . Estimates was presented as OR using 95% confidence interval.

### **7.11 Dissemination Plan**

Results were presented to the Department of Obstetrics & Gynecology, and copies given to the department and KNH.

Papers of the thesis will be published and submitted to journals as well as conferences (both local and international).

### **7.12 Ethical Consideration**

Approval was obtained from ethical and research committee University of Nairobi/Kenyatta National Hospital (UON/KNH).

This study did not raise any serious ethical issue since it is a retrospective study. Data was collected and extracted from the hospital medical record (files) without any physical identification of study participants.

Maximum confidentiality was maintained for all information. All information collected from the patient's files were considered confidential and treated as such.

An informed consent was not required because we used already identified data and we did not interview participants.

### **7.13 Study Limitation**

This was a hospital-based study and it may not be generalized to the whole population. It only includes deaths that occurred during the hospital admission and therefore the risk factors identified here were specifically associated with in-hospital mortality.

Bias may have resulted from the misclassification of causes of death data and missing information in some fields. For instance, pregnancy-related mortality that occurs outside hospital may have other risk factors that were not identified here.

### **7.14 Study Strength**

This study is the first of its kind to be conducted at Kenyatta National Hospital. It is expected to present a detailed contribution of the preexisting conditions of maternal mortality.

Findings of this study are hoped to inform policy, resource allocation and quality of care received by KNH ANC attendees.

## 8.0 RESULTS

Between January and December 2016, a total of 200 files (50 cases and 150 controls) were identified as eligible for this analysis. The results are as follows:

### 8.1 Socio-Demographic and Reproductive Characteristics

**Table 1: Socio-demographic and reproductive characteristics for mothers delivering in KNH from January 2006 to December 2015**

CHARACTERISTICS	NUMBER OF MOTHERS		P Value
	Maternal Mortality N = 50	No Maternal Mortality N = 150	
<b>Age (in Years)</b>			
Mean (SD)	29.90±5.49	28.28±5.59	
15-24	7 (14.0)	38 (25.5)	0.237
25-34	34 (68.0)	86 (57.7)	
35-45	9 (18.0)	25 (16.8)	
<b>Parity</b>			
Mean (SD)	2±1.25	2±1.25	0.196
≤1	21 (42.0)	85 (56.7)	
2-3	24 (48.0)	53 (36.3)	
≥4	5 (10.0)	12 (8.0)	
<b>Marital Status</b>			
Single	9 (18.0)	28 (18.7)	0.916
Married	41 (82.0)	122 (81.3)	
<b>Mother's Occupation</b>			
Unemployed	36 (72.0)	95 (63.3)	0.264
Employed	14 (28.0)	55 (36.7)	
<b>Mother's Education</b>			
No formal education	3 (6.0)	2 (1.3)	0.001
Primary	22 (44.0)	29 (19.3)	
Secondary	11 (22.0)	61 (40.7)	
Tertiary	14 (28.0)	58 (38.7)	
<b>Mother's Religion</b>			
Christian	47 (94.0)	128 (92.0)	0.242
Muslim	1 (2.0)	10 (6.7)	
Atheist	2 (4.0)	2 (1.3)	
<b>ANC Visits</b>			
1-3	31 (62.0)	70 (46.7)	0.060
4 or more	19 (38.0)	80 (53.3)	
<b>Gestational Age (in Weeks)</b>			
Mean (SD)	33.31±8.10	37.55±4.60	
Premature	26 (52.0)	40 (26.7)	0.001
Term	24 (48.0)	110 (73.3)	

Table 1 shows the individual and socio-demographic characteristics for mothers. The case group's age ranged from 18 to 44 with mean age 29.90 (median = 36.00) SD  $\pm$  5.49 years. The control group's age ranged from 16 to 42 with mean age 28.28 (median = 27.50) SD  $\pm$  5.585 years.

On gestational age, the case group's gestational age ranged from 13 to 43 with mean age 33.31 SD  $\pm$  8.10 weeks. The control group's gestational age ranged from 19 to 49 with mean age 37.55 SD  $\pm$  4.60 weeks.

## 8.2 Socio-Demographic and Reproductive Risk Factors

**Table 2: Socio-demographic and reproductive risk factors for maternal mortality in KNH from January 2006 to December 2015**

<b>Sociodemographic and Reproductive Risk Factors</b>				
<b>Risk Factors</b>	<b>Cases N = 50</b>	<b>Controls N = 150</b>	<b>OR (95% CI)</b>	<b>P-value</b>
<b>Age</b>				
15-24	7 (14.0)	38 (25.5)	1	
25-34	34 (68.0)	86 (57.7)	2.585 (0.948-7.047)	0.063
35-45	9 (18.0)	25 (16.8)	2.190 (0.636-7.549)	0.214
<b>Parity</b>				
≤1	21 (42.0)	85 (56.7)	1	
2-3	24 (48.0)	53 (35.3)	1.833 (0.930-3.613)	0.080
≥4	5 (10.0)	12 (8.0)	1.687 (0.535-5.313)	0.372
<b>Marital Status</b>				
Married	9 (18.0)	28 (18.7)	1	
Single	41 (82.0)	122 (81.3)	1.264 (0.505-3.161)	0.616
<b>Mother's Occupation</b>				
Employed	14 (28.0)	55 (36.7)	1	
Unemployed	36 (72.0)	95 (63.3)	1.333 (0.595-2.985)	0.485
<b>Mother's Education</b>				
Primary	22 (44.0)	29 (19.3)	1	
Secondary	11 (22.0)	61 (40.7)	0.238 (0.101-0.555)	<b>0.001</b>
Tertiary	14 (28.0)	58 (38.7)	0.318 (0.142-0.712)	<b>0.005</b>
No education	3 (6.0)	2 (1.3)	1.977 (0.304-12.868)	0.476
<b>Mother's Religion</b>				
Christian	47 (94.0)	138 (92.0)	1	
Muslim	1 (2.0)	10 (6.7)	0.395 (0.047-3.302)	0.392
Atheist	2 (4.0)	2 (1.3)	2.288 (0.270-19.393)	0.448
<b>Gestational Age</b>				
Term	24 (48.0)	110 (73.3)	1	
Premature	26 (52.0)	40 (26.7)	2.808 (1.433-5.503)	<b>0.003</b>
<b>ANC Visits</b>				
1-3	31 (62.0)	70 (46.7)	1	
4 or more	19 (38.0)	80 (53.3)	1.865 (0.969-3.590)	0.060
<b>Iron/Folic Acid Supplementation</b>				
No	4 (8.0)	11 (7.4)	1	
Yes	46 (92.0)	138 (92.6)	1.091 (0.331-3.593)	0.886
<b>Tetanus Toxoid</b>				
No	14 (28.0)	41 (27.7)	1	
Yes	36 (72.0)	107 (72.3)	1.015 (0.497-2.074)	0.968

Table 2 shows the demographic and reproductive characteristic associated with maternal mortality. As many as 50.0% of the cases had only primary education or less compared to 20.5% of the controls. On the other hand, only 22.0% of the cases had secondary education

among cases compared to 40.1% among controls (OR .238, 95% CI .101- .555;  $p < 0.001$ ). There was also a significant difference between tertiary and primary education for mothers who died and those alive, 28.0% of cases having achieved tertiary education compared 38.7% of controls (OR .238, CI 0.142-0.712,  $p < 0.005$ ).

Gestational age also showed significant difference with cases compared with controls (OR 2.808, 95% CI 1.43305.5033;  $p < 0.003$ ).

### 8.3 Pre-Existing Medical Conditions and Maternal Mortality

**Table 3: Mother's history of pre-existing medical conditions associated with maternal mortality in KNH from January 2006 to December 2015**

<b>History of Pre-existing Medical Conditions</b>				
<b>Risk Factor</b>	<b>Cases N = 50</b>	<b>Controls N = 150</b>	<b>OR (95% CI)</b>	<b>P-value</b>
<b>Pre-existing medical condition</b>				
No	16 (32.0)	111 (74.0)	1	
Yes	34 (68.0)	39 (26.0)	6.048 (3.012-12.15)	<b>0.000</b>
<b>Hypertension</b>				
No	44 (88.0)	137 (91.3)	1	
Yes	6 (12.0)	13 (8.7)	0.696 (0.250-1.940)	0.486
<b>Diabetes</b>				
No	48 (98.0)	146 (97.3)	1	
Yes	2 (4.0)	4 (2.7)	0.658 (0.117-3.703)	0.632
<b>Pulmonary Disease</b>				
No	44 (88.0)	142 (94.7)	1	
Yes	6 (12.0)	8 (5.3)	0.413 (0.136-1.255)	0.110
<b>Cardiac Disease</b>				
No	45 (90.0)	149 (99.3)	1	
Yes	5 (10.0)	1 (0.7)	24.428 (2.747-217.2)	<b>0.004</b>
<b>HIV</b>				
No	36 (72.0)	140 (93.3)	1	
Yes	14 (28.0)	10 (6.7)	6.201 (2.490-15.44)	<b>0.000</b>
<b>Anemia</b>				
No	45 (90.0)	146 (97.3)	1	
Yes	5 (10.0)	4 (2.7)	4.371 (1.041-18.34)	<b>0.044</b>
<b>Renal Disease</b>				
No	48 (96.0)	149 (99.3)	1	
Yes	2 (4.0)	1 (0.7)	0.161 (0.014-1.916)	0.093
<b>Other<sup>1*</sup></b>				
No	41 (82.0)	144 (96.0)	1	
Yes	9 (18.0)	6 (4.0)	5.268 (1.772-15.67)	<b>0.003</b>

<sup>1</sup>These include brain tumor (1), breast cancer (1), connective tissue disease (1), cryptococcal meningitis (1), deep veins thrombosis (2), epilepsy (1), kaposi sarcoma (1), liver disease (1), meningitis (1), nasopharyngeal cancer (1), peptic ulcer disease (1), systemic lupus erythromatus (1) and varicose vein (1).

\*Some of the cases had more than one preexisting medical conditions

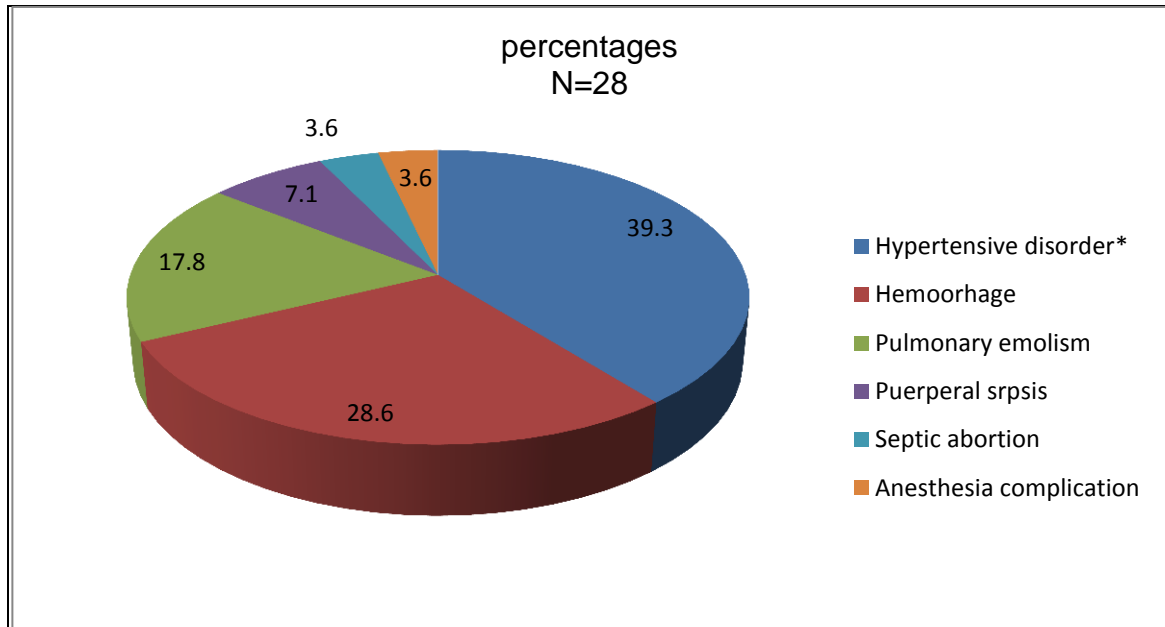
Table 3 shows preexisting medical conditions associated with maternal mortality. Among the cases 68.0% had preexisting medical conditions compared to 26% of the control (OR 6.048, 95% CI 3.012-12.15;  $p < 0.000$ ), 10% of the cases had cardiac disease compared to 0.7% of the controls (OR 24.428, 95% CI 2.747-217.2;  $p = 0.004$ ), 28% of the cases had HIV compared to 6.7% of the controls (OR 6.201, 95% CI 2.490-15.44;  $p = 0.000$ ), 10.0% of the cases had Anemia compared to 2.7% of the control (OR 4.371, 95% CI 1.041-18.34;

$p < 0.004$ ), 18% of the cases had others conditions compared to 4.0% of the control (OR 5.268, 95% CI 1.772-15.67;  $p < 0.003$ ) were all statistically significant characteristic for maternal mortality.



#### 8.4 Direct Causes of Maternal Mortality

**Figure 3: Obstetrics Causes of Maternal Mortality among Women Who Received Antenatal Care in KNH from January 2006 to December 2015**

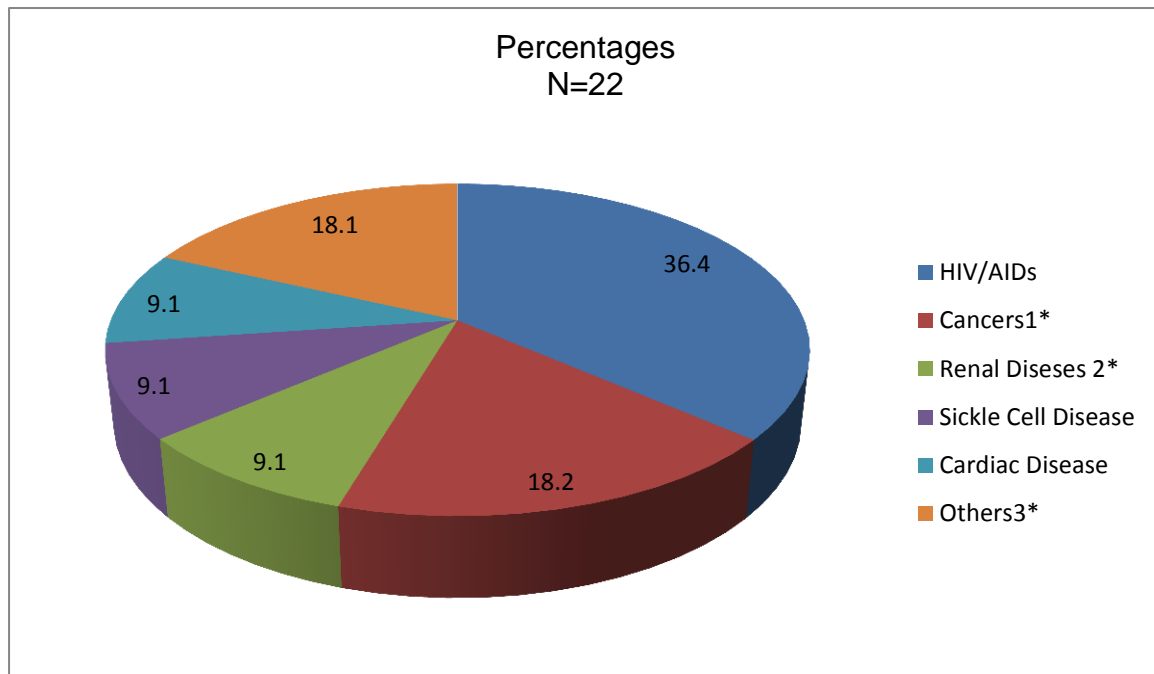


\* These include eclampsia (7) and severe pre-eclampsia (4)

Figure 3 shows direct causes of maternal mortality. Hypertensive disease (eclampsia and preeclampsia) were the leading causes of maternal mortality (39.3%) followed by hemorrhage (28.6%), pulmonary embolism (17.9%), puerperal sepsis (7.1%), septic abortion (3.6%) and Anesthesia complication (3.6%)

## 8.5 Indirect Causes of Maternal Mortality

**Figure 4: Non Obstetrics Causes of Maternal Mortality among Women Who Received Antenatal Care in KNH from January 2006 to December 2015**



<sup>1</sup>These include brain tumor, breast cancer, kaposi sarcoma, and nasopharyngeal cancer.

<sup>2</sup>These include nephrotic syndrome and acute kidney injury.

<sup>3</sup>These include Diabetes Ketoacidosis, Liver Disease, Meningitis and TB.

Figure 4 shows indirect causes of maternal mortality. HIV/AIDS were the leading causes of maternal mortality (36.4%) followed by cancers (18.4%) and renal disease (9.1%).

## **9.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS**

### **9.1 Discussion**

This study determined the factors associated with maternal mortality among women who received antenatal care at Kenyatta National Hospital between January 2006 and December 2015. There has been an improvement in maternal health worldwide evidenced by the reduction in maternal mortality over the last two decades from 385 to 216 deaths per 100,000 live births. All regions have made progress but the challenge still persists especially in developing regions.

Findings of this study show that majority of the women who seek ANC services in KNH are of low socio-economic status as reflected by their employment status (majority are unemployed) and level of schooling (majority are secondary education and below). Majority of them were aged between 25-34 years with the mean of  $29.9 \pm 5.49$  (maternal mortality) and  $28.3 \pm 5.59$  (no maternal mortality), which corresponds to mean reproductive age for Kenyan women which peaks at 20 - 24 years. Overall, the study established that women's ANC visits at KNH are low, with most of them attending 1-3 times. The high unemployment rates among the women mean that women depend on spouses or close relatives for financial support, a factor likely to cause less ANC visits. Thus, achieving the SDG goal of reducing MMR to  $<70$  per 100,000 live births by 2030 can be realized to a larger extent through the provision of quality ANC in public facilities since such facilities are utilized mostly by women of low socioeconomic backgrounds, who are often victims of high mortality burden.

Demographic and reproductive characteristic associated with maternal mortality are largely preventable. Nevertheless, maternal mortality has continued to escalate in Kenya despite all the efforts being made by the government, non-governmental organization and the community. This study finds that most of the deceased were non-literate, for instance, only 22.00% of the cases had secondary education among cases compare to 40.1% among controls (OR .238, 95% CI .101- .555;  $p < 0.001$ ). This validates the results from past studies [34] [17]. This finding is important since it emphasizes the role of education for both the mother and her spouse in obtaining and understanding the benefits of good health and being able to make appropriate decisions during pregnancy. It is important to note that despite the woman's

weaker role in decision-making in African settings, education has a strong influence on mortality.

In the multivariable analysis of each of socio-demographic and reproductive factors, variables significantly associated with maternal mortality also included gestational age. This study found that gestational age was a powerful predictor of maternal mortality. Previous studies have shared similar findings [35]. This study established that preterm (<37 weeks) babies, serves as a strong predictor of maternal mortality. Other studies showed contrary results, for instance, a study showed that mortality was associated only with birth weight and not with gestational age [36].

In this study, pre-existing medical conditions during pregnancy were higher among cases than controls. Our current study demonstrated increased odds of cardiac disease in cases, which is in agreement with another study that found that the delay in diagnosis and treatment of cardiac disease increases the risk of maternal death [37]. There is evidence that screening for pre-existing medical conditions during the antenatal period plays a significant role in reducing the risk of death to the mother [38]. This study also found higher odds of anemia amongst cases, which could explain the increased risk of death due to haemorrhage.

It is therefore imperative to improve the care of pregnant women attending ANC at KNH as well as intrapartum and post-partum care at the hospital. Effort should focus on hypertensive disease (eclampsia, preeclampsia), hemorrhage and preexisting medical conditions. In addition, antenatal care is important in screening for pre-existing medical conditions in the early stages of pregnancy that could impact adversely during pregnancy and childbirth. Since ANC coverage is high in Kenya, there is a need to scale up interventions that empower women to make at least four visits during pregnancy as recommended by international organizations.

Hypertensive disorders, haemorrhage, pulmonary embolism, puerperal sepsis, and anesthesia complications were significant causes of maternal mortality in this study. These findings concur with other previous studies. One other salient finding in this study was septic abortion cases (3.6%) for which a distinctive pattern emerged among women who received antenatal care in KNH. The death rate from this group may be more than it is represented here since it is considered an illegal activity.

This study established that HIV is the leading cause of maternal mortality at KNH, surpassing all the traditional major causes of maternal deaths, a finding which corresponds with those of other studies [39]. The findings here were that indirect causes including HIV, cancer, renal diseases, sickle cell disease, and cardiac disease contributed to maternal deaths. Other research shows that the significant increase in MMRs in Sub-Saharan Africa is predominantly due to increasing HIV prevalence in the region [17]. The findings demonstrate the importance of ANC for screening, detection and management of underlying illnesses that could potentially pose a threat to the mother during pregnancy and childbirth.

## **9.2 Conclusion**

Our study provides important insights into the factors associated with maternal mortality among women who received antenatal care at Kenyatta National Hospital between January 2006 and December 2015. The study found out that the increase in maternal mortality was due to mother's education, gestational age, and pre-existing medical conditions (cardiac disease, HIV, anemia, and other conditions). In addition, HIV was found to be the leading cause of maternal mortality. The findings are timely given Kenya's unfulfilled achievement of MDG Five by 2015. However, making great strides in reducing maternal mortality and reaching the new sustainable development goals (targets to reduce by 2030, the global MMR to <70 per 100,000 live births) is crucial.

## **9.3 Recommendations**

- A concerted effort among all stakeholders is needed to sensitize the community on the importance of obtaining timely and adequate care during pregnancy. Since being poor (lack education and unemployed) is in itself a barrier to seeking adequate care, a multi-sectoral approach to fight poverty among women in the society is recommended.
- There is evidence that screening for pre-existing medical conditions during the antenatal period plays a significant role in reducing the risk of death to the mother. Thus, efforts for specialised consultation and care are highly recommended.
- Periodic maternal mortality studies should be done to monitor emerging trends in maternal mortality causes, as well as evaluate the effectiveness of interventions aimed at reducing maternal mortality.

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## 11.0 APPENDICES

### Appendix I: Questionnaire

1. Study identification number.....
2. Age ( )
3. Parity ( )
4. Marital status
  - a. Married ( )
  - b. Single ( )
5. Mothers occupation
  - a. Employed ( )
  - b. Un employed ( )
6. Mother's education
  - a. No formal education ( )
  - b. Primary education ( )
  - c. Secondary education ( )
  - d. Tertiary education ( )
7. Mother's religious
  - a. Christian ( )
  - b. Muslim ( )
  - c. Atheist ( )
8. Antenatal care
  - a. Gestational Age ( )
  - b. No of ANC attended during pregnancy ( )
  - c. Gestation at first ANC visit ( )
  - d. Iron/folic acid supplementation ( )

- e. Tetanus toxoid(    )
9. Antenatal profile
- a.HB g/dl            (    )
  - b.HIV                (    )
10. Pre-existing medical disease
- a. Hypertension        (    )
  - b. Diabetes(    )
  - c. Pulmonary disease (    )
  - d. Cardiac disease     (    )
  - e. HIV (    )
  - f. Anemia (    )
  - g. Renal disease (    )
  - h. Others specify      (    )
11. Maternal out come
- a. Discharged home ( )
  - b. Maternal death (    )
12. Maternal death
- a. Ante partum (    )
  - b. Intra-partum (    )
  - c. Postpartum (    )
13. Cause of death
- a.Hemorrhage (    )
  - b.Hypertensive disorder
    - Severe pre eclampsia (    )
    - Eclampsia (    )
  - c.Infection

- Puerperal sepsis ( )
- Septic Abortion ( )
- d. Anesthesia complication ( )
- e. Pulmonary Embolism( )
- f. Pre-existing medical disease ( )
  - Hypertension ( )
  - Diabetes ( )
  - Pulmonary disease ( )
  - Cardiac disease ( )
  - HIV ( )
  - Anemia ( )
  - Renal disease ( )
  - Others specify ( )

## Appendix II: Study Time Line

Activities	MAY 2015	JUN 2015	JUL 2015	AUG 2015	SEP 2015	OCT 2015	NOV 2015	DEC 2015	JAN 2016	FEB 2016	MAR 2016	APR 2016
Proposal development												
Research & Ethical Committee approval												
Training of research assistant & Data collection												
Data analysis												
Report writing												
Dissemination of findings												

### Appendix III: Budget

ITEM	QUANTITY	UNIT COST (Ksh)	TOTAL (Ksh)
Printing & Packaging			
Proposal printing	28	10	280
Photocopy of proposal	28*3	3	252
Binding of proposal	3copies	100	300
Proposal printing 2 <sup>nd</sup> draft	3copies	10	840
Photocopy of proposal 2 <sup>nd</sup> draft	3copies	3	252
Binding proposal 2 <sup>nd</sup> draft Ethic: UON/KNH	3copies	100	300
Total			1384
Printing of questionnaire	2	10	20
Photocopy of questionnaire	2*300	3	1800
Printing of result black & white	3copies	10	300
Printing of result color	3copies	20	600
Binding of Final paper	3copies	100	300
Total			3020
Contracted Services			
Statistician	1	30,000	30,000
Research Assistant	4	60,000	60,000
Sub Total			90000
Communication			
Emails & Phone calls	1	5000	5000
Sub Total			5000
Publication	1	50,000	50,000
Contingency 15%	1	22410	22410
Grand Total			171814

**Appendix IV: KNH – UoN ERC Approval Letter**

**Appendix V: KNH Approval Letter**